Fuji Electric

Innovating Energy Technology

USER'S MANUAL

FRENIC MEGA SERIES

24A7-E-0054a

High Performance, Multifunction Inverter

FRENIC-MEGA

User's Manual

The information contained herein is subject to change without prior notice for improvement.

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.

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.

Table 1

Name	Material No.	Description
Catalog	24A1-E-0084	Product scope, features, specifications, external drawings, and options of the product
Instruction Manual	SI47-1582-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, 24A7-E-0099	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.

■ 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.

⚠General Precautions

Figures used in this manual may be drawn with covers and safety guards removed in order to describe hidden details. When using the product, make sure that these covers and safety guards are installed as specified and then run the product as directed in this manual.

Purpose

⚠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.

⚠WARNING

- The FRENIC-MEGA is designed to drive three-phase induction motors only. It cannot be used to drive single-phase motors and/or for any other purposes.
  Otherwise, a fire could occur.
- The FRENIC-MEGA cannot be used for a purpose where human accidents may be directly concerned (e.g., a life support system) without necessary modification.
- Although this product is manufactured under strict quality control, be sure to provide safety measures when using it in facilities where its failure may cause a serious accident or loss.
  Otherwise, an accident could occur.

Installation

⚠WARNING

- Install the inverter on an uninflammable object.
- Do not install the inverter near an inflammable object.
  Otherwise, a fire could occur.
- The enclosure of an inverter of 30 kW or more conforms to IP00 and may touch the terminal block of the main circuit (where electricity exists). It is also true when the optional DC reactor is used. In such cases take a measure to prevent a person from easily touching the inverter.
  Otherwise, an electric shock or injury could occur.

⚠CAUTION

- Do not carry the inverter by holding the front cover.
  Otherwise, an injury could occur due to a falling inverter.
- Prevent any foreign material (e.g., lint, wastepaper, chippage, dust, metal) from entering into the inside of the inverter and/or adhering to the cooling fin.
- Use the specified screws when changing the installation legs.
  Otherwise, a fire or accident could occur.
- Do not install and/or run an inverter with damaged exterior or internal parts.
  Otherwise, a fire, accident, or injury could occur.

Cabling

⚠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.
- Insert an MCCB or RCD/ELCB (with overcurrent protection) recommended for each inverter for its input circuits. Use a recommended MCCB or RCD/ELCB and do not use a device which exceeds the recommended capacity.
- Be sure to use wires of the specified sizes.
- Tighten the terminals with the specified torque.
- When using multiple combinations of inverters and motors, do not use multi-core cables to accommodate multiple combinations of cables.
- Do not install any surge killer in the inverter's output (secondary) lines.
- Use an optional DCR when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

  Otherwise, a fire could occur.
- Implement the Class C or Class D grounding work depending on the input voltage system of the inverter.
- Be sure to ground the grounding wire of the inverter [⏚G].

  Otherwise, an electric shock or fire could occur.
- Cabling must be done by a qualified expert after installing the inverter with its power disconnected.

  Otherwise, an electric shock or injury could occur.
- Make sure that the number of phases and rated voltage match those of the connected power supply.
- Do not connect the power supply line to the inverter output terminals ([U], [V], and [W]).
- When connecting a braking resistor, be sure to connect it to the P(+)-DB terminal.

  Otherwise, a fire or accident could occur.
- Generally, reinforced insulation is not applied to the insulation sheath of control signal lines. Therefore, if a control signal line should touch the main circuit where electricity exists, its insulation sheath may get broken. This may result in applying the high voltage of the main circuit to the control signal line. Make sure that no control signal line touches the main circuit where electricity exists.

  Otherwise, an accident or electrical shock could occur.

⚠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).

  Otherwise, an electric shock could occur.

⚠CAUTION

- Electric noises occur from the inverter, motor, and wire, causing peripheral sensors and/or devices to malfunction. Take a measure against the noises to prevent such malfunctioning.

  Otherwise, an accident could occur.

- Leakage current from the EMC filter built-in type inverter is relatively large. Make sure that it is correctly grounded.

  Otherwise, an electric shock could occur.

Operation

⚠WARNING

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

- Do not operate switches with wet hands.

  Otherwise, an electric shock could occur.

- 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.

- The motor may run with different acceleration/deceleration time and/or frequency due to stall prevention function (current limiting), anti-regenerative control, and overload stop. Design the machinery so that safety is ensured in such cases.

  Otherwise, an accident could occur.

- The STOP key on the keypad works only when "Enable keypad" is selected with the function code F02. Provide an emergency stop switch separately. When the run command source is switched from the keypad with "Link operation selection" (LE), the STOP key will not work. To enable emergency stop with the STOP key on the keypad while the external signal terminal is selected as the run command source, select "STOP key priority" with the function code H96.

- 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.

  Otherwise, an accident could occur.

- 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.

- If the user configures the function codes wrongly without completely understanding this User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.

  Otherwise, an accident or injury could 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.

- 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.

- Even if the motor stops due to DC braking or pre-excitation, voltage is output to inverter's output terminals [U], [V], and [W].

  Otherwise, an electric shock could occur.

- The inverter can easily accept high-speed operation settings. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.

  Otherwise, an injury could occur.

- If the software version is No.3600, never use the terminal function "BATRY" (Enable battery operation). This function will not work. When the battery power is used in an Up/Down operation, the drive target may fall due to insufficient lack in the worst case.

  Otherwise, an accident could occur.

⚠CAUTION

- The cooling fin and braking resistor become very hot. Never touch them.

  Otherwise, a burn could occur.
- The DC braking function of the inverter does not provide any holding mechanism.

  Otherwise, an injury could occur.
- Run commands (e.g., "Run forward" FWD), stop commands (e.g., "Coast to a stop" BX), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed. Change the function code setting after making sure that safety is ensured.
- In digital input, the run and frequency command sources can be switched using "SS1, 2, 4, 8", "Hz2/Hz1", "Hz/PID", "IVS", and "LE". When switching these signals, the motor may run suddenly or change speed rapidly.
- Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command CLC. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.

  Otherwise, an accident or injury could occur.

Maintenance and parts replacement

⚠WARNING⚠

- 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).

  Otherwise, an electric shock could occur.
- Maintenance and parts replacement should be done by a specified person.
- Take off any metal objects (e.g., watch, ring) before work.
- Use insulated tools.
- Never alter anything.

  Otherwise, an electric shock or injury could occur.

Disposal

⚠CAUTION

- Dispose of the FRENIC-MEGA as an industrial waste.

  Otherwise, an injury could occur.

How this manual is organized

This manual contains Chapters 1 through 13 and Appendices.

Chapter 1 BEFORE USE

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

Chapter 2 INSTALLATION AND WIRING

This chapter describes the installation method, notes on cabling, basic connection diagram, terminal specifications, screw specifications, and recommended wire sizes.

Chapter 3 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 4 OPERATION

This chapter describes how to prepare for a test run as well as tuning and basic setting for each control method.

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.

Chapter 6 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.

Chapter 7 MAINTENANCE AND INSPECTION

This chapter describes routine inspection and regular inspection items, regular replacement parts, main circuit electricity flow measurement, insulation test, and product warranty.

Chapter 8 BLOCK DIAGRAMS FOR CONTROL LOGIC

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

Chapter 9 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 (MET271) for details.

Chapter 10 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 11 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 12 SPECIFICATIONS

This chapter describes specifications of the output ratings and external dimensions.

Chapter 13 COMPLIANCE WITH STANDARDS

This chapter describes how to conform to the international specifications such as UL, cUL, and European EMC standards.

Appendices

Icons

The following icons are used throughout this manual.

Note 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.

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

This icon indicates a reference to more detailed information.

CONTENTS

Chapter 1

BEFORE USE

This chapter describes the check items before the use of the inverter.

Contents

1.1 Features

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

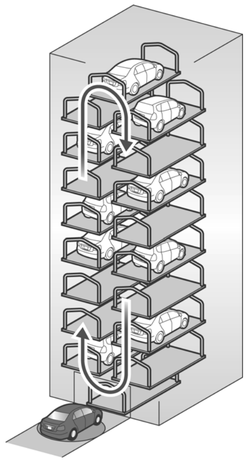
● Ideal for highly accurate control such as positioning

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.

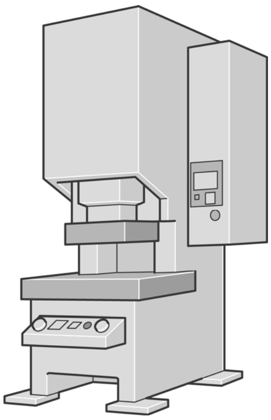


● Maximizing the performance of a general-purpose motor

Vector control without speed sensor

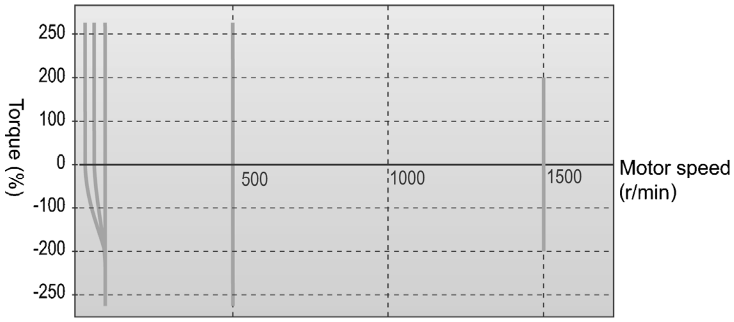
Useful for applications that require a high instant torque and prompt current response, such as pressing machinery.

Speed control range:	1:200
Speed response:	20 Hz
Speed control accuracy:	±0.5%
Current response:	500 Hz
Torque accuracy:	±10%



● 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.

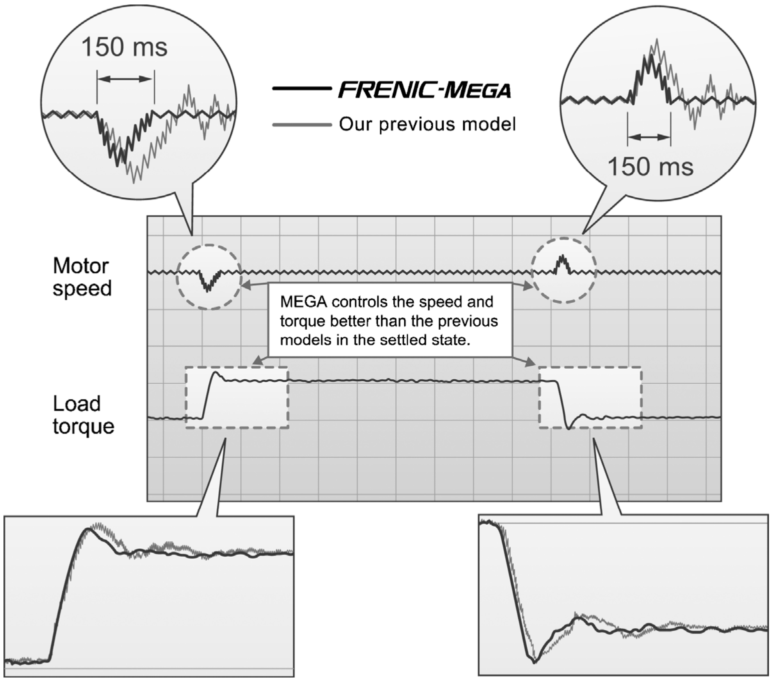


Example torque characteristics [5.5kW]

● 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:



● 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. (HD mode)

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

Drive mode	Rated current overload capability	Major application
HD (High duty) mode:	200% for 3 sec, 150% for 1 min	Heavy duty load applications
MD (Medium duty) mode:	150% for 1 min	Medium duty load applications
LD (Low duty) mode:	120% for 1 min	Low duty load applications

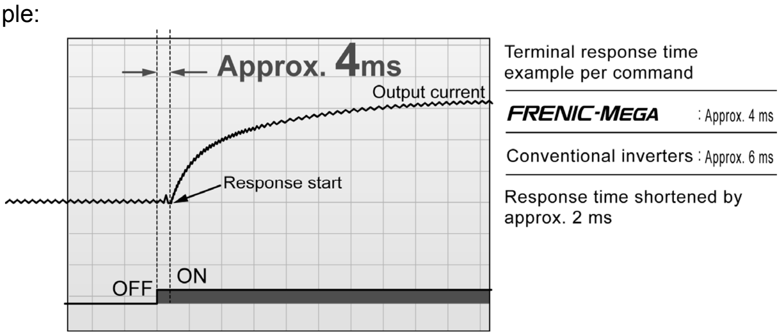
(The MD mode is available only in the 400 V class series of inverters with a capacity of 90 to 400 kW.)

● Quicker response to the run commands

The terminal response to the run 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:

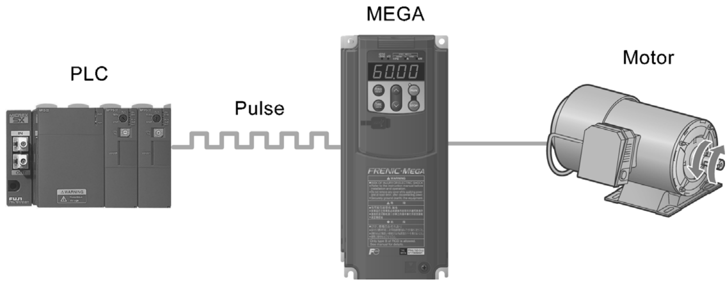


■ Accommodating various applications

● Convenient functions for operations at the specified speed

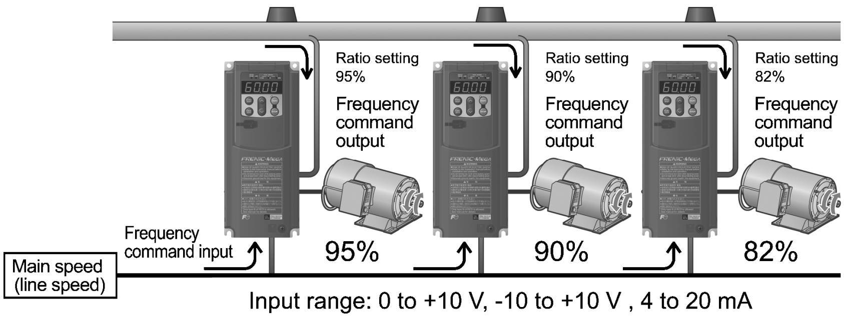
Pulse train input speed command supported as standard

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.



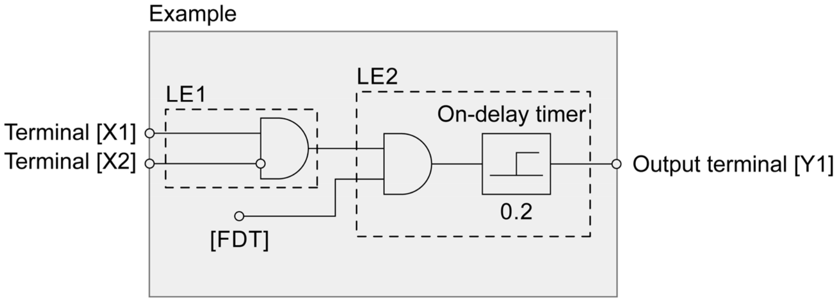
Input range: 0 to +10 V, -10 to +10 V , 4 to 20 mA

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

● Customized logic interface function on the inverter

By setting parameters, logic inputs and outputs can be easily created, enabling easier peripheral circuits.

Example

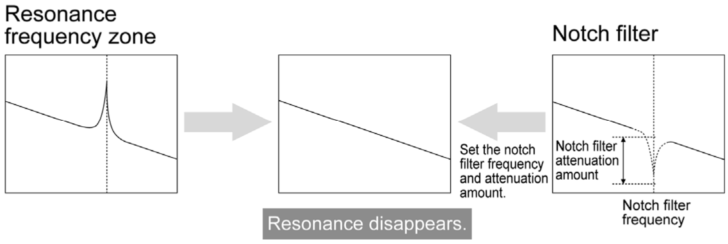


Logic circuits:	AND, OR, XOR, flipflop, leading or trailing edge detection, counter, etc.
General-purpose timer:	On-delay, off-delay, pulse train, etc.
Time setting:	0.0 to 600 sec.
Output signal:	Input/output of inverter control, Input of customized logic

Can be combined up to 10 steps

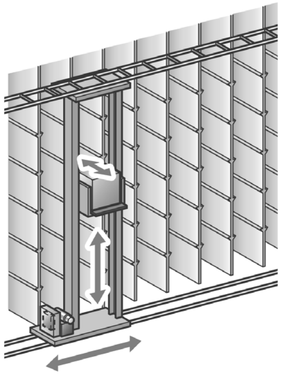
● Suppresses machine vibration with a notch filter

By setting resonant frequency and attenuation, it is possible to suppress machine vibration.



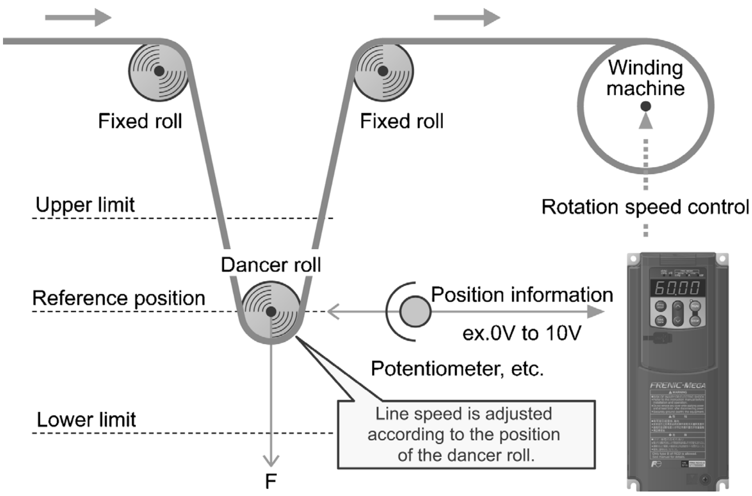
● Optimum function for preventing an object from slipping down

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.



● Optimal for winding control: Dancer control function

The PID value, calculated by comparing the feedback value with the target 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.

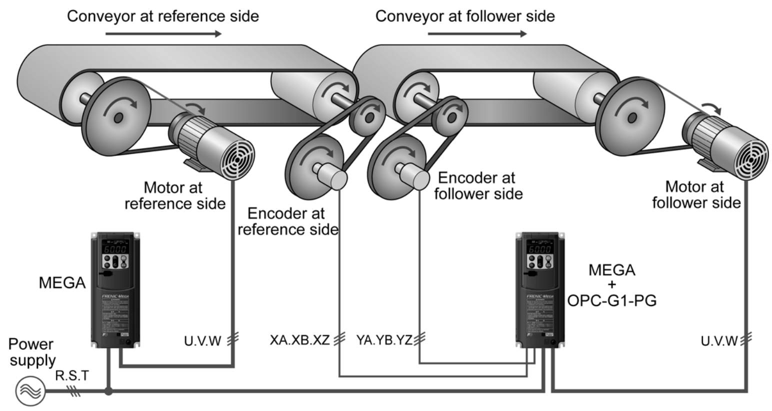
● More functions are available to meet various requirements

(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
(8) Counter-power failure operation supported by the battery power supply

Wide model variation

Synchronous operation (PG interface card)

Optimal control for multiple-conveyor operation that requires positioning start-up, etc. In accordance with the purpose, simultaneous start synchronicity (with Z-phase synchronicity), standby synchronous operation, etc. can be selected.



Servo-lock function (PG interface card)

This is effective for adjusting stopping timing and braking torque in the positioning of motors for carrier machines, etc. This function is useful when torque is applied from outside during the stopping time, or for applications that need a holding torque. This shortens the tact time per cycle through minimizing the deceleration time.

■ Model variation that optimally satisfies customer needs

- Rich model variation

1. Basic type

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

2. EMC filter built-in type

This type has a built-in EMC filter and is compliant with European EMC Directives.
Category C3 (2nd Env) IEC/EN61800-3:2004 compliant

* Use of EMC filter will increase the leakage current.

3. DC reactor built-in type

This type has a built-in DC reactor to suppress harmonics.

This is advantageous in terms of installation space when power factor is to be corrected or harmonic components are to be suppressed.

- Inverters supporting synchronous motors

1. Highly-efficient operation for energy saving

Driving a synchronous motor(s) with the FRENIC-MEGA equipped with our distinctive energy saving control provides higher energy saving effect than conventional inverter operations of induction motors.

2. Compact, light-weight body for space saving

Using advanced, optimum magnetic field analysis technology, thermal analysis technology, and applied analysis technology has attained more compact, light-weight body.

3. General-purpose inverter (supporting synchronous motors) providing high-performance, multi-function operations

(1) Vector control without speed sensor, vector control with speed sensor

(2) Offline tuning

(3) Acceleration characteristics (vector control without speed sensor):
Before startup, the FRENIC-MEGA detects the position of a magnetic pole for smooth, rapid acceleration.

(4) Impact load characteristics (vector control without speed sensor):
The FRENIC-MEGA maintains stable motor speed even under 120% of impact load.

(5) Restart after momentary power failure: After a momentary power failure occurs, the FRENIC-MEGA automatically searches for the idling motor speed and starts the motor smoothly without stopping it.

4. Environmental considerations

The FRENIC-MEGA approximately doubles the bearing life of the motor driven (compared with our conventional induction motors). The designed lives of the various consumable parts inside the FRENIC-MEGA have been extended to 10 years, The FRENIC-MEGA is compliant with RoHS Directives and realizes very low noise operation.

5. List of inverter types

HD mode: Heavy duty specifications 200%-3 s, 150%-1 min
LD mode: Light duty specifications 120%-1 min

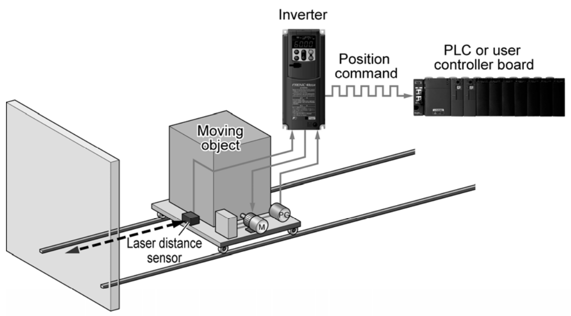
Nominal applied motor [kW]	Basic type: Three-phase 200 V class series HD mode (150%)	Basic type: Three-phase 200 V class series LD mode (120%)	Basic type: Three-phase 400 V class series HD mode (150%)	Basic type: Three-phase 400 V class series LD mode (120%)
5.5	FRN5.5GX1S-2J		FRN5.5GX1S-4J	
7.5	FRN7.5GX1S-2J	FRN5.5GX1S-2J	FRN7.5GX1S-4J	FRN5.5GX1S-4J
11	FRN11GX1S-2J	FRN7.5GX1S-2J	FRN11GX1S-4J	FRN7.5GX1S-4J
15	FRN15GX1S-2J	FRN11GX1S-2J	FRN15GX1S-4J	FRN11GX1S-4J
18.5	FRN18.5GX1S-2J	FRN15GX1S-2J	FRN18.5GX1S-4J	FRN15GX1S-4J
22	FRN22GX1S-2J	FRN18.5GX1S-2J	FRN22GX1S-4J	FRN18.5GX1S-4J
30	FRN30GX1S-2J	FRN22GX1S-2J	FRN30GX1S-4J	FRN22GX1S-4J
37	FRN37GX1S-2J	FRN30GX1S-2J	FRN37GX1S-4J	FRN30GX1S-4J
45	FRN45GX1S-2J	FRN37GX1S-2J	FRN45GX1S-4J	FRN37GX1S-4J
55	FRN55GX1S-2J	FRN45GX1S-2J	FRN55GX1S-4J	FRN45GX1S-4J
75	FRN75GX1S-2J	FRN55GX1S-2J	FRN75GX1S-4J	FRN55GX1S-4J
90	FRN90GX1S-2J	FRN75GX1S-2J	FRN90GX1S-4J	FRN75GX1S-4J
110			FRN110GX1S-4J	FRN90GX1S-4J
132			FRN132GX1S-4J	FRN110GX1S-4J
160			FRN160GX1S-4J	FRN132GX1S-4J
200			FRN200GX1S-4J	FRN160GX1S-4J
220			FRN220GX1S-4J	FRN200GX1S-4J
250			FRN280GX1S-4J	FRN220GX1S-4J
280			FRN280GX1S-4J	FRN220GX1S-4J
300			FRN315GX1S-4J	
315			FRN315GX1S-4J	

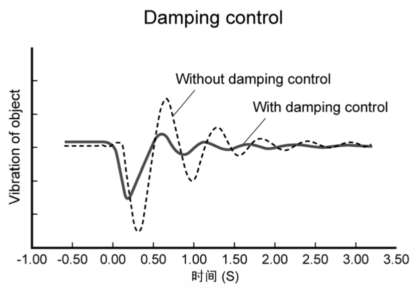
* If you place an order for the FRN55GX1S-2J or FRN55GX1S-4J specified for HD mode, the inverter is delivered with no built-in DC reactor (DCR); if specified for LD mode, it is delivered with a built-in DCR as standard.
* EMC filter built-in type and DC reactor built-in type are also available. Consult your Fuji Electric representative.

For details, see Fuji Synchronous Motors & Inverter Synchronous Drive Systems Catalog (MH618) and/or Permanent Magnet Type Synchronous Motor Drive FRENIC-MEGA Instruction Manual (INR-SI47-1502).

● Position control response type (Built-to-order)

- Optimal for use in multi-story warehouses or for simplified PTP control.
- It is capable of positioning by full-closed control (feeding back outputs from the laser distance sensor and encoder).
- Suppresses low-frequency vibration during deceleration stop by damping control (shortens the tact time).
- Other available functions include return to the home position, OT processing, location presetting, etc.





* Contact our sales support for the details.

● Braking circuit built-in type (Built-to-order)

Because a braking circuit is installed for ≤ 22 kW as a standard setting, this type can be applied to vertical carrier machines, etc, with many applications with regenerative load. (Braking resistor is also built in for ≤ 7.5 kW.)

* A braking circuit built-in type is also available for the capacity of 200 V, 30 kW to 55 kW, or for 400 V, 30 kW to 160 kW, on a built-to-order basis.

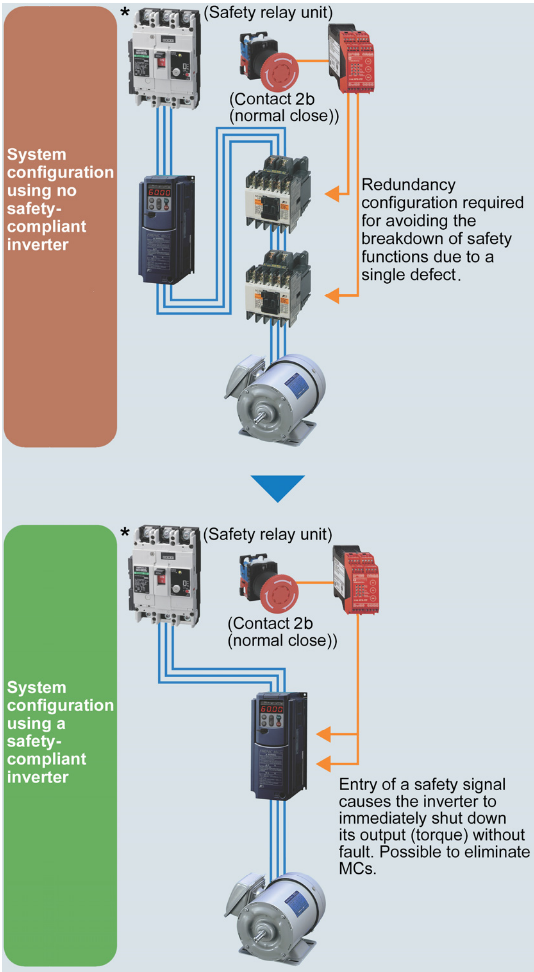
● Safety-compliant inverters (Built-to-order)

Fuji safety-compliant inverters comply with the machine safety standards EN 954-1 Cat3, and EN ISO 13849-1 PL:d Cat3 and IEC/EN 61800-5-2. This type enables easy compliance of your machines with the safety standards.

By using a safety-compliant inverter, main circuit switches can be simplified. The circuit cuts output with hardware, dispensing with software, and is redundantly designed with two systems.

1. By using a safety-compliant inverter, main circuit switches can be simplified.

When a safety signal is input (safety terminal: open), the inverter immediately shuts off the torque (cuts output). The number of contacters to be used can be reduced.



*Before maintenance requiring access to the electrical circuits, be sure to turn off the circuit breaker.

● FRENIC-MEGA Series

Power supply voltage	Nominal applied motor (kW) HD mode	Nominal applied motor (kW) LD mode	Inverter type	
Three-phase 200 V class series	0.4	—	FRN0.4G1S-2JSF1	HD mode
	0.75	—	FRN0.75G1S-2JSF1	HD mode
	1.5	—	FRN1.5G1S-2JSF1	HD mode
	2.2	—	FRN2.2G1S-2JSF1	HD mode
	3.7	—	FRN3.7G1S-2JSF1	HD mode
	5.5	7.5	FRN5.5G1S-2JSF1	HD/LD mode
	7.5	11	FRN7.5G1S-2JSF1	HD/LD mode
	11	15	FRN11G1S-2JSF1	HD/LD mode
	15	18.5	FRN15G1S-2JSF1	HD/LD mode
	18.5	22	FRN18.5G1S-2JSF1	HD/LD mode
	22	30	FRN22G1S-2JSF1	HD/LD mode
	30	37	FRN30G1S-2JSF1	HD/LD mode
	37	45	FRN37G1S-2JSF1	HD/LD mode
	45	55	FRN45G1S-2JSF1	HD/LD mode
	55	—	FRN55G1S-2JSF1	HD mode
	—	75		LD mode
Three-phase 400 V class series	0.4	—	FRN0.4G1S-4JSF1	HD mode
	0.75	—	FRN0.75G1S-4JSF1	HD mode
	1.5	—	FRN1.5G1S-4JSF1	HD mode
	2.2	—	FRN2.2G1S-4JSF1	HD mode
	3.7	—	FRN3.7G1S-4JSF1	HD mode
	5.5	7.5	FRN5.5G1S-4JSF1	HD/LD mode
	7.5	11	FRN7.5G1S-4JSF1	HD/LD mode
	11	15	FRN11G1S-4JSF1	HD/LD mode
	15	18.5	FRN15G1S-4JSF1	HD/LD mode
	18.5	22	FRN18.5G1S-4JSF1	HD/LD mode
	22	30	FRN22G1S-4JSF1	HD/LD mode
	30	37	FRN30G1S-4JSF1	HD/LD mode
	37	45	FRN37G1S-4JSF1	HD/LD mode
	45	55	FRN45G1S-4JSF1	HD/LD mode
	55	—	FRN55G1S-4JSF1	HD mode
	—	75		LD mode
	75	—	FRN75G1S-4JSF1	HD mode
	—	90		LD mode

* For inverters with capacities other than the above, contact your Fuji Electric representative.

* The safety-compliant inverters are available on request. For the delivery schedule, contact your Fuji Electric representative.

For details, see Safety-Compliant Inverters Catalog (MH668).

2. Comparison between safety-compliant models and standard models

Table 1.1−1

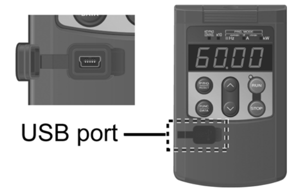
	Standard models	Safety-compliant models
Compliance with safety standards	Non-compliant	EN 954-1 Cat3 EN ISO 13849-1 PL:d Cat3 IEC/EN 61800-5-2
Control circuit terminal block	Round-head screw terminals	Spring terminals
X terminals	Nine [X1] through [X9]	Seven [X1] through [X7] (2 terminals reduced)
Safety terminal	None	Provided (EN1 and EN2 terminals)
Output for meters	FMA (analogue output)	2 analog outputs --FM1 and FM2
	FMP (pulse output)	-

■ Supports for simple maintenance

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

<u>Improved working efficiency in the manufacturing site</u>

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



Features

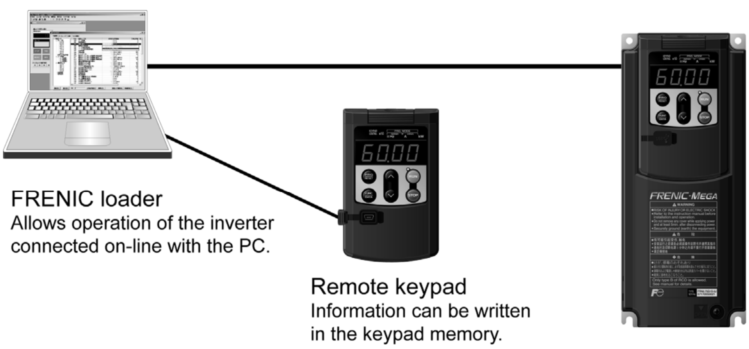
1. The keypad can be directly connected to the computer through a commercial USB cable (mini B) without using a converter. The computer can be connected on-line with the inverter.

Example of use in the office

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



- Multi-function keypads are available (Optional)

Models: TP-G1-J1*
TP-G1-C1*

*: Applicable model FRENIC-Eco, Multi, MEGA

Features

- LCD with a backlight that provides outstanding visibility
- Large, seven-segment LED with five-digit display
- Capable of adding and deleting quick setup items
- Remote/local switching on the keypad
- Data of up to three inverters can be copied
- Languages

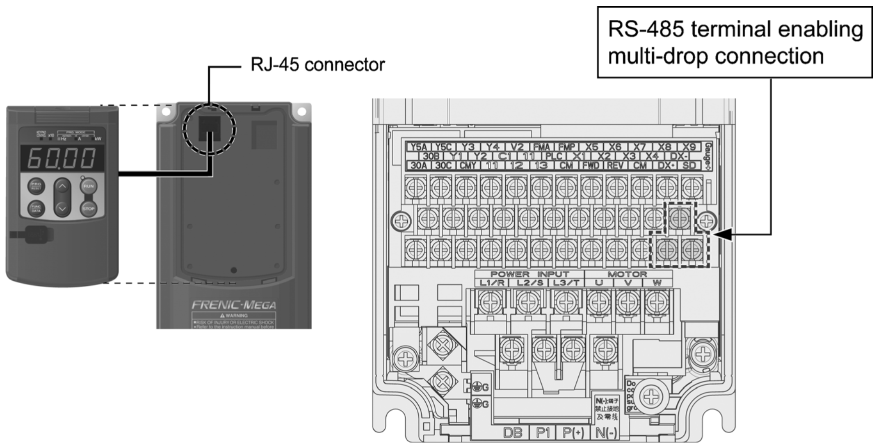
TP-G1-J1:	Japanese, English, German, French, Spanish, and Italian
TP-G1-C1:	Japanese, English, Chinese, and Korean

■ 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.

- Compliant with RS-485 communications as standard (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

The designed lives of the various consumable parts inside the FRENIC-MEGA have been extended to 10 years, which has 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

Life 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

Lives can be easily checked on the keypad or the PC loader,

substantially enhancing the maintainability of the equipment!!

Table 1.1−2

Item	Purpose
Cumulative run time (Unit: h)	Displays the total run time of the inverter. Supply time of the main power supply is indicated in the unit of 1 hour.
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.
Number of startups	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) Number of startups	Early warning signals can be output when preset values are reached. Makes it possible to 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: Capacitance of the main circuit capacitors; Total run time of the cooling fan (with ON/OFF compensation); Total run time of the electrolytic capacitor on the printed circuit board

■ Consideration for environment

● Enhancing resistance to the environmental impact

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: Use outside standard environmental specifications.

When you look for models to be used under conditions as suggested above, please contact our representative for reinforced models.

● Motor-friendly options

Surge suppression unit SSU (optional)

If a long drive cable to the motor is used, ultra-fine surge voltage (micro surge) occurs at the end connected to the motor, causing motor degradation, destruction of insulation, and increased noise. By using a surge suppression unit, such surge voltage can be suppressed.

(1) By simply connecting a surge suppression unit to the motor side, surge voltage can be substantially reduced.
(2) Because no additional installation work is required, the unit can be easily attached to existing equipment.
(3) The unit can be attached regardless of the motor capacity (contact us, however, before attaching the unit to a motor exceeding 75 kW).
(4) The unit does not require power supply, and can be used free of maintenance.
(5) Two types (for 50 m and for 100 m) are available.
(6) The unit is compliant with the environmental standards and the safety standards (complies with the RoHS Directive).

● Structure of surge suppression unit

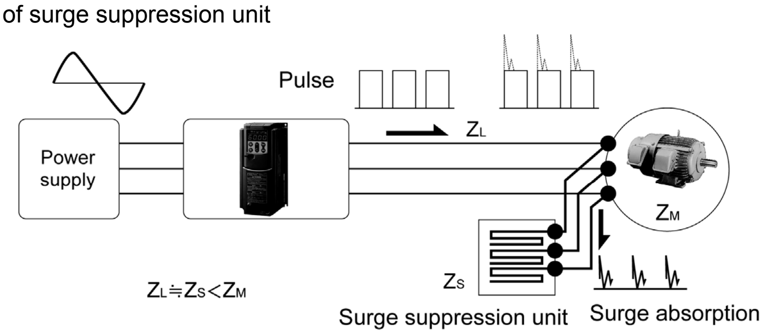


Figure 1.1−1

- Complies with the RoHS Directive

Our inverters comply with the EU Directive on the restriction of the use of certain hazardous substances (RoHS Directive) as standard, and are environment-friendly with restricted use of the six hazardous substances.

<Six hazardous substances>

Lead, mercury, cadmium, hexavalent chromium, Polybrominated Biphenyls (PBBs), and Polybrominated Dephenyl Ethers (PBDEs)

* This excludes components used for certain models.

<What is RoHS? >

DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

■ Global design

- Compliance with global standards

Europe	North America/Canada
EC Directive (CE marking)	UL standard (cUL certified)
CE	c UL US LISTED

Figure 1.1−2

- Switchable between SINK and SOURCE

- Wide input voltage range

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

  * Multi-function keypad is optional. Two types are available (TP-G1-J1 and TP-G1-C1).

1.2 Control System

1.2.1 Theory of inverter

As shown in Figure 1.2-1, 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 PWM frequency is called the "Carrier Frequency.")

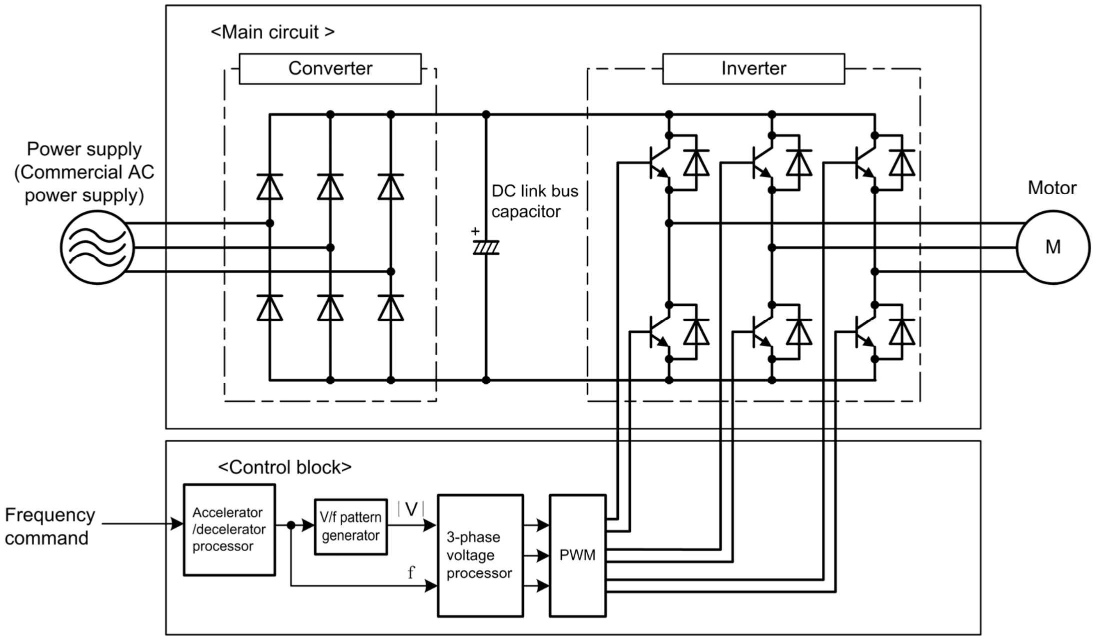
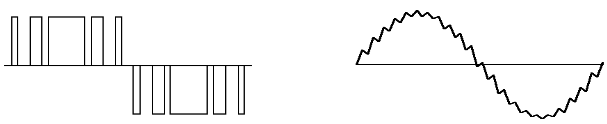


Figure 1.2−1 Schematic Overview of Theory of Inverter

The supplied voltage waveform is modulated by the carrier frequency (Figure 1.2-2 PWM voltage waveform, modulated wave), consisting of alternating cycles of positive and negative pulse trains synchronizing with the inverter’s output frequency. The inverter can supply, to the motor, current that has a sinusoidal waveform (Figure 1.2-2 Current waveform) equal to that of the commercial power supply.



PWM voltage waveform Current waveform

Figure 1.2−2 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.

1.2.2 Motor drive controls

The FRENIC-MEGA supports the following motor drive controls.

Table 1.2−1

<table>
<tr><th>Motor drive controls</th><th>Basic control</th><th>Speed feedback</th><th>Drive control class</th><th>Speed control</th><th>Other restrictions</th></tr>
<tr><td>V/f control with slip compensation inactive</td><td rowspan="5">V/f control</td><td rowspan="3">Disable</td><td rowspan="3">V/f</td><td>Frequency control</td><td>—</td></tr>
<tr><td>Dynamic torque vector control</td><td rowspan="2">Frequency control with slip compensation</td><td>—</td></tr>
<tr><td>Frequency control with slip compensation</td><td>—</td></tr>
<tr><td>V/f control with speed sensor*</td><td rowspan="2">Enabled</td><td rowspan="2">PG V/f</td><td rowspan="2">Frequency control with automatic speed regulator (ASR)</td><td rowspan="2">Maximum frequency: 200 Hz</td></tr>
<tr><td>Dynamic torque vector control with speed sensor*</td></tr>
<tr><td>Vector control without speed sensor</td><td rowspan="2">Vector control</td><td>Estimated speed</td><td>w/o PG</td><td rowspan="2">Speed control with automatic speed regulator (ASR)</td><td>Maximum frequency: 120 Hz
Not available for MD-mode inverters.</td></tr>
<tr><td>Vector control with speed sensor*</td><td>Enabled</td><td>w/ PG</td><td>Maximum frequency: 200 Hz</td></tr>
</table>

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

For the features of the controls, refer to Chapter 10, Section 10.4.1 "Features of motor drive controls."

1.3 Acceptance Inspection

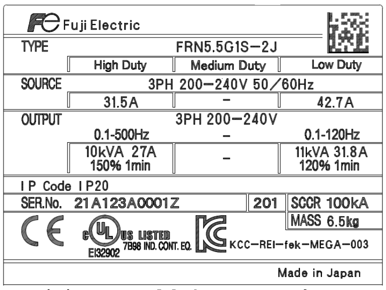
Upon arrival of the inverter, unpack the package and check the following:

(1) An inverter and the following accessories are contained in the package.

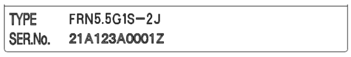
Accessories
- DC reactor (for 55-kW LD mode and for 75 kW or above)
- Instruction manual and CD-ROM

(2) The inverter has not been damaged during transportation — there should be no dents or parts missing.

(3) The inverter is the type you ordered. You can check the type and specifications on the main nameplate. (The main and sub nameplates are attached to the inverter as shown on the next page.)



(a) Main nameplate



(b) Sub nameplate

Figure 1.3−1 Nameplates

TYPE: Inverter type

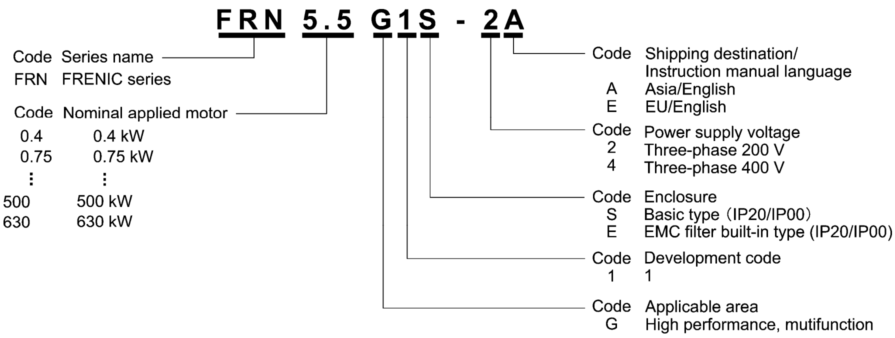


Figure 1.3−2

Note In this manual, inverter types are denoted as "FRN***G1□-2J/4J." '□' indicates an alphabetical letter that signifies the inverter type.

This inverter is available in two drive modes (HD and LD) or in three drive modes (HD, MD and LD). One of these modes should be selected to match the load property of your system. Specifications in each mode are printed on the main nameplate. For details, refer to Chapter 12 "SPECIFICATIONS."

High Duty:	HD mode:	Designed for high duty load applications; Overload capability: 150% for 1 min, 200% for 3 sec.
Medium Duty:	MD mode:	Designed for medium duty load applications; Overload capability: 150% for 1 min.
Low Duty:	LD mode:	Designed for low duty load applications; Overload capability: 120% for 1 min.

SOURCE:	Number of input phases (three-phase: 3PH), input voltage, input frequency, input current
OUTPUT:	Number of output phases, rated output voltage, output frequency range, rated output capacity, rated output current, and overload capability
SCCR:	Short-circuit capacity
MASS:	Mass of the inverter

SER.No.: Product number
2 1 A 1 2 3 A 0 0 0 1 Z

Production year, week
2 01

Production week:
This indicates the week number that is numbered with the 1st week of January as '01'.

Production year: Last digit of year

If you suspect the product is not working properly or if you have any questions about your product, contact your Fuji Electric representative.

1.4 External View

(1) Outside and inside views

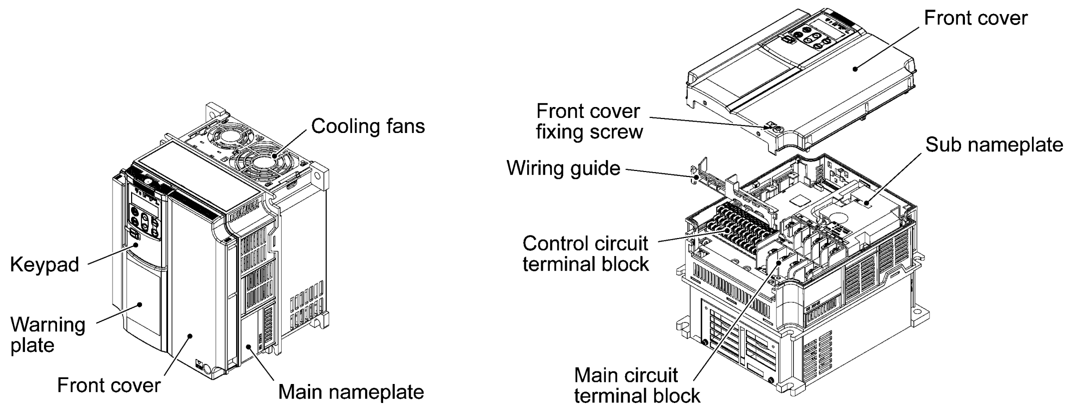


Figure 1.4−1 FRN11G1S-2J

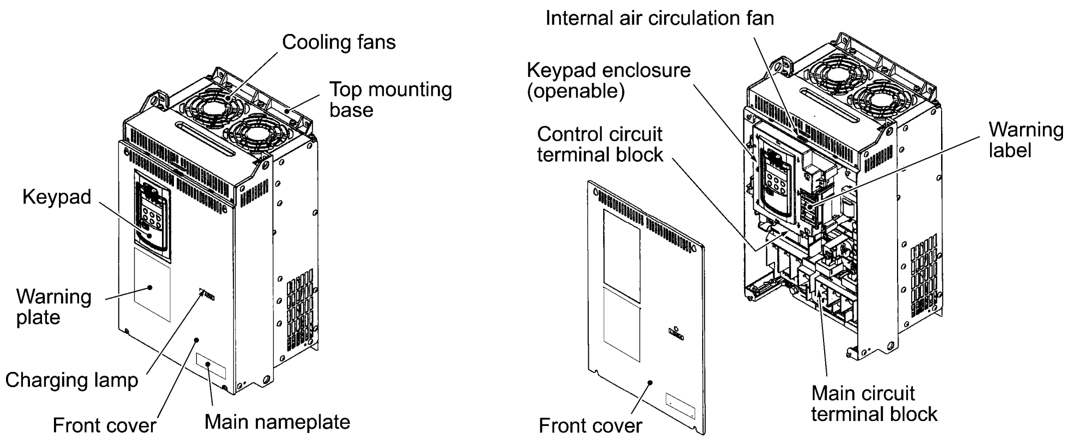
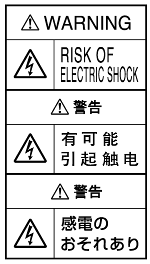


Figure 1.4−2 FRN30G1S-4J

(2) Warning plates and label

(a) FRN11G1S-2J



(b) FRN220G1S-4J

Warning label

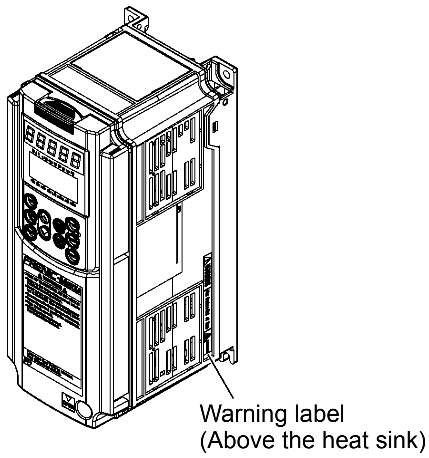
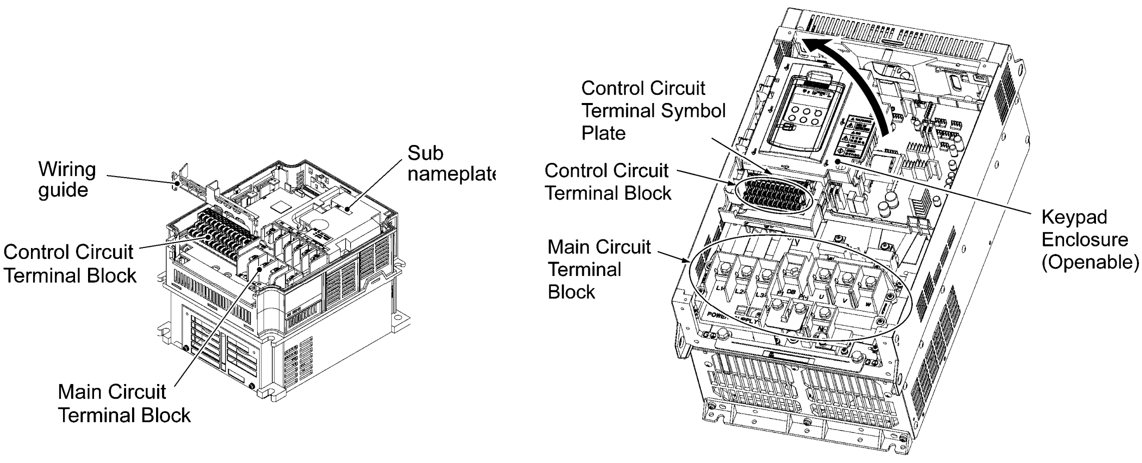


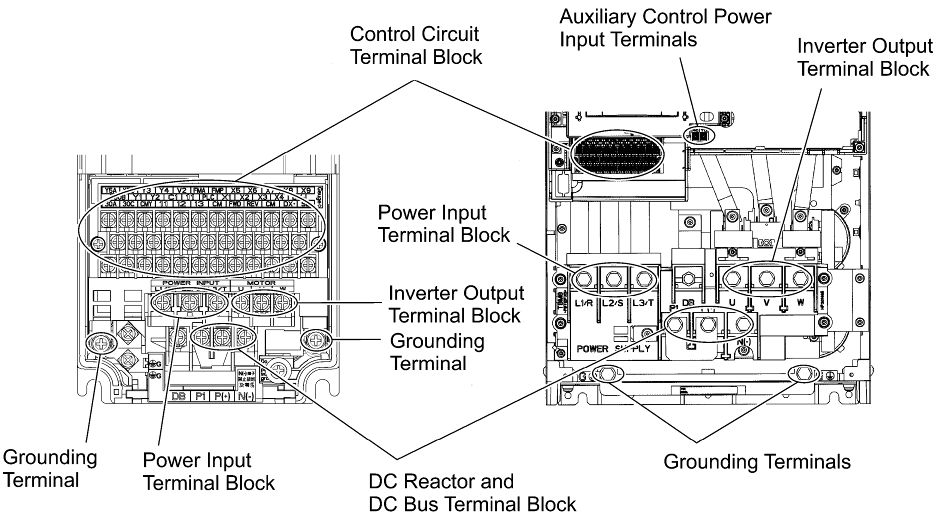
Figure 1.4−3 Warning plates and label

(3) View of the wiring section



(a) FRN11G1S-2J (b) FRN30G1S-2J

Figure 1.4−4 View of the wiring section



(a) FRN0.75G1S-2J (b) FRN30G1S-2J

Figure 1.4−5 Extended view of the terminal block

For the functions, layout and connection of terminals, refer to Chapter 2, "INSTALLATION AND WIRING." For recommended wire types based on wiring purposes, see Chapter 11, Section 11.2.1, "Recommended wires."

1.5 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 10, "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 11, "SELECTING PERIPHERAL EQUIPMENT" for details on the selection of peripheral equipment.

Figure 1.5-1 shows the recommended configuration for an inverter and peripheral equipment.

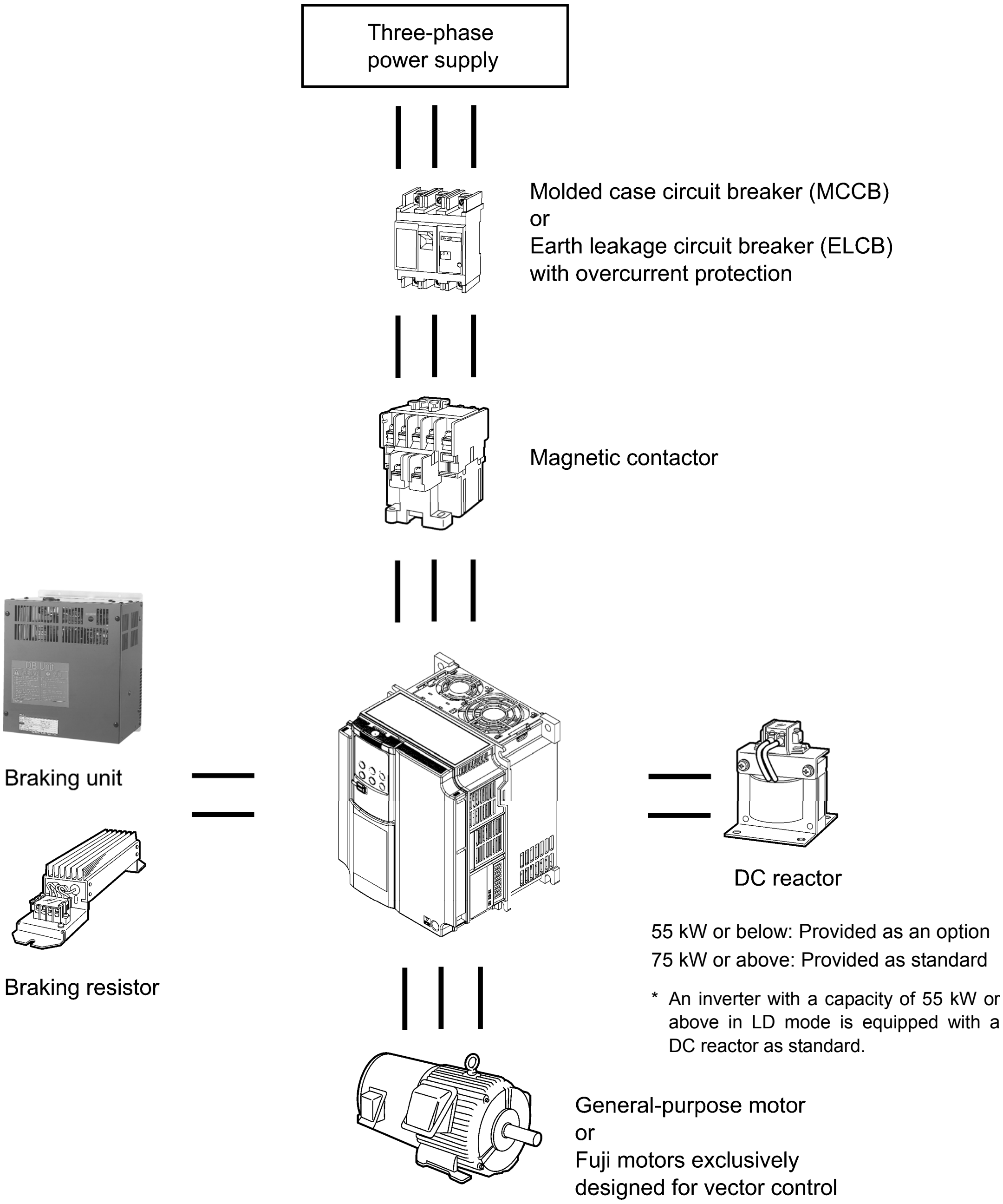


Figure 1.5−1 Recommended Confirmation Diagram

1.6 Precautions for Using Inverters

1.6.1 Operating environment

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

Table 1.6−1 Environmental Requirements

Item	Specifications			
Location	Indoors			
Surrounding temperature	-10 to +50°C (Note 1)			
Relative humidity	5 to 95% (No condensation)			
Ambience	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 only a small amount of salt. (0.01 mg/cm^2 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)			
Air 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 below), 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 1.6-2.

Table 1.6−2 Output Current Derating Factor in Relation to Altitude

Altitude	Output current derating factor
1,000 m or lower	1.00
1,000 to 1,500 m	0.97
1,500 to 2,000 m	0.95
2,000 to 2,500 m	0.91
2,500 to 3,000 m	0.88

1.6.2 Storage environment

[1] Temporary storage

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

Table 1.6−3 Storage and Transport Environments

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

Note 1) The indicated storage temperature range assumes storage over a relatively short time period, such as during transportation.

Note 2) Even if humidity is within the specified requirements, avoid 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 in Table 1.6-3, 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.

[2] Long-term storage

If you will not use the unit for a long time after purchase, store it in a following manner.

(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 1.6-3.

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.

1.6.3 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 1.6-1 in Section 1.6.1.

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.

Table 1.6-4

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, plaster 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 may cause the electronic circuitry to malfunction.	Any of the following measures may be necessary. • Mount the inverter in a sealed panel that shuts out dust. • Secure 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 may cause 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 may get 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
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).

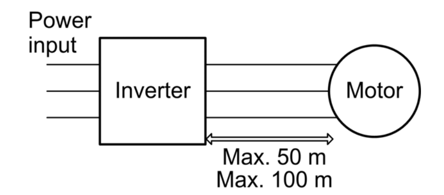
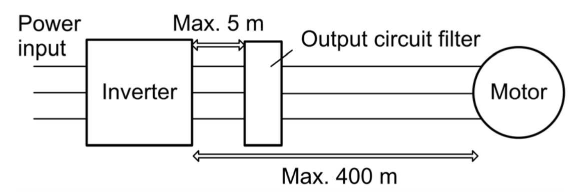
(3) If more than one motor is to be connected to a single inverter, the wiring length should be the total length of wiring between the inverter and motors.

(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).

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).

Table 1.6–5

No output circuit filter installed	Output circuit filter installed
	

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).

(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 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) to "1" and keep the inverter output voltage at a higher level by configuring H50 (Non-linear V/f Pattern, Frequency) and H51 (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) circuit. Mounting it in the input (primary) circuit takes no effect. To correct the inverter power factor, use an optional DC reactor (DCR). Do not mount a phase-advancing capacitor for power factor correction in the inverter's output (secondary) circuit. 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 on the same power supply line. 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 smoothing 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).

Voltage unbalance (%) = [Max voltage (V) - Min voltage (V)] / [Three-phase average voltage (V)] x 67 (IEC61800- 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.

Table 1.6−6

DC reactor type	Remarks
Input power factor of DCR2/4-□□/□□A/□□B: Approx. 90 to 95% Compliant with the Public Construction Works Standard Specifications (Electrical Equipment Works), Edition 2010, supervised by the Ministry of Land, Infrastructure, Transport and Tourism. (Based on Edition 2010, the input power factor calculated with the power factor for the fundamental wave as 1 stands at 94% or higher.)	The last letter identifies the capacitance.
Input power factor of 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.

(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, 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)

Install a recommended molded case circuit breaker (MCCB) or an earth leakage circuit breaker (ELCB) (with overcurrent protection function) in the primary circuit of the inverter to protect wiring. Since using an MCCB or 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 an 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). The breakdown of a braking unit or misconnection of an external braking resistor is possible if a DC link voltage establishment signal is not issued within three seconds after the MC is switched on. Even in such cases, a sequence that shuts down the magnetic contactor (MC) in the inverter input circuit minimizes the impact of failure. 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.

■ 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 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.

■ 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.

Table 1.6−7

Problem	Measures
An earth leakage circuit breaker (with overcurrent protection function) that is connected to the input (primary) side has tripped.	1) Decrease the carrier frequency. 2) Make the wires between the inverter and motor shorter. 3) Make the current sensitivity of the earth leakage circuit breaker larger. 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 has malfunctioned.	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

1.6.4 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 a 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.

- 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."

1.6.5 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.

■ 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 safe operation.

Chapter 2

INSTALLATION AND WIRING

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

Contents

2.1 Installation

(1) Installation Surface

Please install the inverter on non-combustible matter such as metals. Also, do not mount it upside down or horizontally.

⚠WARNING

Install on non-combustible matter such as metals.

Risk of fire exists.

(2) Surrounding Space

Secure the space shown in Figure 2.1-1 and Table 2.1-1. When enclosing FRENIC-MEGA in control panels, be sure to provide adequate board ventilation, as the surrounding temperature may rise. Do not contain it in small enclosures with low heat dissipation capacity.

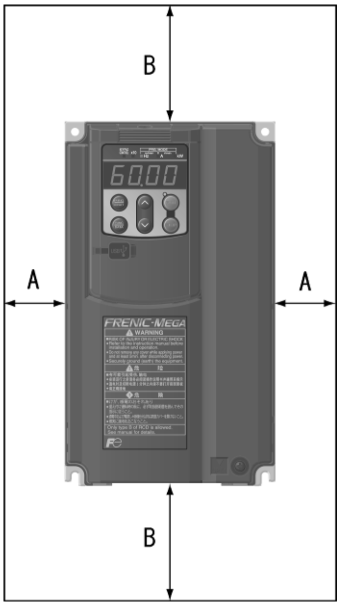


Figure 2.1-1 Installation Direction

■ Installation of Multiple Inverters

When installing 2 or more units in the same equipment or control panel, generally mount them in horizontally parallel position. When the inverters are mounted vertically, attach partitioning boards to prevent the heat dissipated from the lower inverter to affect the upper inverter.

For types with 22 kW or smaller and for ambient temperature below 40ºC only, the units can be installed horizontally without any spacing in between.

Table 2.1-1 Surrounding Space (mm)

Applicable capacity	A	B	C
0.4 to 1.5 kW	50	100	0
2.2 to 22 kW	10		
30 to 220 kW	50		100
280 to 630 kW		150	150

C: Space in front of the inverter unit

■ Installation with External Cooling

The external cooling form reduces internally generated heat by dissipating approximately 70% of the total heat generated (total heat loss) using the cooling fins protruding outside the equipment or control panel.

Installation with external cooling is possible for types with 22 kW or smaller by adding attachments (optional) for external cooling, and for types with 30 kW or greater by moving the mounting bases.

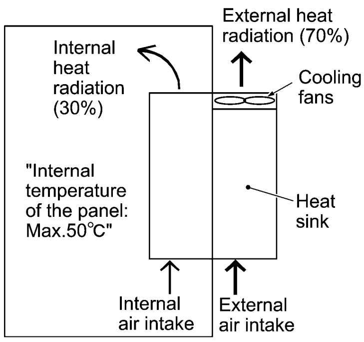


Figure 2.1-2 Installation with External Cooling

⚠CAUTION

Prevent lint, wastepaper, wood shavings, dust, metal scrap, and other foreign material from entering the inverter or from attaching to the cooling fins.

Risk of fire and risk of accidents exist.

To install the 30 kW or greater inverter with external cooling, change the mounting position of the mounting bases following the procedure below. (Refer to Figure 2.1-3)
As the type and number of screws differ by inverter type, please review the following table.

Table 2.1-2 Type and Number of Screws, and Tightening Torque

Inverter type	Mounting base fixation screw	Case attachment screw	Tightening torque (N·m)
FRN30G1□-2J/FRN37G1□-2J FRN30G1□-4J to FRN55G1□-4J	M6×20 (5 screws on top, 3 screws on bottom)	M6×20 (2 screws on top only)	5.8
FRN45G1□-2J/FRN55G1□-2J FRN75G1□-4J	M6×20 (3 screws each on top and bottom)	M6×12 (3 screws on top only)	5.8
FRN75G1□-2J FRN90G1□-4J/FRN110G1□-4J	M5x12 (7 screws each on top and bottom)	M5×12 (7 screws on top only)	3.5
FRN132G1□-4J/FRN160G1□-4J	M5x16 (7 screws each on top and bottom)	M5×16 (7 screws on top only)	3.5
FRN90G1□-2J FRN200G1□-4J/FRN220G1□-4J	M5x16 (8 screws each on top and bottom)	M5×16 (8 screws on top only)	3.5
FRN280G1□-4J/FRN315G1□-4J FRN355G1□-4J/FRN400G1□-4J	M5x16 (2 screws each on top and bottom) M6x20 (6 screws each on top and bottom)	M5x16 (2 screws each on top and bottom) M6x20 (6 screws each on top and bottom)	3.5 5.8
FRN500G1□-4J/FRN630G1□-4J	M8×20 (8 screws each on top and bottom)	M8×20 (8 screws each on top and bottom)	13.5

1) Remove all of the mounting base fixation screws and the case attachment screws on the top of the inverter.
2) Fix the mounting bases to the case attachment screw holes using the mounting base fixation screws. A few screws should remain after changing the position of the mounting bases.
3) Change the position of the mounting bases on the bottom side following the procedure in 1) and 2).
   (No case attachment screws are installed on the bottom of an inverter with a capacity of 220 kW or smaller.)

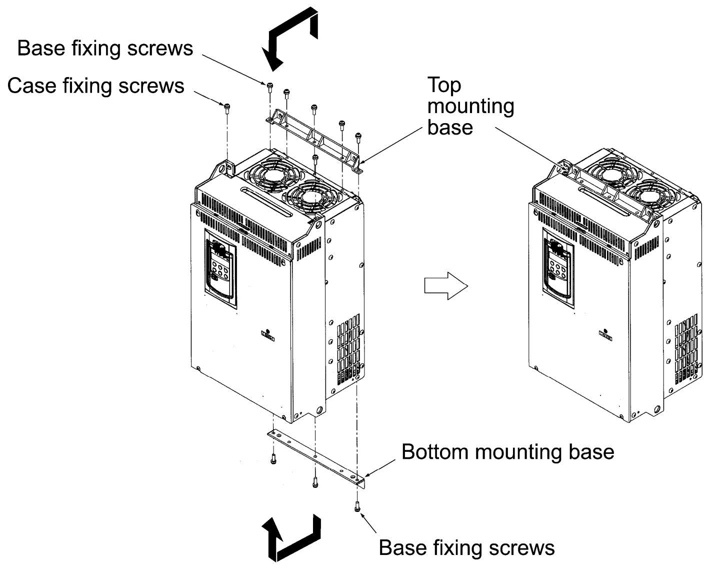


Figure 2.1-3 Method to Change the Mounting Base Positions

⚠CAUTION
Use the specified screws in changing the mounting bases. **Risk of fire and risk of accidents exist.**

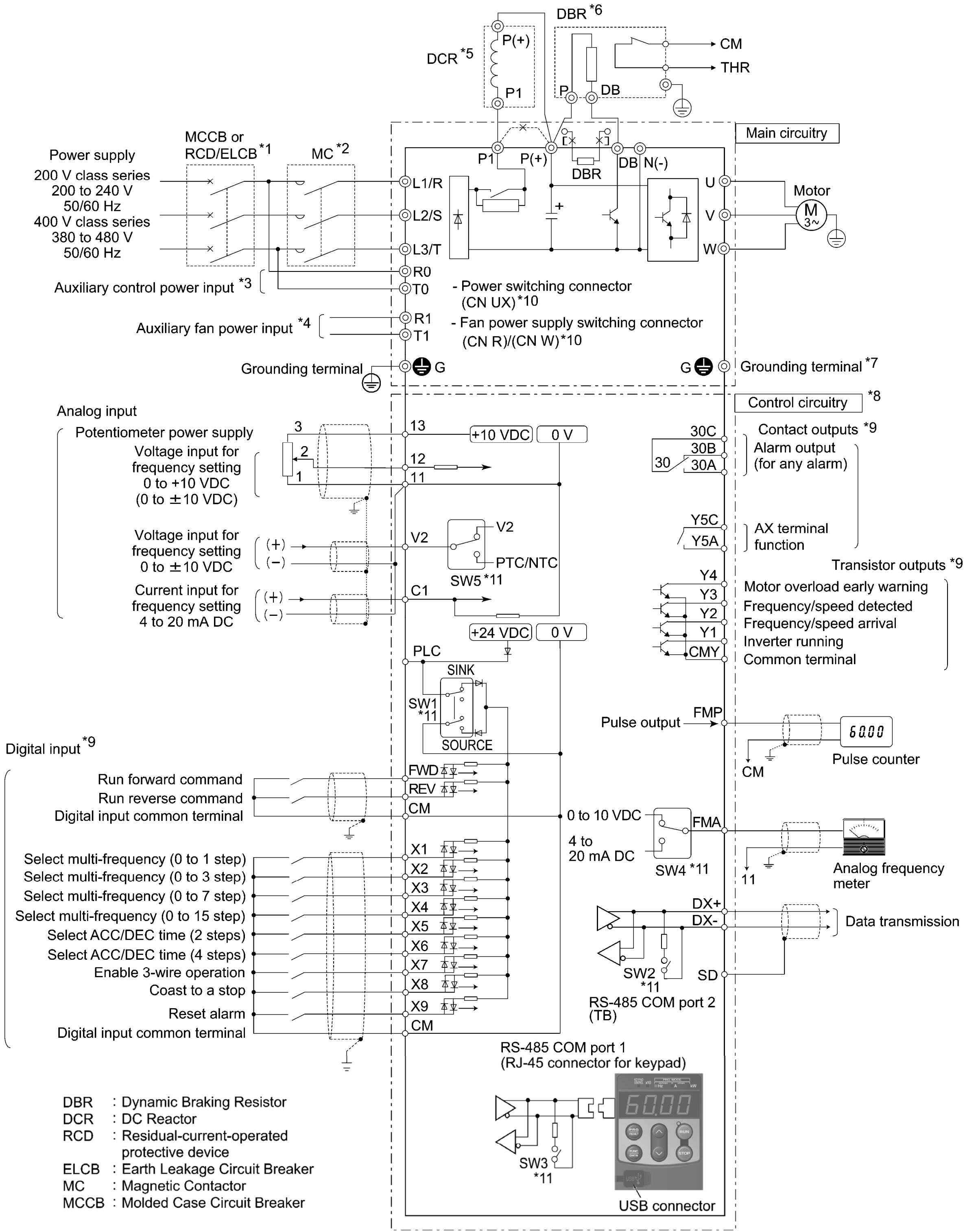
2.2 Wiring

Route the wiring following the steps below. (The inverter is already installed in the descriptions.)

Note The inverter type is shown as "FRN***G1☐-2J/4J" in the tables of this document. The box ☐ replaces an alphabetic character indicating the type.

2.2.1 Connection diagrams

[1] Running a standard motor



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

Figure 2.2-1

*1 Install a recommended molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELCB) (with overcurrent protective function) on 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 recommended magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or 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 issued 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 (optional) 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 optional 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, ground the shield of them. 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 Section 2.2.6 "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 2.2.7 "Setting up the slide switches."

[2] Running a Fuji motor exclusively designed for vector control

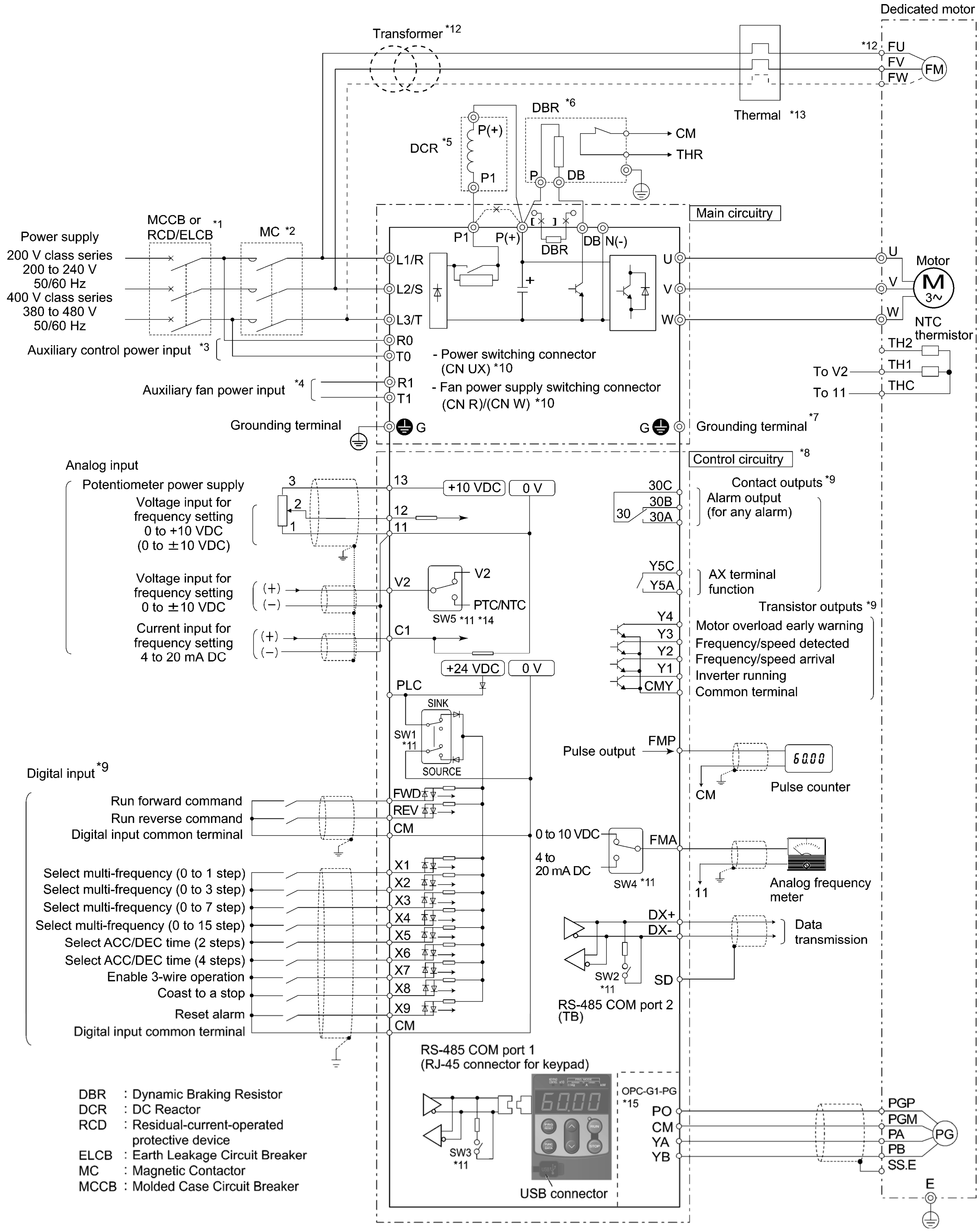


Figure 2.2-2

*1 Install a recommended molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELCB) (with overcurrent protective 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 recommended magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or 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 issued 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 (optional) 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 optional 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, ground the shield of them. 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 Section 2.2.6 "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 2.2.7 "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.

2.2.2 Removing and mounting the front cover and the wiring guide

(1) Types with a capacity of 22 kW or below

1) Loosen the screws of the front cover. Hold both sides of the front cover with the hands, slide the cover downward, and pull. Then remove to the upward direction.
2) Push the wiring guide upward and pull. Let the guide slide and remove.
3) After routing the wires, attach the wiring guide and the front cover reversing the steps above.

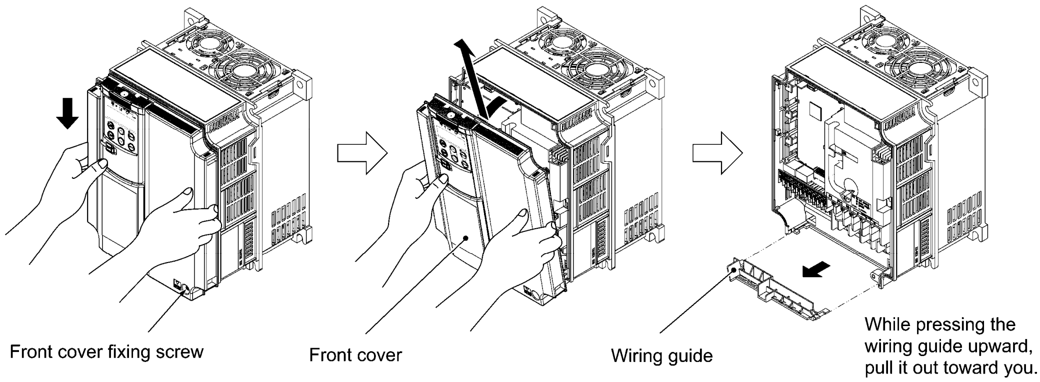
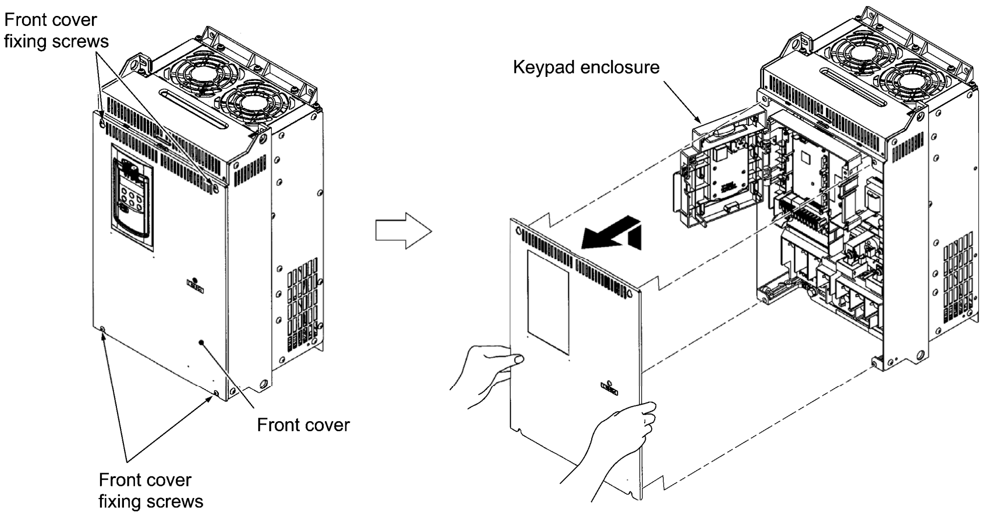


Figure 2.2-3 Removal of the Front Cover and the Wiring Guide (for FRN11G1S-2J)

(2) Types with a capacity of 30 to 630 kW

1) Loosen the screws of the front cover. Hold both sides of the front cover with the hands and slide upward to remove.
2) After routing the wires, align the front cover top edge to the screw holes and attach the cover reversing the steps in figure 2.2-4.

Tip Open the keypad enclosure to view the control printed circuit board.



Tightening torque: 1.8 N•m (M4)
3.5 N•m (M5)

Figure 2.2-4 Removal of the Front Cover (for FRN30G1S-2J)

2.2.3 Wiring precautions

Exercise caution for the following when wiring.

(1) Confirm that the supply voltage is within the input voltage range described on the rating plate.
(2) Always connect the power lines to the inverter main power input terminals L1/R, L2/S, L3/T (3 phase). (The inverter will be damaged when power is applied while the power lines are connected to the wrong terminals.)
(3) Always route the ground line to prevent accidents such as electric shock and fire and to reduce noise.
(4) For the lines connecting to the main circuit terminals, use crimped terminals with insulating sleeves or use crimped terminals in conjunction with insulating sleeves for high connection reliability.
(5) Separate the routing of the lines connected to the main circuit terminal input side (primary side) and the output side (secondary side) and the lines connected to the control circuit terminals.
(6) After removing the main circuit terminal screw, always restore the terminal screw in position and tighten even if lines are not connected.
(7) The wiring guide is used to separately route the main circuit wiring and the control circuit wiring. For inverters with a capacity of 3.7 kW or below, the main circuit wiring and the control circuit wiring can be separated. In a capacity of 5.5 to 22 kW, the main circuit wiring (lower level), the main circuit wiring (upper level) and the control circuit wiring can be separated. Exercise caution for the order of wiring.

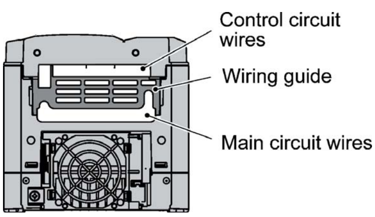


Figure 2.2-5 Case of FRN3.7G1S-2J

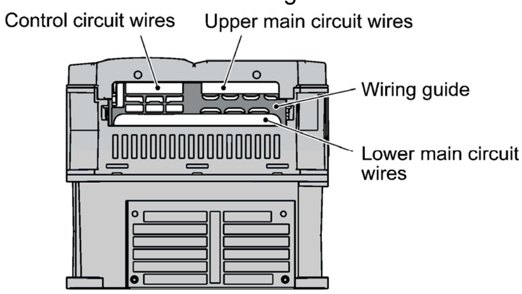
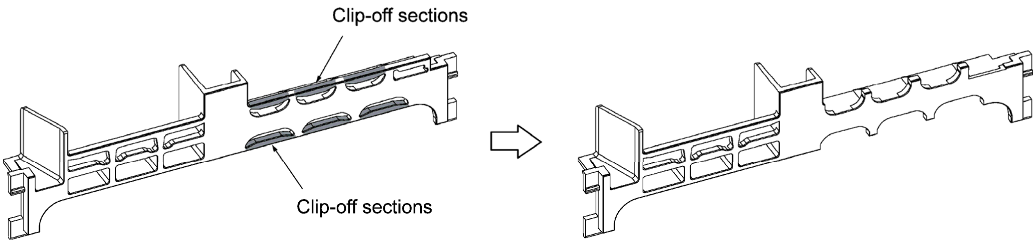


Figure 2.2-6 Case of FRN11G1S-2J

■ **Handling the Wiring Guide**

For inverters with a capacity of 11 to 22 kW (three-phase 200 V class series), the wiring space may become insufficient when routing the main circuit wires, depending on the wire material used. In these cases, the relevant cut-off sections (see the figure below) can be removed using a pair of nippers to secure routing space. Be warned that removing the wiring guide to accommodate the enlarged main circuit wiring will result in non-conformance to IP20 standards.



Before cut off　　After cut off

Figure 2.2-7 Wiring Guide (for FRN15G1S-2J)

(8) Depending on the inverter capacity, straight routing of the main circuit wires from the main circuit terminal block may not be possible. In these cases, route the wires as shown in the figure below and securely attach the front cover.

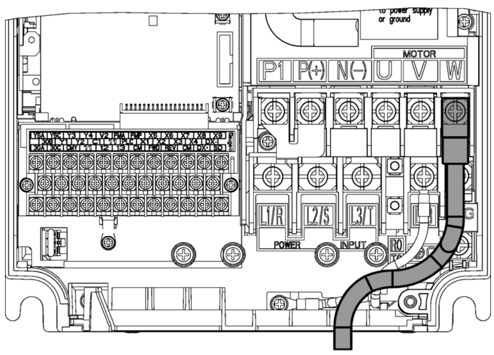


Figure 2.2-8

(9) The input terminals L2/S of inverters with a capacity of 500 kW and 630 kW are arranged in a direction perpendicular to the unit. To connect wires to the terminals, use the supplied bolts, washers and nuts as shown in the figure below.

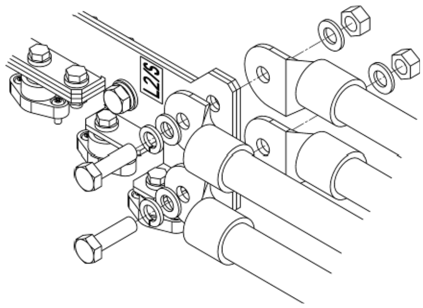


Figure 2.2-9

⚠WARNING

- For each inverter, connect to the power supply via circuit breaker and earth leakage breaker (with overcurrent protective function). Use recommended circuit breakers and earth leakage breakers and do not use breakers which exceed the recommended rated current.
- Always use the specified sizes for the wires.
- Tighten terminals with the defined tightening torque.
- When multiple combinations of inverters and motors exist, do not use multi-core cables for the purpose of bundling the various wires.
- Do not install surge killers on the inverter output side (secondary side).

Risk of fire exists.

- Establish a class C or class D ground for the inverter according to the inverter's voltage class.
- Always ground the ground line connected to the inverter grounding terminal [⏚G].

Risk of electric shock and risk of fire exist.

- Qualified personnel should perform the wiring.
- Perform wiring after confirming that the power is shut off.

Risk of electric shock exists.

- Perform wiring only after the equipment is installed at the location.

Risk of electric shock and risk of injury exist.

- Confirm that the phase of the power input and the rated voltage for the product match with the phase and voltage of the power supply to be connected.
- Do not connect power supply lines to the inverter output terminals (U, V, W).

Risk of fire and risk of accidents exist.

2.2.4 Main circuit terminals

[1] Screw specifications and recommended wire size (main circuit terminals)

The specifications for the screws used in the main circuit wiring and the wire sizes are shown below. Exercise caution as the terminal layout varies by inverter capacity. In the diagram, the two ground terminals [⊕G] are not differentiated for the input side (primary side) and the output side (secondary side).

Use crimp terminals covered with an insulation sleeve or with an insulation tube. The recommended wire sizes for the main circuits are examples of using a single HIV wire (maximum allowable temperature: 75ºC) at a surrounding temperature of 50ºC. For wire sizes when using wires of other specifications, refer to Chapter 11, Section 11.2 "Selecting Wires and Crimp Terminals."

Table 2.2-1 Screw Specifications

<table>
<tr><th colspan="2">Inverter type</th><th rowspan="3">Refer to:</th><th colspan="8">Screw specifications</th></tr>
<tr><th rowspan="2">Three-phase 200 V</th><th rowspan="2">Three-phase 400V</th><th colspan="2">Main circuit terminals</th><th colspan="2">Grounding terminals</th><th colspan="2">Auxiliary control power input terminals [R0, T0]</th><th colspan="2">Auxiliary fan power input terminals [R1, T1]</th></tr>
<tr><th>Screw size</th><th>Tightening torque (N·m)</th><th>Screw size</th><th>Tightening torque (N·m)</th><th>Screw size</th><th>Tightening torque (N·m)</th><th>Screw size</th><th>Tightening torque (N·m)</th></tr>
<tr><td>FRN0.4G1□-2J</td><td>FRN0.4G1□-4J</td><td rowspan="2">Figure A</td><td rowspan="2">M3.5</td><td rowspan="2">1.2</td><td rowspan="2">M3.5</td><td rowspan="2">1.2</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="15">-</td><td rowspan="15">-</td></tr>
<tr><td>FRN0.75G1□-2J</td><td>FRN0.75G1□-4J</td></tr>
<tr><td>FRN1.5G1□-2J</td><td>FRN1.5G1□-4J</td><td rowspan="3">Figure B</td><td rowspan="3">M4</td><td rowspan="3">1.8</td><td rowspan="3">M4</td><td rowspan="3">1.8</td><td rowspan="29">M3.5</td><td rowspan="29">1.2</td></tr>
<tr><td>FRN2.2G1□-2J</td><td>FRN2.2G1□-4J</td></tr>
<tr><td>FRN3.7G1□-2J</td><td>FRN3.7G1□-4J</td></tr>
<tr><td>FRN5.5G1□-2J</td><td>FRN5.5G1□-4J</td><td rowspan="3">Figure C</td><td rowspan="3">M5</td><td rowspan="3">3.5</td><td rowspan="3">M5</td><td rowspan="3">3.5</td></tr>
<tr><td>FRN7.5G1□-2J</td><td>FRN7.5G1□-4J</td></tr>
<tr><td>FRN11G1□-2J</td><td>FRN11G1□-4J</td></tr>
<tr><td>FRN15G1□-2J</td><td>FRN15G1□-4J</td><td rowspan="3">Figure D</td><td rowspan="3">M6</td><td rowspan="3">5.8</td><td rowspan="3">M6</td><td rowspan="3">5.8</td></tr>
<tr><td>FRN18.5G1□-2J</td><td>FRN18.5G1□-4J</td></tr>
<tr><td>FRN22G1□-2J</td><td>FRN22G1□-4J</td></tr>
<tr><td rowspan="4">FRN30G1□-2J</td><td>FRN30G1□-4J</td><td rowspan="4">Figure E</td><td rowspan="4">M8</td><td rowspan="4">13.5</td><td rowspan="9">M8</td><td rowspan="9">13.5</td></tr>
<tr><td>FRN37G1□-4J</td></tr>
<tr><td>FRN45G1□-4J</td></tr>
<tr><td>FRN55G1□-4J</td></tr>
<tr><td>FRN37G1□-2J</td><td rowspan="3">FRN75G1□-4J</td><td rowspan="3">Figure F</td><td rowspan="5">M10</td><td rowspan="5">27</td><td rowspan="16">M3.5</td><td rowspan="16">1.2</td></tr>
<tr><td>FRN45G1□-2J</td></tr>
<tr><td>FRN55G1□-2J</td></tr>
<tr><td>-</td><td>FRN90G1□-4J</td><td rowspan="2">Figure G</td></tr>
<tr><td>-</td><td>FRN110G1□-4J</td></tr>
<tr><td>FRN75G1□-2J</td><td>-</td><td>Figure M</td><td rowspan="11">M12</td><td rowspan="11">48</td><td rowspan="11">M10</td><td rowspan="11">27</td></tr>
<tr><td>-</td><td>FRN132G1□-4J</td><td rowspan="2">Figure H</td></tr>
<tr><td>-</td><td>FRN160G1□-4J</td></tr>
<tr><td rowspan="2">FRN90G1□-2J</td><td>FRN200G1□-4J</td><td rowspan="2">Figure I</td></tr>
<tr><td>FRN220G1□-4J</td></tr>
<tr><td>-</td><td>FRN280G1□-4J</td><td rowspan="2">Figure J</td></tr>
<tr><td>-</td><td>FRN315G1□-4J</td></tr>
<tr><td>-</td><td>FRN355G1□-4J</td><td rowspan="2">Figure K</td></tr>
<tr><td>-</td><td>FRN400G1□-4J</td></tr>
<tr><td>-</td><td>FRN500G1□-4J</td><td rowspan="2">Figure L</td></tr>
<tr><td>-</td><td>FRN630G1□-4J</td></tr>
</table>

⚠WARNING⚠
When the inverter power is ON, a high voltage is applied to the following terminals. Main circuit terminals: L1/R, L2/S, L3/T, P1, P(+), N(-), DB, U, V, W, R0, T0, R1, T1, AUX-contact (30A, 30B, 30C, Y5A, Y5C) Insulation level Main circuit — Enclosure : Basic insulation (Overvoltage category III, Pollution degree 2) Main circuit — Control circuit : Reinforced insulation (Overvoltage category III, Pollution degree 2) Relay output — Control circuit : Reinforced insulation (Overvoltage category II, Pollution degree 2) **Risk of electric shock exists.**

[2] Terminal layout diagrams (main circuit terminals)

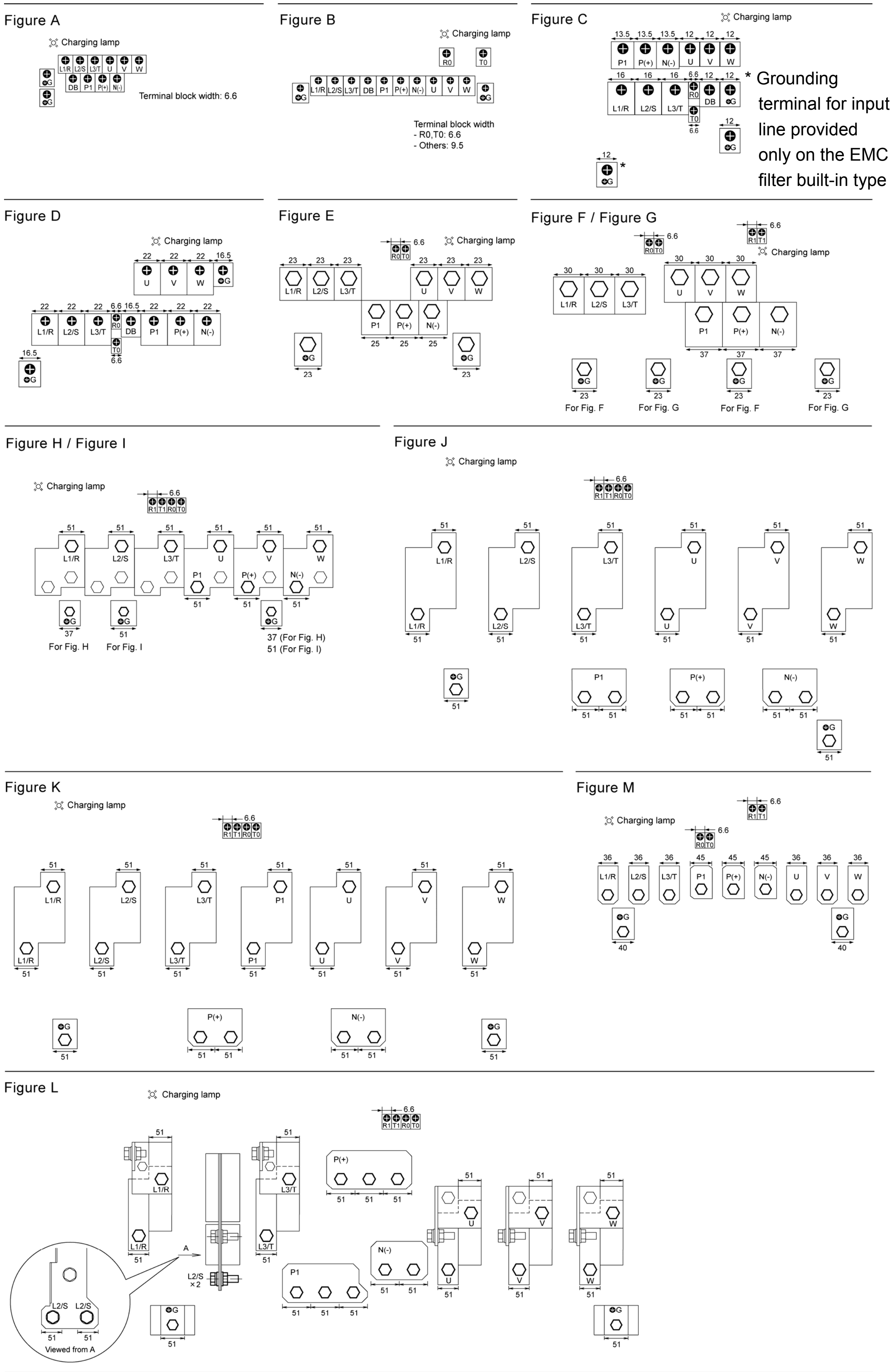


Figure 2.2-10

Table 2.2-2 Recommended Wire Sizes

<table>
<thead>
<tr><th rowspan="3">Power supply voltage</th><th rowspan="3">Nominal applied motor (kW)</th><th colspan="3" rowspan="2">Inverter type</th><th colspan="6">Recommended wire size (mm²)</th></tr>
<tr><th colspan="2">Main circuit power input [L1/R, L2/S, L3/T]</th><th rowspan="2">Grounding [⏚G]</th><th rowspan="2">Inverter output [U, V, W]</th><th rowspan="2">DCR [P1, P(+)]</th><th rowspan="2">Braking resistor [P(+), DB]</th></tr>
<tr><th>HD mode</th><th>LD mode</th><th>MD mode</th><th>w/ DCR</th><th>w/o DCR</th></tr>
</thead>
<tbody>
<tr><td rowspan="20">Three-phase 200 V</td><td>0.4</td><td>FRN0.4G1□-2J</td><td>-</td><td>-</td><td rowspan="6">2.0</td><td rowspan="5">2.0</td><td rowspan="5">2.0</td><td rowspan="5">2.0</td><td rowspan="5">2.0</td><td rowspan="13">2.0</td></tr>
<tr><td>0.75</td><td>FRN0.75G1□-2J</td><td>-</td><td>-</td></tr>
<tr><td>1.5</td><td>FRN1.5G1□-2J</td><td>-</td><td>-</td></tr>
<tr><td>2.2</td><td>FRN2.2G1□-2J</td><td>-</td><td>-</td></tr>
<tr><td>3.7</td><td>FRN3.7G1□-2J</td><td>-</td><td>-</td></tr>
<tr><td>5.5</td><td>FRN5.5G1□-2J</td><td>-</td><td>-</td><td>3.5</td><td>3.5</td><td rowspan="2">3.5</td><td>3.5</td></tr>
<tr><td rowspan="2">7.5</td><td>-</td><td>FRN5.5G1□-2J</td><td>-</td><td rowspan="2">3.5</td><td rowspan="2">5.5</td><td rowspan="3">5.5</td><td rowspan="2">5.5</td></tr>
<tr><td>FRN7.5G1□-2J</td><td>-</td><td>-</td><td>5.5</td></tr>
<tr><td>11</td><td>FRN11G1□-2J</td><td>FRN7.5G1□-2J</td><td>-</td><td>5.5</td><td>14</td><td>8.0</td><td>8.0</td></tr>
<tr><td>15</td><td>FRN15G1□-2J</td><td>FRN11G1□-2J</td><td>-</td><td rowspan="2">14</td><td rowspan="2">22</td><td rowspan="2">8.0</td><td rowspan="2">14</td><td>14</td></tr>
<tr><td>18.5</td><td>FRN18.5G1□-2J</td><td>FRN15G1□-2J</td><td>-</td><td rowspan="2">22</td></tr>
<tr><td>22</td><td>FRN22G1□-2J</td><td>FRN18.5G1□-2J</td><td>-</td><td>22</td><td>38 *1</td><td rowspan="3">14</td><td>22</td></tr>
<tr><td rowspan="2">30</td><td>-</td><td>FRN22G1□-2J</td><td>-</td><td>38 *1</td><td>60 *2</td><td>38 *1</td><td>38 *1</td></tr>
<tr><td>FRN30G1□-2J</td><td>-</td><td>-</td><td rowspan="2">38</td><td rowspan="2">60</td><td rowspan="2">38</td><td>38</td><td rowspan="7">-</td></tr>
<tr><td>37</td><td>FRN37G1□-2J</td><td>FRN30G1□-2J</td><td>-</td><td rowspan="5">22</td><td>60</td></tr>
<tr><td>45</td><td>FRN45G1□-2J</td><td>FRN37G1□-2J</td><td>-</td><td>60</td><td rowspan="2">100</td><td>60</td><td rowspan="2">100</td></tr>
<tr><td>55</td><td>FRN55G1□-2J</td><td>FRN45G1□-2J</td><td>-</td><td>100</td><td>100</td></tr>
<tr><td>75</td><td>FRN75G1□-2J</td><td>FRN55G1□-2J</td><td>-</td><td>150 *3</td><td rowspan="3">-</td><td>150 *3</td><td>150</td></tr>
<tr><td>90</td><td>FRN90G1□-2J</td><td>FRN75G1□-2J</td><td>-</td><td>150</td><td>150</td><td>200</td></tr>
<tr><td>110</td><td>-</td><td>FRN90G1□-2J</td><td>-</td><td>200</td><td>38</td><td>200</td><td>250</td></tr>
<tr><td rowspan="34">Three-phase 400V</td><td>0.4</td><td>FRN0.4G1□-4J</td><td>-</td><td>-</td><td rowspan="9">2.0</td><td rowspan="7">2.0</td><td rowspan="6">2.0</td><td rowspan="8">2.0</td><td rowspan="7">2.0</td><td rowspan="13">2.0</td></tr>
<tr><td>0.75</td><td>FRN0.75G1□-4J</td><td>-</td><td>-</td></tr>
<tr><td>1.5</td><td>FRN1.5G1□-4J</td><td>-</td><td>-</td></tr>
<tr><td>2.2</td><td>FRN2.2G1□-4J</td><td>-</td><td>-</td></tr>
<tr><td>3.7</td><td>FRN3.7G1□-4J</td><td>-</td><td>-</td></tr>
<tr><td>5.5</td><td>FRN5.5G1□-4J</td><td>-</td><td>-</td></tr>
<tr><td>7.5</td><td>FRN7.5G1□-4J</td><td>FRN5.5G1□-4J</td><td>-</td><td rowspan="4">3.5</td></tr>
<tr><td rowspan="2">11</td><td>-</td><td>FRN7.5G1□-4J</td><td>-</td><td rowspan="2">3.5</td><td rowspan="2">3.5</td></tr>
<tr><td>FRN11G1□-4J</td><td>-</td><td>-</td><td rowspan="2">3.5</td></tr>
<tr><td>15</td><td>FRN15G1□-4J</td><td>FRN11G1□-4J</td><td>-</td><td>3.5</td><td>5.5</td><td rowspan="2">5.5</td></tr>
<tr><td>18.5</td><td>FRN18.5G1□-4J</td><td>FRN15G1□-4J</td><td>-</td><td rowspan="2">5.5</td><td>8.0 *4</td><td rowspan="2">5.5</td><td>5.5</td></tr>
<tr><td>22</td><td>FRN22G1□-4J</td><td>FRN18.5G1□-4J</td><td>-</td><td rowspan="2">14</td><td>8.0 *4</td><td>8.0 *4</td></tr>
<tr><td rowspan="2">30</td><td>-</td><td>FRN22G1□-4J</td><td>-</td><td rowspan="3">14</td><td rowspan="4">8.0</td><td rowspan="3">14</td><td rowspan="2">14</td></tr>
<tr><td>FRN30G1□-4J</td><td>-</td><td>-</td><td rowspan="2">22</td><td rowspan="21">-</td></tr>
<tr><td>37</td><td>FRN37G1□-4J</td><td>FRN30G1□-4J</td><td>-</td><td rowspan="2">22</td></tr>
<tr><td>45</td><td>FRN45G1□-4J</td><td>FRN37G1□-4J</td><td>-</td><td rowspan="2">22</td><td rowspan="2">38</td><td>22</td></tr>
<tr><td>55</td><td>FRN55G1□-4J</td><td>FRN45G1□-4J</td><td>-</td><td rowspan="3">14</td><td>38</td><td>38</td></tr>
<tr><td>75</td><td>FRN75G1□-4J</td><td>FRN55G1□-4J</td><td>-</td><td>38</td><td rowspan="17">-</td><td rowspan="2">60</td><td>60</td></tr>
<tr><td>90</td><td>FRN90G1□-4J</td><td>FRN75G1□-4J</td><td>-</td><td>60</td><td rowspan="2">100</td></tr>
<tr><td>110</td><td>FRN110G1□-4J</td><td>FRN90G1□-4J</td><td>FRN90G1□-4J</td><td rowspan="2">100</td><td rowspan="3">22</td><td rowspan="2">100</td></tr>
<tr><td>132</td><td>FRN132G1□-4J</td><td>FRN110G1□-4J</td><td>FRN110G1□-4J</td><td rowspan="2">150</td></tr>
<tr><td>160</td><td>FRN160G1□-4J</td><td>FRN132G1□-4J</td><td>FRN132G1□-4J</td><td rowspan="2">150</td><td>150</td></tr>
<tr><td>200</td><td>FRN200G1□-4J</td><td>FRN160G1□-4J</td><td>FRN160G1□-4J</td><td rowspan="5">38</td><td rowspan="2">200</td><td rowspan="2">250</td></tr>
<tr><td>220</td><td>FRN220G1□-4J</td><td>FRN200G1□-4J</td><td>FRN200G1□-4J</td><td>200</td></tr>
<tr><td>250</td><td>-</td><td>-</td><td>FRN220G1□-4J</td><td rowspan="3">250</td><td>250</td><td>325</td></tr>
<tr><td rowspan="2">280</td><td>-</td><td>FRN220G1□-4J</td><td>-</td><td>150x2</td><td rowspan="3">200x2</td></tr>
<tr><td>FRN280G1□-4J</td><td>-</td><td>-</td><td rowspan="2">325</td></tr>
<tr><td>315</td><td>FRN315G1□-4J</td><td>-</td><td>FRN280G1□-4J</td><td>150x2</td><td rowspan="2">60</td></tr>
<tr><td>355</td><td>FRN355G1□-4J</td><td>FRN280G1□-4J</td><td>FRN315G1□-4J</td><td rowspan="2">200x2</td><td>200x2</td><td>250x2</td></tr>
<tr><td>400</td><td>FRN400G1□-4J</td><td>FRN315G1□-4J</td><td>FRN355G1□-4J</td><td rowspan="5">100</td><td rowspan="2">250x2</td><td rowspan="2">325x2</td></tr>
<tr><td>450</td><td>-</td><td>FRN355G1□-4J</td><td>FRN400G1□-4J</td><td>250x2</td></tr>
<tr><td>500</td><td>FRN500G1□-4J</td><td>FRN400G1□-4J</td><td>-</td><td>325x2</td><td>325x2</td><td rowspan="2">325x3</td></tr>
<tr><td>630</td><td>FRN630G1□-4J</td><td>FRN500G1□-4J</td><td>-</td><td>325x3</td><td>325x3</td></tr>
<tr><td>710</td><td>-</td><td>FRN630G1□-4J</td><td>-</td><td>250x4</td><td>325x4</td><td>325x4</td></tr>
</tbody>
</table>

*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 mm² wires for main circuit terminals of FRN55G1□-2J (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.

Table 2.2-3

Terminals common to all inverter types	Recommended wire size (mm^2)	Remarks
Auxiliary control power input terminals [R0, T0]	2.0	1.5 kW or above
Auxiliary fan power input terminals [R1, T1]	2.0	200 V class series with 37 kW or above and 400 V class series with 75 kW or above

[3] Description of terminal functions (main circuit terminals)

Table 2.2-4

Classification	Symbol	Name	Functional description
Main circuit	L1/R, L2/S, L3/T	Main circuit power input	Connect the three-phase input power lines.
	U, V, W	Inverter output	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(+)	For direct current 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	For braking resistor connection	Connect a braking resistor (option).
	P(+), N(-)	For DC link bus connection	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	For inverter and motor grounding	Grounding terminals for the inverter's chassis (or case) and motor. Earth one of the terminals and connect the other to the grounding terminal of the motor. Inverters provide a pair of grounding terminals that function equivalently.

(1) Inverter ground terminal⏚G

The terminal is the ground terminal for the inverter chassis (case). Always connect to ground for safety and as a countermeasure for noise. To prevent accidents such as electric shock and fire, the electric facility technical standards require grounding construction for metallic frames in electric instruments.

Follow the steps below in connecting the ground terminal on the power supply side.

1) Connect to a class D grounding electrode (200 V class series) or a class C grounding electrode (400 V class series) according to the electric facility technical standards.
2) The grounding wire should be thick, with large surface area, and as short as possible.

Table 2.2-5 Grounding Instruments in Compliance with the Electric Facility Technical Standards

Power supply voltage	Grounding class	Grounding resistance
Three-phase 200 V	Class D grounding	100 Ω or below
Three-phase 400 V	Class C grounding	10 Ω or below

Note: The 200 V/400 V class series of inverters (5.5 to 11 kW) with a built-in EMC filter have three grounding terminals. To achieve more effective noise reduction, connect the ground line to the designated grounding terminal.
(📖 Chapter 13, Section 13.3.2 "Recommended installation method"

(2) Inverter output terminals U, V, W, motor ground terminal⏚G

1) Connect the 3 phase motor terminals U, V, and W while matching the phase sequence.
2) Connect the ground line of the outputs (U, V, W) to the ground terminal (⏚G).

Note When multiple combinations of inverters and motors exist, do not use multi-core cables for the purpose of bundling the various wires.

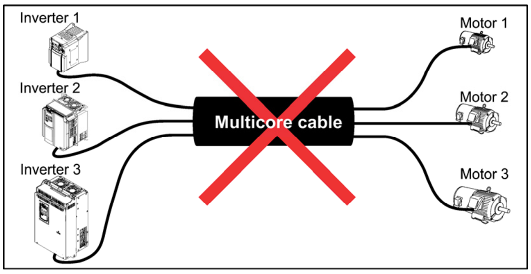


Figure 2.2-11

(3) Direct current reactor connection terminals P1, P(+)

Connect a DC reactor (DCR) for correcting power factor.

1) Remove the jumper bar from the circuit terminals P1 and P(+).
2) Connect the P1, P(+) terminals for the DC reactor (option).

Note
- Keep the wiring length less than 10 m.
- Do not remove the jumper bar if a DC reactor is not used.
- 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.
- DCRs do not have to be connected when connecting PWM converters.

⚠WARNING

Always connect a DCR (option) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

Risk of fire exists.

(4) Braking resistor connection terminals P(+) DB (22 kW or below)

Table 2.2-6

Capacity (kW)	Braking transistor	Built-in braking resistor	Additional instruments for connection (option)	Work procedure
0.4 - 7.5	Built-in	Built-in	Braking resistor (added capacity)	Follow the steps 1), 2) and 3)
11 - 22	Built-in	Not equipped	Braking resistor	Follow the steps 2) and 3)

When the capability of the built-in braking resistor in an inverter with a capacity of 7.5 kW or below is insufficient (operations with increased frequency or a heavy inertia load), a large-capacity braking resistor (option) is required to improve braking capacity. In these cases, the built-in braking resistor needs to be removed. Perform the following steps.

1) For inverters with a capacity of 0.4 to 3.7 kW, disconnect the wires of the built-in braking resistor connected to the terminals P(+), DB. For inverters with a capacity of 5.5 kW and 7.5 kW, disconnect the wires of the built-in braking resistor connected to the terminal DB and the internal relay terminal (see the figure below). Insulate the ends of the removed wires with an insulating tape and the like.

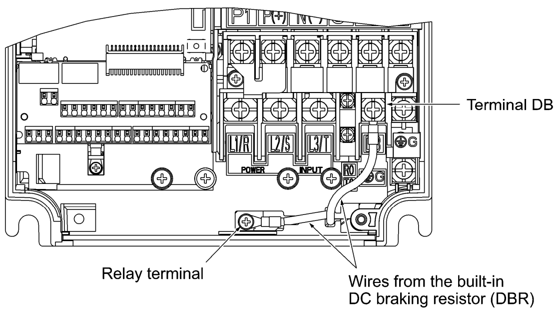


Figure 2.2-12

2) Connect the terminals P(+), DB of a braking resistor (option).
The internal relay terminal of inverters with a capacity of 5.5 kW and 7.5 kW should not be used.
3) Arrange the inverter main body and the braking resistor such that the wiring length will be less than 5 m and route the two wires twisted or in contact with each other (parallel).

⚠WARNING

Do not connect to terminals other than P(+) and DB when connecting braking resistors.

Risk of fire exists.

(5) DC link bus terminals P(+), N(-)

Table 2.2-7

Capacity (kW)	Braking transistor	Built-in braking resistor	Additional instruments for connection (option)	Instruments connected/connection terminals
30 - 630	Not equipped	Not equipped	Braking unit	Inverter - Braking unit: P(+), N(-)
			Braking resistor	Braking unit - Braking resistor: P(+), DB

1) Connecting the braking unit/braking resistor (option)

Braking units and braking resistors are necessary for inverters with a capacity of 30 kW or above.

Connect terminals P(+), N(-) of the braking unit to the inverter terminals P(+), N(-). Arrange the equipment such that the wiring length is below 5 m and route the two wires twisted or in contact with each other (parallel).

Connect the terminals P(+), DB of the braking unit to the terminals P(+), DB of the braking resistor. Arrange the equipment such that the wiring length is below 10 m and route the two wires twisted or in contact with each other (parallel).

For details such as other wiring, refer to the instruction manual for the braking unit.

2) Connection of other instruments

The DC link circuit of other inverters and PWM converters can be connected.

Note When you use DC link bus terminals P(+), N(-), consult your Fuji Electric representative.

(6) Main circuit power input terminals L1/R, L2/S, L3/T (3 phase input)

Connect the three-phase input power lines.

1) For safety, confirm that the molded case circuit breaker (MCCB) or the magnetic contactor (MC) is OFF prior to wiring the power lines.
2) Connect the power lines (L1/R, L2/S, L3/T) to MCCB or the earth leakage breaker (ELCB)*, or connect via MC as necessary. The phase sequence of the power lines and the inverter do not need to be matched.

* With overcurrent protection

Tip In emergencies such as when the inverter protective function is activated, disconnecting the inverter from the power source to prevent magnification of failure or accident may be desired. Installation of an MC which allows manual disconnection of the power source is recommended.

Note If you wish to use a single-phase power source to supply power, consult your Fuji Electric representative.

(7) Auxiliary control power input terminals R0, T0 (1.5 kW or above)

The inverter can run without power input to the auxiliary power input terminals for control circuit. However, the various inverter output signals and the keypad display will be terminated when the inverter main power is shut off and the control power source is lost.

To retain an alarm output signal issued 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. When the inverter input side has a magnetic contactor (MC), wire from the input side (primary side) of the magnetic contactor (MC).

Terminal rating: 200 to 240 VAC, 50/60 Hz, maximum current 1.0 A (200 V series, 22 kW or below)
200 to 230 VAC, 50/60 Hz, maximum current 1.0 A (200 V series, 30 kW or above)
380 to 480 VAC, 50/60 Hz, maximum current 0.5 A (400 V series)

Note When connecting an earth leakage breaker, connect terminals R0, T0 to the output side of the earth leakage breaker. When connections are made to the input side of the earth leakage breaker, the earth leakage breaker will malfunction because the inverter input is 3 phase and the terminals R0, T0 are single phase. When connecting to terminals R0, T0 from the input side of the earth leakage breaker, make sure that the insulating transformer or the auxiliary B contact of the magnetic contactor is connected as in the figure below.

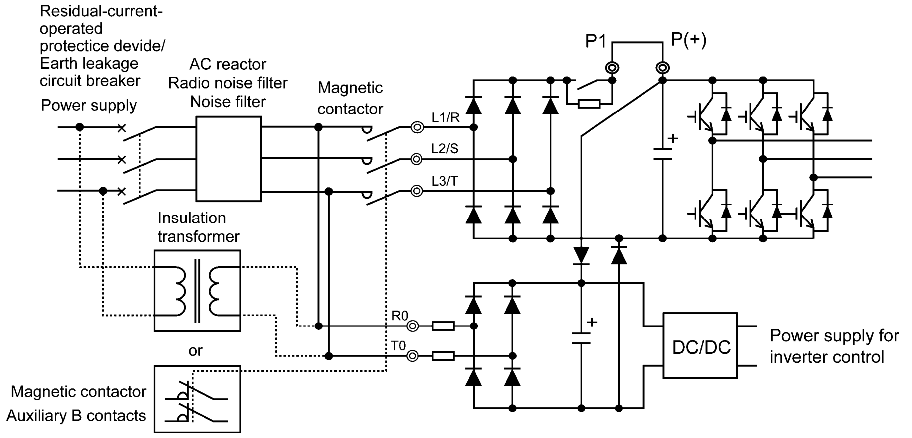


Figure 2.2-13 Connection of the Earth Leakage Breaker

Note When connecting with a PWM converter, do not connect power source directly to the inverter's auxiliary power input terminals (R0, T0) for control circuit. Insert an insulating transformer or the auxiliary B contact of a magnetic contactor on the power supply side.

On connection examples for the PWM converter side, refer to the instruction manual for PWM converters.

The R0, T0 terminals of older models may be directly connected to the power source. Exercise extra caution when replacing an older model.

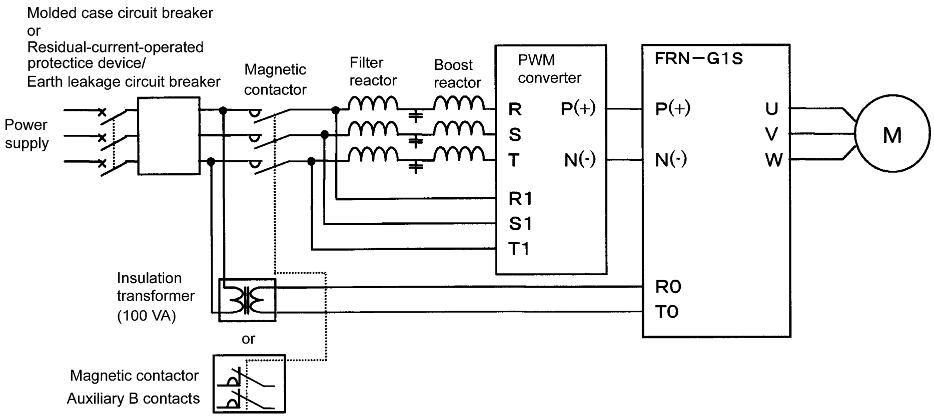


Figure 2.2-14 Example of Connection in Combination with PWM Converter

(8) Auxiliary power input terminals for fan R1, T1

The terminals are equipped on inverters of 37 kW or above in 200 V class series and 75 kW or above in 400 V class series but are not used ordinarily.

Connect an AC power source when using direct current power supply input (such as in combination with PWM converters).

Also switch the fan power source switching connectors "CN R", "CN W."

Terminal rating: 200 to 220 VAC/50 Hz, 200 to 230 VAC/60 Hz, maximum current 1.0 A (200 V series, 37 kW or above)

380 to 440 VAC/50 Hz, 380 to 480 VAC/60 Hz, maximum current 1.0 A (400 V series, between 75 kW and 400 kW)

380 to 440 VAC/50 Hz, 380 to 480 VAC/60 Hz, maximum current 2.0 A (400 V series, 500 kW, 630 kW)

2.2.5 Control circuit terminals (common to all inverter types)

[1] Screw specifications and recommended wire size (control circuit terminals)

The specifications for the screws used in the control circuit wiring and the wire size are shown below.

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

Table 2.2-8 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] Terminal layout diagrams (control circuit terminals)

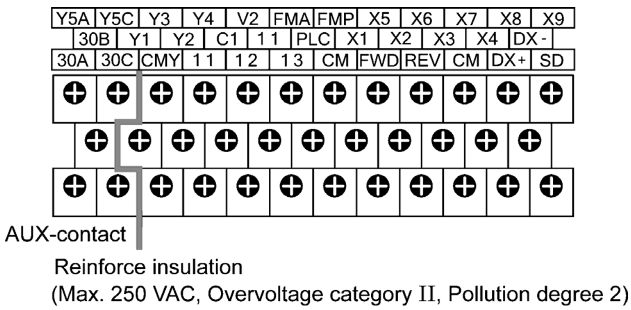


Figure 2.2-15

[3] Notes on control circuit wiring

■ For FRN75G1S-2J, FRN90G1S-2J, and FRN132G1S-4J to FRN630G1S-4J

(1) As shown in Figure 2.2-16, run the wires along the left-side panel of the inverter.
(2) Secure the wires to the wire fixing holders with cable ties (wire bands, etc.).
The cable ties should be max. 3.8 mm in width and max. 1.5 mm in thickness.

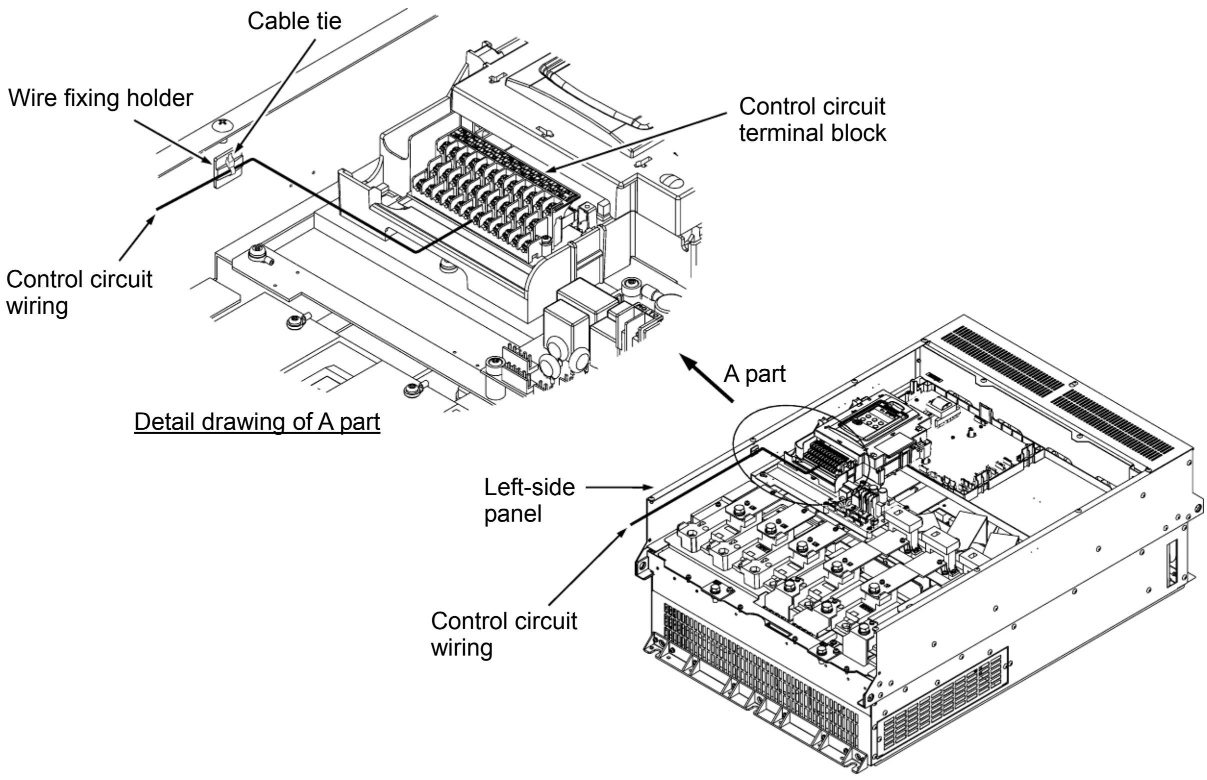


Figure 2.2-16 Control Circuit Wiring Layout and Secured Position

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).

⚠WARNING
Generally, the insulation for control signal wires are not enhanced. When the control signal wires come into direct contact with the main circuit live section, the insulation cover may be damaged. High voltage of the main circuit may be applied on the control signal wires, so exercise caution such that the main circuit live sections do not contact the control signal wires.
Risk of accidents and risk of electric shock exist.

⚠CAUTION
Noise is generated by the inverter, motor, and wiring.
Exercise caution to prevent malfunction of peripheral sensors and instruments.
Risk of accidents exists.

The connection method differs for the control circuit terminals depending on the functional code setting matching the purpose of inverter operation.
Properly wire such that the impact of noise generated by the main circuit wiring is reduced.

[4] Terminal functions (control circuit)

Analog input terminals

Table 2.2-9

Classification	Symbol	Name	Functional description
Analog input	[13]	Power supply for the potentiometer	Power supply (+10 VDC) for frequency command potentiometer (Potentiometer: 1 to 5 kΩ) 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, torque command value*1, *2/torque current command value*1, *2, speed limit*4, or analog input monitor can be assigned to this terminal. (3) Hardware specifications * Input impedance: 22 kΩ * 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."

*1 Available under vector control without speed sensor.

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

*4 Available in inverters having a ROM version 3600 or later.

Table 2.2-10

Classification	Symbol	Name	Functional description
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%, 0 to 20 mA DC/0 to 100% *4 (Normal operation) • 20 to 4 mA DC/0 to 100%, 20 to 0 mA DC/0 to 100% *4 (Inverse operation) (2) In addition to frequency setting, PID command, PID feedback signal, auxiliary frequency command setting, ratio setting, torque limiter level setting, torque command value*1, *2/torque current command value*1, *2, speed limit*4, or analog input monitor can be assigned to this terminal. (3) Hardware specifications * Input impedance: 250 Ω * 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, torque command value*1, *2/torque current command value*1, *2, speed limit*4, or analog input monitor can be assigned to this terminal. (3) Hardware specifications * Input impedance: 22 kΩ * 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."

*1 Available under vector control without speed sensor.

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

*4 Available in inverters having a ROM version 3600 or later.

Table 2.2-11

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functional description</th></tr>
<tr><td rowspan="3">Analog input</td><td>[V2]</td><td>PTC/NTC thermistor input

(PTC/NTC function)</td><td>(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 2.2.7 "Setting up the slide switches").

The figure shown below 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 2.2.7 "Setting up the slide switches." In this case, you must also change data of the function code H26.

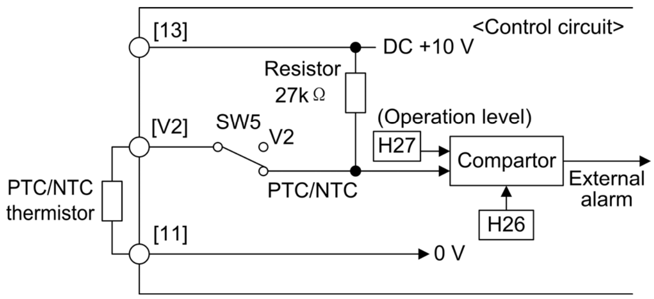


Figure 2.2-17 Internal Circuit Diagram (SW5 Selecting PTC/NTC)</td></tr>
<tr><td>[11]</td><td>Analog common</td><td>Common for analog input/output signals ([13], [12], [C1], [V2] and [FMA]).

Isolated from terminals [CM] and [CMY].</td></tr>
<tr><td colspan="3">Note

- Since control signal wires 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 2.2-18, 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 analog input signal wiring. 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 2.2-19.
- Do not apply a voltage of +7.5 VDC or higher to terminal [C1]. Doing so could damage the internal control circuit.

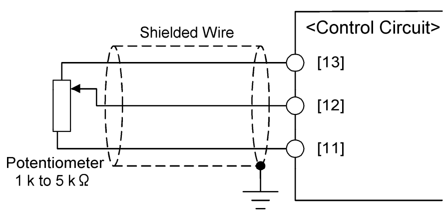


Figure 2.2-18 Connection of Shielded Wire

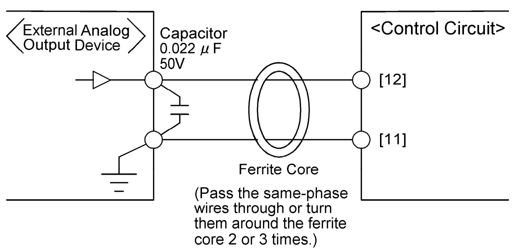


Figure 2.2-19 Example of Electric Noise Reduction</td></tr>
</table>

Digital input terminals

Table 2.2-12

Classification	Symbol	Name	Functional description
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 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 2.2.7 "Setting up the slide switches.") (3) The operating mode between individual digital input terminals and terminal CM can be switched to "ON when shorted (active ON)" or "OFF when shorted (active OFF)." (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 2-26.) 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."
	[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	

(Digital input circuit specifications)

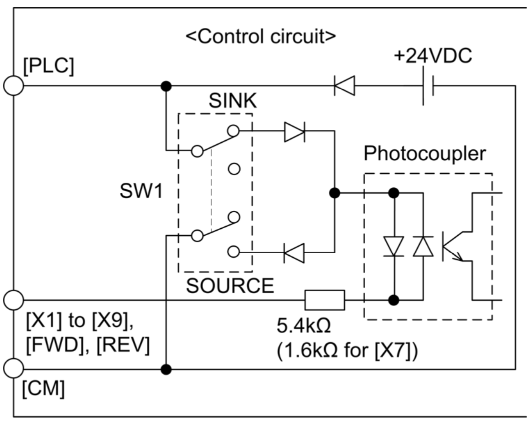


Figure 2.2-20 Digital Input Circuit

Table 2.2-13

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

Table 2.2-14

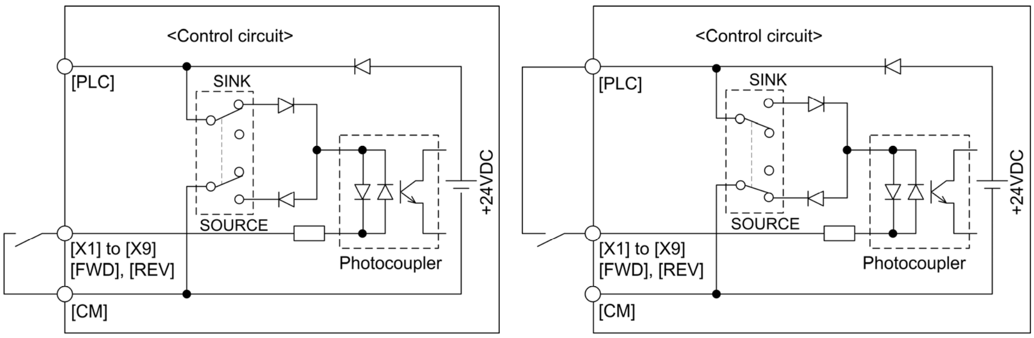
Classification	Symbol	Name	
Digital input	[PLC]	PLC signal power	(1) Connects to PLC output signal power supply. Rated voltage: +24 VDC (Allowable range: +22 to +27 VDC), Maximum 100 mA DC (2) The terminal can also be used as a power source for the load connected to the transistor output. Refer to "Transistor output" described later in this table for more.
	[CM]	Digital 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 2.2-21 shows two examples of a circuit that uses a relay contact. In circuit (a), the slide switch 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 2.2-21 Circuit Configuration Using a Relay Contact

Tip

■ **Using a programmable logic controller (PLC) to turn [X1] to [X9], [FWD], or [REV] ON or OFF**

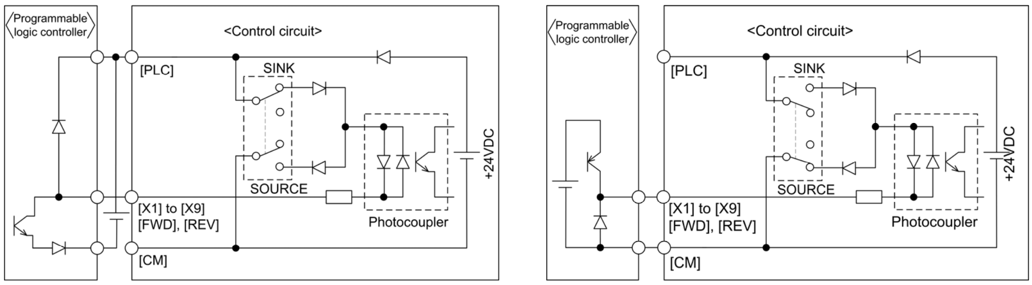
Figure 2.2-22 shows two examples of a circuit that uses a programmable logic controller (PLC). In circuit (a), the slide switch has been turned to SINK, whereas in circuit (b) it has been turned to SOURCE.

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.

Table 2.2-15

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functional description</th></tr>
<tr><td rowspan="2">Digital input</td><td colspan="3">



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

Figure 2.2-22 Circuit Configuration Using a PLC

For details about the slide switch setting, refer to Section 2.2.7 "Setting up the slide switches."

</td></tr>
<tr><td>Note</td><td colspan="2">

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

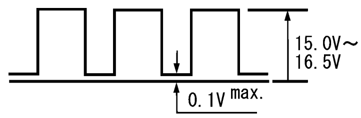
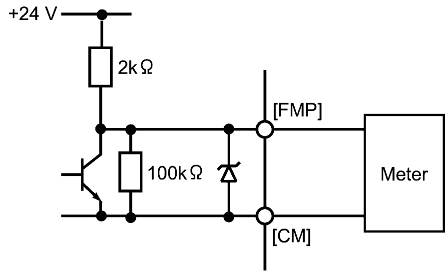
Inputting from a pulse generator with an open collector transistor output, stray capacity on the wiring between the pulse generator and the inverter may disable transmission of the pulse train. As a countermeasure against this problem, insert a pull-up resistor between the open collector output signal (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 (terminal [X7]) and the digital common terminal (terminal [CM]) if the switch selects the SOURCE mode input. A recommended pull-up/down resistor is 1 kΩ 2 W. Check if the pulse train is correctly transmitted because stray capacity is significantly affected by the wire types and wiring conditions.

</td></tr>
</table>

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

Table 2.2-16

Classification	Symbol	Name	Functional description
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 or 0 to +20 mA *4) 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 • Power consumption • PID feedback amount • Speed (PG feedback value) • DC link bus voltage • Universal AO • Motor output • Analog output test • PID command • PID output • Angular deviation (synchronous mode)*3 * Input impedance of the external device: Min. 5 kΩ (at 0 to 10VDC 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. 500 Ω (at 4 to 20 mA DC output) * Adjustable range of the gain: 0 to 300%
	[11]	Analog common	Two common terminals for analog input/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. 5 kΩ (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  Figure 2.2-23 • FMP output circuit  Figure 2.2-24
	[CM]	Digital common	Two common terminals for digital input and [FMP] output signals. These terminals are electrically isolated from the terminals [11]s and [CMY]. These are the shared terminals with the digital input terminal [CM]s.

*3 Available in inverters having a ROM version 3000 or later.

*4 Available in inverters having a ROM version 3600 or later.

Table 2.2-17

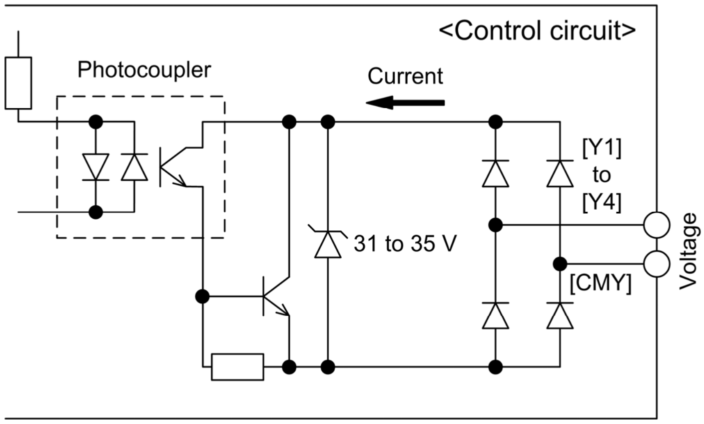
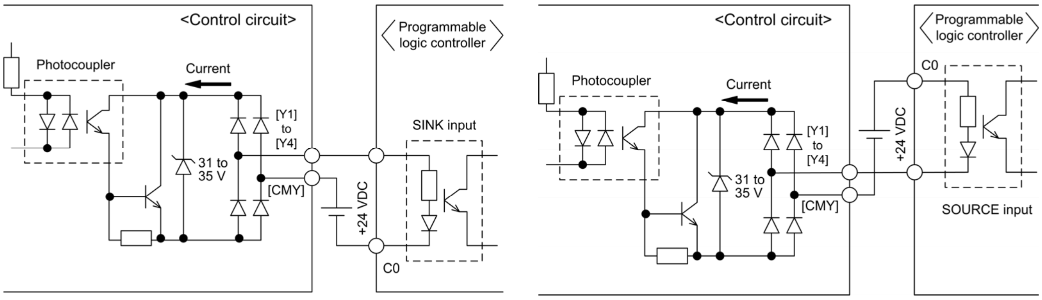
<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functional description</th></tr>
<tr><td rowspan="5">Transistor output</td><td>[Y1]</td><td>Transistor output 1</td><td rowspan="4">
(1) Various signals such as Inverter Running, Frequency Arrival and Overload Early Warning can be output from these terminals by setting function code E20 to E24. Refer to Chapter 5 "FUNCTION CODES" for details.
(2) The operating mode between transistor output terminals [Y1] to [Y4] and terminal [CMY] can be switched to "ON at signal output (active ON)" or "OFF at signal output (active OFF)."
(Transistor output circuit specifications)


Figure 2.2-25 Transistor Output Circuit
Table 2.2-18
<table>
<tr><th colspan="2">Item</th><th>Max.</th></tr>
<tr><td rowspan="2">Operating voltage</td><td>ON level</td><td>2V</td></tr>
<tr><td>OFF level</td><td>27V</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 2.2-26 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>

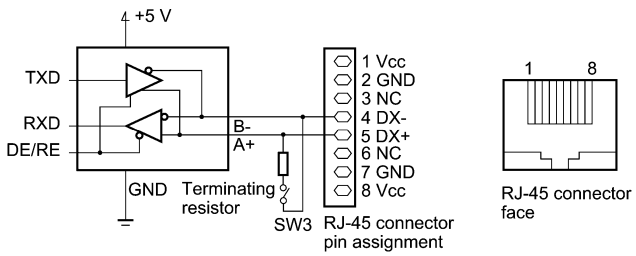
Table 2.2-19

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functional description</th></tr>
<tr><td>Transistor output</td><td colspan="3">Tip
■ Connecting programmable logic controller (PLC) to terminal [Y1], [Y2], [Y3] or [Y4]
Figure 2.2-26 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 2.2-26 Connecting PLC to Control Circuit</td></tr>
<tr><td rowspan="2">Contact output</td><td>[Y5A/C]</td><td>General purpose relay output</td><td>(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.).</td></tr>
<tr><td>[30A/B/C]</td><td>Alarm relay output (for any fault)</td><td>(1) When the inverter stops upon an alarm, output is generated on the relay contact (1C).
Contact rating: 250 VAC 0.3 A, cos φ = 0.3,
48 VDC, 0.5 A
(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.).</td></tr>
</table>

RS-485 communications port

Table 2.2-20

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 2.2.7 "Setting up the slide switches.")
	RJ-45 connector for the keypad	RS-485 communications port 1 (connector for the keypad)	(1) Used to connect the inverter with the keypad. 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 2.2.7 "Setting up the slide switches.")  Figure 2.2-27 RJ-45 Connector and its Pin Assignment • Pins 1, 2, 7, and 8 are exclusively assigned to power lines for the keypad. When connecting this RJ-45 connector to other equipment, do not use these pins.
	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 contained in the provided CD-ROM. FRENIC Loader is also available as a free download from our website at: http://www.fujielectric.co.jp/products/inverter/ On the Fuji website shown above, proceed through "Product Information Download-FRENIC-MEGA Series-PC Loader Software." Then download the "FRENIC-Mini/Eco/Multi/MEGA PC Loader Software (FRENIC Loader)" and "FRENIC Loader/PC Loader Instruction Manual."

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).

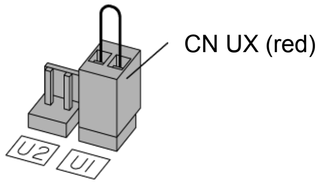
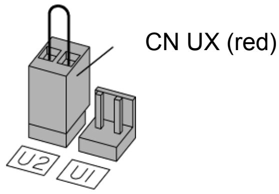
2.2.6 Switching connectors

■ Power supply switching connector "CN UX" (400 V class series with 75 kW or above)

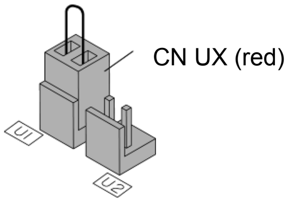
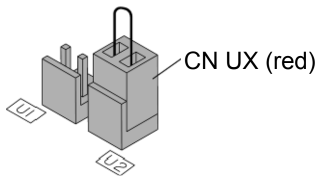
The power supply switching connector "CN UX" is equipped on inverters of 75 kW or above in 400 V class series. When the power supply connecting to the main power supply input terminals (L1/R, L2/S, L3/T) or the auxiliary power input terminals for the fan (R1, T1) meets the following requirements, move the connector CN UX to U2 side. Otherwise, leave it on the U1 side, which is the factory default.

For details on the switching procedure, refer to Figures 2.2-28 and 2.2-29 appearing on the following pages.

(a) For FRN75G1S-4J to FRN110G1S-4J

Setting		
Applicable voltage	398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default)	380 to 398 V/50 Hz, 380 to 430 V/60 Hz

(b) For FRN132G1S-4J to FRN630G1S-4J

Setting		
Applicable voltage	398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default)	380 to 398 V/50 Hz, 380 to 430 V/60 Hz

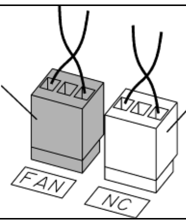
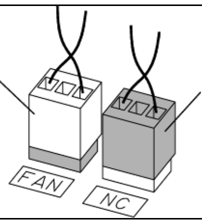
Note The allowable voltage range is +10% and -15%.

■ Fan power source switching connector "CN R", "CN W" (200 V class series with 37 kW or above, 400 V class series with 75 kW or above)

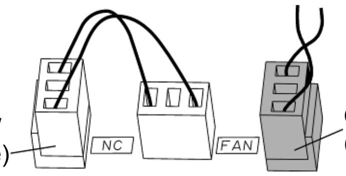
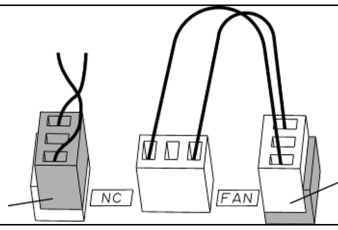
FRENIC-MEGA supports direct current power supply input with PWM converters in the standard specification. However, inverters of 37 kW or above in 200 V class series and 75 kW or above in 400 V class series contain parts which are driven by AC power supply such as the AC fan, so AC power must also be supplied. When using DC power for the inverter, move connector "CN R" to NC side, move connector "CN W" to FAN side, and connect a designated AC power source to the auxiliary power input terminals for the fan (R1, T1).

For details on the switching procedure, refer to Figures 2.2-28 and 2.2-29.

(a) For FRN37G1S-2J to FRN75G1S-2J, and FRN75G1S-4J to FRN110G1S-4J

Setting	CN R (red)  CN W (white)	CN W (white)  CN R (red)
Application	In the case terminals R1 and T1 are NOT used (Factory default)	In the case terminals R1 and T1 are used • DC bus input type • Combination with PWM converter

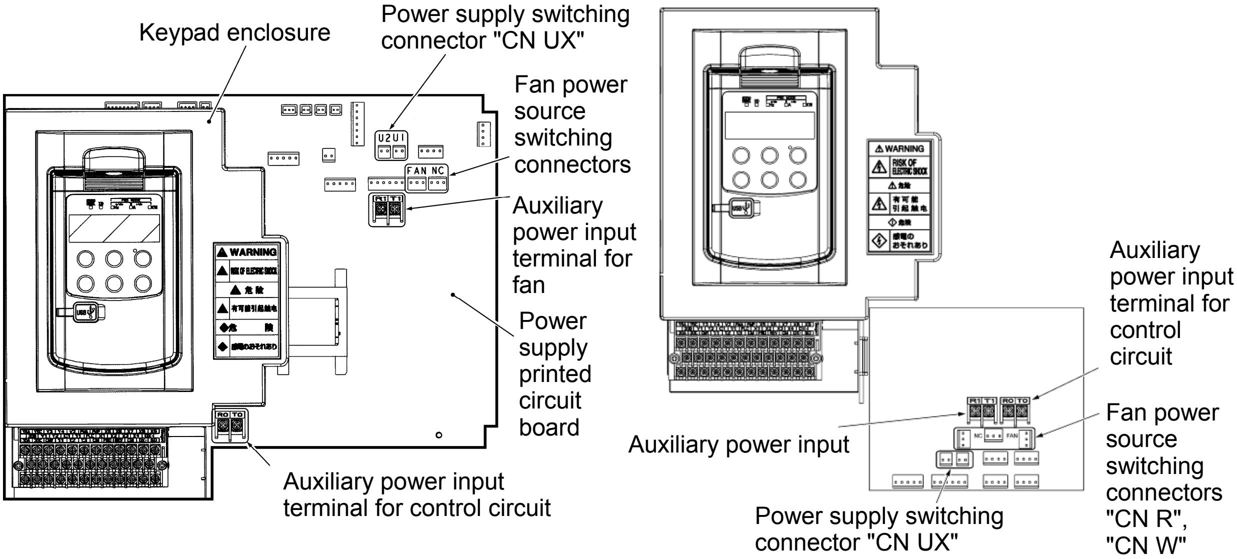
(b) For FRN90G1S-2J, and FRN132G1S-4J to FRN630G1S-4J

Setting	CN W (white)  CN R (red)	CN R (red)  CN W (white)
Application	In the case terminals R1 and T1 are NOT used (Factory default)	In the case terminals R1 and T1 are used • DC bus input type • Combination with PWM converter

Note The fan power source switching connector "CN R" is on FAN and "CN W" is on NC when shipped from the factory. When direct current power supply input is not used, do not alter the setting.
Mistakes in the fan power source switching connector setting may prevent the cooling fan from operating, and alarms such as cooling fin overheat OH1 and charging circuit error PbF may be generated.

■ Position of each connector

The individual switching connectors are positioned on the power supply printed circuit board as shown in the figure below.



(a) For FRN37G1S-2J to FRN75G1S-2J, and FRN75G1S-4J to FRN110G1S-4J

(b) For FRN90G1S-2J, and FRN132G1S-4J to FRN630G1S-4J

Figure 2.2-28 Switching Connector Positions

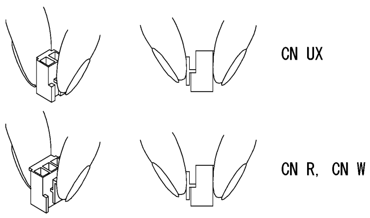


Figure 2.2-29 Attachment and Removal of the Switching Connector

Note When removing the individual connectors, pinch the upper portion of the connector with the fingers, unlock the fastener, and pull. When inserting the connector, push in until the fastener lock engages with the receiving end with a click.

2.2.7 Setting up the slide switches

⚠WARNING

Before changing the switches, 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).

Risk of electric shock exists.

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 these switches are shown in Figure 2.2-30.

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 Section 2.2.2 "Removing and mounting the front cover and the wiring guide."

Table 2.2-21 lists the function of each slide switch.

Table 2.2-21 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.>
This switches the output form (VO/IO) of the terminal [FMA]. When changing this switch setting, also change the data of function code F29.
Table 2.2-22
<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>
</table>

<table>
<tr>
<td>SW5</td>
<td>
<Switches the property of the analog input terminal [V2]>
This switches the property of the terminal 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 2.2-23
<table>
<tr><th>Output mode</th><th>SW5</th><th>Set data of H26 to:</th></tr>
<tr><td>Analog setting current 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>

The following diagram shows the location of slide switches on the control PCB.

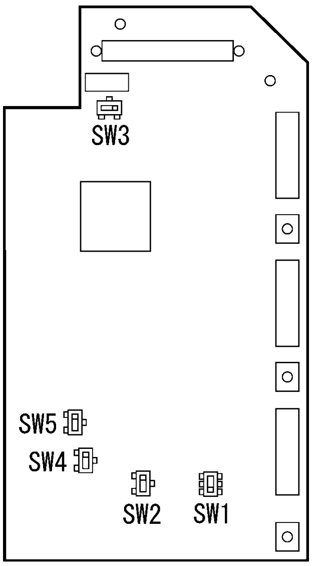


Figure 2.2-30 Location of the Slide Switches on the Control PCB

Table 2.2-24 Switching Examples and Factory Default

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

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.

2.3 Attachment and Connection of Keypad

You can remove the keypad from the inverter main body to mount it on the board or remotely control it at hand.

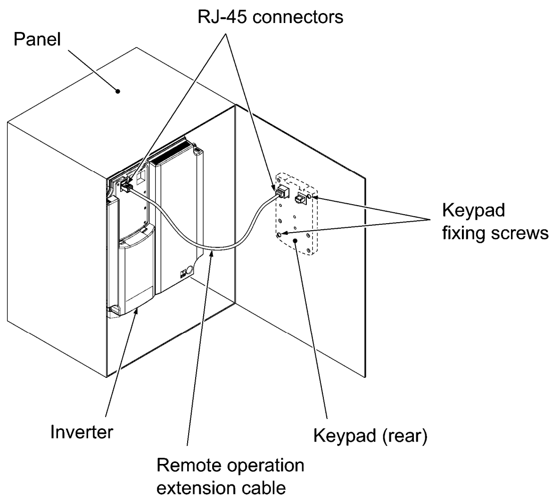


Figure2.3-1 Attaching the Keypad on the Board

The following parts are necessary when attaching the keypad to locations other than the inverter main body.

Table 2.3-1

Part name	Type	Remarks
Extension cable for remote operation (Note 1)	CB-5S, CB-3S, CB-1S	Three lengths available (5 m, 3 m, 1 m)
Keypad attachment screw	M3x☐ (Note 2)	2 screws required (prepared by user)

(Note 1) When using a commercially available LAN cable, use 10BASE-T/100BASE-TX straight cables (below 20 m) which meet the ANSI/TIA/EIA-568A category 5 standards of U.S.A.
Recommended LAN cable
Manufacturer: Sanwa Supply, Inc.
Type: KB-10T5-01K (for 1 m)
KB-STP-01K (for 1 m) (shielded cable)

(Note 2) When attaching to the board, use attachment screws with a length appropriate for the board thickness. (The depth of threaded holes in the keypad is 11 mm)

■ **How to remove and attach the keypad**

To remove the keypad, keep the hook pressed in the direction of the arrow and pull the keypad toward you. To attach the keypad, reverse the steps.

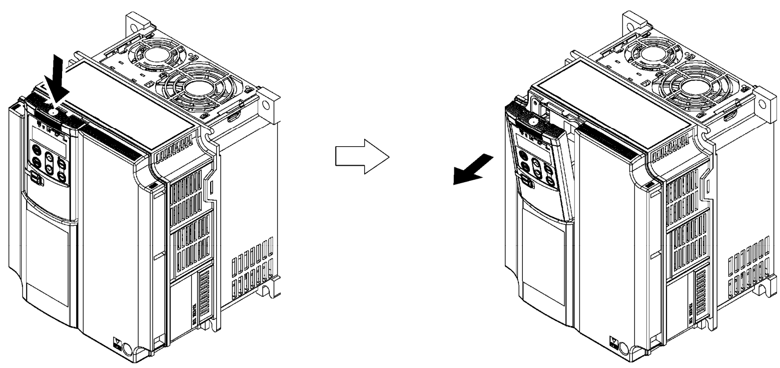


Figure 2.3-2 Removal of the Keypad

2.4 Protective Functions

The table below lists the name of the protective functions, description, and alarm codes on the LED monitor. If an alarm code appears on the LED monitor, remove the cause of activation of the alarm function referring to Chapter 6 "TROUBLESHOOTING."

Table 2.4-1

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 models of 22 kW in 200 V class series and 22 kW or below in 400 V class series)	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 models of 30 kW in 200 V class series and 30 kW or above in 400 V class series)	-	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*

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 blown fuse 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*

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

Table 2.4-2

Name		Description	LED monitor displays	Alarm output [30A/B/C] (Note)
Overspeed		- When d35 = 999, stops the inverter if the detected speed is 120% or over of the maximum output frequency × (d32 or d33). *1 to *4 - When d35 ≠ 999, stops the inverter if the detected speed is greater than or equal to the maximum output frequency × (d35). *3, *6 - Stops the inverter if the detected speed is 120% or over of 120 Hz. *3 - Stops the inverter if the detected speed is 120% or over of 200 Hz. *4	OS	Yes
PG wire break *1,*2,*4		Stops the inverter output if a PG wire break is detected.	PG	Yes
Motor protection	Electronic thermal overload	The inverter stops running to protect the motor in accordance with the electronic thermal overload protection setting. - Protects general-purpose motors over the entire frequency range. - Protects inverter motors over the entire frequency range. * The operation level and thermal time constant can be set. (0.5 to 75.0 minutes)	OL1 OL2 OL3 OL4	Yes*
	PTC thermistor	Upon detecting an abnormal motor temperature, the PTC thermistor stops the inverter to protect the motor. Connect a PTC thermistor between terminals [V2] and [11] and set the function codes and slide switch on the control PCB accordingly.	OH4	Yes*
	NTC thermistor	The NTC thermistor detects the motor temperature. Connect an NTC thermistor between terminals [V2] and [11] and set the function codes and slide switch on the control PCB accordingly.		
	NTC thermistor wire break	Stops the inverter upon detecting a wire break in the NTC thermistor embedded in the motor.	nrb	Yes
	Overload early warning	Outputs a preliminary alarm (0L) 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.	Er1	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, this function stops the inverter output.	Er4	Yes
Option error detection		When an option card has detected an error, this function stops the inverter output.	Er5	Yes

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-6.)	Er-6	Yes*
	Start check function	To prevent a sudden start, the inverter prohibits any run operations and displays Er-6 on the 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.		

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)
*6 Available in inverters having a ROM version 3600 or later.

Table 2.4-3

Name	Description	LED monitor displays	Alarm output [30A/B/C] (Note)
Tuning error detection	During tuning of motor parameters, if the tuning has failed or has been aborted, or an abnormal condition has been detected in the tuning result, the inverter stops its output.	Er7	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.	Er8	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.	ErE	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.	ErF	Yes
Excessive position deviation *1,*2,*4,*5	Stops the inverter output if the position deviation (difference between the target position and the current position) exceeds the preset value.	Ero	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.	ErP	Yes*
Hardware error	Stops the inverter output upon detecting a malfunction of LSI on the power printed circuit board, which is mainly caused by noise.	ErH	Yes
Mock alarm	Mock alarm can be generated with keypad operations.	Err	Yes
PID feedback wire break	When the PID feedback is assigned to the current input, if a wire break is detected, either the warning with transistor output or the alarm output can be selected.	CoF	Yes*
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 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).	rEF	-
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).	−	-

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)
*5 Available in inverters having a ROM version 3000 or later.

Table 2.4-4

Name	Description	LED monitor displays	Alarm output [30A/B/C] (Note)
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), Braking resistor overheat (dbH), Overload of motor 1 through 4 (OL1 to OL4), Option communications error (Er-4), Option error (Er-5), RS-485 communications error (COM port 1)(Er-8), RS-485 communications error (COM port 2) (Er-P), Speed mismatch or excessive speed deviation (Er-E), Excessive position deviation (Er-o)*5, PID feedback wire break (CoF), DC fan locked (FAL), Motor overload early warning (OL), Heat sink overheat early warning (OH), Lifetime alarm (LiF), Reference command loss detected (rEF), PID alarm (Pid), Low torque output (UTL), 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.

*5 Available in inverters having a ROM version 3000 or later.

Chapter 3

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.

Contents

3.1 LED Monitor, Keys and LED Indicators on the Keypad

The keypad allows you to run and stop the inverter, display various data, specify the function code data, and monitor I/O signal states, maintenance information, and alarm information.

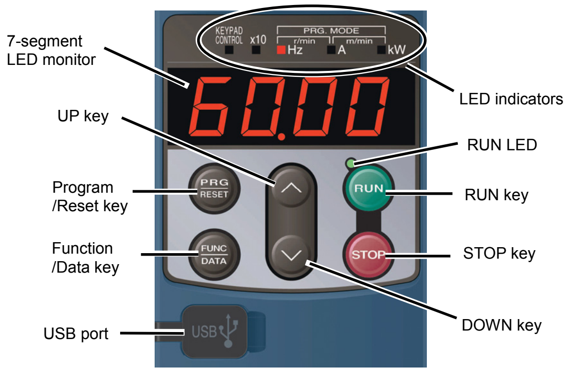


Figure 3.1-1 Appearance of Keypad and Names of Parts

Table 3.1-1 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	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	Performs the operations in each mode as follows: ■ In Running mode: 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 keys. ■ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code.
	RUN	Runs the motor.
	STOP	Stops the motor.
	∧ / ∨	Selects the setting items and changes 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. In Programming and Alarm modes, however, pressing the key cannot run the inverter even if this indicator lights.

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Indicators	Unit LEDs (3 LEDs)	Hz, A, kW, r/min, m/min: The unit of numeral displayed on the LED monitor in Running mode is identified by combination of lit and unlit states of these three LED indicators. Refer to Section 3.3.1 "Monitoring the running status" for details.
		PRG. MODE: While the inverter is in Programming mode, the LEDs of Hz and kW light. (■Hz □A ■kW)
	x10 LED	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 data is 12,345, the LED monitor displays 1234 and x10 LED lights at the same time, meaning that the actual value is "1,234 × 10 = 12,340."
USB Port		The inverter can be connected to a PC via a USB cable. The connector type on the inverter side is a miniB type.

■ 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.

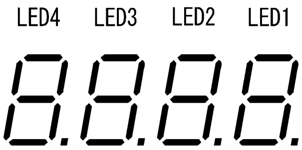


Figure 3.1-2 7-Segment LED Monitor

Table 3.1-2 Alphanumeric Characters on the LED Monitor

Character	7-segment	Character	7-segment	Character	7-segment	Character	7-segment
0	0	9	9	i	i	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.)

3.2 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 and 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.
* Alarm code: Indicates the cause of the alarm condition. For details, refer to Chapter 2, Section 2.4 "Protective Functions" and Section 3.4.7 "Reading alarm information" in this Chapter.

Figure 3.2-1 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.

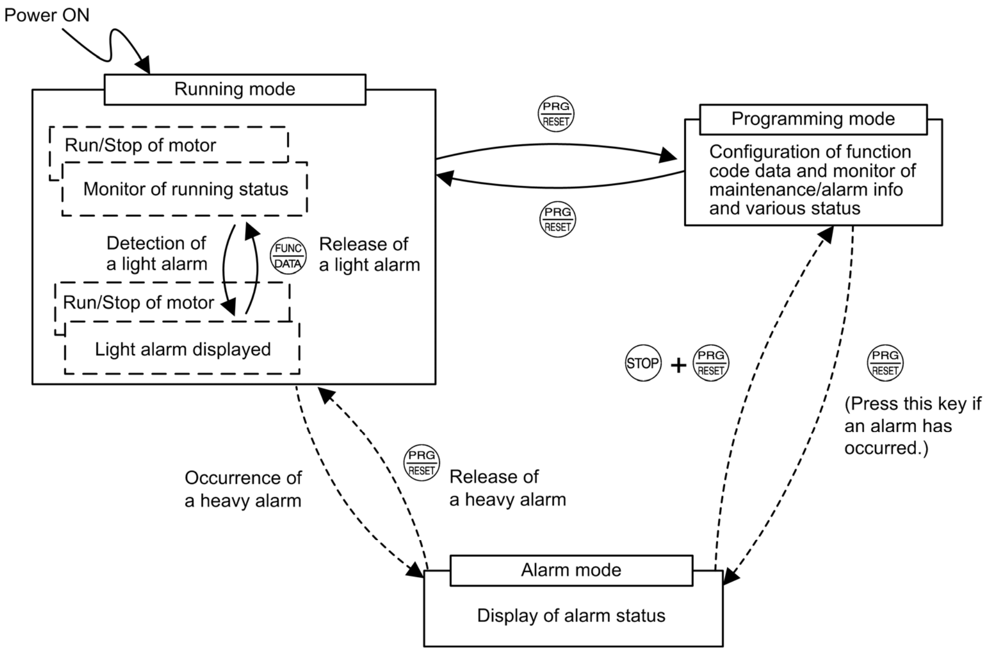
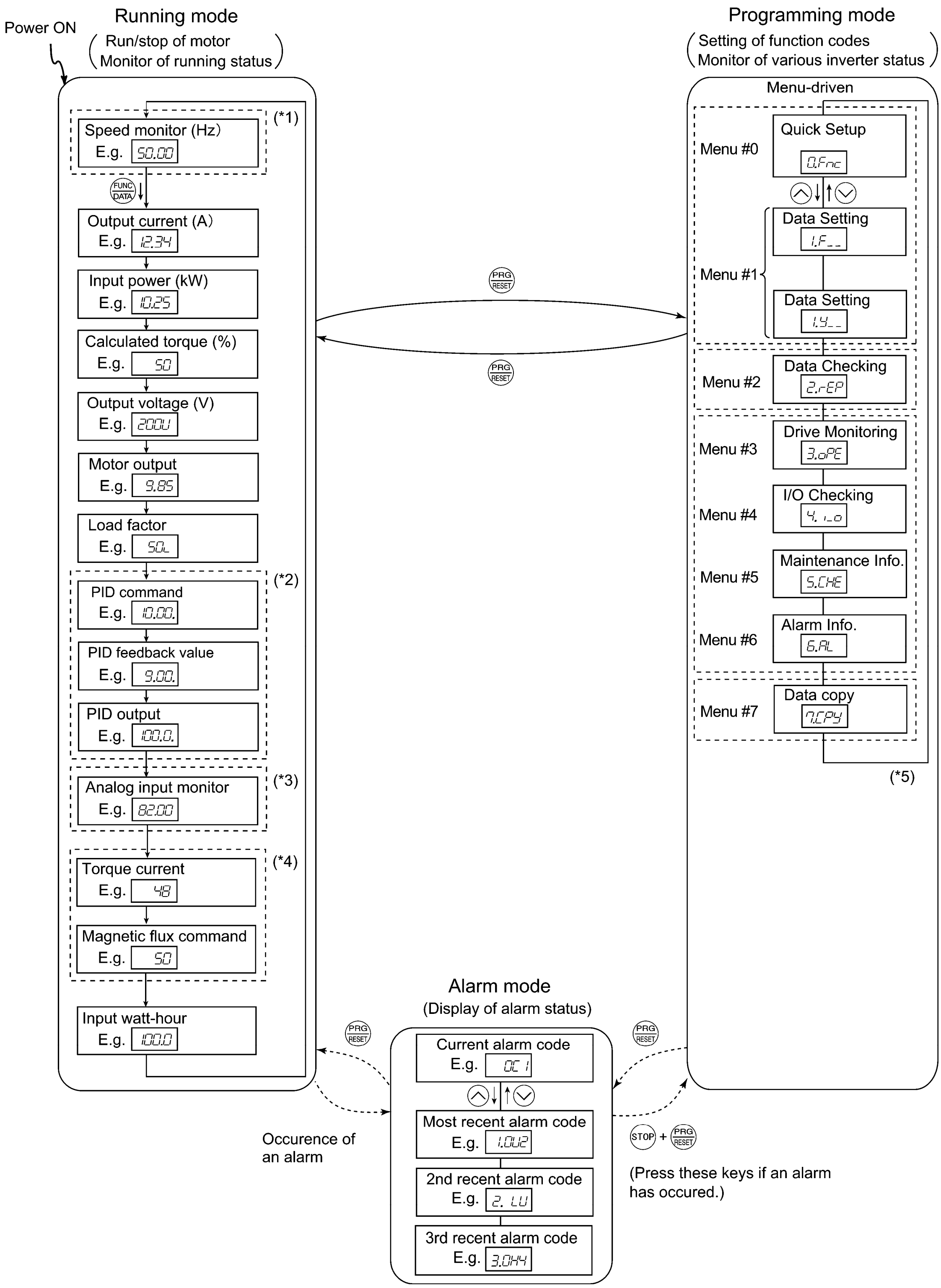


Figure 3.2-1 Status Transition between Operation Modes

The figure below 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 speed monitor items by using function code E48.

(*2) Applicable only when PID control is active (J01 = 1 to 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.

(*4) 0 appears under the V/f control.

(*5) Applicable only when the full-menu mode is selected (E52 = 2).

Figure 3.2-2 Transition between Basic Screens in Individual Operation Mode

3.3 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

3.3.1 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 3.3-1 Monitoring Items

Monitor item	Display sample (*1)	LED indicator	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 $\times \frac{120}{P01}$	(E48 = 3)
Load shaft speed	300.0	■Hz■A□kW	r/min	Output frequency (Hz) X E50	(E48 = 4)
Line speed	300.0	□Hz■A■kW	m/min	Output frequency (Hz) X E50	(E48 = 5)
Display speed (%)	50.0	□Hz□A□kW	%	$\frac{\text{Output frequency}}{\text{Maximum frequency}} \times 100$	(E48 = 7)
Output current	12.34	□Hz■A□kW	A	Current output from the inverter in RMS	3
Output voltage (*2)	200U	□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 and its feedback converted into physical quantities of the object to be controlled. 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 command	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	$\frac{\text{Input watt-hour (kWh)}}{100}$	25

■ On, □ Off

(*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.

(*9) 0 appears under the V/f control.

Tip

Excepting the speed monitor (E43 = 0), the monitor display of various running status on the keypad can be filtered. If the display varies unstably so as to be hard to read due to load fluctuation or other causes, increase this filter value. (Function code E42)

3.3.2 Monitoring light alarms

The FRENIC-MEGA identifies abnormal states in two categories--Heavy alarm and Light alarm (displayed on digital output terminals). 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 (data = 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 2.4 "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 3.4.6 "Reading maintenance information."

■ Releasing the light alarm

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, the KEYPAD CONTROL LED stops blinking and the digital output LALM also goes OFF. If any light alarm factor persists (e.g., detecting a DC fan lock), the KEYPAD CONTROL LED continues blinking and the LALM remains ON.

3.3.3 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 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" (∧ and ∨ keys on keypad). If the keypad is in Program mode or Alarm mode, the current reference frequency cannot be set with the ∧/∨ key. Enter Running mode to allow you to display the reference frequency by using the ∧/∨ key.

(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 FUNC/DATA key. You can choose either way using function code E64.
- If you have set function code F01 to "0" or "8" (∧ and ∨ 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 the ∧ and ∨ 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 PRG/RESET key changes data in the least significant digit and moves the cursor to the next higher digit.
- After the least significant digit blinks by pressing the ∧/∨ key once, 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 action is called "Cursor movement."
- Setting F01 data to "8" (∧ and ∨ 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. Even if this function is used to switch the current frequency, shockless running can be done.

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.
  (Refer to the description of F18.)
- Noise reduction filters are applicable to these analog inputs (voltage inputs to terminals [12] and [V2], and current input to terminal [C1]).
  (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.)

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 differ depending upon the current LED monitor setting. If the LED monitor is set to the speed monitor, you can access manual speed commands (frequency command); if it is set to any other, you can access the PID process command.

<u>Setting the PID process command with ∧ and ∨ keys</u>

(1) Set function code J02 to "0" (∧ and ∨ 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 FUNC/DATA 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 frequency command. The decimal point blinks or lights when a PID command or PID feedback amount is displayed, respectively.

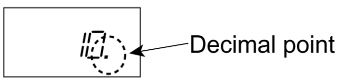


Table 3.3-2 PID Process Command Manually Set with ∧/∨ Key and Requirements

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

<u>Setting up the frequency command with ∧ and ∨ keys under PID process control</u>

When function code F01 is set to "0" (∧ and ∨ 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 ∧ and ∨ keys.

However, if the keypad is in Program mode or Alarm mode, the current reference frequency cannot be set with the ∧/∨ key. Enter Running mode to allow you to display the reference frequency by using the ∧/∨ key. Refer to Table 3.3-3 and the figure below. Table 3.3-3 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.

Pressing the ∧/∨ key shows frequencies setting other than the above, as follows:

Table 3.3-3 Manual Speed (Frequency) Command Specified with ∧ and ∨ Keys and Requirements

PID control (Mode selection) J01	LED Monitor E43	Frequency command 1 F01	Multi-frequency SS2	Multi-frequency SS1	Communications link operation LE	Cancel PID control Hz / PID	Pressing ∧ and ∨ 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

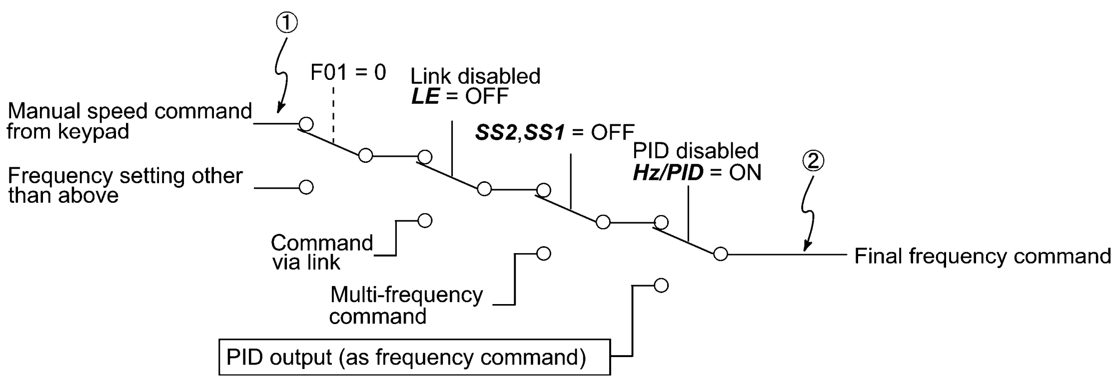


Figure 3.3-1

■ 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 differ depending upon the current LED monitor setting. If the LED monitor is set to the speed monitor, 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 function code J02 to "0" (∧ and ∨ 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 (dancer position) 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 and its decimal point blink 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 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 frequency command. The decimal point blinks or lights when a PID command or PID feedback amount is displayed, respectively.

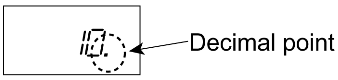


Table 3.3-4 PID Process Command Manually Set with ∧/∨ Key and Requirements

PID control (Mode selection) J01	PID control (Remote command) J02	LED monitor E43	Multi-frequency SS4, SS8	With ∧/∨ key
3	0	Other than 0	ON or OFF	PID process 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" (∧ and ∨ 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 ∧ and ∨ keys. In Programming or Alarm mode, the ∧ and ∨ keys are disabled to modify the frequency command. You need to switch to Running mode. Refer to the table and the figure below. Table 3.3-5 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.

Pressing the ∧/∨ key shows frequencies setting other than the above, as follows:

Table 3.3-5 Primary (Frequency) Command Specified with ∧ and ∨ Keys and Requirements

<table>
<tr><th>PID control (Mode selection) J01</th><th>LED Monitor E43</th><th>Frequency command 1 F01</th><th>Multi-frequency SS2</th><th>Multi-frequency SS1</th><th>Communications link operation LE</th><th>Cancel PID control Hz / PID</th><th>Pressing ∧ and ∨ keys controls:</th></tr>
<tr><td rowspan="4">3</td><td rowspan="4">0</td><td rowspan="2">0</td><td rowspan="2">OFF</td><td rowspan="2">OFF</td><td rowspan="2">OFF</td><td>OFF (PID enabled)</td><td>Final frequency command modified by PID output</td></tr>
<tr><td>ON (PID disabled)</td><td>Keypad primary command (Frequency)</td></tr>
<tr><td colspan="4" rowspan="2">Other than the above</td><td>OFF (PID enabled)</td><td>Final frequency command modified by PID output</td></tr>
<tr><td>ON (PID disabled)</td><td>Current primary command (Frequency)</td></tr>
</table>

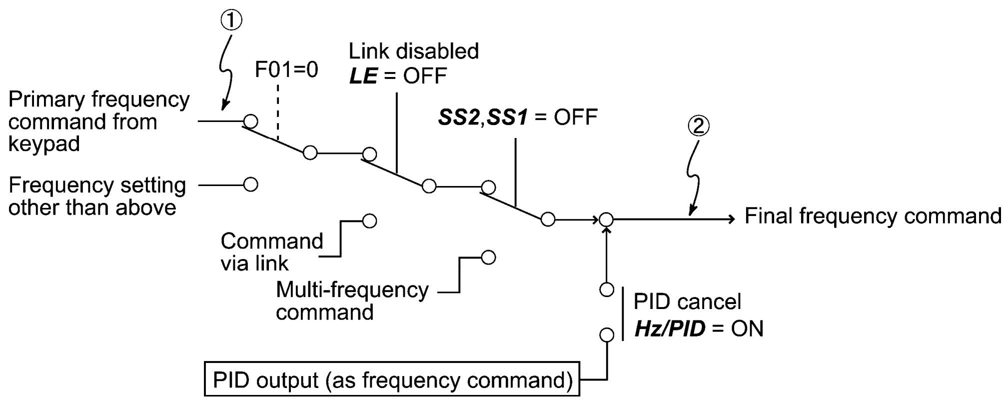


Figure 3.3-2

3.3.4 Running/stopping the motor

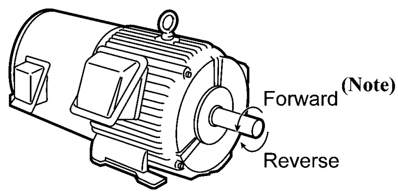
By factory default, pressing the RUN key starts running the motor in the forward direction and pressing the STOP key decelerates the motor to stop. The RUN key is enabled only in Running mode.

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 3.3-6 Motor Rotational Direction Specified by F02

Data for F02	Motor Rotational Direction
0	In the direction commanded by terminal [FWD] or [REV]
1	Key disabled (The motor is driven by terminal [FWD] or [REV] command.)
2	Running forward
3	Running reverse



(Note) The rotational direction of IEC-compliant motors is opposite to that of the motor shown here

For details, refer to Chapter 5 "FUNCTION CODES."

3.3.5 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 3-5)
- 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 specify the jogging frequency. Function codes H54 and H55 set acceleration and deceleration time, respectively. Use these function codes exclusively for the jogging operation with your needs. Enable them individually according to 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 RUN 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)."

3.3.6 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.

The table below shows the input procedures of run commands from the keypad in the local mode.

Table 3.3-7

<table>
<tr><th>Data for F02</th><th>Input Procedures of Run Commands from Keypad</th></tr>
<tr><td>0: Enable the keys on keypad
(Motor rotational direction from digital terminals [FWD]/[REV])</td><td>Run or stop the motor with the RUN/STOP key on the keypad.
Motor rotation direction is selected using terminal FWD or REV.</td></tr>
<tr><td>1: External signals</td><td rowspan="2">Run or stop the motor with the RUN/STOP key on the keypad.
No specification of the motor rotational direction is required.
Pressing the key runs the motor in the forward direction only.</td></tr>
<tr><td>2: Running on the keypad
(Forward)</td></tr>
<tr><td>3: Running on the keypad
(Reverse)</td><td>Run or stop the motor with the RUN/STOP key on the keypad.
No specification of the motor rotational direction is required.
Pressing the key runs the motor in the reverse direction only.</td></tr>
</table>

The remote and local modes can be switched by a digital input signal provided from the outside of the inverter. Run and frequency command sources are then switched.

To enable the switching, you need to assign LOC as a digital input signal to any of terminals. (Set "data = 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 for the rotation direction will be carried over. If, however, there is a discrepancy between the settings used in local 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.

Status transition and running status differ depending on combinations of remote/local mode and the Select local (keypad) operation "LOC" signal. Also, refer to the status transition diagram below and the table above for details.

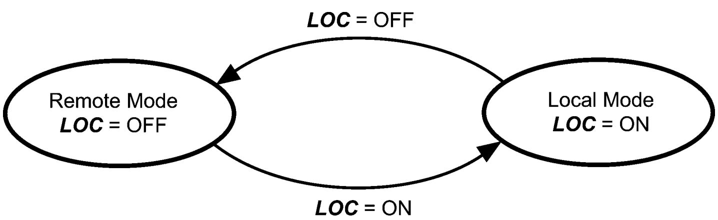


Figure 3.3-3 Transition between Remote and Local Modes by LOC

3.3.7 External run/frequency command

By factory default, run commands (RUN and STOP keys) 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.

Table 3.3-8

Function code	Name	Data	Factory default
F 01	Frequency Command 1	1: Analog voltage input to terminal [12]	0
F 02	Operation Method	1: External signals (Digital input terminal commands)	2
E 98	Terminal [FWD] function	98: Run forward command FWD	98
E 99	Terminal [REV] function	99: Run reverse command REV	99

Note: If terminal [FWD] and [REV] are ON (short-circuited), 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 the Chapter 2.

3.4 Programming Mode

The Programming mode provides you with these functions--setting and checking function code data, monitoring maintenance information and input/output (I/O) terminal status. The functions can be easily selected with the menu-driven system. Table 3.4-1 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 3.4-1 Menus Available in Programming Mode

<table>
<tr><th>Menu #</th><th>Menu</th><th>LED monitor display</th><th colspan="2">Main functions</th><th>Refer to:</th></tr>
<tr><td>0</td><td>Quick setup</td><td>0.Fnc</td><td colspan="2">Displays only basic function codes to customize the inverter operation.</td><td>Section 3.4.1.</td></tr>
<tr><td rowspan="13">1</td><td rowspan="13">Data setting</td><td>1.F__</td><td>F codes
(Fundamental functions)</td><td rowspan="13">Selecting each of these function codes enables its data to be displayed/ changed.</td><td rowspan="13">Section 3.4.2.</td></tr>
<tr><td>1.E__</td><td>E codes
(Extension terminal functions)</td></tr>
<tr><td>1.C__</td><td>C codes
(Control functions)</td></tr>
<tr><td>1.P__</td><td>P codes
(Motor 1 parameters)</td></tr>
<tr><td>1.H__</td><td>H codes
(High performance functions)</td></tr>
<tr><td>1.A__</td><td>A codes
(Motor 2 parameters)</td></tr>
<tr><td>1.b__</td><td>b codes
(Motor 3 parameters)</td></tr>
<tr><td>1.r__</td><td>r codes
(Motor 4 parameters)</td></tr>
<tr><td>1.J__</td><td>J codes
(Application functions 1)</td></tr>
<tr><td>1.d__</td><td>d codes
(Application functions 2)</td></tr>
<tr><td>1.U__</td><td>U codes
(Application functions 3)</td></tr>
<tr><td>1.y__</td><td>y codes
(Link functions)</td></tr>
<tr><td>1.o__</td><td>o codes
(Option function) (Note)</td></tr>
<tr><td>2</td><td>Data checking</td><td>2.rEP</td><td colspan="2">Displays only function codes that have been changed from their factory defaults. You can refer to or change those function code data.</td><td>Section 3.4.3.</td></tr>
<tr><td>3</td><td>Drive monitoring</td><td>3.oPE</td><td colspan="2">Displays the running information required for maintenance or test running.</td><td>Section 3.4.4.</td></tr>
<tr><td>4</td><td>I/O checking</td><td>4. I_o</td><td colspan="2">Displays external interface information.</td><td>Section 3.4.5.</td></tr>
<tr><td>5</td><td>Maintenance information</td><td>5.CHE</td><td colspan="2">Displays maintenance information including cumulative run time.</td><td>Section 3.4.6.</td></tr>
<tr><td>6</td><td>Alarm information</td><td>6.AL</td><td colspan="2">Displays the recent four alarm codes. You can refer to the running information at the time when the alarm occurred.</td><td>Section 3.4.7.</td></tr>
<tr><td>7</td><td>Data copying</td><td>7.CPY</td><td colspan="2">Allows you to read, write, and verify function code data.
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.</td><td>Section 3.4.8.</td></tr>
</table>

(Note) The o codes are displayed only when the corresponding option is mounted. For details, refer to the Instruction Manual for the corresponding option.

Figure 3.4-1 illustrates the menu transition in Programming mode.

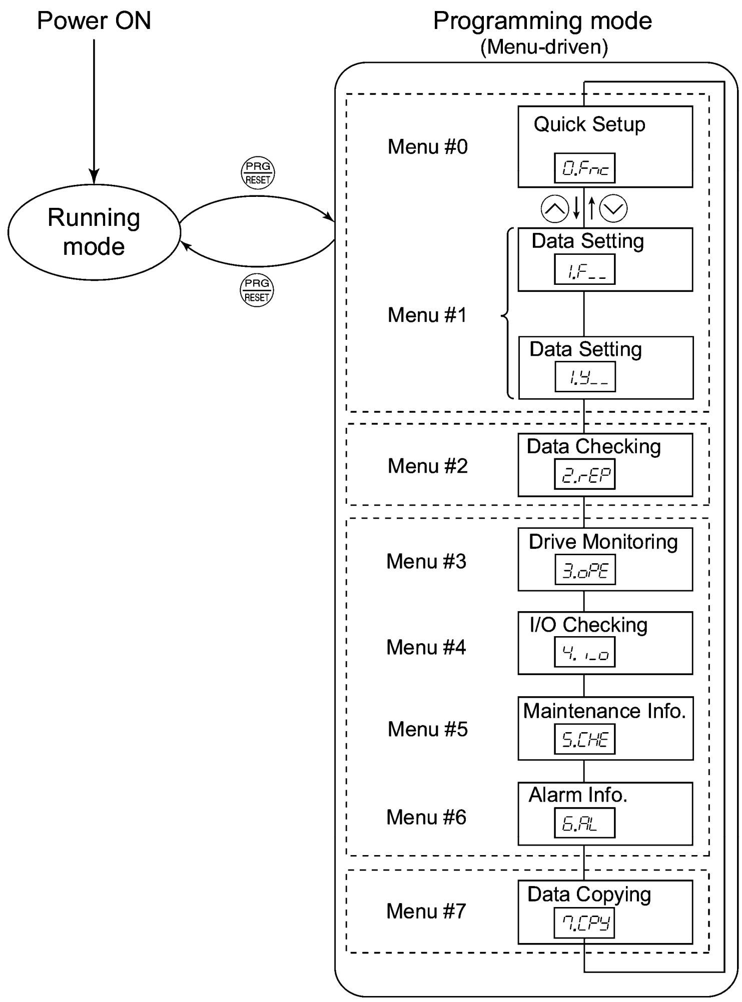


Table3.4-1 Menu Transition in Programming Mode

■ Selecting menus to display

Function code E52 is available to cycle through necessary menus only for simple operation. 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, as shown in Table 3.4-2.

Table 3.4-2 Keypad Display Mode Selection

Function Code E52	Menus selectable
0: Function code data setting mode	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 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.

3.4.1 Setting up basic function codes quickly "Quick Setup"

Menu #0 "Quick Setup" in Programming mode allows you to display only the predefined basic function codes and set up function code data.

Display function codes with Menu #0 "Quick Setup" requires the data of function code E52 to be set to "0" (function code data setting mode) or "2" (full-menu mode).

The predefined set of function codes that are subject to quick setup are held in the inverter.

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:

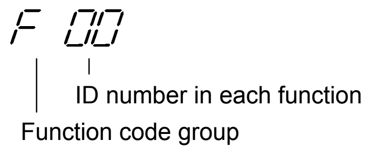


Figure 3.4-2

Table 3.4-3 Function Codes Available on FRENIC-MEGA

Function Code Group	Function Codes	Function	Description
F codes (Fundamental functions)	F00 to F80	Fundamental functions	Functions concerning basic motor running
E codes (Extension terminal functions)	E01 to E99	Extension terminal functions	Functions concerning the assignment of control circuit terminals Functions concerning the display of the LED monitor
C codes (Control functions of frequency)	C01 to C53	Control functions	Functions associated with frequency settings
P codes (Motor 1 parameters)	P01 to P99	Motor 1 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
H codes (High performance functions)	H03 to H98	High performance functions	Highly added-value functions and functions for sophisticated control
A codes (Motor 2 parameters)	A01 to A56	Motor 2 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
b codes (Motor 3 parameters)	b01 to b56	Motor 3 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
r codes (Motor 4 parameters)	r01 to r56	Motor 4 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
J codes (Application functions 1)	J01 to J96	Application functions 1	Functions for applications such as PID control
d codes (Application functions 2)	d01 to d63	Application functions 2	Functions for applications such as speed control
U codes (Application functions 3)	U00 to U91	Application functions 3	Functions for applications such as customizable logic
y codes (Link functions)	y01 to y99	Link functions	Functions for controlling communication
o codes (Option functions)	o27 to o59	Option 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.

■ 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 3.4-3 shows the menu transition in Menu #0 "Quick Setup" and function code data changing procedure.

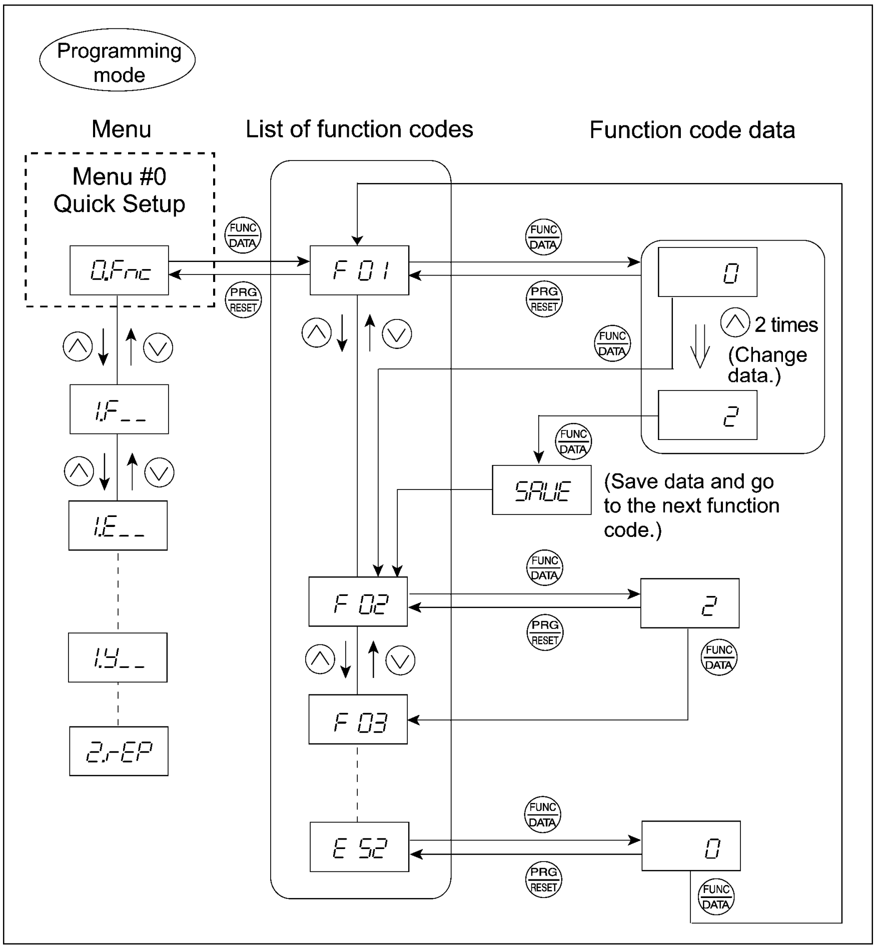


Figure 3.4-3 Menu Transition in Menu #0 "Quick Setup" and Function Code Data Changing Procedure

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 3.4-3.
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)."

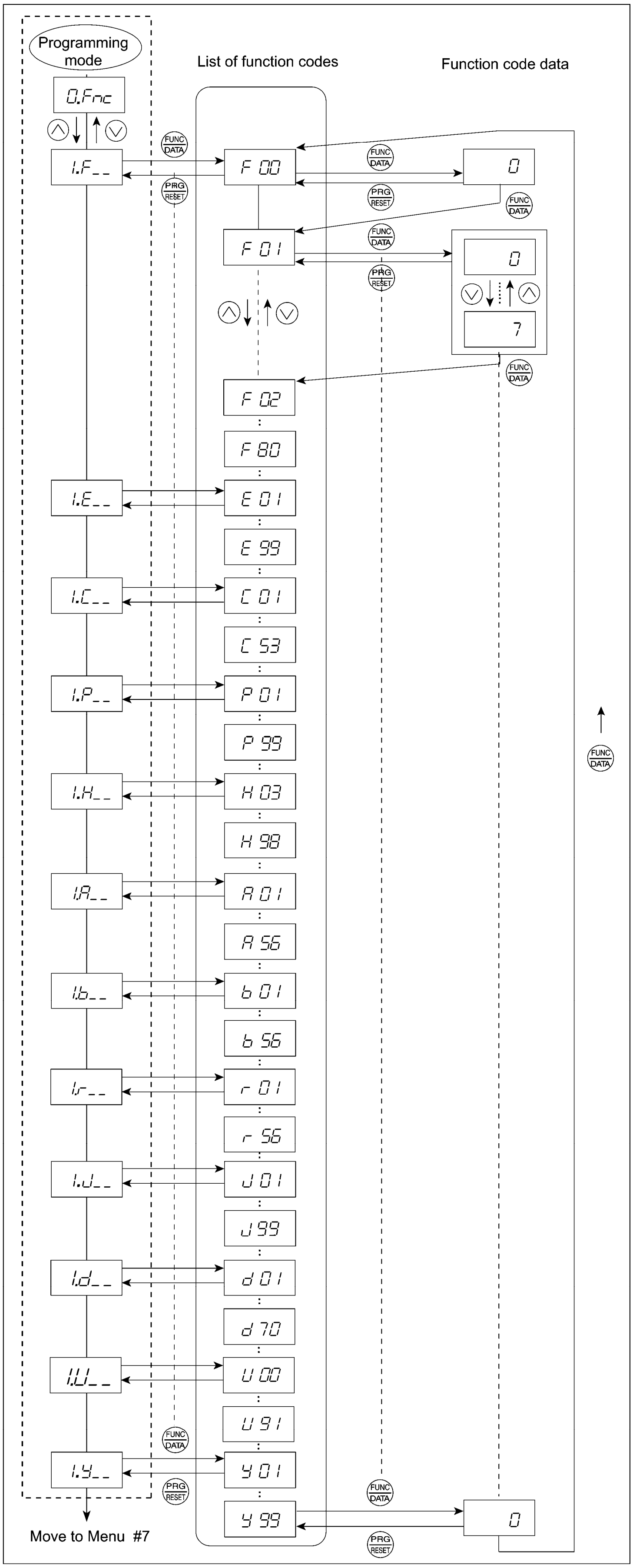
(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears. (In this example, 0.Fnc is displayed.)
(2) If anything other than 0.Fnc, use the ∧ and ∨ keys to display 0.Fnc.
(3) Press the FUNC/DATA key to proceed to the list of function codes.
(4) Use the ∧ and ∨ keys to select the desired function code, then press the FUNC/DATA key.
The data of this function code appears. (In this example, select function code F 01 to display data 0.)
(5) Change the function code data using the ∧ and ∨ keys. (In this example, press the ∧ key twice to change the function code data from 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 appears.)
Pressing the PRG/RESET key instead of the FUNC/DATA key cancels the change made to the data and displays the original function code.
(7) Press the PRG/RESET key to return to the menu from the function code list.

Tip <Cursor movement>
You can move the cursor to change data when changing function code data by holding down the PRG/RESET key for 1 second or longer. 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.

3.4.2 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 setting mode) or "2" (Full-menu mode).
Figure 3.4-4 shows the menu transition in Menu #1 "Data Setting."



(Note) The o codes are displayed only when the corresponding option is mounted. For details, refer to the Instruction Manual for the corresponding option.

Figure 3.4-4 Menu Transition in Menu #1 "Data Setting"

Basic key operation

The basic key operation 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 1.F_ _ through 1.Y_ _.

(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 select 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 and displays the original function code.

(7) Press the key [PRG/RESET] to return to the menu from the function code list.

3.4.3 Checking changed function codes Menu #2 "Data Checking"

Menu #2 "Data Checking: 2.rEP" 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 3.4-5 shows the menu transition in Menu #2 "Data Checking."

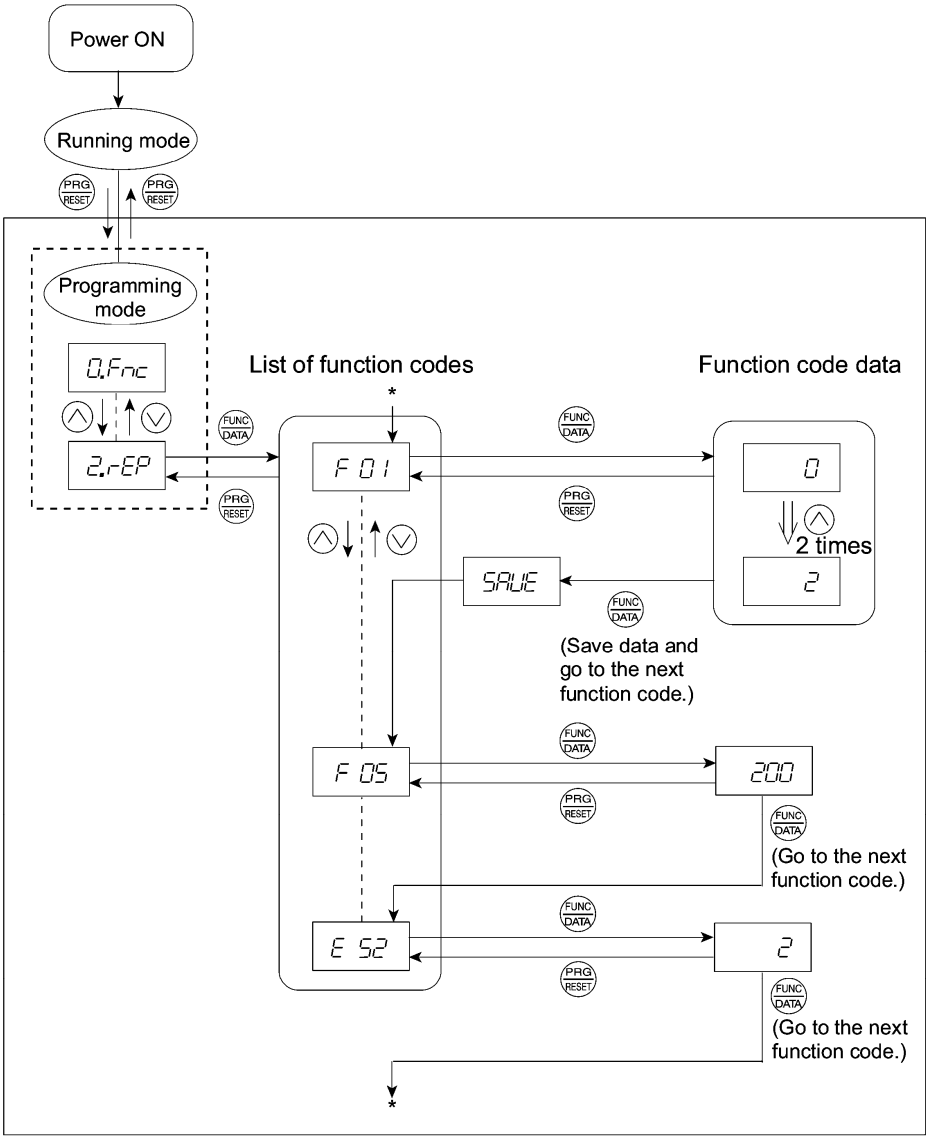


Figure 3.4-5 Menu Transition in Menu #2 "Data Checking" (Changing F01, F05 and E52 data only)

Basic key operation

The basic key operation is just like that in Menu #0 "Quick Setup."

3.4.4 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 3.4-4. Figure 3.4-6 shows the menu transition in Menu #3 "Drive Monitoring."

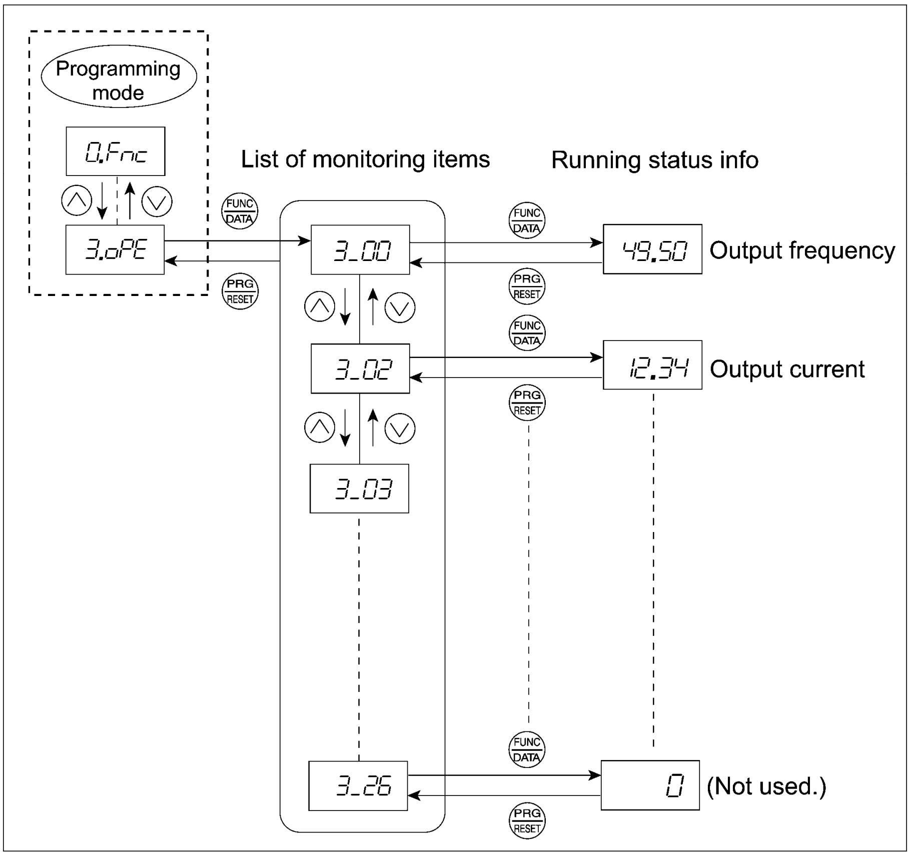


Figure 3.4-6 Menu Transition in Menu #3 "Drive Monitoring"

<u>Basic key operation</u>

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 monitoring 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 3.4-4 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	%	Motor output torque in % (Calculated value)
3_05	Reference frequency	Hz	Reference frequency
3_06	Rotational direction	None	Rotational direction being outputted F: forward, r: reverse, ----: stop
3_07	Running status	None	Running status is displayed 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)× $\frac{120}{\text{(Number of motor poles)}}$ 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	None	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	None	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 limiter level	%	Driving torque limit value A (based on motor rated torque)
3_13	Torque limiter level	%	Driving 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.
3_16	(Not used.)	-	—
3_17	Target position pulse (synchronous operation)	Pulse	Target position pulse for synchronous operation appears.
3_18	Current position pulse (synchronous operation)	Pulse	Current position pulse for synchronous operation appears.
3_19	Current deviation pulse (synchronous operation)	Pulse	Current deviation pulse for synchronous operation appears.

LED monitor shows:	Item	Unit	Description
3_20	Control state monitor (Synchronous operation)	-	Current control status appears. 0: Synchronous control disabled 20: Synchronous control cancel 21: Synchronous control stop 22: Wait for Z-phase detection 23: Basic Z-phase detection 24: Slave Z-phase detection 25: Synchronizing 26: Completely synchronized
3_21	PID output value	%	PID output value appears. (100% at the maximum frequency) If PID control is disabled, "----" appears.
3_22	Magnetic flux command	%	Magnetic flux command value appears.
3_23	Running status 2	None	Running status 2 is displayed in 4-digit hexadecimal format. For details, refer to "■ Displaying running status (3_07) and running status 2 (3_23)" shown 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	Position deviation (Synchronous operation)	deg	Position deviation (angle unit) for synchronous operation appears.

■ 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 3.4-5 and 3.4-6. Table 3.4-7 shows the relationship between each of the status assignments and the LED monitor display.

Table 3.4-8 gives the conversion table from 4-bit binary to hexadecimal.

Table 3.4-5 Running Status (3_07) Bit Assignment

Bit	Code	Content	Bit	Code	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.

Table 3.4-6 Running Status 2 (3_23) Bit Assignment

Bit	Code	Content	Bit	Code	Content
15	-	(Not used.)	7	-	Speed limiting (under torque control)
14			6	-	(Not used.)
13			5	-	Motor switching 00: Motor 1 01: Motor 2 10: Motor 3 11: Motor 4
12			4	-	
11			3	-	Inverter drive control 0000: V/f control with slip compensation inactive 0001: Dynamic torque vector control 0010: V/f control with slip compensation active 0011: V/f control with speed sensor 0100: Dynamic torque 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)
10			2	-	
9			1	-	
8			0	-	

Table 3.4-7 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
Code		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
	Hexadecimal on the LED monitor	LED4: 8				LED3: 3				LED2: 2				LED1: 1			

■ 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.

Table 3.4-8 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

3.4.5 Checking I/O signal status Menu #4 "I/O Checking"

Using Menu #4 "I/O Checking" displays the I/O status of external signals on the LED monitor without using a measuring instrument. External signals that can be displayed include digital and analog I/O signals. Table 3.4-9 lists check items available. The menu transition in Menu #4 "I/O Checking" is shown in Figure 3.4-7.

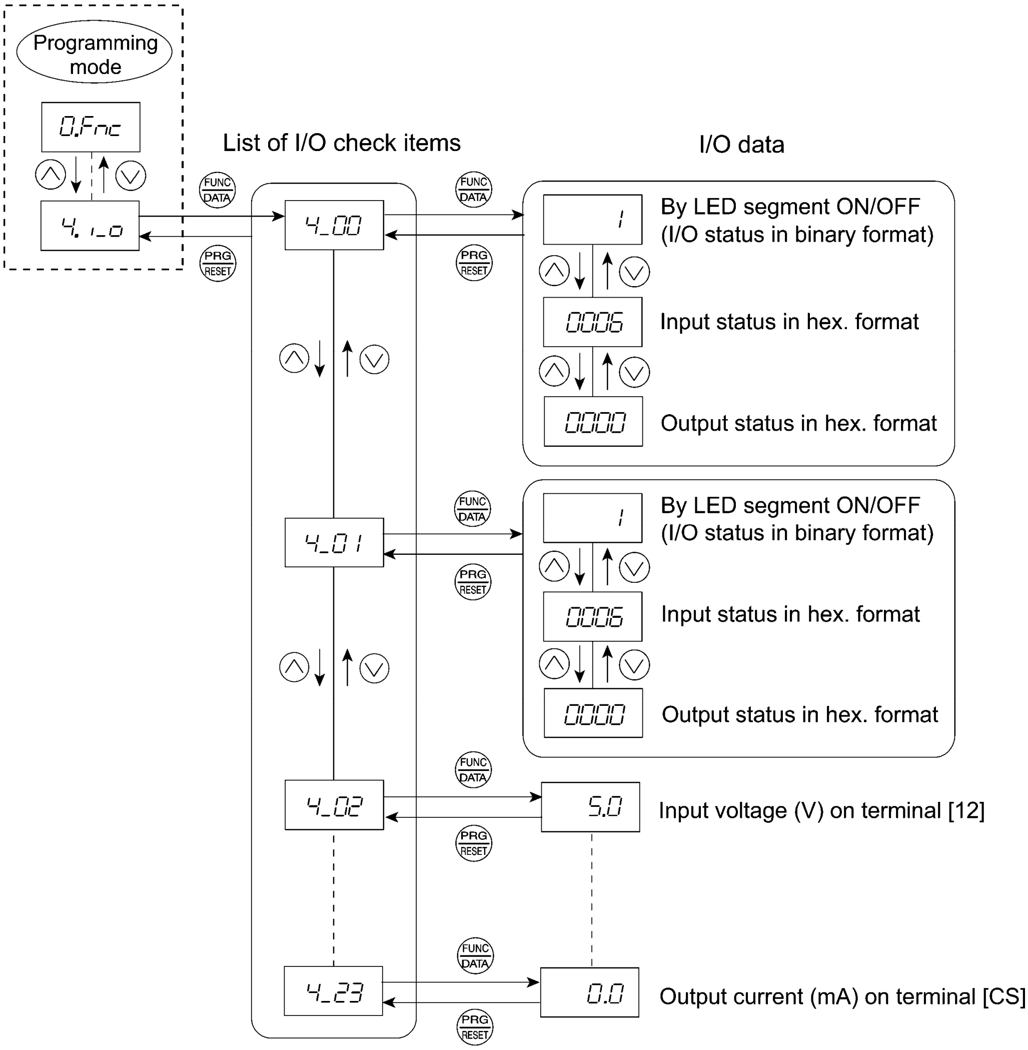


Figure 3.4-7 Menu Transition in Menu #4 "I/O Checking"

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) Press the ∧/∨ key 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 select the desired I/O check item, then press the FUNC/DATA key.

The corresponding I/O check item data appears. For the item 4_00 or 4_01, using the ∧ and ∨ keys switches the display method between the segment display and the hexadecimal display (for I/O). (Refer to Table 3.4-10 and Table 3.4-11.)

(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 3.4-9 I/O Check Items

LED monitor	Item	Description
4_00	I/O signals on the control circuit terminals	Displays 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 field path 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 circuit terminal on digital I/O interface cards" on page 3-34 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. (Shows 1.00 with 1000 p/s.)
4_16	PG pulse rate (Z phase signal from the reference PG)	Shows the pulse rate (p/s) of the Z phase signal fed back from the reference PG.

LED monitor	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. (Shows 1.00 with 1000 p/s.)
4_18	PG pulse rate (Z phase signal from the slave PG)	Shows the pulse rate (p/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 [A0] 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

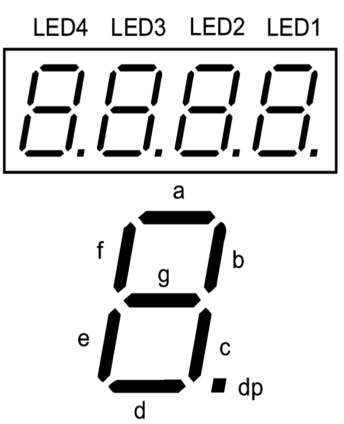
The status of control I/O signal terminals may be displayed with ON/OFF of the LED segment or in hexadecimal.

● Displaying the I/O signal status with ON/OFF of each LED segment

As shown in Table 3.4-10 and the figure below, each of segment "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 segment "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 below indicates the ON/OFF status of the terminals, not the active/inactive status of input/output.

Table 3.4-10 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 in 16-digit binary. 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.

The table below presents bit assignment and an example of corresponding hexadecimal display on the 7-segment LED assigned to bits 15 through 0.

Tip The segment display below indicates the ON/OFF status of the terminals, not the active/inactive status of input/output.

Table 3.4-11 7-Segment LED for I/O Signal Status in Hexadecimal Display (Example)

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		-	-	-	-	-	-	-	30A/B/C	-	-	-	Y5A/C	Y4	Y3	Y2	Y1
Display example (Input terminal)	Binary	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	Hexadecimal LED Monitor	LED4 LED3 LED2 LED1 0 0 0 5															

–: 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" 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).

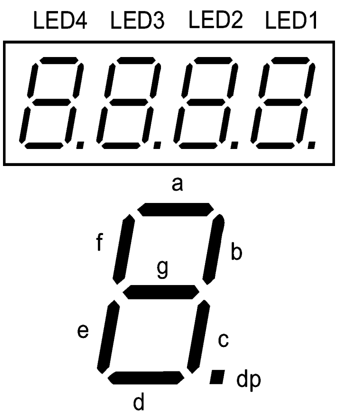
For details about input commands sent through the communications link, refer to the RS-485 Communication User's Manual and the instruction manual of communication-related options as well.

■ Displaying control circuit terminal on digital I/O interface cards

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.

Digital I/O signals are assigned to the LED segments, as follows:

Table 3.4-12 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

3.4.6 Reading maintenance information Menu #5 "Maintenance Information"

Menu #5 "Maintenance Information" (5.CHE) contains information necessary for performing maintenance on the inverter.

Figure 3.4-8 shows the menu transition in Menu #5 "Maintenance Information."

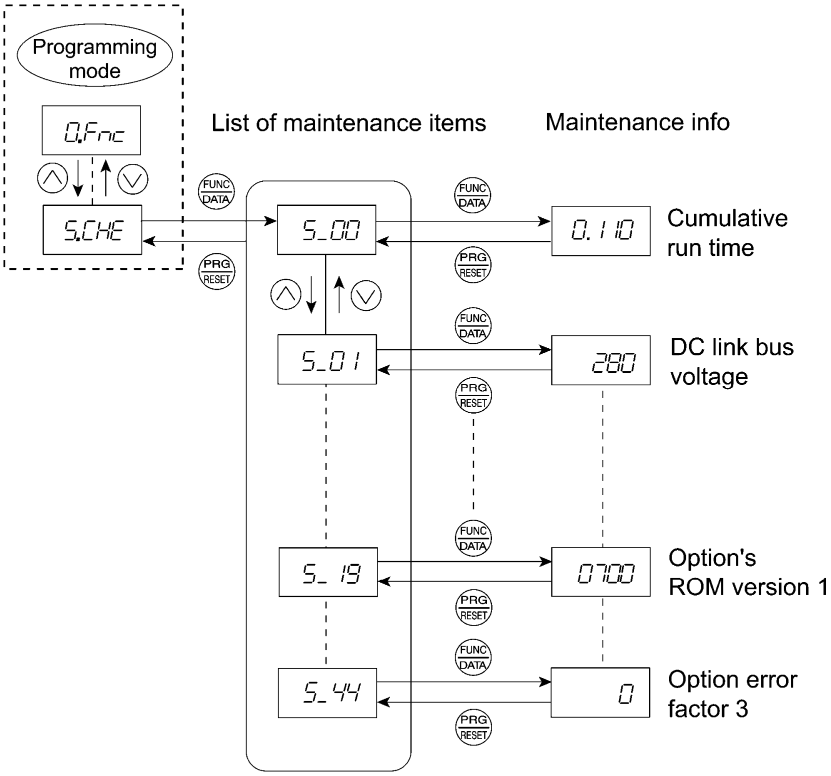


Figure 3.4-8 Menu Transition in Menu #5 "Maintenance Information"

<u>Basic key operation</u>

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 ∧/∨ key 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 ∧/∨ key 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.

Table 3.4-13 Display Items for Maintenance Information

LED monitor	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) at the least significant digit. 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 max. effective current value for every hour. Unit: A (amperes)
5_05	Capacitance of the DC link bus capacitor	Shows the current capacitance of the main circuit 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. Display: %
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, with a voltage applied, by the coefficient based on the surrounding temperature condition. Counter range: 0 to 99,990 hours Display: 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_06 above.
5_08	Startup count for motor	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.

LED monitor	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	The input watt-hour data shows the input watt-hour (kWh) × function code E51 data. The data range of function code E51 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.) 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 9,999, 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, connection to keypad) 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 9,999, 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_16	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 9,999, 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.

LED monitor	Item	Description
5_23	Cumulative run time of motor	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 main circuit capacitor (elapsed hours)	Shows the cumulative time during which a voltage is applied to the electrolytic capacitor of main circuit. When the main power is shut down, the inverter automatically measures the discharging time of the electrolytic capacitor of main circuit and corrects the elapsed time. The display method is the same as for 5_06 above.
5_27	Lifetime of main circuit capacitor (remaining hours)	Shows the remaining lifetime of the electrolytic capacitor of main circuit, 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	Startup counter for motor 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	Startup counter for motor 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	Startup counter for motor 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.

LED monitor	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.

3.4.7 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 3.4-9 shows the menu transition in Menu #6 "Alarm Information" and Table 3.4-14 lists the details of the alarm information.

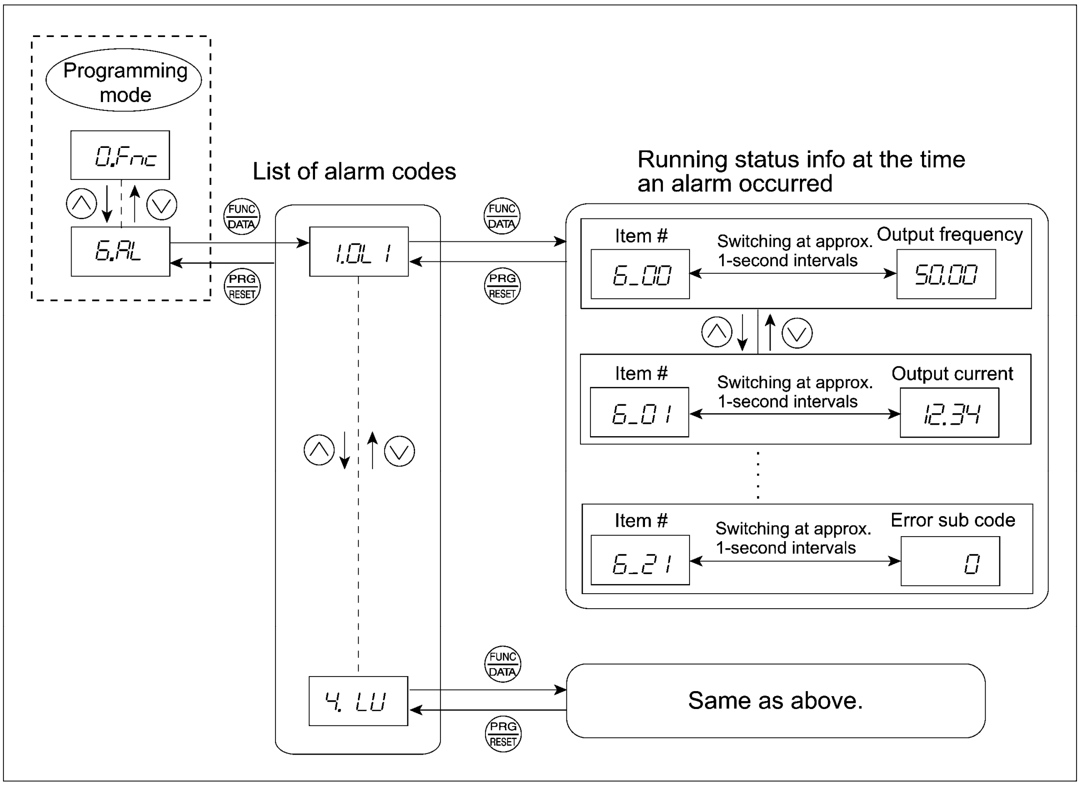


Figure 3.4-9 Menu Transition in Menu #6 "Alarm Information"

<u>Basic key operation</u>

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.OL 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 ∧/∨ 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 ∧/∨ key 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 3.4-14 Alarm Information Displayed

LED monitor (item No.)	Item	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 torque
6_04	Reference frequency	Reference frequency
6_05	Rotational direction	Rotational direction being outputted F: forward, r: reverse, ----: stop
6_06	Running status	Running status is displayed in 4-digit hexadecimal format. Refer to "■Displaying running status (3_07) and running status 2 (3_23)" in Section 3.4.4 "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) at the least significant digit. When the count exceeds 65,535, the counter will be reset to "0" and start over again.
6_08	Startup count for motor	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)	Displays the ON/OFF state of the digital I/O terminals. Refer to "■Displaying control I/O signal terminals" in Section 3.4.5 "Checking I/O signal status" for details.
6_13	Terminal input signal status (in hexadecimal)	
6_14	Terminal output signal status (in hexadecimal)	

LED monitor (item No.)	Item	Description
5_15	No. of consecutive occurrences	The number of times the same alarm occurs consecutively.
5_16	Multiple alarm 1	Simultaneously occurring alarm codes (1) ("----" is displayed if no alarms have occurred.)
5_17	Multiple alarm 2	Simultaneously occurring alarm codes (2) ("----" is displayed if no alarms have occurred.)
5_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 3.4.5 "Checking I/O signal status" for details.
5_19	Terminal input signal status under communications control (in hexadecimal format)	
5_20	Terminal output signal status under communications control (in hexadecimal format)	
5_21	Error sub code	Secondary error code for the alarm.
5_22	Running status 2	Running status 2 is displayed in 4-digit hexadecimal format. Refer to "■Displaying running status (3_07) and running status 2 (3_23)" in Section 3.4.4 "Monitoring the running status."
5_23	Detected speed	Speed detected value appears.

Note: When the same alarm occurs repeatedly, 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.

3.4.8 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 to save configuration data 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 running FRENIC Loader and check the inverter running status information stored in the keypad, refer to the FRENIC Loader Instruction Manual.

Figure 3.4-10 shows the menu transition in Menu #7 "Data Copying." The keypad can hold function code data for a single inverter.

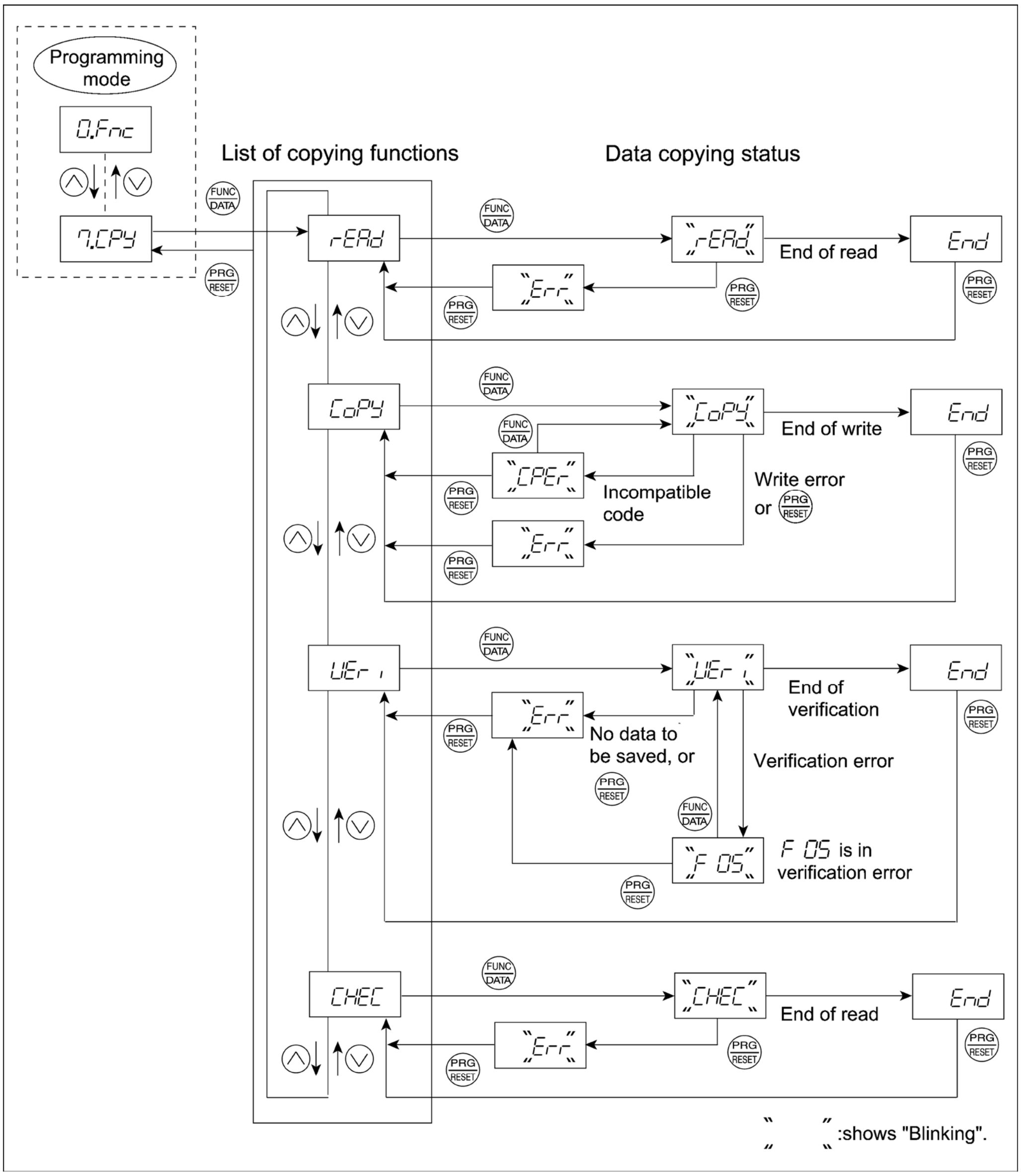


Figure 3.4-10 Menu Transition in Menu #7 "Data Copying"

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. rEAd).

(4) Use the ∧ and ∨ keys to select the desired function, then press the FUNC/DATA key to execute the selected function.

(e.g. 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.

Details of the data copying functions are listed below.

Table 3.4-15 List of Data Copying Functions

LED monitor	Function	Description
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 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. Pressing the PRG/RESET key during a write operation (when CoPY is blinking) immediately aborts the operation and displays Err (blinking). The write operation will be forcefully closed. If this happens, the contents of the inverter's 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 3-45.
UEr i	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 UEr i is blinking) immediately aborts the operation and displays Err (blinking). The verify operation will be forcefully closed. 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 When Err is blinking, press the PRG/RESET key to get out of the error state.
When CPEr is blinking, pressing FUNC/DATA key allows you to continue the operation.
However, extended function code data cannot be changed.

■ 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.

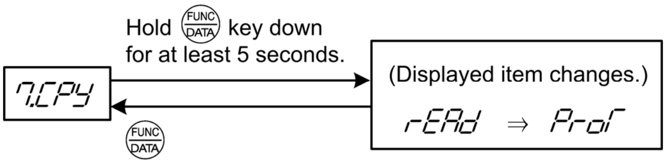
To enable or disable the data protection, follow the steps below.

(1) Select the "Data Copying" (7.CPY) on the function selection menu.

(2) When the "Data Copying" (7.CPY) is displayed, holding down the FUNC/DATA key for at least 5 seconds alternates data protection status between enabled or disabled.

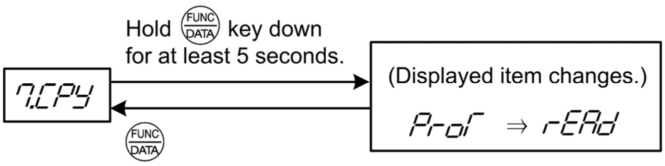
Note For switching the data protection status, be sure to hold the FUNC/DATA key down for at least 5 seconds. Once the key is released within 5 seconds, press the PRG/RESET key to go back to the 7.CPY display and perform the keying operation again.

- Enabling the disabled data protection



While "Data Copying" (7.CPY) is displayed, holding down the FUNC/DATA key shows rEAd for 5 seconds and then switches to Prot, enabling the data protection.

- Disabling the enabled data protection



While "Data Copying" (7.CPY) is displayed, holding down the FUNC/DATA key 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 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)
- 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 are not compatible with each other, CPEr is blinking.

• If the inverter type is the same.

The error occurs due to difference in software version. Pressing the FUNC/DATA key allows you to continue the copying operation. In this case, function codes added for version update are not copied.

• If the inverter types are different due to use of special specifications, etc.:

Do not make copies because copied data is incompatible.

3.5 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.

3.5.1 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.

3.5.2 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.

3.5.3 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 3.4-14 in Section 3.4.7, "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.

3.5.4 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 3.5-1 summarizes the possible transitions between different menu items.

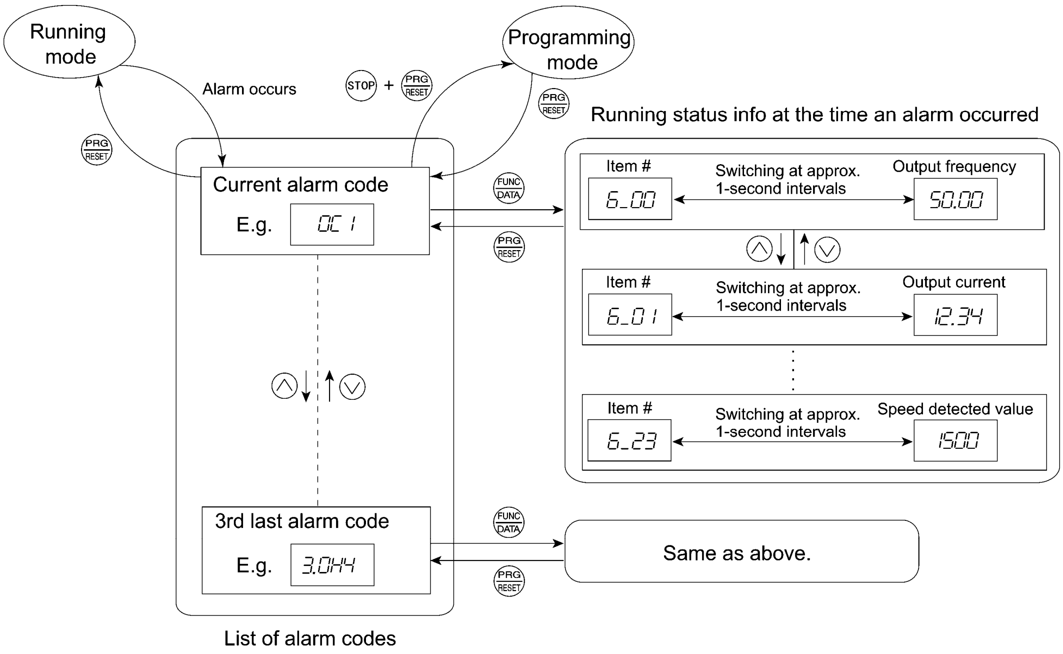


Figure 3.5-1 Menu Transition in Alarm Mode

3.6 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 and connect it to a PC running FRENIC Loader at an office or off-site place. Function code data and inverter running status information stored in the keypad can be edited, set, or confirmed on a PC FRENIC Loader.

For details on how to store data into the keypad, refer to Section 3.4.8 "Copying Data."

Chapter 4

OPERATION

Contents

4.1 Test Run

4.1.1 Test run procedure

Make a test run of the motor using the flowchart given below.

This chapter describes the test run procedure with motor 1 dedicated function codes that are marked with an asterisk (*). For motors 2 to 4, replace those asterisked function codes with motor 2 to 4 dedicated ones.

📖 For the function codes dedicated to motors 2 to 4, see Chapter 5 "FUNCTION CODES."

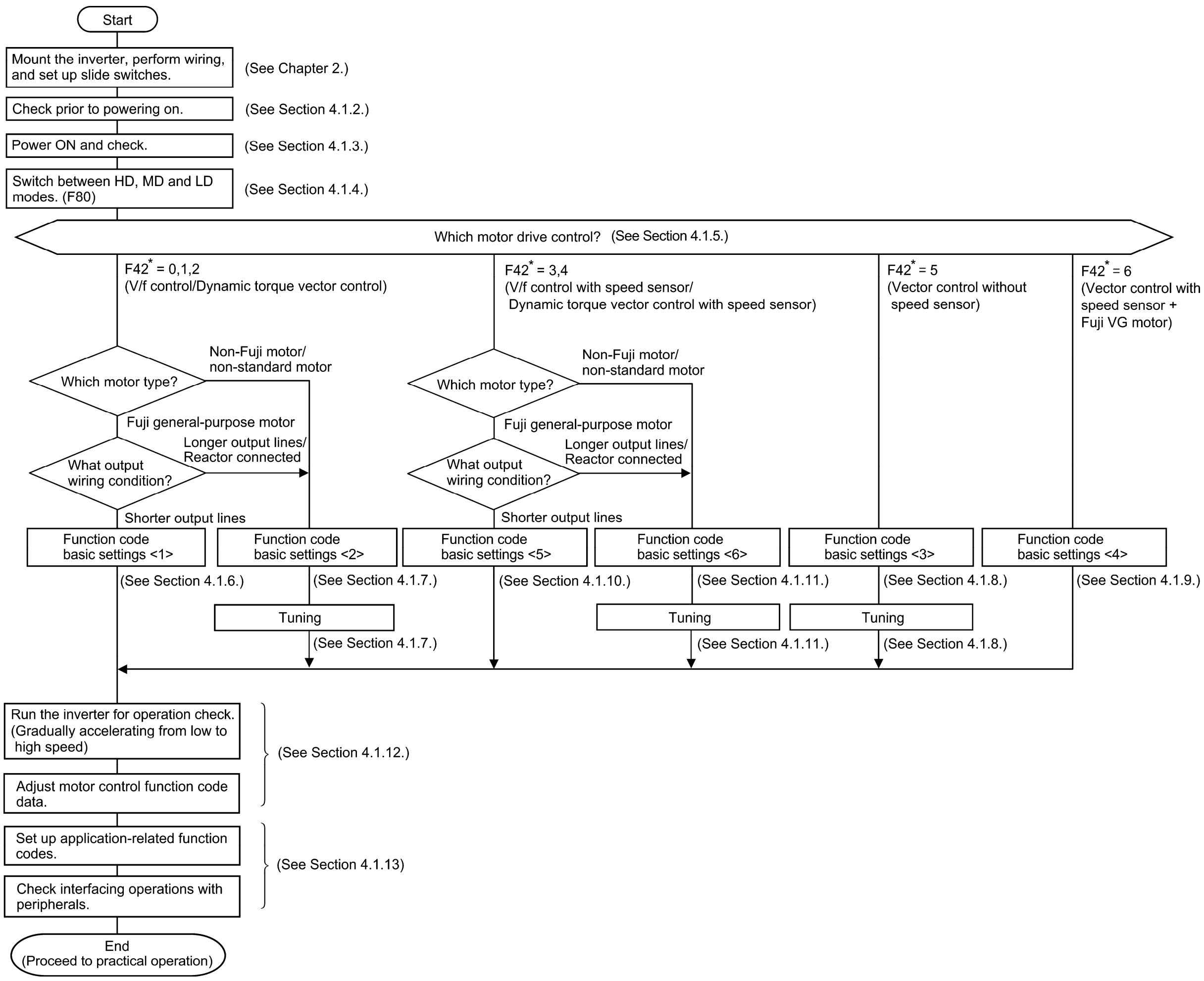


Figure 4.1-1 Test Run Procedure

4.1.2 Checking prior to powering on

Check the following before powering on the inverter.

(1) Check that the wiring is correct. Especially check the wiring to the inverter input terminals L1/R, L2/S and L3/T and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⏚ G) correctly. (See Figure 4.1-2.)

⚠WARNING

- Never connect power supply wires to the inverter output terminals U, V, and W. Doing so and turning the power ON breaks the inverter.
- Be sure to connect the grounding wires of the inverter and the motor to the ground electrodes.

Otherwise, an electric shock could occur.

(2) Check the control circuit terminals and main circuit terminals for short circuits or ground faults.

(3) Check for loose terminals, connectors and screws.

(4) Check that the motor is separated from mechanical equipment.

(5) Make sure that all switches of devices connected to the inverter are turned OFF. (Powering on the inverter with any of those switches being ON may cause an unexpected motor operation.)

(6) Check that safety measures are taken against runaway of the equipment, e.g., a defence to prevent people from access to the equipment.

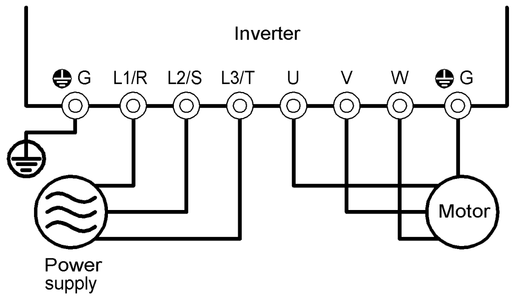


Figure 4.1-2 Connection of Main Circuit Terminals

4.1.3 Powering on and checking

⚠WARNING

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.
- Do not operate switches with wet hands.

Otherwise, an electric shock could occur.

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

(1) Check that the LED monitor displays 0.00 (indicating that the reference frequency is 0 Hz) that is blinking. (See Figure 4.1-3.)

If the LED monitor displays a value other than 0.00, use the ∧/∨ keys to display 0.00.

(2) Check that the built-in cooling fans rotate. (An inverter of 1.5 kW or less does not have cooling fans.)

Figure 4.1-3 Display of the LED Monitor after Power-on

Note For the G1E model (with the built-in EMC filter), the reactor and capacitor in the inverter may generate noises due to voltage distortion or other causes. It is not a failure.

4.1.4 Selecting an inverter drive mode (HD/MD/LD)

The 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), and the user can switch the drive modes on site. (The MD mode is supported by the 400 V class series of inverters with 90 kW or above.)

Table 4.1-1

F80 data	Drive mode	Application	Continuous current rating level	Overload capability	Maximum frequency
0	HD (High Duty) mode:	Heavy duty load	Capable of driving a motor whose capacity is the same as the inverter's one.	150% for 1 min, 200% for 3 s	500 Hz
2	MD (Medium Duty) mode:	Medium duty load applications	Capable of driving a motor whose capacity is one rank higher than the inverter's one.	150% 1 min	120 Hz
1	LD (Low Duty) mode:	Light duty load applications	Capable of driving a motor whose capacity is one or two ranks higher than the inverter's one.	120% 1 min	120 Hz

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 12 "SPECIFICATIONS."

Note When the optional multi-function keypad (TP-G1-J1) is used, description of data 2 of the function code F80 may not be displayed depending on the keypad version, but setting can be done normally.
("2: Medium D" may be displayed as "2: ---".)

In the MD/LD modes, the inverter is subject to restrictions on the function code data setting range and internal processing as listed below.

Table 4.1-2

Function code	Name	HD mode	MD mode	LD mode	Remarks
F21*	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 LD mode.
F26	Motor sound (carrier frequency)	Data setting range 0.75 to 16 kHz (0.4 to 55 kW) 0.75 to 10 kHz (75 to 400 kW) 0.75 to 6 kHz (500 and 630 kW)	Data setting range 0.75 to 2 kHz (90 to 400 kW)	Data 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 500 kW) 0.75 to 4 kHz (630 kW)	
F44	Current limiter (mode selection)	Initial value: 160%	Initial value: 145%	Initial value: 130%	Switching the drive mode with function code F80 automatically initializes the F44 data to the value specified at left.
F03*	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.
—	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 between the drive modes does not automatically change the motor rated capacity (P02*) to the one suitable for the rank-changed motor, so configure the P02* data to match the applied motor rating as required.

4.1.5 Selecting a motor drive control

The FRENIC-MEGA supports the following motor drive controls.

Table 4.1-3

F42* data	Drive control	Basic control	Speed feedback	Drive control type	Speed control	Other restrictions
0	V/f control with slip compensation inactive	V/f control	Disabled	V/f	Frequency control	—
1	Dynamic torque vector control				Frequency control with slip compensation active	—
2	V/f control with slip compensation active					—
3	V/f control with speed sensor		Enabled	PG V/f	Frequency control with automatic speed regulator (ASR)	Maximum frequency: 200 Hz
4	Dynamic torque vector control with speed sensor					
5	Vector control without speed sensor	Vector control	Estimated speed	w/o PG	Speed control with automatic speed regulator (ASR)	Maximum frequency: 120 Hz Not available for MD-mode inverters.
6	Vector control with speed sensor		Enabled	w/ PG		Maximum frequency: 200 Hz

■ V/f control with slip compensation inactive

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.

■ 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.

The compensation value is specified by combination of function codes P12* (Rated slip frequency), P09* (Slip compensation gain for driving) and P11* (Slip compensation gain for braking).

H68* enables or disables the slip compensation function according to the motor driving conditions.

Table 4.1-4

H68* data	Motor driving conditions		Motor driving frequency zone	
	Accl/Decel	Constant speed	Base frequency or below	Above the base frequency
0	Enabled	Enabled	Enabled	Enabled
1	Disabled	Enabled	Enabled	Enabled
2	Enabled	Enabled	Enabled	Disabled
3	Disabled	Enabled	Enabled	Disabled

■ **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 the dynamic torque vector control automatically enables the auto-torque boost and slip compensation.

This control is effective for improving the system response to external disturbances such as load fluctuation, and the motor speed control accuracy.

Note that the inverter may not respond to a rapid load fluctuation since this control is an open-loop V/f control that does not perform the current control, unlike the vector control. The advantages of this control include larger maximum torque per output current than that the vector control.

■ **V/f control with speed sensor**

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. V/f control with speed sensor detects the motor rotation speed by an encoder attached on the motor shaft and compensates the slip frequency by PI control to adjust the motor rotation to the specified speed, improving the motor speed control precision.

■ **Dynamic torque vector control with speed sensor**

In contrast to V/f control with speed sensor, 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. This control is effective for improving the system response to external disturbances such as load fluctuation, 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. 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.

■ **Vector control with speed sensor**

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 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.

It is possible to obtain the desired response by adjusting the control constants (PI constants) using the speed regulator (PI controller).

This enables quicker-response control of the motor speed with higher accuracy than vector control without speed sensor.

(It is recommended to use Fuji motors (VG motors) exclusively designed for vector control.)

Note Since slip compensation and dynamic torque vector control use motor parameters, the following conditions should be satisfied; otherwise, full control performance may not be obtained.

- A single motor should be controlled per inverter.
- Motor parameters P02*, P03*, and P06* to P23*, P55*, and P56* should be properly configured or auto-tuning should be performed. (When using a VG motor under vector control with speed sensor, just selecting the VG motor (setting the function code P99*＝2) is enough and auto-tuning is not required.)
- 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 and should be the same capacity as the inverter under vector control with/without 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.

■ **Performance comparison for drive controls (summary)**

Each drive control has advantages and disadvantages. The table below compares the drive controls, showing their relative performance in each characteristic. Select the one that shows high performance in the characteristics that are important in your machinery. In rare cases, the performance shown below may not be obtained due to various conditions including motor characteristics or mechanical rigidity. The final performance should be determined by adjusting the speed control system or other elements with the inverter being connected to the machinery (load). If you have any questions, contact your Fuji Electric representative.

Table 4.1-5

F42* data	Drive control	Output frequency stability	Speed control accuracy	Speed control response	Maximum torque	Load disturbance	Current control	Torque accuracy
0	V/f control with slip compensation inactive	⊙	–	–	⊙	–	–	△
1	Dynamic torque vector control	△	△	△	⊙	△	–	O
2	V/f control with slip compensation active	△	▲	▲	⊙	△	–	△
3	V/f control with speed sensor	△	⊙	O	⊙	△	–	△
4	Dynamic torque vector control with speed sensor	△	⊙	O	⊙	△	–	O
5	Vector control without speed sensor	△	O	O	△	O	⊙	O
6	Vector control with speed sensor	△	⊙	⊙	△	⊙	⊙	⊙

Relative performance symbols ⊙: Excellent O: Good △: Effective ▲: Less effective -: Not effective

4.1.6 Basic settings of function codes < 1 >

Driving a Fuji general-purpose motor under the V/f control (F42* = 0 or 2) or dynamic torque vector control (F42* = 1) requires configuring the following basic function codes.

Select Fuji standard 8- or 6-series motors with the function code P99*.

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

📖 For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 “Data Setting”."

Table 4.1-6

Function Code	Name	Function code data	Factory default
F04*	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F05*	Rated voltage at base frequency 1		Three-phase 200 V: 200 (V) Three-phase 400 V: 400 (V)
P99*	Motor 1 selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 3: Motor characteristics 3 (Fuji standard motors, 6-series)	Motor characteristics 0 (Fuji standard motors, 8-series)
P02*	Motor 1 (Rated capacity)	Capacity of motor connected	Nominal applied motor capacity
F03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)

After the above configuration, initialize motor 1 with the function code (H03 = 2). It automatically updates the function codes P01*, P03*, and P06* to P23*, P53* to P56*, and H46 for the required motor parameters.

Note

Be very careful when changing the P02* data because doing so automatically updates the data of the function codes P03*, P06* to P23*, P53* to P56*, and H46. However, changing the P02 data remotely does not automatically update them.

The motor rating should be specified properly when performing auto-torque boost, torque calculation monitoring, auto energy saving, torque limiting, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, torque vector control, droop control, or overload stop.

In any of the following cases, the full control performance may not be obtained from the inverter because the motor parameters differ from the factory defaults, so perform auto-tuning. (Refer to Section 4.1.7.)

- The motor to be driven is not a Fuji product or is a non-standard product.
- The wiring distance between the inverter and the motor is too long (generally 20 m or more).
- A reactor is inserted between the inverter and the motor.

4.1.7 Basic settings/tuning of function codes < 2 >

Under the V/f control (F42* = 0 or 2) or dynamic torque vector control (F42* = 1), when a non-Fuji motor or non-standard motor is driven, or a Fuji general-purpose motor is driven and the wiring distance between the inverter and motor is long or a reactor is connected, the basic function codes should be configured and auto-tuning should be performed for controlling the motor before operation.

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

For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 “Data Setting”."

Table 4.1-7

Function Code	Name	Function code data	Factory default
F 04*	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F 05*	Rated voltage at base frequency 1		Three-phase 200 V: 200 (V) Three-phase 400 V: 400 (V)
P 02*	Motor 1 (Rated capacity)		Nominal applied motor capacity
P 03*	Motor 1 (Rated current)		Rated current of nominal applied motor
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)

Note: Be very careful when changing the P02* data because doing so automatically updates the data of the function codes P03*, P06* to P23*, P53* to P56*, and H46.

■ Tuning procedure

(1) Selection of tuning type

Check the situation of the machinery and select "Tuning with the motor stopped (P04* = 1)" or "Tuning with the motor running (P04* = 2)." For the latter tuning, adjust the acceleration and deceleration times (F07 and F08) and specify the rotation direction that matches the actual rotation direction of the machinery.

Table 4.1-8

P04* data	Tuning type	Motor parameters subject to tuning	Tuning	Select under the following conditions
1	Tune while the motor stops.	Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) %X correction factor 1 and 2 (P53* and P54*)	Tuning with the motor stopped.	Cannot rotate the motor.
2	Tune while the motor is rotating under V/f control	No-load current (P06*) Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) Magnetic saturation factor 1 - 5 Extended magnetic saturation factor a - c (P16* - P23*) %X correction factor 1 and 2 (P53* and P54*)	Tuning the %R1 and %X, with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency. Tuning again the rated slip frequency, with the motor stopped.	Can rotate the motor, provided that it is safe. Note that little load should be applied during tuning. Tuning with load applied decreases the tuning accuracy.

The tuning results of motor parameters will be automatically saved into their respective function codes.

If P04* tuning is performed, for instance, the tuning results will be saved into P* codes (Motor 1* parameters).

(2) Preparation of machinery

Perform appropriate preparations on the motor and its load, such as disengaging the coupling from the motor and deactivating the safety devices.

(3) Tuning procedure

1) Set function code P04* to "1" or "2" and press the FUNC/DATA key. (The blinking of 1 or 2 on the LED monitor will slow down.)
2) Enter a run command. (The factory default is RUN key on the keypad for forward rotation. To switch to reverse rotation or to select the terminal signal FWD or REV as a run command, change the data of function code F02.)
3) The moment a run command is entered, the display of 1 or 2 lights up, and tuning starts with the motor stopped.
   (Maximum tuning time: Approx. 40 to 80 s.)
4) If P04* = 2, after the tuning in 3) above, the motor is accelerated to approximately 50% of the base frequency and then tuning starts. Upon completion of measurements, the motor decelerates to a stop.
   (Estimated tuning time: Acceleration time + 20 to 75 s + Deceleration time)
5) If P04* = 2, after the motor decelerates to a stop in 4) above, tuning continues with the motor stopped.

(Maximum tuning time: Approx. 40 to 80 s.)

6) If the terminal signal FWD or REV is selected as a run command (F02 = 1), End appears upon completion of the measurements. Turning the run command OFF completes the tuning.
If the run command has been given through the keypad or the communications link, it automatically turns OFF upon completion of the measurements, which completes the tuning.

7) Upon completion of the tuning, the subsequent function code for P04* appears on the keypad.

■ **Tuning errors**

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the tuning results or any error in the tuning process, it displays Er7 and discards the tuning data.

Listed below are possible causes that trigger tuning errors.

Table 4.1-9

Possible tuning error causes	Details
Error in tuning results	An interphase voltage unbalance or output phase loss has been detected, or tuning has resulted in an abnormally high or low value of a parameter due to the output circuit opened.
Output current error	An abnormally high current has flown during tuning.
Sequence error	During tuning, a run command has been turned OFF, or STOP (Force to stop), BX (Coast to a stop), DWP (Protect from dew condensation), or other similar terminal command has been received.
Error due to limitation	Any of the operation limiters has been activated during tuning, or the maximum frequency or the frequency limiter (high) has limited tuning operation.
Other errors	An undervoltage or any other alarm has occurred.

If any of these errors occurs, remove the error cause and perform tuning again, or consult your Fuji Electric representative.

Note If a filter other than the Fuji optional output filter (OFL-☐☐☐-☐A) is connected to the inverter's output (secondary) circuit, the tuning result cannot be assured. When replacing the inverter connected with such a filter, make a note of the old inverter's settings for the primary resistance %R1, leakage reactance %X, no-load current, and rated slip frequency, and specify those values to the new inverter's function codes.

Vibration that may occur when the motor's coupling is elastic can be regarded as normal vibration due to the output voltage pattern applied in tuning. The tuning does not always result in an error; however, run the motor and check its running state.

4.1.8 Basic settings/tuning of function codes < 3 >

When using "vector control without speed sensor (F42*＝5), auto-tuning should be performed without regard to the motor type (including the Fuji motors (VG motors) exclusively designed for vector control.

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

For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 "Data Setting"."

Table 4.1-10

Function Code	Name	Function code data	Factory default
F 04*	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F 05*	Rated voltage at base frequency 1		Three-phase 200 V: 200 (V) Three-phase 400 V: 400 (V)
P 02*	Motor 1 (Rated capacity)		Nominal applied motor capacity
P 03*	Motor 1 (Rated current)		Rated current of nominal applied motor
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)

Note
- Be very careful when changing the P02* data because doing so automatically updates the data of the function codes P03*, P06* to P23*, P53* to P56*, and H46.
- Vector control without speed sensor uses lower rated voltage (base frequency voltage) of the motor. However, use the normal value for the base frequency voltage. After auto-tuning, the motor voltage will be automatically lowered from the base frequency voltage.
- Not available for the MD mode.

When combining the inverter with the Fuji motors (VG motors) exclusively designed for vector control, configure the function codes as listed below, and perform auto-tuning after initializing the motor (H03 = 2).

Table 4.1-11

Function Code	Name	Function code data	Factory default
P 99*	Motor 1 selection	2: Motor characteristics 2 (VG motor)	0: Motor characteristics 0
P 02*	Motor 1 (Rated capacity)	Capacity of motor connected	Nominal applied motor capacity
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)

Note Initializing the motor 1 using the function code H03 (H03 = 2) automatically configures the function codes F04*, F05*, P01*, P03*, P06* to P23*, P53* to P56*, and H46. Perform auto-tuning after this auto configuration.

■ **Tuning procedure**

(1) Selection of tuning type

Check the situation of the machinery and select "Tuning with the motor running (P04* = 3)." For the latter tuning, adjust the acceleration and deceleration times (F07 and F08) and specify the rotation direction that matches the actual rotation direction of the machinery.

Note If "Tuning with the motor running (P04* = 3)" cannot be selected due to a restriction of the facilities, refer to "■ When tuning with the motor running cannot be performed."

Table 4.1-12

P04* data	Tuning type	Motor parameters subject to tuning	Tuning	Select under the following conditions	Drive control		
					V/f	w/o PG	w/ PG
1	Tune while the motor stops	Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) %X correction factor 1 and 2 (P53* and P54*)	Tuning with the motor stopped.	Cannot rotate the motor.	○	△	△
2	Tune while the motor is rotating under V/f control	No-load current (P06*) Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) Magnetic saturation factor 1 - 5 Extended magnetic saturation factor a - c (P16* - P23*) %X correction factor 1 and 2 (P53* and P54*)	Tuning the %R1 and %X, with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency. Tuning again the rated slip frequency, with the motor stopped.	Can rotate the motor, provided that it is safe. Note that little load should be applied during tuning. Tuning with load applied decreases the tuning accuracy.	○	×	×
3	Tuning while the motor is running for vector control	No-load current (P06*) Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) Magnetic saturation factor 1 - 5 Extended magnetic saturation factor a - c (P16* - P23*) %X correction factor 1 and 2 (P53* and P54*)	Tuning the %R1, %X, and rated slip frequency with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency twice.	Can rotate the motor, provided that it is safe. Note that little load should be applied during tuning. Tuning with load applied decreases the tuning accuracy.	×	○	○

○: Tunable △: Conditionally tunable ×: Not tunable

The tuning results of motor parameters will be automatically saved into their respective function codes. If P04* tuning is performed, for instance, the tuning results will be saved into P* codes (Motor 1* parameters).

(2) Preparation of machinery

Perform appropriate preparations on the motor and its load, such as disengaging the coupling from the motor and deactivating the safety devices.

(3) Tuning procedure (tuning while the motor is running for vector control)

1) Set function code P04* to "3" and press the FUNC/DATA key. (The blinking of 3 on the LED monitor will slow down.)

2) Enter a run command. (The factory default is RUN key on the keypad for forward rotation. To switch to reverse rotation or to select the terminal signal FWD or REV as a run command, change the data of function code F02.)

3) The moment a run command is entered, the display of 3 lights up, and tuning starts with the motor stopped.
(Maximum tuning time: Approx. 40 to 75 s.)

4) The motor is accelerated to approximately 50% of the base frequency and then tuning starts. Upon completion of measurements, the motor decelerates to a stop. (Estimated tuning time: Acceleration time + 20 to 75 s + Deceleration time)

5) After the motor decelerates to a stop, tuning continues with the motor stopped.
(Maximum tuning time: Approx. 20 to 35 s.)

6) The motor is accelerated to approximately 50% of the base frequency again and then tuning starts. Upon completion of measurements, the motor decelerates to a stop.
(Estimated tuning time: Acceleration time + 20 to 160 s + Deceleration time)

7) After the motor decelerates to a stop, tuning continues with the motor stopped.
(Maximum tuning time: Approx. 20 to 30 s.)

8) If the terminal signal FWD or REV is selected as a run command (F02 = 1), End appears upon completion of the measurements. Turning the run command OFF completes the tuning.
If the run command has been given through the keypad or the communications link, it automatically turns OFF upon completion of the measurements, which completes the tuning.

9) Upon completion of the tuning, the subsequent function code for P04* appears on the keypad.

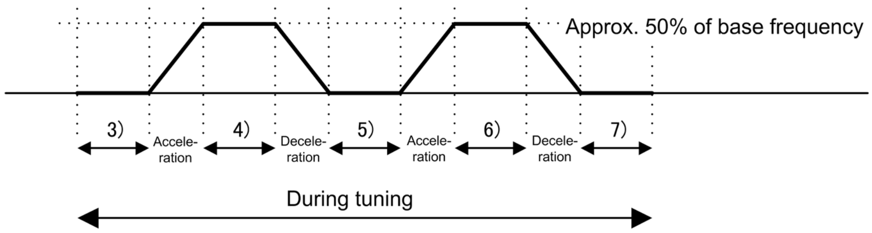


Figure 4.1-4

Note The speed controller is initially set to a low value to avoid hunting. However, hunting may occur during tuning due to dependency on the machinery. In this case, a tuning error (Er 7) or speed mismatch error (Er-E) may occur. *When* Er 7 occurs, lower the gain of the speed controller. When Er-E occurs, cancel speed mismatch detection (d23＝0) and perform tuning again.

■ When tuning with the motor running cannot be performed

If "Tuning while the motor is running for vector control (P04* = 3)" cannot be selected due to a restriction of the facilities, perform "Tuning with motor stopped (P04* = 1) as directed below. Since this tuning may produce results with lower speed control precision and stability than "Tuning while the motor is running for vector control," perform the combination test with the machinery thoroughly.

(1) For Fuji standard motors, 8-series/6-series, or Fuji motors (VG motors) exclusively designed for vector control

1) Set the function code P99* in accordance with the motor type.

2) Initialize the motor 1 with the function code H03 (H03 = 2).

3) Set the function codes F04*, F05*, P02*, and P03* in accordance with the ratings of the motor.

4) Perform "Tuning with the motor stopped (P04* = 1)."

(2) When the motor parameters are unknown (e.g., for non-Fuji motors)

1) Set the function codes F04*, F05*, P02*, and P03* in accordance with the ratings printed on the nameplate of the motor.

2) Set the motor parameters (P06* and P16* to P23*) by referencing the motor test report.
For details about converting the test report values into various parameters, consult your Fuji Electric representative.

3) Perform "Tuning with the motor stopped (P04* = 1)."

(3) Tuning procedure (tuning with the motor stopped)

1) Set function code P04* to "1" and press the FUNC DATA key. (The blinking of 1 on the LED monitor will slow down.)

2) Enter a run command. (The factory default is RUN key on the keypad for forward rotation. To switch to reverse rotation or to select the terminal signal FWD or REV as a run command, change the data of function code F02.)

3) The moment a run command is entered, the display of 1 lights up, and tuning starts with the motor stopped.
(Maximum tuning time: Approx. 40 s.)

4) If the terminal signal FWD or REV is selected as a run command (F02 = 1), End appears upon completion of the measurements. Turning the run command OFF completes the tuning.
If the run command has been given through the keypad or the communications link, it automatically turns OFF upon completion of the measurements, which completes the tuning.

5) Upon completion of the tuning, the subsequent function code for P04* appears on the keypad.

■ Tuning errors

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the tuning results or any error in the tuning process, it displays Er7 and discards the tuning data.

Listed below are possible causes that trigger tuning errors.

Table 4.1-13

Possible tuning error causes	Details
Error in tuning results	An interphase voltage unbalance or output phase loss has been detected, or tuning has resulted in an abnormally high or low value of a parameter due to the output circuit opened.
Output current error	An abnormally high current has flown during tuning.
Sequence error	During tuning, a run command has been turned OFF, or STOP (Force to stop), BX (Coast to a stop), DWP (Protect from dew condensation), or other similar terminal command has been received.
Error due to limitation	Any of the operation limiters has been activated during tuning, or the maximum frequency or the frequency limiter (high) has limited tuning operation.
Other errors	An undervoltage or any other alarm has occurred.

If any of these errors occurs, remove the error cause and perform tuning again, or consult your Fuji Electric representative.

Note If a filter other than the Fuji optional output filter (OFL-□□□-□A) is connected to the inverter's output (secondary) circuit, the tuning result cannot be assured. When replacing the inverter connected with such a filter, make a note of the old inverter's settings for the primary resistance %R1, leakage reactance %X, no-load current, and rated slip frequency, and specify those values to the new inverter's function codes.

Vibration that may occur when the motor's coupling is elastic can be regarded as normal vibration due to the output voltage pattern applied in tuning. The tuning does not always result in an error; however, run the motor and check its running state.

4.1.9 Basic settings of function codes < 4 >

When using "vector control with speed sensor (F42*=6)" and combining the inverter with the Fuji motors (VG motors) exclusively designed for vector control, set the function code data as listed below.

For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 “Data Setting”."

Table 4.1-14

Function Code	Name	Function code data	Factory default
P 99*	Motor 1 selection	2: Motor characteristics 2 (VG motor)	0: Motor characteristics 0
P 02*	Motor 1 (Rated capacity)	Capacity of motor connected	Nominal applied motor capacity
H 26	Thermistor (for motor) (operation selection)	3: Operation (with NTC connected) Also switch SW5 on the control PCB.	0: No operation
d 14	Feedback input Pulse input system	2: 90 degree phase shifted A/B pulse trains	2: A/B phases
d 15	Feedback input Encoder pulse resolution	0400 (1024)	0400 (1024)
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 11*	Electronic thermal 1 (for motor protection) (operation level)	0.00 (No operation)	For each inverter capacity

After the above configuration, initialize motor 1 with the function code (H03 = 2). The function codes F04*, F05*, P01*, P03*, P06* to P23*, P53* to P56*, and H46 for the motor parameters required for vector control are automatically set.

Note Be very careful when changing the P02* data because doing so automatically updates the data of the function codes F04*, F05*, P03*, P06* to P23*, P53* to P56*, and H46.

4.1.10 Basic settings of function codes < 5 >

When driving a Fuji general-purpose motor under "V/f control with speed sensor (F42* = 3)" or "dynamic torque vector control with speed sensor (F42* = 4)," the following basic function codes should be set.

Select Fuji standard 8- or 6-series motors with the function code P99*.

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

For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 "Data Setting"."

Table 4.1-15

Function Code	Name	Function code data	Factory default
F 04*	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F 05*	Rated voltage at base frequency 1		Three-phase 200 V: 200 (V) Three-phase 400 V: 400 (V)
F 99*	Motor 1 selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 3: Motor characteristics 3 (Fuji standard motors, 6-series)	0: Motor characteristics 0 (Fuji standard motors, 8-series)
P 02*	Motor 1 (Rated capacity)	Capacity of motor connected	Nominal applied motor capacity
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
d 15	Feedback encoder pulse resolution	Pulse resolution of the target motor encoder 0400 HEX/1024 P/R	0400 HEX
d 16	Feedback pulse correction factor 1	Set the deceleration rate between the motor and encoder. Motor speed = Encoder speed x (d17)/(d16)	1
d 17	Feedback pulse correction factor 2		1

After the above configuration, initialize motor 1 with the function code (H03 = 2). It automatically updates the function codes P01*, P03*, and P06* to P23*, P53* to P56*, and H46 for the required motor parameters.

Note Be very careful when changing the P02* data because doing so automatically updates the data of the function codes P03*, P06* to P23*, P53* to P56*, and H46.

The motor rating should be specified properly when performing auto-torque boost, torque calculation monitoring, auto energy saving, torque limiting, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, torque vector control, droop control, or overload stop.

In any of the following cases, the full control performance may not be obtained from the inverter because the motor parameters differ from the factory defaults, so perform auto-tuning.

- The motor to be driven is not a Fuji product or is a non-standard product.
- The wiring distance between the inverter and the motor is too long (generally 20 m or more).
- A reactor is inserted between the inverter and the motor.

4.1.11 Basic settings/tuning of function codes < 6 >

Under the V/f control with speed sensor (F42* = 3) or dynamic torque vector control with speed sensor (F42* = 4), when a non-Fuji motor or non-standard motor is driven, or a Fuji general-purpose motor is driven and the wiring distance between the inverter and motor is long or a reactor is connected, the basic function codes should be configured and auto-tuning should be performed for controlling the motor before operation.

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

📖 For details on how to modify the function code data, see Chapter 3, Section 3.4.2 "Setting up function codes Menu #1 "Data Setting"."

Table 4.1-16

Function Code	Name	Function code data	Factory default
F 04*	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F 05*	Rated voltage at base frequency 1		Three-phase 200 V: 200 (V) Three-phase 400 V: 400 (V)
P 02*	Motor 1 (Rated capacity)		Nominal applied motor capacity
P 03*	Motor 1 (Rated current)		Rated current of nominal applied motor
F 03*	Maximum frequency 1	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	60.0 (Hz)
F 07	Acceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
F 08	Deceleration time 1 **(Note)**		22 kW or less: 6.00 (s) 30 kW or more: 20.00 (s)
d 15	Feedback encoder pulse resolution	Pulse resolution of the target motor encoder 0400 HEX/1024 P/R	0400 HEX
d 16	Feedback pulse correction factor 1	Set the deceleration rate between the motor and encoder. Motor speed = Encoder speed x (d17)/(d16)	1
d 17	Feedback pulse correction factor 2		1

Note Be very careful when changing the P02* data because doing so automatically updates the data of the function codes P03*, P06* to P23*, P53* to P56*, and H46.

■ **Tuning procedure**

(1) Selection of tuning type

Check the situation of the machinery and select "Tuning with the motor stopped (P04* = 1)" or "Tuning with the motor running (P04* = 2)." For the latter tuning, adjust the acceleration and deceleration times (F07 and F08) and specify the rotation direction that matches the actual rotation direction of the machinery.

Table 4.1-17

P04* data	Tuning type	Motor parameters subject to tuning	Tuning	Select under the following conditions
1	Tune while the motor stops	Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) %X correction factor 1 and 2 (P53* and P54*)	Tuning with the motor stopped.	Cannot rotate the motor.
2	Tune while the motor is rotating under V/f control	No-load current (P06*) Primary resistance (%R1) (P07*) Leakage reactance (%X) (P08*) Rated slip frequency (P12*) Magnetic saturation factor 1 - 5 Extended magnetic saturation factor a - c (P16* - P23*) %X correction factor 1 and 2 (P53* and P54*)	Tuning the %R1 and %X, with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency. Tuning again the rated slip frequency, with the motor stopped.	Can rotate the motor, provided that it is safe. Note that little load should be applied during tuning. Tuning with load applied decreases the tuning accuracy.

The tuning results of motor parameters will be automatically saved into their respective function codes. If P04* tuning is performed, for instance, the tuning results will be saved into P* codes (Motor 1* parameters).

(2) Preparation of machinery

Perform appropriate preparations on the motor and its load, such as disengaging the coupling from the motor and deactivating the safety devices.

(3) Tuning procedure

1) Set function code P04* to "1" or "2" and press the FUNC/DATA key. (The blinking of 1 or 2 on the LED monitor will slow down.)

2) Enter a run command. (The factory default is RUN key on the keypad for forward rotation. To switch to reverse rotation or to select the terminal signal FWD or REV as a run command, change the data of function code F02.)

3) The moment a run command is entered, the display of 1 or 2 lights up, and tuning starts with the motor stopped.
(Maximum tuning time: Approx. 40 to 80 s.)

4) If P04* = 2, after the tuning in 3) above, the motor is accelerated to approximately 50% of the base frequency and then tuning starts. Upon completion of measurements, the motor decelerates to a stop.
(Estimated tuning time: Acceleration time + 20 to 75 s + Deceleration time)

5) If P04* = 2, after the motor decelerates to a stop in 4) above, tuning continues with the motor stopped.
(Maximum tuning time: Approx. 40 to 80 s.)

6) If the terminal signal FWD or REV is selected as a run command (F02 = 1), End appears upon completion of the measurements. Turning the run command OFF completes the tuning.
If the run command has been given through the keypad or the communications link, it automatically turns OFF upon completion of the measurements, which completes the tuning.

7) Upon completion of the tuning, the subsequent function code for P04* appears on the keypad.

■ **Tuning errors**

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the tuning results or any error in the tuning process, it displays Er 7 and discards the tuning data.
Listed below are possible causes that trigger tuning errors.

Table 4.1-18

Possible tuning error causes	Details
Error in tuning results	An interphase voltage unbalance or output phase loss has been detected, or tuning has resulted in an abnormally high or low value of a parameter due to the output circuit opened.
Output current error	An abnormally high current has flown during tuning.
Sequence error	During tuning, a run command has been turned OFF, or STOP (Force to stop), BX (Coast to a stop), DWP (Protect from dew condensation), or other similar terminal command has been received.
Error due to limitation	Any of the operation limiters has been activated during tuning, or the maximum frequency or the frequency limiter (high) has limited tuning operation.
Other errors	An undervoltage or any other alarm has occurred.

If any of these errors occurs, remove the error cause and perform tuning again, or consult your Fuji Electric representative.

Note If a filter other than the Fuji optional output filter (OFL-□□□-□A) is connected to the inverter's output (secondary) circuit, the tuning result cannot be assured. When replacing the inverter connected with such a filter, make a note of the old inverter's settings for the primary resistance %R1, leakage reactance %X, no-load current, and rated slip frequency, and specify those values to the new inverter's function codes.

Vibration that may occur when the motor's coupling is elastic can be regarded as normal vibration due to the output voltage pattern applied in tuning. The tuning does not always result in an error; however, run the motor and check its running state.

4.1.12 Running the inverter for motor operation check

⚠WARNING
If the user configures the function codes wrongly without completely understanding this User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine. **Accident or injury may result.**

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

⚠CAUTION
If any abnormality is found in the inverter or motor, immediately stop operation and investigate the cause referring to Chapter 6, "TROUBLESHOOTING."

------------------------------------- **Test run procedure** --

(1) Turn the power ON and check that the reference frequency 0.00 is blinking on the LED monitor.

(2) Set a low reference frequency such as 5 Hz, using the ∧/∨ keys. (Check that the frequency is blinking on the LED monitor.)

(3) Press the RUN key to start running the motor in the forward direction. (Check that the reference frequency is lit on the LED monitor.)

(4) To stop the motor, press the STOP key.

<Check points during a test run>

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

When no abnormality is found, press the RUN key again to start driving the motor, then increase the reference frequency using ∧/∨ keys. Check the above points again.

Tip

Depending on the function code setting, the motor speed may increase to an unexpected level. This is especially true for vector control with/without speed sensor. The inverter is equipped with a speed limit function to ensure safety even if the function codes are set incorrectly.

Until you are familiarized with the function codes (e.g., when you run the system for the first time), it is recommended to use the frequency limiter (high) (F15) and torque control (speed limit) (d32/d33). For the first run, gradually increase the speed limit values while checking the operation to ensure safer work.

The speed limit function works as the speed limiter for the over speed level or torque control. For the details of the speed limit function, refer to Chapter 5 "FUNCTION CODES."

<Modification of motor control function code data>

Modifying the current function code data sometimes can solve an insufficient torque or overcurrent incident. The table below lists the major function codes to be accessed. For details, see Chapter 5 "FUNCTION CODES" and Chapter 6 "TROUBLESHOOTING."

Table 4.1-19

Function code	Name	Modification key points	Drive control			
			V/f	PG V/f	w/o PG	w/ PG
F 07	Acceleration time 1	If the current limiter is activated due to a short acceleration time and large drive current, prolong the acceleration time.	O	O	O	O
F 08	Deceleration time 1	If an overvoltage trip occurs due to a short deceleration time, prolong the deceleration time.	O	O	O	O
F 09*	Torque boost 1	If the starting motor torque is deficient, increase the torque boost. If the motor with no load is overexcited, decrease the torque boost.	O	O	×	×
F 44	Current limiter (Mode selection)	If the stall prevention function is activated by the current limiter during acceleration or deceleration, increase the operation level.	O	O	×	×
P 09*	Motor 1 (Slip compensation gain for driving)	For excessive slip compensation during driving, decrease the gain; for insufficient one, increase the gain.	O	×	O	×
P 11*	Motor 1 (Slip compensation gain for braking)	For excessive slip compensation during braking, decrease the gain; for insufficient one, increase the gain.	O	×	O	×
H 80*	Output current fluctuation damping gain 1 (For motor 1)	If the motor vibrates due to current fluctuation, increase the suppression gain.	O	O	×	×

O: Modification effective ×: Modification ineffective

If modification of motor control function code data does not resolve a problem under V/f control with speed sensor, dynamic torque vector control with speed sensor, vector control without speed sensor, or vector control with speed sensor, modify the function codes listed below.

A PI controller is used to control speed in drive control above. The PI parameters may require modification due to inertia on the load side. The main function codes requiring modification are listed below. For details, see Chapter 5 "FUNCTION CODES" and Chapter 6 "TROUBLESHOOTING."

Table 4.1-20

Function Code	Name	Modification key points
d 01*	Speed control 1 (speed command filter)	If the overshoot is too large over changes of the speed command, increase the filter constant value.
d 02*	Speed control 1 (speed detection filter)	If the speed control gain cannot be increased due to a ripple during speed detection, increase the filter constant value to increase the gain.
d 03*	Speed control 1 P (gain)	Decrease the gain when the speed hunting occurs. Increase the gain if the response is too slow.
d 04*	Speed control 1 I (integration time)	Shorten the integration time if the response is too slow.

4.1.13 Preparation for production run

After checking that the motor runs normally in test runs, connect the inverter to the machinery and cable them for production run.

(1) Set the **function codes for application** to run the machinery.

(2) **Check the interfaces with the peripheral circuits**.

1) Failure simulation

Simulate a failure and check the failure sequence. A failure can be simulated by pressing and holding the STOP + FUNC/DATA keys on the keypad for 5 seconds or more. The inverter stops and outputs an alarm output signal.

2) Life check of capacitors on main circuit

The inverter can be configured to check the life of the capacitors on the main circuit by measuring the discharge time when the power is turned off. For this purpose, measurement of the reference capacitor capacity (initial value) is required. For details, refer to Chapter 7.

3) I/O check

Use the keypad and select the menu #4 in the program mode to run the I/O check of the inverter for checking the interfaces with the peripheral circuits. (For details, refer to Chapter 3.)

4) Analog input adjustment

Inputs to the terminals 12, C1, and V2 can be adjusted. Use the offset filter gain to cancel errors in the analog input. For details, refer to Chapter 5.

5) FMA adjustment

Adjust the output from the terminal FMA to which an analog meter is connected. Selecting the analog output test with the function code F31 outputs a voltage equivalent to 10V. Adjust the full scale of the meter.

6) Failure history clear

Clear the history of alarms which occurred during adjustment. Do this by setting the function code H97 to "1."

Note Depending on the production run conditions, modification to the torque boost (F09*), acceleration/deceleration time (F07 and F08), and/or PI controller for speed control under vector control. Check the function codes and modify them as appropriate.

4.2 Special Operation

4.2.1 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 3-1.)
- Press the STOP + ∧ keys simultaneously. The LED monitor displays the jogging frequency for approximately one second and then returns to JOG again.

Tip

- The function code C20 specifies the jogging frequency, and the function codes H54 and H55 specify the jogging acceleration and deceleration times, respectively. These function codes are exclusively used for the jogging operation. Set them according to 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 RUN key.

(3) Exiting the ready-to-jog state and returning to the normal operation state.

- Press the STOP + ∧ keys simultaneously.

4.2.2 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.

The table below shows the input procedures of run commands from the keypad in the local mode.

Table 4.2-1

Data for F02	Input Procedures of Run Commands from Keypad
0: Enable the keypad (Motor rotational direction from digital terminals)	Pressing the RUN / STOP keys runs or stops the motor. The rotational direction is specified by the terminals FWD and REV.
1: External signal	Pressing the RUN / STOP keys runs or stops the motor. No specification of the motor rotational direction is required. However, the motor can only rotate in the forward direction.
2: Keypad operation (forward)	
3: Keypad operation (reverse)	Pressing the RUN / STOP keys runs or stops the motor. No specification of the motor rotational direction is required. However, the motor can only rotate in the reverse direction.

The remote and local modes can be switched by a digital input signal provided from the outside of the inverter, to switch the method for specifying the operation commands and frequency.

To enable the switching, the local (keypad) command selection "LOC" needs to be assigned LOC as a digital input signal. (Set "35" to any of the function codes 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. Refer to the status transition diagram given below and the above table for details.

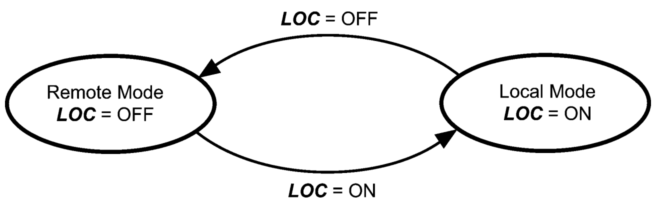


Figure 4.2-1 Transition between Remote and Local Modes

4.2.3 External run/frequency command

By factory default, the run and frequency commands are sourced from the keypad (RUN and STOP keys).

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.

(1) Configure the function codes as listed below.

Table 4.2-2

Function Code	Name	Data	Factory default
F 01	Frequency command 1	1: Analog voltage input to terminal [12]	0
F 02	Operation method	1: External digital input signal	2
E 98	Terminal [FWD] function	98: Run forward command "FWD"	98
E 99	Terminal [REV] function	99: Run reverse command "REV"	99

Note If terminal [FWD] and [REV] are ON (short-circuit), 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 "INSTALLATION AND WIRING."

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.

Contents

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 13 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, 2 and 3 (J, d and U 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.

5.2 Function Code Tables

■ 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. The following descriptions on "Change when running" symbols supplement those given in the function code tables.

Table 5.2-1

Notation	Change when running	Validating and saving function code data
Y*	Possible	If the data of the codes marked with Y* is changed with / 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 / 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. As necessary, respectively specify function codes that are not copied. 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 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.

■ Using negative logic for programmable I/O terminals

The negative logic signaling system can be used for the programmable, digital input terminals, and transistor and contact output terminals by setting the function code data specifying the properties for those terminals. Negative logic refers to the inverted ON/OFF state of input or output signal, switching active-ON (function becomes valid when turned ON: positive logic) and active-OFF (function becomes valid when turned OFF: negative logic). Negative logic may not be available for some signal functions.

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 using the function code E01:

Table 5.2-2

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 any of the following drive controls. Some functional codes assigned apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the "Drive control" column of the functional code tables.

Table 5.2-3

Abbreviation in "Drive control" column in function code tables	Control target (H18)	Drive control (F42)
V/f	Speed (Frequency for V/f and PG V/f)	V/f control Dynamic torque vector control
PG V/f		V/f control with speed sensor Dynamic torque vector control with speed sensor
w/o PG		Vector control without speed sensor
w/ PG		Vector control with speed sensor
Torque control	Torque	Vector control with/without 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, with drive controls equivalent to 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 equation.

Equation: Motor speed (r/min) = 120 x Frequency (Hz) / Number of poles

■ Difference in display formats between the standard keypad and the multi-function keypad

Because the multi-function keypad displays in a larger number of digits than the standard keypad, display formats have been changed for enhanced visibility of data.
Note that display formats have been changed as follows:

Table 5.2-4

<table>
<tr><th>Function Code</th><th>Name</th><th>Standard keypad</th><th>Multi-function keypad (TP-G1-J1, TP-G1-C1)</th></tr>
<tr><td>H42</td><td>Capacitance of DC link bus capacitor</td><td rowspan="9">Hexadecimal (HEX) indication</td><td rowspan="9">Decimal indication</td></tr>
<tr><td>H44</td><td>Startup Counter for Motor 1</td></tr>
<tr><td>H47</td><td>Initial capacitance of DC link bus capacitor</td></tr>
<tr><td>H79</td><td>Preset startup count for maintenance (M1)</td></tr>
<tr><td>A52</td><td>Startup Counter for Motor 2</td></tr>
<tr><td>b52</td><td>Startup Counter for Motor 3</td></tr>
<tr><td>r52</td><td>Startup Counter for Motor 4</td></tr>
<tr><td>d15</td><td>Feedback Input (Encoder pulse resolution)</td></tr>
<tr><td>d60</td><td>Command (Pulse Rate Input) (Encoder pulse resolution)</td></tr>
<tr><td>H43</td><td>Cumulative run time of cooling fan</td><td rowspan="8">Indicated in the unit of 10 hours</td><td rowspan="8">Indicated in the unit of 1 hour</td></tr>
<tr><td>H48</td><td>Cumulative Run Time of Capacitors on Printed Circuit Boards</td></tr>
<tr><td>H77</td><td>Service Life of DC Link Bus Capacitor (Remaining time)</td></tr>
<tr><td>H78</td><td>Maintenance interval (M1)</td></tr>
<tr><td>H94</td><td>Cumulative Motor Run Time 1</td></tr>
<tr><td>A51</td><td>Cumulative Motor Run Time 2</td></tr>
<tr><td>b51</td><td>Cumulative Motor Run Time 3</td></tr>
<tr><td>r51</td><td>Cumulative Motor Run Time 4</td></tr>
<tr><td>d78</td><td>Synchronous operation
(deviation detection excess range)</td><td>Indicated in the unit of 10 pulses

Set values of 10000 or larger are indicated by the "x10" LED on, combined with indication in the unit of 100 pulses.</td><td>Indicated in the unit of 10 pulses</td></tr>
</table>

The following tables list the function codes available for the FRENIC-MEGA series of inverters.

Table 5.2-5

■ F codes: Fundamental Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
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	Y	Y	5-61
F01	Frequency Command 1	0: ∧ / ∨ keys on keypad 1: Voltage input to terminal [12] (0 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: UP/DOWN control 8: ∧ / ∨ keys on the keypad (balanceless-bumpless switching available) 10: Pattern operation 11: Digital input interface card (option) 12: Pulse train input	N	Y	0	Y	Y	Y	Y	N	5-62
F02	Operation Method	0: RUN/STOP keys on keypad (Motor rotational direction: Terminal block) 1: External signals (Digital input terminal commands) 2: RUN/STOP keys on keypad (forward) 3: RUN/STOP keys on keypad (reverse)	N	Y	2	Y	Y	Y	Y	Y	5-71
F03	Maximum Output Frequency 1	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	Y	Y	5-72
F04	Base Frequency 1	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	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	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	Y	N	N	Y	
F07	Acceleration Time 1	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	Y	N	5-76
F08	Deceleration Time 1	* Entering 0.00 cancels the acceleration time, requiring external soft-start and -stop.	Y	Y	*1	Y	Y	Y	Y	N	
F09	Torque Boost 1	0.0% to 20.0% (percentage with respect to "r03: Rated Voltage at Base Frequency 1")	Y	Y	*2	Y	Y	N	N	N	5-79 5-104
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 (FV)-driven motor with separately powered cooling fan	Y	Y	1	Y	Y	Y	Y	Y	5-80
F11	(Operation 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	Y	Y	
F12	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	Y	
F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately 1: Trip after 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	Y	N	5-83
F15	Frequency Limiter (High)	0.0 to 500.0 Hz	Y	Y	70.0	Y	Y	Y	Y	N	5-93
F16	(Low)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	
F18	Bias (Frequency command 1)	-100.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	Y	N	5-62 5-93
F20	DC Braking 1 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	5-94
F21	(Braking level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	Y	N	
F22	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
F23	Starting Frequency 1	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	Y	N	5-96
F24	(Holding time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
F25	Stop Frequency	0.0 to 60.0 Hz	Y	Y	0.2	Y	Y	Y	Y	N	
F26	Motor Sound (Carrier frequency)	0.75 to 16 kHz (HD-mode inverters with 0.4 to 55 kW, and LD-mode ones with 5.5 to 18.5 kW) 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 / 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	Y	Y	5-99
F27	(Tone)	0: Level 0 (Inactive) 1: Level 1 2: Level 2 3: Level 3	Y	Y	0	Y	Y	N	N	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 5.2-17.

*3 The motor rated current is automatically set. See Table 5.2-18 (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

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
F29	Analog Output [FMA] (Mode selection)	0: Output in voltage (0 to +10 VDC) 1: Output in current (4 to 20 mA DC) 2: Output in current (0 to 20 mA DC)	Y	Y	0	Y	Y	Y	Y	Y	5-101
F30	(Gain to output voltage)	0 to 300%	Y*	Y	100	Y	Y	Y	Y	Y	
F31	(Function selection)	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: Power consumption 7: PID feedback value 8: PG feedback value 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Analog output test (+) 15: PID command (SV) 16: PID output (MV)	Y	Y	0	Y	Y	Y	Y	Y	
		17: Synchronous angle deviation	Y	Y	0	N	Y	N	Y	N	
F33	Pulse Output [FMP] (Pulse rate)	25 to 6000 p/s (Pulse rate at 100% output)	Y*	Y	1440	Y	Y	Y	Y	Y	5-103
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	Y	Y	
F35	(Function selection)	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: Power consumption 7: PID feedback value 8: PG feedback value 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Analog output test (+) 15: PID command (SV) 16: PID output (MV)	Y	Y	0	Y	Y	Y	Y	Y	
		17: Synchronous angle deviation	Y	Y	0	N	Y	N	Y	N	
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 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	Y	N	Y	N	5-104
F38	Stop Frequency (Detection mode)	0: Detected speed 1: Reference speed	N	Y	0	N	N	N	Y	N	5-96
F39	(Holding time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	Y	N	5-107
F40	Torque limiter 1-1	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	5-107
F41	1-2	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	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	Y	Y	5-114
F43	Current Limiter (Mode selection)	0: Disable 1: Enable at constant speed (Disable during ACC/DEC) 2: Enable during ACC/constant speed operation (Disable during DEC)	Y	Y	2	Y	Y	N	N	N	5-117
F44	(Operation level)	20% to 200% (Rated current reference value of inverter)	Y	Y	160	Y	Y	N	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	Y	Y	5-119
F51	(Allowable average loss)	0.001 to 99.99 kW	Y	Y1, Y2	0.001	Y	Y	Y	Y	Y	
F52	(Resistance)	0.01 to 999Ω	Y	Y1, Y2	0.01	Y	Y	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	Y	Y	5-121

*5 0 for inverters with a capacity of 7.5 kW or below; OFF for those with 11 kW or above

Table 5.2-6

■ E codes: Extension Terminal Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
E01	Terminal [X1] Function	0 (1000): Select multi-frequency (0 to 1 step) ***(SS1)***	N	Y	0	Y	Y	Y	Y	N	5-122
E02	Terminal [X2] Function	1 (1001): Select multi-frequency (0 to 3 steps) ***(SS2)***	N	Y	1	Y	Y	Y	Y	N	
E03	Terminal [X3] Function	2 (1002): Select multi-frequency (0 to 7 steps) ***(SS4)***	N	Y	2	Y	Y	Y	Y	N	
E04	Terminal [X4] Function	3 (1003): Select multi-frequency (0 to 15 steps) ***(SS8)***	N	Y	3	Y	Y	Y	Y	N	
E05	Terminal [X5] Function	4 (1004): Select ACC/DEC time (2 steps) ***(RT1)***	N	Y	4	Y	Y	Y	Y	N	
E06	Terminal [X6] Function	5 (1005): Select ACC/DEC time (4 steps) ***(RT2)***	N	Y	5	Y	Y	Y	Y	N	
E07	Terminal [X7] Function	6 (1006): Self-hold ***(HLD)***	N	Y	6	Y	Y	Y	Y	Y	
E08	Terminal [X8] Function	7 (1007): Coast to a stop ***(BX)***	N	Y	7	Y	Y	Y	Y	Y	
E09	Terminal [X9] Function	8 (1008): Reset alarm ***(RST)***	N	Y	8	Y	Y	Y	Y	Y	
		9 (1009): Enable external alarm trip ***(THR)*** (9 = Active OFF, 1009 = Active ON)				Y	Y	Y	Y	Y	
		10 (1010): Ready for jogging ***(JOG)***				Y	Y	Y	Y	N	
		11 (1011): Select frequency command 2/1 ***(Hz2/Hz1)***				Y	Y	Y	Y	N	
		12 (1012): Select motor 2 ***(M2)***				Y	Y	Y	Y	Y	
		13: Enable DC braking ***(DCBRK)***				Y	Y	Y	Y	N	
		14 (1014): Select torque limiter level 2/1 ***(TL2/TL1)***				Y	Y	Y	Y	Y	
		15: Switch to commercial power (50 Hz) ***(SW50)***				Y	Y	N	N	N	
		16: Switch to commercial power (60 Hz) ***(SW60)***				Y	Y	N	N	N	
		17 (1017): UP (Increase output frequency) ***(UP)***				Y	Y	Y	Y	N	
		18 (1018): DOWN (Decrease output frequency) ***(DOWN)***				Y	Y	Y	Y	N	
		19 (1019): Enable data change with keypad (data can be modified) ***(WE-KP)***				Y	Y	Y	Y	Y	
		20 (1020): Cancel PID control **(Hz/PID)**				Y	Y	Y	Y	N	
		21 (1021): Switch normal/inverse operation ***(IVS)***				Y	Y	Y	Y	N	
		22 (1022): Interlock ***(IL)***				Y	Y	Y	Y	Y	
		23 (1023): Cancel torque control ***(Hz/TRQ)***				N	N	N	N	Y	
		24 (1024): Enable communications link via RS-485 or fieldbus (optional) ***(LE)***				Y	Y	Y	Y	Y	
		25 (1025): Universal DI ***(U-DI)***				Y	Y	Y	Y	Y	
		26 (1026): Enable auto search for idling motor speed at starting ***(STM)***				Y	Y	Y	N	Y	
		30 (1030): Force to stop ***(STOP)*** (30 = Active OFF, 1030 = Active ON)				Y	Y	Y	Y	Y	
		32 (1032): Pre-excitation ***(EXITE)***				N	N	Y	Y	N	
		33 (1033): Reset PID integral and differential components ***(PID-RST)***				Y	Y	Y	Y	N	
		34 (1034): Hold PID integral component ***(PID-HLD)***				Y	Y	Y	Y	N	
		35 (1035): Select local (keypad) operation ***(LOC)***				Y	Y	Y	Y	Y	
		36 (1036): Select motor 3 ***(M3)***				Y	Y	Y	Y	Y	
		37 (1037): Select motor 4 ***(M4)***				Y	Y	Y	Y	Y	
		39: Protect motor from dew condensation ***(DWP)***				Y	Y	Y	Y	Y	
		40: Enable integrated sequence to switch to commercial power (50 Hz) ***(ISW50)***				Y	Y	N	N	N	
		41: Enable integrated sequence to switch to commercial power (60 Hz) ***(ISW60)***				Y	Y	N	N	N	
		47 (1047): Servo-lock command ***(LOCK)***				N	N	N	Y	N	
		48: Pulse train input (available only on terminal [X7] (E07)) ***(PIN)***				Y	Y	Y	Y	Y	
		49 (1049): Pulse train sign ***(SIGN)*** (available on terminals except [X7] (E01 to E06, E08 and E09))				Y	Y	Y	Y	Y	
		59 (1059): Enable battery-driven operation ***(BATRY)***				Y	Y	Y	Y	Y	
		70 (1070): Cancel constant peripheral speed control ***(Hz/LSC)***				Y	Y	Y	Y	N	
		71 (1071): Hold the constant peripheral speed control frequency in the memory ***(LSC-HLD)***				Y	Y	Y	Y	N	
		72 (1072): Count the run time of commercial power-driven motor 1 ***(CRUN-M1)***				Y	Y	N	N	Y	
		73 (1073): Count the run time of commercial power-driven motor 2 ***(CRUN-M2)***				Y	Y	N	N	Y	
		74 (1074): Count the run time of commercial power-driven motor 3 ***(CRUN-M3)***				Y	Y	N	N	Y	
		75 (1075): Count the run time of commercial power-driven motor 4 ***(CRUN-M4)***				Y	Y	N	N	Y	
		76 (1076): Select droop control ***(DROOP)***				Y	Y	Y	Y	N	
		77 (1077): Cancel PG alarm ***(PG-CCL)***				N	Y	N	Y	Y	
		80 (1080): Cancel customizable logic ***(CLC)***				Y	Y	Y	Y	Y	
		81 (1081): Clear all customizable logic timers ***(CLTC)***				Y	Y	Y	Y	Y	
		100: No function assigned ***(NONE)***				Y	Y	Y	Y	Y	
		110 (1110): Servo-lock (Gain) ***(SLG2)***				N	N	N	Y	N	
		111 (1111): Force to stop (terminal block only) ***(STOP-T)*** (111 = Active OFF, 1111 = Active ON)				Y	Y	Y	Y	Y	
		* Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.)									
E 10	Acceleration Time 2	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	Y	N	5-76
E 11	Deceleration Time 2	* Entering 0.00 cancels the acceleration time, requiring external soft-start and -stop.	Y	Y	*1	Y	Y	Y	Y	N	5-140
E 12	Acceleration Time 3		Y	Y	*1	Y	Y	Y	Y	N	
E 13	Deceleration Time 3		Y	Y	*1	Y	Y	Y	Y	N	
E 14	Acceleration Time 4		Y	Y	*1	Y	Y	Y	Y	N	
E 15	Deceleration Time 4		Y	Y	*1	Y	Y	Y	Y	N	

*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 V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
E16	Torque limiter 2-1	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	5-107
E17	2-2	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	5-141
E20	Terminal [Y1] Function (Function selection)	0 (1000): Inverter running ***(RUN)***	N	Y	0	Y	Y	Y	Y	Y	5-141
E21	Terminal [Y2] Function	1 (1001): Frequency (speed) arrival signal ***(FAR)***	N	Y	1	Y	Y	Y	Y	N	
E22	Terminal [Y3] Function	2 (1002): Frequency (speed) detected ***(FDT)***	N	Y	2	Y	Y	Y	Y	Y	
E23	Terminal [Y4] Function	3 (1003): Undervoltage detected ***(LU)***	N	Y	7	Y	Y	Y	Y	Y	
E24	Terminal [Y5A/C] Function	4 (1004): Torque polarity detected ***(B/D)***	N	Y	15	Y	Y	Y	Y	Y	
E27	Terminal [30A/B/C] (Relay output)	5 (1005): Inverter output limiting ***(IOL)***	N	Y	99	Y	Y	Y	Y	Y	
		6 (1006): Auto-restarting after momentary power failure ***(IPF)***				Y	Y	Y	Y	Y	
		7 (1007): Motor overload early warning ***(OL)***				Y	Y	Y	Y	Y	
		8 (1008): Keypad operation enabled ***(KP)***				Y	Y	Y	Y	Y	
		10 (1010): Inverter ready to run ***(RDY)***				Y	Y	Y	Y	Y	
		11: Switch motor drive source between commercial power and inverter output ***(SW88)***				Y	Y	N	N	N	
		12: Switch motor drive source between commercial power and inverter output ***(SW52-2)***				Y	Y	N	N	N	
		13: Switch motor drive source between commercial power and inverter output ***(SW52-1)***				Y	Y	N	N	N	
		15 (1015): Select AX terminal function ***(AX)***				Y	Y	Y	Y	Y	
		16 (1016): Time-up signal for pattern operation ***(TU)***				Y	Y	Y	Y	N	
		17 (1017): Cycle completion signal for pattern operation ***(T0)***				Y	Y	Y	Y	N	
		18 (1018): Pattern operation stage No.1 ***(STG1)***				Y	Y	Y	Y	N	
		19 (1019): Pattern operation stage No.2 ***(STG2)***				Y	Y	Y	Y	N	
		20 (1020): Pattern operation stage No.4 ***(STG4)***				Y	Y	Y	Y	N	
		22 (1022): Inverter output limiting with delay ***(IOL2)***				Y	Y	Y	Y	Y	
		25 (1025): Cooling fan ON/OFF control ***(FAN)***				Y	Y	Y	Y	Y	
		26 (1026): Auto-resetting ***(TRY)***				Y	Y	Y	Y	Y	
		27 (1027): Universal DO ***(U-DO)***				Y	Y	Y	Y	Y	
		28 (1028): Cooling fan overheat early warning ***(OH)***				Y	Y	Y	Y	Y	
		29 (1029): SY Synchronized ***(SY)***				N	Y	N	Y	N	
		30 (1030): Lifetime alarm ***(LIFE)***				Y	Y	Y	Y	Y	
		31 (1031): Frequency (speed) detected 2 ***(FDT2)***				Y	Y	Y	Y	Y	
		33 (1033): Reference loss detected ***(REF OFF)***				Y	Y	Y	Y	Y	
		35 (1035): Inverter output on ***(RUN2)***				Y	Y	Y	Y	Y	
		36 (1036): Overload prevention control ***(OLP)***				Y	Y	Y	Y	N	
		37 (1037): Current detected ***(ID)***				Y	Y	Y	Y	Y	
		38 (1038): Current detected 2 ***(ID2)***				Y	Y	Y	Y	Y	
		39 (1039): Current detected 3 ***(ID3)***				Y	Y	Y	Y	Y	
		41 (1041): Low current detected ***(IDL)***				Y	Y	Y	Y	Y	
		42 (1042): PID alarm ***(PID-ALM)***				Y	Y	Y	Y	N	
		43 (1043): Under PID control ***(PID-CTL)***				Y	Y	Y	Y	N	
		44 (1044): Motor stopped due to slow flowrate under PID control ***(PID-STP)***				Y	Y	Y	Y	N	
		45 (1045): Low output torque detected **(U-TL)**				Y	Y	Y	Y	Y	
		46 (1046): Torque detected 1 ***(TD1)***				Y	Y	Y	Y	Y	
		47 (1047): Torque detected 2 ***(TD2)***				Y	Y	Y	Y	Y	
		48 (1048): Motor 1 switched ***(SWM1)***				Y	Y	Y	Y	Y	
		49 (1049): Motor 2 switched ***(SWM1)***				Y	Y	Y	Y	Y	
		50 (1050): Motor 3 switched ***(SWM3)***				Y	Y	Y	Y	Y	
		51 (1051): Motor 4 switched ***(SWM4)***				Y	Y	Y	Y	Y	
		52 (1052): Running forward ***(FRUN)***				Y	Y	Y	Y	Y	
		53 (1053): Running reverse ***(RRUN)***				Y	Y	Y	Y	Y	
		54 (1054): In remote operation ***(RMT)***				Y	Y	Y	Y	Y	
		56 (1056): Motor overheat detected by thermistor ***(THM)***				Y	Y	Y	Y	Y	
		57 (1057): Brake signal **(BRKS)**				Y	Y	Y	Y	N	
		58 (1058): Frequency (speed) detected 3 ***(FDT3)***				Y	Y	Y	Y	Y	
		59 (1059): Terminal [C1] wire break ***(C1OFF)***				Y	Y	Y	Y	Y	
		70 (1070): Speed validation ***(DNZS)***				N	Y	Y	Y	Y	
		71 (1071): Speed agreement ***(DSAG)***				N	Y	Y	Y	N	
		72 (1072): Frequency (speed) arrival signal 3 ***(FAR3)***				Y	Y	Y	Y	N	
		76 (1076): PG error detected ***(PG-ERR)***				N	Y	Y	Y	N	
		77 (1077): Low DC medium voltage detected ***(U-EDC)***				Y	Y	Y	Y	Y	
		79 (1079): Deceleration due to momentary power failure in progress ***(IPF2)***				Y	Y	Y	Y	N	
		82 (1082): Positioning completion signal ***(PSET)***				N	N	N	Y	N	
		84 (1084): Maintenance timer ***(MNT)***				Y	Y	Y	Y	Y	
		90 (1090): Alarm details 1 ***(AL1)***				Y	Y	Y	Y	Y	
		91 (1091): Alarm details 2 ***(AL2)***				Y	Y	Y	Y	Y	
		92 (1092): Alarm details 4 ***(AL4)***				Y	Y	Y	Y	Y	
		93 (1093): Alarm details 8 ***(AL8)***				Y	Y	Y	Y	Y	
		98 (1098): Light alarm ***(L-ALM)***				Y	Y	Y	Y	Y	
		99 (1099): Batch alarm ***(ALM)***				Y	Y	Y	Y	Y	
		105 (1105): Braking transistor broken ***(DBAL)***				Y	Y	Y	Y	Y	
		111 (1111): Customizable logic output signal 1 ***(CLO1)***				Y	Y	Y	Y	Y	
		112 (1112): Customizable logic output signal 2 ***(CLO2)***				Y	Y	Y	Y	Y	
		113 (1113): Customizable logic output signal 3 ***(CLO3)***				Y	Y	Y	Y	Y	
		114 (1114): Customizable logic output signal 4 ***(CLO4)***				Y	Y	Y	Y	Y	
		115 (1115): Customizable logic output signal 5 ***(CLO5)*** * Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.)				Y	Y	Y	Y	Y	

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
E30	Frequency Arrival (Detection width)	0.0 to 10.0 Hz	Y	Y	2.5	Y	Y	Y	Y	N	5-152
E31	Frequency Detection (Operation level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	Y	Y	5-153
E32	(Hysteresis width)	0.0 to 500.0 Hz	Y	Y	1.0	Y	Y	Y	Y	Y	
E34	Overload Early Warning/Current Detection (Operation level)	0.00 (Disable); 1% to 200% of the inverter rated current	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	5-153
E35	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E36	Frequency Detection 2 (Operation level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	Y	Y	5-154
E37	Current Detection 2/Low Current Detection (Operation level)	0.00 (Disable); 1% to 200% of the inverter rated current	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	
E38	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E40	PID Display Coefficient A	-999 to 0.00 to 9990	Y	Y	100	Y	Y	Y	Y	N	5-155
E41	PID Display Coefficient B	-999 to 0.00 to 9990	Y	Y	0.00	Y	Y	Y	Y	N	
E42	LED Display Filter	0.0 to 5.0 s	Y	Y	0.5	Y	Y	Y	Y	Y	5-156
E43	LED Monitor (Item selection)	0: Speed monitor (select by E48) 3: Output current 4: Output voltage 8: Calculated torque 9: Power consumption 10: PID command 12: PID feedback value 14: PID output 15: Load factor 16: Motor output 17: Analog input monitor 23: Torque current (%) 24: Magnetic flux command value (%) 25: Integral power consumption	Y	Y	0	Y	Y	Y	Y	Y	5-157
E44	(Display when stopped)	0: Specified value 1: Output value	Y	Y	0	Y	Y	Y	Y	Y	5-158
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	Y	Y	—
E46	(Language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian	Y	Y	0	Y	Y	Y	Y	Y	
E47	(Contrast control)	0 (Low) to 10 (High)	Y	Y	5	Y	Y	Y	Y	Y	
E48	LED Monitor (Speed monitor selection)	0: Output frequency 1 (Before slip compensation) 1: Output frequency 2 (After slip compensation) 2: Reference frequency 3: Motor speed 4: Load shaft speed 5: Line speed 7: Display speed (%)	Y	Y	0	Y	Y	Y	Y	Y	5-157 5-158
E49	Torque Monitor (Polarity selection)	0: Torque polarity 1: + for drive, - for brake	Y	Y	1	Y	Y	Y	Y	Y	5-159
E50	Coefficient for speed indication	0.01 to 200.00	Y	Y	30.00	Y	Y	Y	Y	Y	5-160
E51	Display Coefficient for Integral Power Data	0.000 (Cancel/reset), 0.001 to 9999	Y	Y	0.010	Y	Y	Y	Y	Y	
E52	Keypad Menu Selection	0: Function code data setting mode (Menus #0, #1, and #7) 1: Function code data check mode (Menu #2 and #7) Full-menu mode 2: Full-menu mode	Y	Y	0	Y	Y	Y	Y	Y	5-161
E54	Frequency Detection 3 (Operation level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	Y	Y	5-153
E55	Current Detection 3 (Operation level)	0.00 (Disable); 1% to 200% of the inverter rated current	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	5-161
E56	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E61	Terminal [12] Extended Function	0: No assignment 1: Auxiliary frequency command 1 2: Auxiliary frequency command 2 3: PID process command 1 5: PID feedback value 6: Ratio setting 7: Analog torque limit value A 8: Analog torque limit value B 10: Torque command 11: Torque current command 17: Forward (FWD) side speed limit value 18: Reverse (REV) side speed limit value 20: Analog input monitor	N	Y	0	Y	Y	Y	Y	Y	5-162
E62	Terminal [C1]		N	Y	0	Y	Y	Y	Y	Y	
E63	Terminal [V2]		N	Y	0	Y	Y	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	Y	Y	5-163
E65	Reference Loss Detection (Continuous running frequency)	0: Decelerate to stop, 20% to 120%, 999: Cancel	Y	Y	999	Y	Y	Y	Y	Y	
E76	DC Medium Voltage Detection Level	200 to 400 V: (200 V class series) 400 to 800 V: (400 V class series)	Y	Y2	235 470	Y	Y	Y	Y	Y	
E78	Torque Detection 1 (Operation level)	0 to 300%	Y	Y	100	Y	Y	Y	Y	Y	5-164
E79	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E80	Torque Detection 2/ Low Torque Detection (Operation level)	0 to 300%	Y	Y	20	Y	Y	Y	Y	Y	
E81	(Timer)	0.01 to 600.00 s	Y	Y	20.00	Y	Y	Y	Y	Y	

The shaded function codes ( ) are applicable to the quick setup.

*3 The motor rated current is automatically set. See Table 5.2-18.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
E98	Terminal [FWD] Function	0 (1000): Select multi-frequency (0 to 1 step) ***(SS1)***	N	Y	98	Y	Y	Y	Y	N	5-122
E99	Terminal [REV] Function	1 (1001): Select multi-frequency (0 to 3 steps) ***(SS2)***	N	Y	99	Y	Y	Y	Y	N	5-165
		2 (1002): Select multi-frequency (0 to 7 steps) ***(SS4)***				Y	Y	Y	Y	N	
		3 (1003): Select multi-frequency (0 to 15 steps) ***(SS8)***				Y	Y	Y	Y	N	
		4 (1004): Select ACC/DEC time (2 steps) ***(RT1)***				Y	Y	Y	Y	N	
		5 (1005): Select ACC/DEC time (4 steps) ***(RT2)***				Y	Y	Y	Y	N	
		6 (1006): Self-hold ***(HLD)***				Y	Y	Y	Y	Y	
		7 (1007): Coast to a stop ***(BX)***				Y	Y	Y	Y	Y	
		8 (1008): Reset alarm ***(RST)***				Y	Y	Y	Y	Y	
		9 (1009): External alarm ***(THR)*** (9 = Active OFF, 1009 = Active ON)				Y	Y	Y	Y	Y	
		10 (1010): Ready for jogging ***(JOG)***				Y	Y	Y	Y	N	
		11 (1011): Select frequency command 2/1 ***(Hz2/Hz1)***				Y	Y	Y	Y	N	
		12 (1012): Select motor 2 ***(M2)***				Y	Y	Y	Y	Y	
		13: DC braking command ***(DCBRK)***				Y	Y	Y	Y	N	
		14 (1014): Torque limit 2/1 ***(TL2/TL1)***				Y	Y	Y	Y	Y	
		15: Switch to commercial power (50 Hz) ***(SW50)***				Y	Y	N	N	N	
		16: Switch to commercial power (60 Hz) ***(SW60)***				Y	Y	N	N	N	
		17 (1017): UP command ***(UP)***				Y	Y	Y	Y	N	
		18 (1018): DOWN command ***(DOWN)***				Y	Y	Y	Y	N	
		19 (1019): Enable data change with keypad (data can be modified) ***(WE-KP)***				Y	Y	Y	Y	Y	
		20 (1020): Cancel PID control ***(Hz/PID)***				Y	Y	Y	Y	N	
		21 (1021): Switch normal/inverse operation ***(IVS)***				Y	Y	Y	Y	N	
		22 (1022): Interlock ***(IL)***				Y	Y	Y	Y	Y	
		23 (1023): Cancel torque control ***(Hz/TRQ)***				N	N	N	N	Y	
		24 (1024): Enable communications link via RS-485 or fieldbus (optional) ***(LE)***				Y	Y	Y	Y	Y	
		25 (1025): Universal DI ***(U-DI)***				Y	Y	Y	Y	Y	
		26 (1026): Start characteristics selection ***(STM)***				Y	Y	Y	N	Y	
		30 (1030): Force to stop ***(STOP)*** (30 = Active OFF, 1030 = Active ON)				Y	Y	Y	Y	Y	
		32 (1032): Pre-excitation ***(EXITE)***				N	N	Y	Y	N	
		33 (1033): Reset PID integral and differential components ***(PID-RST)***				Y	Y	Y	Y	N	
		34 (1034): Hold PID integral component ***(PID-HLD)***				Y	Y	Y	Y	N	
		35 (1035): Select local (keypad) operation ***(LOC)***				Y	Y	Y	Y	Y	
		36 (1036): Select motor 3 ***(M3)***				Y	Y	Y	Y	Y	
		37 (1037): Select motor 4 ***(M4)***				Y	Y	Y	Y	Y	
		39: Protect motor from dew condensation ***(DWP)***				Y	Y	Y	Y	Y	
		40: Enable integrated sequence to switch to commercial power (50 Hz) ***(ISW50)***				Y	Y	N	N	N	
		41: Enable integrated sequence to switch to commercial power (60 Hz) ***(ISW60)***				Y	Y	N	N	N	
		47 (1047): Servo-lock command ***(LOCK)***				N	N	N	Y	N	
		49 (1049): Pulse train sign ***(SIGN)***				Y	Y	Y	Y	Y	
		59 (1059): Enable battery-driven operation ***(BATRY)***				Y	Y	Y	Y	Y	
		70 (1070): Cancel constant peripheral speed control ***(Hz/LSC)***				Y	Y	Y	Y	N	
		71 (1071): Hold the constant peripheral speed control frequency in the memory ***(LSC-HLD)***				Y	Y	Y	Y	N	
		72 (1072): Count the run time of commercial power-driven motor 1 ***(CRUN-M1)***				Y	Y	N	N	Y	
		73 (1073): Count the run time of commercial power-driven motor 2 ***(CRUN-M2)***				Y	Y	N	N	Y	
		74 (1074): Count the run time of commercial power-driven motor 3 ***(CRUN-M3)***				Y	Y	N	N	Y	
		75 (1075): Count the run time of commercial power-driven motor 4 ***(CRUN-M4)***				Y	Y	N	N	Y	
		76 (1076): Select droop control ***(DROOP)***				Y	Y	Y	Y	N	
		77 (1077): Cancel PG alarm ***(PG-CCL)***				N	Y	N	Y	Y	
		80 (1080): Cancel customizable logic ***(CLC)***				Y	Y	Y	Y	Y	
		81 (1081): Clear all customizable logic timers ***(CLTC)***				Y	Y	Y	Y	Y	
		98: Run/stop forward ***(FWD)***				Y	Y	Y	Y	Y	
		99: Run/stop reverse ***(REV)***				Y	Y	Y	Y	Y	
		100: No function assigned ***(NONE)***				Y	Y	Y	Y	Y	
		110 (1110): Select servo-lock gain ***(SLG2)***				N	N	N	Y	N	
		111 (1111): Force to stop (terminal block only) ***(STOP-T)*** (111 = Active OFF, 1111 = Active ON)				Y	Y	Y	Y	Y	
		* Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.)									

Table 5.2-7

■ C codes: Control Functions of Frequency

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
C01	Jump Frequency 1	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	5-166
C02	2		Y	Y	0.0	Y	Y	Y	Y	N	
C03	3		Y	Y	0.0	Y	Y	Y	Y	N	
C04	(Width)	0.0 to 30.0 Hz	Y	Y	3.0	Y	Y	Y	Y	N	
C05	Multi-frequency 1	0.00 to 500.00 Hz	Y	Y	0.00	Y	Y	Y	Y	N	
C06	2		Y	Y	0.00	Y	Y	Y	Y	N	
C07	3		Y	Y	0.00	Y	Y	Y	Y	N	
C08	4		Y	Y	0.00	Y	Y	Y	Y	N	
C09	5		Y	Y	0.00	Y	Y	Y	Y	N	
C10	6		Y	Y	0.00	Y	Y	Y	Y	N	
C11	7		Y	Y	0.00	Y	Y	Y	Y	N	
C12	8		Y	Y	0.00	Y	Y	Y	Y	N	
C13	9		Y	Y	0.00	Y	Y	Y	Y	N	
C14	10		Y	Y	0.00	Y	Y	Y	Y	N	
C15	11		Y	Y	0.00	Y	Y	Y	Y	N	
C16	12		Y	Y	0.00	Y	Y	Y	Y	N	
C17	13		Y	Y	0.00	Y	Y	Y	Y	N	
C18	14		Y	Y	0.00	Y	Y	Y	Y	N	
C19	15		Y	Y	0.00	Y	Y	Y	Y	N	
C20	Jogging Frequency	0.00 to 500.00 Hz	Y	Y	0.00	Y	Y	Y	Y	N	5-168
C21	Pattern operation (Mode selection)	0: One-cycle operation 1: Repeated operation 2: Low-speed operation after one-cycle operation	N	Y	0	Y	Y	Y	Y	N	
C22	(Stage 1 run time)	0.00 to 6000 s	Y	Y	0.00	Y	Y	Y	Y	N	
C23	(Stage 2 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C24	(Stage 3 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C25	(Stage 4 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C26	(Stage 5 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C27	(Stage 6 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C28	(Stage 7 run time)		Y	Y	0.00	Y	Y	Y	Y	N	
C30	Frequency Command 2	0: Enable ∧/∨ keys on the keypad 1: Voltage input to terminal [12] (0 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: UP/DOWN control 8: Enable ∧/∨ keys on the keypad (balanceless-bumpless switching available) 10: Pattern operation 11: Digital input interface card (option) 12: Pulse train input	N	Y	2	Y	Y	Y	Y	N	5-62 5-173
C31	Analog Input Adjustment for [12] (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	5-173
C32	(Gain)	0.00 to 200.00% (ROM version earlier than 2000) 0.00 to 400.00% (ROM version 2000 or later)	Y*	Y	100.00	Y	Y	Y	Y	Y	
C33	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C34	(Gain base point)	0.00 to 100.00%	Y*	Y	100.00	Y	Y	Y	Y	Y	
C35	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	Y	Y	
C36	Analog input adjustment for [C1] (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	
C37	(Gain)	0.00 to 200.00% (ROM version earlier than 2000) 0.00 to 400.00% (ROM version 2000 or later)	Y*	Y	100.00	Y	Y	Y	Y	Y	
C38	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C39	(Gain base point)	0.00 to 100.00%	Y*	Y	100.00	Y	Y	Y	Y	Y	
C40	Terminal [C1] Range Selection	0: 4 to 20 mA 1: 0 to 20 mA	N	Y	0	Y	Y	Y	Y	Y	
C41	Analog input adjustment for [V2] (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	
C42	(Gain)	0.00 to 200.00% (ROM version earlier than 2000) 0.00 to 400.00% (ROM version 2000 or later)	Y*	Y	100.00	Y	Y	Y	Y	Y	
C43	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C44	(Gain base point)	0.00 to 100.00%	Y*	Y	100.00	Y	Y	Y	Y	Y	
C45	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	Y	Y	
C50	Bias (Frequency command 1) (Bias base point)	0.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	Y	Y	5-62 5-174
C51	Bias (PID command 1) (Bias base point)	-100.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	Y	Y	5-174
C52	(Bias base point)	0.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	Y	Y	
C53	Selection of Normal/Inverse Operation (Frequency command 1)	0: Normal operation 1: Inverse operation	Y	Y	0	Y	Y	Y	Y	Y	
C82	Pattern operation (Stage 1 rotation direction, ACC/DEC time)	1: Forward, ACC time F07, DEC time F08 2: Forward, ACC time E10, DEC time E11 3: Forward, ACC time E12, DEC time E13 4: Forward, ACC time E14, DEC time E15 11: Forward, ACC time F07, DEC time F08 12: Forward, ACC time E10, DEC time E11 13: Forward, ACC time E12, DEC time E13 14: Forward, REV time E14, DEC time E15	Y	Y	1	Y	Y	Y	Y	N	
C83	(Stage 2 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	
C84	(Stage 3 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	
C85	(Stage 4 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	
C86	(Stage 5 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	
C87	(Stage 6 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	
C88	(Stage 7 rotation direction, ACC/DEC time)		Y	Y	1	Y	Y	Y	Y	N	

Table 5.2-8

■ P codes: Motor 1 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
P01	Motor 1 (No. of poles)	2 to 22 poles	N	Y1, Y2	4	Y	Y	Y	Y	Y	5-175
P02	(Capacity)	0.01 to 1000 kW (when P99 = 0, 2 to 4) 0.01 to 1000 HP (when P99 = 1)	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
P03	(Rated current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	5-176
P04	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune the motor while it is rotating under V/f control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c") 3: Tune the motor while it is rotating under vector control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c"; enabled under vector control only)	N	N	0	Y	Y	Y	Y	Y	5-177
P05	(Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	5-178
P06	(No-load current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
P07	(%R1)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P08	(%X)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P09	(Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	5-179
P10	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1, Y2	0.12	Y	Y	N	N	N	
P11	(Slip compensation gain for braking)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
P12	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1, Y2	*6	Y	Y	Y	Y	N	
P13	(Iron loss factor 1)	0.00 to 20.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P14	(Iron loss factor 2)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
P15	(Iron loss factor 3)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
P16	(Magnetic saturation factor 1)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P17	(Magnetic saturation factor 2)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P18	(Magnetic saturation factor 3)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P19	(Magnetic saturation factor 4)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P20	(Magnetic saturation factor 5)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P21	(Magnetic saturation extension factor "a")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P22	(Magnetic saturation extension factor "b")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P23	(Magnetic saturation extension factor "c")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
P53	(%X correction factor 1)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	5-180
P54	(%X correction factor 2)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
P55	(Torque current under vector control)	0.00 to 2000 A	N	Y1, Y2	*6	N	N	Y	Y	Y	
P56	(Induced voltage factor under vector control)	50 to 100%	N	Y1, Y2	*6	N	N	Y	Y	Y	
P57	Reserved *9	0.000 to 20.000 s	Y	Y1, Y2	*6	-	-	-	-	Y	—
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	Y	Y	5-180

Table 5.2-9

■ H codes: High Performance Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
H03	Data initialization	0: Manually set value 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	Y	Y	5-181
H04	Auto-reset (Times)	0: Disable; 1 to 10: Auto-reset times	Y	Y	0	Y	Y	Y	Y	Y	5-182
H05	(Restart time)	0.5 to 20.0 s	Y	Y	5.0	Y	Y	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	Y	Y	5-183
H07	Curvilinear acceleration/deceleration	0: Disable (Linear ACC/DEC) 1: S-curve DEC (Weak) 2: S-curve DEC (Arbitrary, according to H57 to H60 data) 3: Curvilinear acceleration/deceleration	Y	Y	0	Y	Y	Y	Y	N	5-76 5-183
H08	Rotational direction limitation	0: Disable 1: Enable (Reverse rotation inhibited) 2: Enable (Forward rotation inhibited)	N	Y	0	Y	Y	Y	Y	N	5-184

The shaded function codes ( ) are applicable to the quick setup.

*6 The motor rated current is automatically set, depending upon the inverter's capacity. See Table 5.2-18.

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control: V/f	Drive control: PG V/f	Drive control: w/o PG	Drive control: w/ PG	Drive control: Torque control	Refer to page:
H09	Starting Mode (Auto search)	0: Disable 1: Enable (Only at restart after momentary power failure) 2: Enable (At normal start and at restart after momentary power failure)	N	Y	0	Y	Y	N	N	N	5-184
H11	Deceleration Mode	0: Normal deceleration, 1: Coast-to-stop	Y	Y	0	Y	Y	Y	Y	N	5-186
H12	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable; 1: Enable	Y	Y	1	Y	Y	N	N	N	5-118 5-186
H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0 s (ROM version earlier than 2000) 0.1 to 20.0 s (ROM version 2000 or later)	Y	Y1, Y2	*2	Y	Y	Y	Y	N	5-83
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	Y	N	N	5-186
H15	(Continuous running level)	200 to 300 V: (200 V class series) 400 to 600 V: (400 V class series)	Y	Y2	235 470	Y	Y	N	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	Y	N	
H18	Torque Control (Mode selection)	0: Disable (Speed control) 2: Enable (Torque current command) 3: Enable (Torque command)	N	Y	0	N	N	Y	Y	Y	5-187
H26	Thermistor (for motor) (Mode selection)	0: Disable 1: PTC (The inverter immediately trips with 0H4 displayed.) 2: PTC (The inverter issues output signal ***THM*** and continues to run.) 3: NTC (When connected)	Y	Y	0	Y	Y	Y	Y	Y	5-189
H27	(Operation level)	0.00 to 5.00 V	Y	Y	0.35	Y	Y	Y	Y	Y	
H28	Droop control	-60.0 to 0.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	5-190
H30	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	Y	Y	5-191
H42	Capacitance of DC link bus capacitor	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	5-193
H43	Cumulative run time of cooling fan	Indication for replacement of cooling fan Cumulative run time of cooling fan (in units of 10 hours)	Y	N	-	Y	Y	Y	Y	Y	
H44	Startup Counter for Motor 1	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	5-196
H45	Mock alarm	0: Disable 1: Mock alarm is issued.	Y	N	0	Y	Y	Y	Y	Y	5-197 5-198
H46	Starting Mode (Auto search delay time 2)	0.1 to 10.0 s (ROM version earlier than 2000) 0.1 to 20.0 s (ROM version 2000 or later)	Y	Y1, Y2	*6	Y	Y	Y	N	Y	5-184 5-197
H47	Initial capacitance of DC link bus capacitor	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	5-193
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	Y	Y	5-197
H49	Starting Mode (Auto search delay time 1)	0.0 to 10.0 s	Y	Y	0.0	Y	Y	Y	Y	Y	5-184 5-197
H50	Non-linear V/f Pattern 1 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	*7	Y	Y	N	N	N	5-72
H51	(Voltage)	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)	N	Y2	*8	Y	Y	N	N	N	5-197
H52	Non-linear V/f Pattern 2 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	0.0	Y	Y	N	N	N	
H53	(Voltage)	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)	N	Y2	0	Y	Y	N	N	N	
H54	Acceleration Time (Jogging)	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	Y	N	5-76
H55	Deceleration Time (Jogging)	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	Y	N	5-197
H56	Deceleration Time for Forced Stop	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	Y	N	
H57	1st S-curve acceleration range (Leading edge)	0 to 100%	Y	Y	10	Y	Y	Y	Y	N	
H58	2nd S-curve acceleration range (Trailing edge)	0 to 100%	Y	Y	10	Y	Y	Y	Y	N	
H59	1st S-curve deceleration range (Leading edge)	0 to 100%	Y	Y	10	Y	Y	Y	Y	N	
H60	2nd S-curve deceleration range (Trailing edge)	0 to 100%	Y	Y	10	Y	Y	Y	Y	N	
H61	UP/DOWN Control (Initial frequency selection)	0: 0.00 Hz as default 1: Default is the frequency set by the last UP/DOWN command immediately before the run command is turned off.	N	Y	1	Y	Y	Y	Y	N	5-62 5-197
H63	Low Limiter (Mode selection)	0: Limit by F16 (Frequency limiter: Low) and continue to run 1: If the frequency lowers below the one limited by F16 (Frequency limiter: Low), decelerate to stop the motor.	Y	Y	0	Y	Y	Y	Y	N	5-93 5-198
H64	(Lower limiting frequency)	0.0: Depends on F16 (Frequency limiter, Low), 0.1 to 60.0 Hz	Y	Y	1.6	Y	Y	N	N	N	5-198
H65	Non-linear V/f Pattern 3 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	0.0	Y	Y	N	N	N	5-72
H66	(Voltage)	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)	N	Y2	0	Y	Y	N	N	N	5-198

*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 5.2-17.

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table 5.2-18.

*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

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
H67	Auto Energy Saving Operation (Mode selection)	0: Enable during running at constant speed 1: Enable in all modes	Y	Y	0	Y	Y	N	Y	N	5-104 5-198
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	Y	N	N	N	5-114 5-198
H69	Anti-regenerative control (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	Y	N	5-198
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	Y	N	5-199
H71	Deceleration Characteristics	0: Disable; 1: Enable	Y	Y	0	Y	Y	N	N	N	5-200
H72	Main Power Down Detection (Mode selection)	0: Disable; 1: Enable	Y	Y	1	Y	Y	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	Y	Y	5-107 5-200
H74	(Control target)	0: Torque limit 1: Torque current limit 2: Output power limit	N	Y	1	N	N	Y	Y	Y	
H75	(Target quadrants)	0: Drive/brake 1: Same for all four quadrants 2: Upper/lower limits	N	Y	0	N	N	Y	Y	Y	
H76	Torque Limiter (Frequency increment limit for braking)	0.0 to 500.0Hz	Y	Y	5.0	Y	Y	N	N	N	5-198 5-200
H77	Service Life of DC Link Bus Capacitor (Remaining time)	0 to 8760 (in units of 10 hours)	Y	N	-	Y	Y	Y	Y	Y	5-201
H78	Maintenance interval (M1)	0 (Disable): 1 to 9999 (in units of 10 hours)	Y	N	8760	Y	Y	Y	Y	Y	
H79	Preset Startup Count for Maintenance (M1)	0000 (Disable): 0001 to FFFF (hex.)	Y	N	0	Y	Y	Y	Y	Y	5-196 5-202
H80	Output Current Fluctuation Damping Gain for Motor 1	0.00 to 0.40 (ROM version earlier than 2000) 0.00 to 1.00 (ROM version 2000 or later)	Y	Y	0.20	Y	Y	N	N	Y	5-202
H81	Light Alarm Selection 1	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	Y	Y	5-203
H82	Light Alarm Selection 2	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	Y	Y	
H84	Pre-excitation (Initial level)	100 to 400%	Y	Y	100	N	N	Y	Y	Y	5-205
H85	(Braking time)	0.00 (Disable), 0.01 to 30.00 s	Y	Y	0.00	N	N	Y	Y	Y	
H86	Reserved *9	0 to 2	Y	Y1, Y2	0	-	-	-	-	-	5-206
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	0.0 (Disable alarm detection), 0.1 to 60.0 s	Y	Y	0.0	Y	Y	Y	Y	N	5-207
H92	Continuity of Running (P)	0.000 to 10.000 times; 999	Y	Y1, Y2	999	Y	Y	N	N	N	5-83
H93	(I)	0.010 to 10.000 s; 999	Y	Y1, Y2	999	Y	Y	N	N	N	5-207
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	Y	Y	5-201 5-207
H95	DC Braking (Braking response mode)	0: Slow 1: Quick	Y	Y	1	Y	Y	N	N	N	5-94 5-207
H96	STOP key priority/ Start check function	0: STOP key priority: Disable, Start check function: Disable 1: STOP key priority: Enable, Start check function: Disable 2: STOP key priority: Disable, Start check function: Enable 3: STOP key priority: Enable, Start check function: Enable	Y	Y	0	Y	Y	Y	Y	Y	5-207
H97	Clear Alarm Data	0: Disable 1: Enable (Setting "1" clears alarm data and then returns to "0.")	Y	N	0	Y	Y	Y	Y	Y	5-197 5-208
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	Y	Y	5-208

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Table 5.2-10

■ A codes: Motor 2 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
A01	Maximum Output Frequency 2	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	Y	Y	—
A02	Base Frequency 2	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	Y	Y	
A03	Rated Voltage at Base Frequency 2	0: AVR disabled (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	Y	Y	
A04	Maximum Output Voltage 2	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	N	N	Y	
A05	Torque Boost 2	0.0% to 20.0% (percentage with respect to Rated Voltage at Base Frequency 2)	Y	Y	*2	Y	Y	N	N	N	
A06	Electronic Thermal Overload Protection for Motor 2 (Select motor characteristics)	1: Enable (For a general-purpose motor with shaft-driven cooling fan) 2: Enable (For an inverter (FV)-driven motor with separately powered cooling fan)	Y	Y	1	Y	Y	Y	Y	Y	
A07	(Operation level)	0.00 (Disable), 1% to 135% of the rated current of the inverterr	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	
A08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	Y	
A09	DC Braking 2 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	
A10	(Operation level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	Y	N	
A11	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
A12	Starting Frequency 2	0.0 to 60.0Hz	Y	Y	0.5	Y	Y	Y	Y	N	
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	Y	N	Y	N	
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	Y	Y	
A15	Motor 2 (No. of poles)	2 to 22 poles	N	Y1, Y2	4	Y	Y	Y	Y	Y	
A16	(Rated capacity)	0.01 to 1000 kW (when A39 = 0 or 2 to 4) 0.01 to 1000 HP (when A39 = 1)	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
A17	(Rated current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
A18	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune the motor while it is rotating under V/f control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c") 3: Tune the motor while it is rotating under vector control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c"; enabled under vector control only)	N	N	0	Y	Y	Y	Y	Y	
A19	(Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	
A20	(No-load current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
A21	(%R1)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A22	(%X)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A23	(Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
A24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1, Y2	0.12	Y	Y	N	N	N	
A25	(Slip compensation gain for braking)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
A26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1, Y2	*6	Y	Y	Y	Y	N	
A27	(Iron loss factor 1)	0.00 to 20.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A28	(Iron loss factor 2)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
A29	(Iron loss factor 3)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
A30	(Magnetic saturation factor 1)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A31	(Magnetic saturation factor 2)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A32	(Magnetic saturation factor 3)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A33	(Magnetic saturation factor 4)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A34	(Magnetic saturation factor 5)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A35	(Magnetic saturation extension factor "a")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A36	(Magnetic saturation extension factor "b")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
A37	(Magnetic saturation extension factor "c")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	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	Y	Y	

*2 The factory default differs depending upon the inverter's capacity. See Table 5.2-17.
*3 The motor rated current is automatically set. See Table 5.2-18 (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 5.2-18.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
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 disable at base frequency or above	N	Y	0	Y	Y	N	N	N	—
A41	Output Current Fluctuation Damping Gain for Motor 2	0.00 to 0.40	Y	Y	0.20	Y	Y	N	N	N	
A42	Motor/Parameter Switching 2 (Mode selection)	0: Motor (Switch to the 2nd motor) 1: Parameter (Switch to A codes)	N	Y	0	Y	Y	Y	Y	Y	5-211
A43	Speed Control 2 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	Y	N	—
A44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	Y	N	
A45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	Y	N	
A46	I (Integral time)	0.001 to 9.999 s 999: Integration disabled	Y	Y	0.100	N	Y	Y	Y	N	
A47	(Feed Forward Gain)	0.00 to 99.99 s	Y*	Y	0.00	N	N	Y	Y	N	
A48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	Y	N	
A49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	N	Y	N	
A50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	N	Y	N	
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	Y	Y	
A52	Startup Counter 2	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	
A53	Motor 2 (%X correction factor 1)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
A54	(%X correction factor 2)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
A55	(Torque current under vector control)	0.00 to 2000 A	N	Y1, Y2	*6	N	N	Y	Y	Y	
A56	(Induced voltage factor under vector control)	50 to 100%	N	Y1, Y2	*6	N	N	Y	Y	Y	
A57	Reserved *9	0.000 to 20.000 s	Y	Y1, Y2	*6	-	-	-	-	-	

Table 5.2-11

■ b codes: Motor 3 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
b01	Maximum Output Frequency 3	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	Y	Y	—
b02	Base Frequency 3	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	Y	Y	
b03	Rated Voltage at Base Frequency 3	0: AVR disabled (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	Y	Y	
b04	Maximum Output Voltage 3	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	N	N	Y	
b05	Torque Boost 3	0.0% to 20.0% (percentage with respect to Rated Voltage at Base Frequency 3)	Y	Y	*2	Y	Y	N	N	N	
b06	Electronic Thermal Overload Protection for Motor 3 (Select motor characteristics)	1: Enable (For a general-purpose motor with shaft-driven cooling fan) 2: Enable (For an inverter (FV)-driven motor with separately powered cooling fan)	Y	Y	1	Y	Y	Y	Y	Y	
b07	(Operation level)	0.00 (Disable), 1% to 135% of the rated current of the inverter	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	
b08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	Y	
b09	DC Braking 3 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	
b10	(Operation level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	Y	N	
b11	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
b12	Starting Frequency 3	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	Y	N	
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	Y	N	Y	N	
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	Y	Y	
b15	Motor 3 (No. of poles)	2 to 22 poles	N	Y1, Y2	4	Y	Y	Y	Y	Y	
b16	(Rated capacity)	0.01 to 1000 kW (when b39 = 0 or 2 to 4) 0.01 to 1000 HP (when b39 = 1)	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
b17	(Rated current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	

*2 The factory default differs depending upon the inverter's capacity. See Table 5.2-17.
*3 The motor rated current is automatically set. See Table 5.2-18 (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 5.2-18.
*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	PG V/f	w/o PG	w/ PG	Torque control	Refer to page:
b18	Motor 3 (Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune the motor while it is rotating under V/f control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c") 3: Tune the motor while it is rotating under vector control (%R1, %X and rated slip frequency, no-load current, magnetic saturation factors 1 to 5, magnetic saturation extension factors "a" to "c"; enabled under vector control only)	N	N	0	Y	Y	Y	Y	Y	—
b19	(Online tuning)	0: Disable, 1: Enable	Y	Y	0	Y	N	N	N	N	
b20	(No-load current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
b21	(%R1)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b22	(%X)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b23	(Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
b24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1, Y2	0.12	Y	Y	N	N	N	
b25	(Slip compensation gain for braking)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
b26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1, Y2	*6	Y	Y	Y	Y	N	
b27	(Iron loss factor 1)	0.00 to 20.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b28	(Iron loss factor 2)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
b29	(Iron loss factor 3)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
b30	(Magnetic saturation factor 1)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b31	(Magnetic saturation factor 2)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b32	(Magnetic saturation factor 3)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b33	(Magnetic saturation factor 4)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b34	(Magnetic saturation factor 5)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b35	(Magnetic saturation extension factor "a")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b36	(Magnetic saturation extension factor "b")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
b37	(Magnetic saturation extension factor "c")	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	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	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	Y	N	N	N	
b41	Current Fluctuation Damping Gain for Motor 3	0.00 to 0.40	Y	Y	0.20	Y	Y	N	N	N	
b42	Motor/Parameter Switching 3 (Mode selection)	0: Motor (Switch to the 3rd motor) 1: Parameter (Switch to b codes)	N	Y	0	Y	Y	Y	Y	Y	5-211
b43	Speed Control 3 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	Y	N	—
b44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	Y	N	
b45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	Y	N	
b46	I (Integral time)	0.001 to 9.999 s 999: Integration disabled	Y	Y	0.100	N	Y	Y	Y	N	
b47	(Feed Forward Gain)	0.00 to 99.99 s	Y*	Y	0.00	N	N	Y	Y	N	
b48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	Y	N	
b49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	N	Y	N	
b50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	N	Y	N	
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	Y	Y	
b52	Startup Counter 3	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	
b53	Motor 3 (%X correction factor 1)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
b54	(%X correction factor 2)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
b55	(Torque current under vector control)	0.00 to 2000 A	N	Y1, Y2	*6	N	N	Y	Y	Y	
b56	(Induced voltage factor under vector control)	50 to 100%	N	Y1, Y2	*6	N	N	Y	Y	Y	
b57	Reserved *9	0.000 to 20.000 s	Y	Y1, Y2	*6	-	-	-	-	-	

Table 5.2-12

■ r codes: Motor 4 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control: V/f	Drive control: PG V/f	Drive control: w/o PG	Drive control: w/ PG	Drive control: Torque control	Refer to page:
r01	Maximum Output Frequency 4	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	Y	Y	—
r02	Base Frequency 4	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	Y	Y	
r03	Rated Voltage at Base Frequency 4	0: AVR disabled (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	Y	Y	

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table 5.2-18.

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
r04	Maximum Output Voltage 4	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	N	N	Y	—
r05	Torque Boost 4	0.0% to 20.0% (percentage with respect to Rated Voltage at Base Frequency 4)	Y	Y	*2	Y	Y	N	N	N	
r06	Electronic Thermal Overload Protection for Motor 4 (Select motor characteristics)	1: Enable (For a general-purpose motor with shaft-driven cooling fan) 2: Enable (For an inverter (FV)-driven motor with separately powered cooling fan)	Y	Y	1	Y	Y	Y	Y	Y	
r07	(Operation level)	0.00 (Disable), 1% to 135% of the rated current of the inverter	Y	Y1, Y2	*3	Y	Y	Y	Y	Y	
r08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	Y	
r09	DC Braking 4 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	
r10	(Operation level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	Y	N	
r11	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
r12	Starting Frequency 4	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	Y	N	
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	Y	N	Y	N	
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	Y	Y	
r15	Motor 4 (No. of poles)	2 to 22 poles	N	Y1, Y2	4	Y	Y	Y	Y	Y	
r16	(Rated capacity)	0.01 to 1000 kW (when r39 = 0 or 2 to 4) 0.01 to 1000 HP (when r39 = 1)	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
r17	(Rated current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	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	Y	Y	
r19	(Online tuning)	0: Disable 1: Enable	Y	Y	0	Y	N	N	N	N	
r20	(No-load current)	0.00 to 2000 A	N	Y1, Y2	*6	Y	Y	Y	Y	Y	
r21	(%R1)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r22	(%X)	0.00 to 50.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r23	(Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
r24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1, Y2	0.12	Y	Y	N	N	N	
r25	(Slip compensation gain for braking)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	Y	N	
r26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1, Y2	*6	Y	Y	Y	Y	N	
r27	(Iron loss factor 1)	0.00 to 20.00%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r28	(Iron loss factor 2)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
r29	(Iron loss factor 3)	0.00 to 20.00%	Y	Y1, Y2	0.00	Y	Y	Y	Y	Y	
r30	(Magnetic saturation factor 1)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r31	(Magnetic saturation factor 2)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r32	(Magnetic saturation factor 3)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r33	(Magnetic saturation factor 4)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r34	(Magnetic saturation factor 5)	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r35	(Magnetic saturation extension factor	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r36	(Magnetic saturation extension factor	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	Y	Y	Y	
r37	(Magnetic saturation extension factor	0.0 to 300.0%	Y	Y1, Y2	*6	Y	Y	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	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	Y	N	N	N	
r41	Current Fluctuation Damping Gain for Motor 4	0.00 to 0.40	Y	Y	0.20	Y	Y	N	N	N	
r42	Motor/Parameter Switching 4 (Mode selection)	0: Motor (Switch to the 4th motor) 1: Parameter (Switch to r codes)	N	Y	0	Y	Y	Y	Y	Y	5-211

*2 The factory default differs depending upon the inverter's capacity. See Table 5.2-17.

*3 The motor rated current is automatically set. See Table 5.2-18 (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 5.2-18.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
r43	Speed Control 4 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	Y	N	—
r44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	Y	N	
r45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	Y	N	
r46	I (Integral time)	0.001 to 9.999 s 999: Integration disabled	Y	Y	0.100	N	Y	Y	Y	N	
r47	(Feed Forward Gain)	0.00 to 99.99 s	Y*	Y	0.00	N	N	Y	Y	N	
r48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	Y	N	
r49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	N	Y	N	
r50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	N	Y	N	
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	Y	Y	
r52	Startup Counter 4	Indication for replacement (0000 to FFFF (hex.))	Y	N	-	Y	Y	Y	Y	Y	
r53	Motor 4 (%X correction factor 1)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
r54	(%X correction factor 2)	0 to 300%	Y	Y1, Y2	100	Y	Y	Y	Y	Y	
r55	(Torque current under vector control)	0.00 to 2000 A	N	Y1, Y2	*6	N	N	Y	Y	Y	
r56	(Induced voltage factor under vector control)	50 to 100%	N	Y1, Y2	*6	N	N	Y	Y	Y	
r57	Reserved *9	0.000 to 20.000 s	Y	Y1, Y2	*6	-	-	-	-	-	

Table 5.2-13

■ J codes: Application Functions 1

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
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	Y	N	5-214
J02	(Remote command)	0: Enable ∧/∨ keys on the keypad 1: PID command 1 (Analog input terminals [12], [C1], and [V2]) 3: UP/DOWN 4: Communications link	N	Y	0	Y	Y	Y	Y	N	5-215
J03	P (Gain)	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	Y	N	5-219
J04	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	Y	N	
J05	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
J06	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	Y	Y	Y	Y	N	
J08	(Pressurization starting frequency)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	5-223
J09	(Pressurizing time)	0 to 60 s	Y	Y	0	Y	Y	Y	Y	N	
J10	(Anti reset windup)	0 to 200%	Y	Y	200	Y	Y	Y	Y	N	5-225
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	Y	N	
J12	(Upper level alarm (AH))	-100% to +100%	Y	Y	100	Y	Y	Y	Y	N	
J13	(Lower level alarm (AL))	-100% to +100%	Y	Y	0	Y	Y	Y	Y	N	
J15	(Stop frequency for slow flowrate)	0.0 (Disable): 1.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	5-226
J16	(Slow flowrate level stop latency)	0 to 60 s	Y	Y	30	Y	Y	Y	Y	N	5-226
J17	(Starting frequency)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	Y	N	
J18	(Upper limit of PID process output)	-150% to +150%; 999 (Depends on setting of F15)	Y	Y	999	Y	Y	Y	Y	N	5-227
J19	(Lower limit of PID process output)	-150% to 150%; 999 (Depends on setting of F16)	Y	Y	999	Y	Y	Y	Y	N	
J21	Dew Condensation Prevention (Duty)	1 to 50%	Y	Y	1	Y	Y	Y	Y	Y	
J22	Commercial Power Switching Sequence	0: Standard sequence 1: Automatically switched by inverter alarm	N	Y	0	Y	Y	N	N	Y	5-122 5-227
J56	PID Control (Speed command filter)	0.00 to 5.00 s	Y	Y	0.10	Y	Y	Y	Y	N	5-228
J57	(Dancer reference position)	-100% to 0% to 100%	Y	Y	0	Y	Y	Y	Y	N	
J58	(Detection width of dancer position deviation)	0: Disable switching PID constant 1 to 100%: Manually set value	Y	Y	0	Y	Y	Y	Y	N	
J59	P (Gain) 2	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	Y	N	
J60	I (Integral time) 2	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	Y	N	
J61	D (Differential time) 3	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	Y	N	
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	Y	N	

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table 5.2-18.

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	PG V/f	w/o PG	w/ PG	Torque control	Refer to page:
J68	Brake Signal (Brake-OFF current)	0 to 300%	Y	Y	100	Y	Y	Y	Y	N	5-229
J69	(Brake-OFF frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	Y	N	N	N	
J70	(Brake-OFF timer)	0.0 to 5.0 s	Y	Y	1.0	Y	Y	Y	Y	N	
J71	(Brake-ON frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	Y	N	N	N	
J72	(Brake-ON timer)	0.0 to 5.0 s	Y	Y	1.0	Y	Y	Y	Y	N	
J95	(Brake-OFF torque)	0 to 300%	Y	Y	100	N	N	Y	Y	N	
J96	(Mode selection)	0 to 31	N	Y	0						
		Bit 0: Select Detected/Reference speed (0: Detected speed; 1: Reference speed)				N	N	Y	Y	N	
		Bit 1: Not used.				N	N	N	N	N	
		Bit 2: Select current response (0: Slow response; 1: Quick response)				Y	Y	Y	Y	N	
		Bit 3: Select Brake-ON frequency (0: Stop frequency; 1: Brake-ON frequency)				N	N	Y	Y	N	
		Bit 4: Select Brake-ON conditions (0: Run command OFF disabled; 1: Run command OFF enabled)				N	N	Y	Y	N	
J97	Servo-lock (Gain)	0.00 to 10.00 times	Y*	Y	0.10	N	N	N	Y	N	5-233
J98	(Completion timer)	0.000 to 1.000 s	Y	Y	0.100	N	N	N	Y	N	
J99	(Completion range)	0 to 9999 pulses	Y	Y	10	N	N	N	Y	N	

Table 5.2-14

■ d codes: Application Functions 2

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	PG V/f	w/o PG	w/ PG	Torque control	Refer to page:
d01	Speed Control 1 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	Y	N	5-235
d02	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	Y	N	
d03	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	Y	N	
d04	I (Integral time)	0.001 to 9.999 s 999: Integration disabled	Y	Y	0.100	N	Y	Y	Y	N	
d05	(Feed Forward Gain)	0.00 to 99.99 s	Y*	Y	0.00	N	N	Y	Y	N	5-237
d06	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	Y	N	5-235
d07	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	N	Y	N	5-238
d08	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	N	Y	N	
d09	Speed Control (Jogging) (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	Y	N	5-235 5-239
d10	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	Y	N	
d11	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	Y	N	
d12	I (Integral time)	0.001 to 9.999 s 999: Integration disabled	Y	Y	0.100	N	Y	Y	Y	N	
d13	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	Y	N	
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	Y	N	Y	Y	5-239
d15	(Encoder pulse resolution)	0014 to EA60 (hex.) (20 to 60000 pulses)	N	Y	0400 (1024)	N	Y	N	Y	Y	
d16	(Pulse count factor 1)	1 to 9999	N	Y	1	N	Y	N	Y	Y	
d17	(Pulse count factor 2)	1 to 9999	N	Y	1	N	Y	N	Y	Y	
d21	Speed Agreement/PG Error (Detection width)	0.0 to 50.0%	Y	Y	10.0	N	Y	Y	Y	N	5-241
d22	(Detection timer)	0.00 to 10.00 s	Y	Y	0.50	N	Y	Y	Y	N	
d23	PG Error Processing	0: Continue to run 1 1: Stop running with alarm 1 2: Stop running with alarm 2 3: Continue to run 2 4: Stop running with alarm 3 5: Stop running with alarm 4	N	Y	2	N	Y	Y	Y	N	
d24	Zero Speed Control	0: Not permit at startup 1: Permit at startup	N	Y	0	N	N	Y	Y	N	5-96 5-242
d25	ASR switching time	0.000 to 1.000 s	Y	Y	0.000	N	Y	Y	Y	Y	5-211 5-242
d27	Servo-lock (Gain) Switching Time	0.000 to 1.000 s	Y	Y	0.000	N	N	N	Y	N	
d28	Servo-lock (Gain 2)	0.00 to 10.00 times	Y*	Y	0.10	N	N	N	Y	N	
d32	Torque Control (Speed limit 1)	0 to 110%	Y	Y	100	N	N	Y	Y	Y	5-243
d33	(Speed limit 2)	0 to 110%	Y	Y	100	N	N	Y	Y	Y	
d35	Excessive speed detection level	0 to 120% 999: Follow the setting by d32 or d33	Y	Y	999	N	Y	Y	Y	Y	
d41	Application control selection	0: Disable (Ordinary control)	N	Y	0	Y	Y	Y	Y	Y	5-245
		1: Enable (Constant peripheral speed control)				N	Y	N	N	N	
		2: Synchronized operation enabled (simultaneous start synchronized (without Z phase))				N	Y	N	Y	N	
		3: Synchronized operation enabled (standby synchronized)				N	Y	N	Y	N	
		4: Synchronized operation enabled (simultaneous start synchronized (with Z phase)				N	Y	N	Y	N	

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
d51	Reserved *9	0 to 500	N	Y	*10	-	-	-	-	-	5-247
d52	Reserved *9	0 to 500	N	Y	*10	-	-	-	-	-	
d53	Reserved *9	0 to 500	N	Y	*10	-	-	-	-	-	
d54	Reserved *9	0 to 500	N	Y	*10	-	-	-	-	-	
d55	Reserved *9	0000 to 00FF (hex.)	N	Y	0000	-	-	-	-	-	
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	Y	Y	5-62 5-247
d60	(Encoder pulse resolution)	0014 to 0E10 (hex.) (20 to 3600)	N	Y	0400 (1024)	N	Y	N	Y	N	5-247
d61	(Filter time constant)	0.000 to 5.000 s	Y	Y	0.005	Y	Y	Y	Y	Y	
d62	(Pulse count factor 1)	1 to 9999	Y *12	Y	1	Y	Y	Y	Y	Y	
d63	(Pulse count factor 2)	1 to 9999	Y *12	Y	1	Y	Y	Y	Y	Y	
d67	Starting Mode (Auto search)	0: Disable 1: Enable (Only at restart after momentary power failure) 2: Enable (At normal start and at restart after momentary power failure)	N	Y	2	N	N	Y	N	Y	5-184
d68	Reserved *9	0.0 to 10.0 Hz	N	Y	4.0	-	-	-	-	-	5-247
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	Y	N	N	N	5-248
d71	Synchronous Operation (Main ASR gain)	0.00 to 1.50 times	Y	Y	1.00	N	Y	N	Y	N	5-247
d72	(APR P gain)	0.00 to 200.00 times	Y	Y	15.00	N	Y	N	Y	N	
d73	(APR output + side limitter)	20 to 200%; 999: No limitter	Y	Y	999	N	Y	N	Y	N	
d74	(APR output - side limitter)	20 to 200%; 999: No limitter	Y	Y	999	N	Y	N	Y	N	
d75	(Z phase shift agreement gain)	0.00 to 10.00 times	Y	Y	1.00	N	Y	N	Y	N	
d76	(Synchronous offset angle)	0 to 359 deg	Y	Y	0	N	Y	N	Y	N	
d77	(Synchronization completion detection angle)	0 to 100 deg	Y	Y	15	N	Y	N	Y	N	
d78	(Deviation excess detection width)	0 to 65535 (in the unit of 10 pulses) (For a set value of 10000 or above, the first four digits are indicated in the unit of 100 pulses)	Y	Y	65535 *11	N	Y	N	Y	N	
d81	Reserved *9	0 to 1	Y	Y	1	-	-	-	-	-	—
d82	Magnetic flux weakening control (Vector control without speed sensor)	0: Disabled 1: Enabled	Y	Y	1	N	N	N	N	Y	5-248
d83	Magnetic flux weakening lower limit (Vector control without speed sensor)	10 to 70%	Y	Y	40%	N	N	N	N	Y	
d84	Reserved *9	0 to 20 dB	Y	Y	5dB	-	-	-	-	-	—
d85	Reserved *9	0 to 200%	Y	Y	95%	-	-	-	-	-	—
d86	ACC/DEC Filter Time Constant	0.000 to 5.000 s	Y	Y	0.000	Y	N	N	N	N	5-248
d90	Magnetic flux level during deceleration (under vector control)	100 to 300%	Y	Y	150%	N	N	Y	Y	N	5-248
d91	Reserved *9	0.00 to 200, 999	Y	Y	999	-	-	-	-	-	—
d92	Reserved *9	0.00 to 3.00	Y	Y	0.00	-	-	-	-	-	—
d98	Reserved *9	0000 to FFFF (hex.)	Y	Y	0000	Y	Y	N	N	N	—
d99	Extended Function 1	0 to 31	Y	Y	0						5-248
		Bit 0: Reserved *9				-	-	-	-	-	
		Bit 1: Reserved *9				-	-	-	-	-	
		Bit 2: Reserved *9				-	-	-	-	-	
		Bit 3: JOG operation from communications (0: Disabled; 1: Enabled)				Y	Y	Y	Y	N	
		Bit 4: Reserved *9				-	-	-	-	-	

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

*10 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

*11 On a standard keypad, "6553" is indicated in the LED display, and the "x10" LED lamp goes on.

*12 Change when running is not possible with the ROM version 3700 or earlier.

Table 5.2-15

■ U codes: Application Functions 3

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
U00	Customizable Logic (Mode selection)	0: Disable; 1: Enable (Customizable logic operation)	Y*12	Y	0	Y	Y	Y	Y	Y	5-249
U01	Customizable Logic (Input 1)	0 (1000): Inverter running *(RUN*	N	Y	0	Y	Y	Y	Y	Y	
U02	Step 1 (Input 2)	1 (1001): Frequency (speed) arrival signal *(FAR)*	N	Y	0	Y	Y	Y	Y	N	
		2 (1002): Frequency (speed) detected *(FDT)*				Y	Y	Y	Y	Y	
		3 (1003): Undervoltage detected *(LU)*				Y	Y	Y	Y	Y	
		4 (1004): Torque polarity detected *(B/D)*				Y	Y	Y	Y	Y	
		5 (1005): Inverter output limiting *(IOL)*				Y	Y	Y	Y	Y	
		6 (1006): Auto-restarting after momentary power failure *(IPF)*				Y	Y	Y	Y	Y	
		7 (1007): Motor overload early warning *(OL)*				Y	Y	Y	Y	Y	
		8 (1008): Keypad operation enabled *(KP)*				Y	Y	Y	Y	Y	
		10 (1010): Inverter ready to run *(RDY)*				Y	Y	Y	Y	Y	
		11: Switch motor drive source between commercial power and inverter output *(SW88)*				Y	Y	N	N	N	
		12: Switch motor drive source between commercial power and inverter output *(SW52-2)*				Y	Y	N	N	N	
		13: Switch motor drive source between commercial power and inverter output *(SW52-1)*				Y	Y	N	N	N	
		15 (1015): Select AX terminal function *(AX)*				Y	Y	Y	Y	Y	
		16 (1016): Time-up signal for pattern operation *(TU)*				Y	Y	Y	Y	N	
		17 (1017): Cycle completion signal for pattern operation *(TO)*				Y	Y	Y	Y	N	
		18 (1018): Pattern operation stage No.1 *(STG1)*				Y	Y	Y	Y	N	
		19 (1019): Pattern operation stage No.2 *(STG2)*				Y	Y	Y	Y	N	
		20 (1020): Pattern operation stage No.4 *(STG4)*				Y	Y	Y	Y	N	
		22 (1022): Inverter output limiting with delay *(IOL2)*				Y	Y	Y	Y	Y	
		25 (1025): Cooling fan ON/OFF control *(FAN)*				Y	Y	Y	Y	Y	
		26 (1026): Auto-resetting *(TRY)*				Y	Y	Y	Y	Y	
		28 (1028): Cooling fan overheat early warning *(OH)*				Y	Y	Y	Y	Y	
		29 (1029): SY synchronized *(SY)*				N	Y	N	Y	N	
		30 (1030): Lifetime alarm *(LIFE)*				Y	Y	Y	Y	Y	
		31 (1031): Frequency (speed) detected 2 *(FDT2)*				Y	Y	Y	Y	Y	
		33 (1033): Reference loss detected *(REF OFF)*				Y	Y	Y	Y	Y	
		35 (1035): Inverter output on *(RUN2)*				Y	Y	Y	Y	Y	
		36 (1036): Overload prevention control *(OLP)*				Y	Y	Y	Y	N	
		37 (1037): Current detected *(ID)*				Y	Y	Y	Y	Y	
		38 (1038): Current detected 2 *(ID2)*				Y	Y	Y	Y	Y	
		39 (1039): Current detected 3 *(ID3)*				Y	Y	Y	Y	Y	
		41 (1041): Low current detected *(IDL)*				Y	Y	Y	Y	Y	
		42 (1042): PID alarm *(PID-ALM)*				Y	Y	Y	Y	N	
		43 (1043): Under PID control *(PID-CTL)*				Y	Y	Y	Y	N	
		44 (1044): Motor stopped due to slow flowrate under PID control *(PID-STP)*				Y	Y	Y	Y	N	
		45 (1045): Low output torque detected *(U-TL)*				Y	Y	Y	Y	Y	
		46 (1046): Torque detected 1 *(TD1)*				Y	Y	Y	Y	Y	
		47 (1047): Torque detected 2 *(TD2)*				Y	Y	Y	Y	Y	
		48 (1048): Motor 1 switched *(SWM1)*				Y	Y	Y	Y	Y	
		49 (1049): Motor 2 switched *(SWM2)*				Y	Y	Y	Y	Y	
		50 (1050): Motor 3 switched *(SWM3)*				Y	Y	Y	Y	Y	
		51 (1051): Motor 4 switched *(SWM4)*				Y	Y	Y	Y	Y	
		52 (1052): Running forward *(FRUN)*				Y	Y	Y	Y	Y	
		53 (1053): Running reverse *(RRUN)*				Y	Y	Y	Y	Y	
		54 (1054): In remote operation *(RMT)*				Y	Y	Y	Y	Y	
		56 (1056): Motor overheat detected by thermistor *(THM)*				Y	Y	Y	Y	Y	
		57 (1057): Brake signal *(BRKS)*				Y	Y	Y	Y	N	
		58 (1058): Frequency (speed) detected 3 *(FDT3)*				Y	Y	Y	Y	Y	
		59 (1059): Terminal [C1] wire break *(C1OFF)*				Y	Y	Y	Y	Y	
		70 (1070): Speed valid *(DNZS)*				N	Y	Y	Y	Y	
		71 (1071): Speed agreement *(DSAG)*				N	Y	Y	Y	N	
		72 (1072): Frequency (speed) arrival signal 3 *(FAR3)*				Y	Y	Y	Y	N	
		76 (1076): PG error detected *(PG-ERR)*				N	Y	Y	Y	N	
		82 (1082): Positioning completion signal *(PSET)*				N	N	N	Y	N	
		77 (1077): Low DC medium voltage detected *(U-EDC)*				Y	Y	Y	Y	Y	
		79 (1079): Deceleration due to momentary power failure in progress *(IPF2)*				Y	Y	Y	Y	N	
		84 (1084): Maintenance timer *(MNT)*				Y	Y	Y	Y	Y	
		90 (1090): Alarm details 1 *(AL1)*				Y	Y	Y	Y	Y	
		91 (1091): Alarm details 2 *(AL2)*				Y	Y	Y	Y	Y	
		92 (1092): Alarm details 4 *(AL4)*				Y	Y	Y	Y	Y	
		93 (1093): Alarm details 8 *(AL8)*				Y	Y	Y	Y	Y	

*12 Change when running is not possible with the ROM version 3600 or earlier.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control					Refer to page:
						V/f	PG V/f	w/o PG	w/ PG	Torque control	
		98 (1098): Light alarm *(L-ALM)*				Y	Y	Y	Y	Y	
		99 (1099): Batch alarm processing *(ALM)*				Y	Y	Y	Y	Y	
		105 (1105): Braking transistor broken *(DBAL)*				Y	Y	Y	Y	Y	
		2001 (3001): Output of step 1 *(SO01)*				Y	Y	Y	Y	Y	
		2002 (3002): Output of step 2 *(SO02)*				Y	Y	Y	Y	Y	
		2003 (3003): Output of step 3 *(SO03)*				Y	Y	Y	Y	Y	
		2004 (3004): Output of step 4 *(SO04)*				Y	Y	Y	Y	Y	
		2005 (3005): Output of step 5 *(SO05)*				Y	Y	Y	Y	Y	
		2006 (3006): Output of step 6 *(SO06)*				Y	Y	Y	Y	Y	5-249
		2007 (3007): Output of step 7 *(SO07)*				Y	Y	Y	Y	Y	
		2008 (3008): Output of step 8 *(SO08)*				Y	Y	Y	Y	Y	
		2009 (3009): Output of step 9 *(SO09)*				Y	Y	Y	Y	Y	
		2010 (3010): Output of step 10 *(SO10)*				Y	Y	Y	Y	Y	
		4001 (5001): Terminal [X1] input signal *(X1)*				Y	Y	Y	Y	Y	
		4002 (5002): Terminal [X2] input signal *(X2)*				Y	Y	Y	Y	Y	
		4003 (5003): Terminal [X3] input signal *(X3)*				Y	Y	Y	Y	Y	
		4004 (5004): Terminal [X4] input signal *(X4)*				Y	Y	Y	Y	Y	
		4005 (5005): Terminal [X5] input signal *(X5)*				Y	Y	Y	Y	Y	
		4006 (5006): Terminal [X6] input signal *(X6)*				Y	Y	Y	Y	Y	
		4007 (5007): Terminal [X7] input signal *(X7)*				Y	Y	Y	Y	Y	
		4008 (5008): Terminal [X8] input signal *(X8)*				Y	Y	Y	Y	Y	
		4009 (5009): Terminal [X9] input signal *(X9)*				Y	Y	Y	Y	Y	
		4010 (5010): Terminal [FWD] input signal *(FWD)*				Y	Y	Y	Y	Y	
		4011 (5011): Terminal [REV] input signal *(REV)*				Y	Y	Y	Y	Y	
		6000 (7000): Final run command *(FL_RUN)*				Y	Y	Y	Y	Y	
		6001 (7001): Final FWD run command *(FL_FWD)*				Y	Y	Y	Y	Y	
		6002 (7002): Final REV run command *(FL_REV)*				Y	Y	Y	Y	Y	
		6003 (7003): During acceleration *(DACC)*				Y	Y	Y	Y	Y	
		6004 (7004): During deceleration *(DDEC)*				Y	Y	Y	Y	Y	
		6005 (7005): Under anti-regenerative control *(REGA)*				Y	Y	Y	Y	Y	
		6006 (7006): Within dancer reference position *(DR_REF)*				Y	Y	Y	Y	Y	
		6007 (7007): Alarm factor presence *(ALM_ACT)* * Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.)				Y	Y	Y	Y	Y	
U03	(Logic circuit)	0: No function assigned 1: Through output + General-purpose timer 2: ANDing + General-purpose timer 3: ORing + General-purpose timer 4: XORing + General-purpose timer 5: Set priority flip-flop + General-purpose timer 6: Reset priority flip-flop + General-purpose timer 7: Rising edge detector + General-purpose timer 8: Falling edge detector + General-purpose timer 9: Rising & falling edges detector + General-purpose timer 10: Hold + General-purpose timer 11: Increment counter 12: Decrement counter 13: Timer with reset input	N	Y	0	Y	Y	Y	Y	Y	
U04	(Type of timer)	0: No timer 1: On-delay timer 2: Off-delay timer 3: Pulse 4: Retriggerable timer 5: Pulse train output	N	Y	0	Y	Y	Y	Y	Y	
U05	(Time setting)	0.00 to 600.00	N	Y	0.00	Y	Y	Y	Y	Y	
U06	Customizable logic (Input 1)	See U01.	N	Y	0	See U01.					
U07	Step 2 (Input 2)	See U02.	N	Y	0	See U02.					
U08	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U09	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U10	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U11	Customizable logic (Input 1)	See U01.	N	Y	0	See U01.					
U12	Step 3 (Input 2)	See U02.	N	Y	0	See U02.					
U13	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U14	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U15	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U16	Customizable logic (Input 1)	See U01.	N	Y	0	See U01.					
U17	Step 4 (Input 2)	See U02.	N	Y	0	See U02.					
U18	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U19	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U20	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U21	Customizable logic (Input 1)	See U01.	N	Y	0	See U01.					
U22	Step 5 (Input 2)	See U02.	N	Y	0	See U02.					
U23	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U24	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U25	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	PG V/f	w/o PG	w/ PG	Torque control	Refer to page:
U26	Customizable Logic: (Input 1)	See U01.	N	Y	0	See U01.					5-249
U27	Step 6 (Input 2)	See U02.	N	Y	0	See U02.					
U28	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U29	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U30	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U31	Customizable Logic: (Input 1)	See U01.	N	Y	0	See U01.					
U32	Step 7 (Input 2)	See U02.	N	Y	0	See U02.					
U33	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U34	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U35	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U36	Customizable Logic: (Input 1)	See U01.	N	Y	0	See U01.					
U37	Step 8 (Input 2)	See U02.	N	Y	0	See U02.					
U38	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U39	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U40	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U41	Customizable Logic: (Input 1)	See U01.	N	Y	0	See U01.					
U42	Step 9 (Input 2)	See U02.	N	Y	0	See U02.					
U43	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U44	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U45	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U46	Customizable Logic: (Input 1)	See U01.	N	Y	0	See U01.					
U47	Step 10 (Input 2)	See U02.	N	Y	0	See U02.					
U48	(Logic circuit)	See U03.	N	Y	0	Y	Y	Y	Y	Y	
U49	(Type of timer)	See U04.	N	Y	0	Y	Y	Y	Y	Y	
U50	(Time setting)	See U05.	N	Y	0.00	Y	Y	Y	Y	Y	
U71	Customizable Logic Output signal 1 (Output selection)	0: Disable 1: Output of step 1 ***(SO01)*** 2: Output of step 2 ***(SO02)*** 3: Output of step 3 ***(SO03)*** 4: Output of step 4 ***(SO04)*** 5: Output of step 5 ***(SO05)*** 6: Output of step 6 ***(SO06)*** 7: Output of step 7 ***(SO07)*** 8: Output of step 8 ***(SO08)*** 9: Output of step 9 ***(SO09)*** 10: Output of step 10 ***(SO10)***	N	Y	0	Y	Y	Y	Y	Y	
U72	Output signal 2 (Output selection)		N	Y	0	Y	Y	Y	Y	Y	
U73	Output signal 3 (Output selection)		N	Y	0	Y	Y	Y	Y	Y	
U74	Output signal 4 (Output selection)		N	Y	0	Y	Y	Y	Y	Y	
U75	Output signal 5 (Output selection)		N	Y	0	Y	Y	Y	Y	Y	
U81	Customizable Logic Output signal 1 (Function selection)	0 (1000): Select multi-frequency (0 to 1 step) ***(SS1)***	N	Y	100	Y	Y	Y	Y	N	
		1 (1001): Select multi-frequency (0 to 3 steps) ***(SS2)***				Y	Y	Y	Y	N	
U82	Output signal 2 (Function selection)	2 (1002): Select multi-frequency (0 to 7 steps) ***(SS4)***	N	Y	100	Y	Y	Y	Y	N	
U83	Output signal 3 (Function selection)	3 (1003): Select multi-frequency (0 to 15 steps) ***(SS8)***	N	Y	100	Y	Y	Y	Y	N	
U84	Output signal 4 (Function selection)	4 (1004): Select ACC/DEC time (2 steps) ***(RT1)***	N	Y	100	Y	Y	Y	Y	N	
U85	Output signal 5 (Function selection)	5 (1005): Select ACC/DEC time (4 steps) ***(RT2)***	N	Y	100	Y	Y	Y	Y	N	
		6 (1006): Self-hold ***(HLD)***				Y	Y	Y	Y	Y	
		7 (1007): Coast to a stop ***(BX)***				Y	Y	Y	Y	Y	
		8 (1008): Reset alarm ***(RST)***				Y	Y	Y	Y	Y	
		9 (1009): Enable external alarm trip ***(THR)*** (9 = Active OFF, 1009 = Active ON)				Y	Y	Y	Y	Y	
		10 (1010): Ready for jogging ***(JOG)***				Y	Y	Y	Y	N	
		11 (1011): Select frequency command 2/1 ***(Hz2/Hz1)***				Y	Y	Y	Y	N	
		12 (1012): Select motor 2 ***(M2)***				Y	Y	Y	Y	Y	
		13: Enable DC braking ***(DCBRK)***				Y	Y	Y	Y	N	
		14 (1014): Select torque limiter level 2/1 ***(TL2/TL1)***				Y	Y	Y	Y	Y	
		15: Switch to commercial power (50 Hz) ***(SW50)***				Y	Y	N	N	N	
		16: Switch to commercial power (60 Hz) ***(SW60)***				Y	Y	N	N	N	
		17 (1017): UP command ***(UP)***				Y	Y	Y	Y	N	
		18 (1018): DOWN command ***(DOWN)***				Y	Y	Y	Y	N	
		20 (1020): Cancel PID control ***(Hz/PID)***				Y	Y	Y	Y	N	
		21 (1021): Switch normal/inverse operation ***(IVS)***				Y	Y	Y	Y	N	
		22 (1022): Interlock ***(IL)***				Y	Y	Y	Y	Y	
		23 (1023): Cancel torque control ***(Hz/TRQ)***				N	N	N	N	Y	
		24 (1024): Enable communications link via RS-485 or fieldbus (optional) ***(LE)***				Y	Y	Y	Y	Y	
		25 (1025): Universal DI ***(U-DI)***				Y	Y	Y	Y	Y	
		26 (1026): Enable auto search for idling motor speed at starting ***(STM)***				Y	Y	Y	N	Y	
		30 (1030): Force to stop ***(STOP)*** (30 = Active OFF, 1030 = Active ON)				Y	Y	Y	Y	Y	

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control V/f	Drive control PG V/f	Drive control w/o PG	Drive control w/ PG	Drive control Torque control	Refer to page:
		32 (1032): Pre-excitation ***(EXITE)***				N	N	Y	Y	N	5-249
		33 (1033): Reset PID integral and differential components ***(PID-RST)***				Y	Y	Y	Y	N	
		34 (1034): Hold PID integral component ***(PID-HLD)***				Y	Y	Y	Y	N	
		35 (1035): Select local (keypad) operation ***(LOC)***				Y	Y	Y	Y	Y	
		36 (1036): Select motor 3 ***(M3)***				Y	Y	Y	Y	Y	
		37 (1037): Select motor 4 ***(M4)***				Y	Y	Y	Y	Y	
		39: Protect motor from dew condensation ***(DWP)***				Y	Y	Y	Y	Y	
		40: Enable integrated sequence to switch to commercial power (50 Hz) ***(ISW50)***				Y	Y	N	N	N	
		41: Enable integrated sequence to switch to commercial power (60 Hz) ***(ISW60)***				Y	Y	N	N	N	
		47 (1047): Servo-lock command ***(LOCK)***				N	N	N	Y	N	
		49 (1049): Pulse train sign ***(SIGN)***				Y	Y	Y	Y	Y	
		59 (1059): Enable battery-driven operation ***(BATR***				Y	Y	Y	Y	Y	
		70 (1070): Cancel constant peripheral speed control ***(Hz/LSC)***				Y	Y	Y	Y	N	
		71 (1071): Hold the constant peripheral speed control frequency in the memory ***(LSC-HLD)***				Y	Y	Y	Y	N	
		72 (1072): Count the run time of commercial power-driven motor 1 ***(CRUN-M1)***				Y	Y	N	N	Y	
		73 (1073): Count the run time of commercial power-driven motor 2 ***(CRUN-M2)***				Y	Y	N	N	Y	
		74 (1074): Count the run time of commercial power-driven motor 3 ***(CRUN-M3)***				Y	Y	N	N	Y	
		75 (1075): Count the run time of commercial power-driven motor 4 ***(CRUN-M4)***				Y	Y	N	N	Y	
		76 (1076): Select droop control ***(DROOP)***				Y	Y	Y	Y	N	
		77 (1077): Cancel PG alarm ***(PG-CCL)***				N	Y	N	Y	Y	
		81 (1081): Clear all customizable logic timers ***(CLTC)***				Y	Y	Y	Y	Y	
		98: Run/stop forward ***(FWD)***				Y	Y	Y	Y	Y	
		99: Run/stop reverse ***(REV)***				Y	Y	Y	Y	Y	
		100: No function assigned ***(NONE)***				Y	Y	Y	Y	Y	
		110 (1110): Servo-lock (Gain) ***(SLG2)***				N	N	N	Y	N	
		111 (1111): Force to stop (terminal block only) ***(STOP-T)*** (111 = Active OFF, 1111 = Active ON)				Y	Y	Y	Y	Y	
		* Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.)									
U91	Customizable logic timer monitor (Step selection)	1: Step 1 2: Step 2 3: Step 3 4: Step 4 5: Step 5 6: Step 6 7: Step 7 8: Step 8 9: Step 9 10: Step 10	N	Y	1	Y	Y	Y	Y	Y	

Table 5.2-16

■ y codes: LINK Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control: V/f	Drive control: PG V/f	Drive control: w/o PG	Drive control: w/ PG	Drive control: Torque control	Refer to page:
y01	RS-485 Communication 1 (Station address)	1 to 255	N	Y	1	Y	Y	Y	Y	Y	5-272
y02	(Communications error processing)	0: Immediately trip with alarm Er8 1: Trip with alarm Er8 after running for the period specified by the timer 2: Retry during the period specified by the timer. If the retry fails, trip with alarm Er8. If it succeeds, continue to run. 3: Continuity of running	Y	Y	0	Y	Y	Y	Y	Y	
y03	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	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	Y	Y	
y05	(Data length)	0: 8 bits; 1: 7 bits	Y	Y	0	Y	Y	Y	Y	Y	
y06	(Parity bit selection)	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	Y	Y	
y07	(Stop bit selection)	0: 2 bits; 1: 1 bit	Y	Y	0	Y	Y	Y	Y	Y	
y08	(No-response error detection time)	0: No detection; 1 to 60 s	Y	Y	0	Y	Y	Y	Y	Y	
y09	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	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	Y	Y	
y11	RS-485 Communication 2 (Station address)	1 to 255	N	Y	1	Y	Y	Y	Y	Y	5-272
y12	(Communications error processing)	0: Immediately trip with alarm ErP 1: Trip with alarm ErP after running for the period specified by the timer 2: Retry during the period specified by the timer. If the retry fails, trip with alarm ErP. If it succeeds, continue to run. 3: Continuity of running	Y	Y	0	Y	Y	Y	Y	Y	
y13	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	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	Y	Y	
y15	(Data length)	0: 8 bits; 1: 7 bits	Y	Y	0	Y	Y	Y	Y	Y	
y16	(Parity bit selection)	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	Y	Y	
y17	(Stop bit selection)	0: 2 bits; 1: 1 bit	Y	Y	0	Y	Y	Y	Y	Y	
y18	(No-response error detection time)	0: No detection; 1 to 60 s	Y	Y	0	Y	Y	Y	Y	Y	
y19	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	Y	Y	Y	
y20	(Protocol selection)	0: Modbus RTU protocol 1: FRENIC Loader protocol (SX protocol) 2: Fuji general-purpose inverter protocol	Y	Y	0	Y	Y	Y	Y	Y	
y96	Reserved *9	0 to 1	Y	Y	0	-	-	-	-	-	-
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	Y	Y	5-275
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	Y	Y	5-191 5-275
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	Y	Y	5-276

*9 These function codes are reserved for particular manufacturers. Do not access these function codes.

Table 5.2-17 Factory Defaults Depending upon Inverter Capacity

<table>
<tr><th>Inverter capacity (kW)</th><th>Torque boost 1 to 4 F09/A05/b05/r05</th><th>Auto-restart after momentary power failure (Restart time) H13</th><th>Inverter capacity (kW)</th><th>Torque boost 1 to 4 F09/A05/b05/r05</th><th>Auto-restart after momentary power failure (Restart time) H13</th></tr>
<tr><td>0.4</td><td>7.1</td><td rowspan="7">0.5</td><td>55</td><td rowspan="14">0.0</td><td rowspan="4">1.5</td></tr>
<tr><td>0.75</td><td rowspan="3">6.8</td><td>75</td></tr>
<tr><td>1.5</td><td>90</td></tr>
<tr><td>2.2</td><td>110</td></tr>
<tr><td>3.7</td><td>5.5</td><td>132</td><td rowspan="2">2.0</td></tr>
<tr><td>5.5</td><td>4.9</td><td>160</td></tr>
<tr><td>7.5</td><td>4.4</td><td>200</td><td rowspan="3">2.5</td></tr>
<tr><td>11</td><td>3.5</td><td rowspan="6">1.0</td><td>220</td></tr>
<tr><td>15</td><td>2.8</td><td>280</td></tr>
<tr><td>18.5</td><td rowspan="2">2.2</td><td>315</td><td rowspan="2">4.0</td></tr>
<tr><td>22</td><td>355</td></tr>
<tr><td>30</td><td rowspan="3">0.0</td><td>400</td><td rowspan="3">5.0</td></tr>
<tr><td>37</td><td>500</td></tr>
<tr><td>45</td><td>1.5</td><td>630</td></tr>
</table>

Table 5.2-18 Motor Parameters

[1] When "Fuji standard motors, 8-series" or "Other motors" is selected with P99/A39/b39/r39 (data = 0 or 4)

■ Three-phase 200 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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	0.44	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	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

■ Three-phase 400 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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	85	0.027	0.5
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	
0.40 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		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	2.0
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	
22.00 to 29.99	22	39.00	12.60	2.70	16.00	0.90	3.28	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	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	90	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		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 to 314.9	280	462.0	93.70	1.36	19.18		1.27	92.7	85.6	72.9	60.9		109.3	120.2	133.5	449.1		0.589	5.5
315.0 to 354.9	315	520.0	120.0	0.84	16.68	0.45	1.81									505.2		0.862	5.6
355.0 to 399.9	355	580.0	132.0	0.83	16.40	0.43	1.77									569.3		0.891	
400.0 to 449.9	400	670.0	200.0	0.62	15.67	0.29	1.58									641.5		0.683	7.5
450.0 to 499.9	450	770.0	270.0	0.48	13.03	0.23	1.84									721.7		0.694	9.8
500.0 to 559.9	500	835.0		0.51	12.38	0.18	1.80									801.9		1.393	
560.0 to 629.9	560	940.0		0.57	13.94	0.20	1.61									898.1			
630.0 to 709.9	630	1050.0	355.0	0.46	11.77	0.17	1.29									1010		1.395	10.5
710.0 or above	710	1150.0	290.0	0.54	14.62	0.21	0.97									1139		1.560	

[2] When "Fuji standard motors, 6-series" is selected with P99/A39/b39/r39 (data = 3)

■ Three-phase 200 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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	0.44	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	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	1.00	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	
0.40 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	1.07	3.92	91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9	37.36		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	2.0
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	
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

■ Three-phase 400 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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	85	0.027	0.5
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	
0.40 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		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	2.0
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	
22.00 to 29.99	22	39.00	12.60	2.70	16.05	0.90	3.28	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	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	90	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		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 to 314.9	280	462.0	93.70	1.36	19.18	0.54	1.27	92.7	85.6	72.9	60.9		109.3	120.2	133.5	449.1		0.589	5.5
315.0 to 354.9	315	520.0	120.0	0.84	16.68	0.45	1.81									505.2		0.862	5.6
355.0 to 399.9	355	580.0	132.0	0.83	16.40	0.43	1.77									569.3		0.891	
400.0 to 449.9	400	670.0	200.0	0.62	15.67	0.29	1.58									641.5		0.683	7.5
450.0 to 499.9	450	770.0	270.0	0.48	13.03	0.23	1.84									721.7		0.694	9.8
500.0 to 559.9	500	835.0		0.51	12.38	0.18	1.80									801.9		1.393	
560.0 to 629.9	560	940.0		0.57	13.94	0.20	1.61									898.1			
630.0 to 709.9	630	1050.0	355.0	0.46	11.77	0.17	1.29									1010		1.395	10.5
710.0 or above	710	1150.0	290.0	0.54	14.62	0.21	0.97									1139		1.560	

[3] When "Fuji motors exclusively designed for vector control" is selected with P99/A39/b39/r39 (data = 2)

■ 200 V class series

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 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	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	200	0.44	0.40	13.79	11.75	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	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	15.62	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

Chapter 5 Function Code

■ 400 V class series

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 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	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	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	0.10	85	0.027	0.5
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	
0.40 to 0.74	0.4	400	1.15	0.83	10.20	13.66		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		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	2.0
18.50 to 21.99	18.5	376	37.00	14.02	2.66	12.45	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	36.06	85	0.148	
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 to 244.9	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	
250.0 to 279.9	250	400																					5.0
280.0 to 314.9	280																						5.5
315.0 to 354.9	315																						5.6
355.0 to 399.9	355																						
400.0 to 449.9	400																						7.5
450.0 to 529.9	450																						9.8
530.0 or above	530																						

[4] When "HP rating motors" is selected with P99/A39/b39/r39 (data = 1)

■ 200 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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 0.11	0.1	0.44	0.40	13.79	11.75	2.50	14.00	93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8	0.21	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 to 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

■ 400 V class series

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	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	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	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 0.11	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	
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	2.0
30.00 to 39.99	30	36.2	9.88	1.90	32.55	1.00	3.28	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	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			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		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		109.9	122.2	137.8	339.9			5.0
350.0 to 399.9	350	375.0	68.3	0.99	19.24	0.46	1.27									366.1		1.126	5.5
400.0 to 449.9	400	429.0	80.7	1.11	18.92	0.46	1.81									418.4	90	1.098	5.6
450.0 to 499.9	450	481.0	85.5	0.95	19.01	0.48	1.77									470.7		1.107	
500.0 to 599.9	500	534.0	99.2	1.05	18.39	0.45	1.58	92.7	85.6	72.9	60.9	48.9	109.3	120.2	133.5	523.0		1.128	7.5
600.0 to 699.9	600						1.84									627.6		1.098	
700.0 to 749.9	700	638.0	140.0	0.85	18.38	0.39										732.2		0.578	9.8
750.0 to 799.9	750						1.70									784.0			
800.0 or above	800															837.0		0.842	10.5

5.3 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.

Table 5.3-1

To	Function code	Name	Refer to page:
Set the command source that specifies reference frequency.	F01	Frequency Command 1	5-62
Select the source that specifies a run command that runs or stops the motor.	F02	Operation Method	5-71
Specify the maximum frequency to limit the output frequency (motor rotation).	F03	Maximum Output Frequency 1	5-72
Limit the reference frequency.	F16	Frequency Limiter (Low)	5-93
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	5-72
Specify the acceleration/deceleration time.	F07 F08	Acceleration Time 1 Deceleration Time 1	5-76
Adjust the output voltage with the torque boost to secure a sufficient starting torque.	F09	Torque Boost 1	5-79
Protect the motor.	F10 F11	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics) (Operation level)	5-80
Select the restart mode to apply after momentary power failure.	F14	Restart Mode after Momentary Power Failure (Mode selection)	5-83
Reduce an audible noise generated by the motor.	F26	Motor Sound (Carrier frequency)	5-99
Remove restrictions on the menu display to use various checking functions on the keypad.	E52	Keypad (Menu display mode)	5-161
Specify the motor parameters.	P02 P03 P04 P99	Motor 1 (Rated capacity) (Rated current) (Auto-tuning) Motor 1 Selection	5-175 5-176 5-177 5-180

5.3.2 Setting up the frequency

[1] Frequency setting from the keypad

Table 5.3-2

To	Function code	Name	Refer to page:
Set up the reference frequency from the keypad.	F01 E64	Frequency Command 1 Saving of Digital Reference Frequency	5-62 5-163

[2] Frequency setting by analog input

Table 5.3-3

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	5-62

To	Function code	Name	Refer to page:
Apply bias and gain (e.g., 1 to 5 V) 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 command1) (Bias base point)	5-62
	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)	5-173
Select the polarity for terminal [12] or [V2]: bipolar (e.g., -10 V and +10 V) or unipolar (e.g., -10 V).	C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	5-173
Use terminal [C1] in the range 0 to 20 mA *4	C40	Selection of Terminal [C1] Range	5-173
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)	5-173
Suppress noise superimposed on analog input with the filter.	C33 C38 C43	Analog Input Adjustment for: [12] (Filter) [C1] (Filter) [V2] (Filter)	5-173
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 to E09	Selection of Normal/Inverse Operation (Frequency command 1) Terminal [X1] to [X9] Functions ***(IVS)***	5-174 5-122
Detect an external frequency command potentiometer failure or a potentiometer wire break, output an alarm, and continue the inverter operation.	E65 E20 to E24	Reference Loss Detection (Continuous running frequency) Terminal [Y1] to [Y5A/C] Functions ***(REF OFF)***	5-163 5-141

*4 Available for inverters with ROM version 3600 or later.

[3] Other frequency settings

Table 5.3-4

To		Function code	Name	Refer to page:
UP/DOWN	Set up the reference frequency with the terminal command UP (acceleration) or DOWN (deceleration).	F01 E01 to E09	Frequency Command 1 Terminal [X1] to [X9] Functions ***(UP, DOWN)***	5-62 5-122
	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)	5-62
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 E01 to E09 C05 to C19	Frequency Command 1 Terminal [X1] to [X9] Functions ***(SS1, 2, 4, 8)*** Multi-frequency 1 to 15	5-62 5-122 5-166
Pulse train input	Set up the reference frequency with pulse train input.	F01	Frequency Command 1	5-62
	Receive pulses from other motor's PG to perform ratio operation.	d59 d61 d62 d63 E01 to E09	**Command (Pulse Rate Input)** (Pulse input format) (Filter time constant) (Pulse count factor 1) (Pulse count factor 2) Terminal [X1] to [X9] Functions (Pulse train input ***PIN***, available only on terminal [X7]) (Pulse train sign ***SIGN***, available on terminals except [X7])	5-122
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 nearby.	F01 C30 E01 to E09	Frequency Command 1 Frequency Command 2 Terminal [X1] to [X9] Functions ***(Hz2/Hz1)***	5-62 5-122

To		Function code	Name	Refer to page:
UP/DOWN	Set up the reference frequency with the terminal command UP (acceleration) or DOWN (deceleration).	F01 E01 to E09	Frequency Command 1 Terminal [X1] to [X9] Functions ***(UP, DOWN)***	5-62 5-122
	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)	5-62
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 E01 to E09 C05 to C19	Frequency Command 1 Terminal [X1] to [X9] Functions ***(SS1, 2, 4, 8)*** Multi-frequency 1 to 15	5-62 5-122 5-166
Pulse train input	Set up the reference frequency with pulse train input.	F01	Frequency Command 1	5-62
	Receive pulses from other motor's PG to perform ratio operation.	d59 d61 d62 d63 E01 to E09	**Command (Pulse Rate Input)** (Pulse input format) (Filter time constant) (Pulse count factor 1) (Pulse count factor 2) Terminal [X1] to [X9] Functions (Pulse train input ***PIN***, available only on terminal [X7]) (Pulse train sign ***SIGN***, available on terminals except [X7])	5-122
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	5-162
Ratio setting	Apply the ratio setting using analog input to multiply the reference frequency by the ratio for override control.	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-162
Digital input interface card (optional) *1	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 Instruction Manual.)	F01	Frequency Command 1	5-62

*1 Available for inverters with ROM version 0500 or later.

5.3.3 Entering a run command

Table 5.3-5

To		Function code	Name	Refer to page:
Keypad	Run or stop the motor with the keys on the keypad.	F02 E98 E99 E20 to E24	Operation Method Terminal [FWD] Function Terminal [REV] Function Terminal [Y1] to [Y5A/C] Functions ***(KP)***	5-71 5-122 5-141
External signals	Run or stop the motor with terminal commands ***FWD and REV*** assigned to terminals [FWD] and [REV] (2-wire operation).	F02 E98 E99	Operation Method Terminal [FWD] Function Terminal [REV] Function	5-71 5-122
	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 E98 E99 E01 to E09	Operation Method Terminal [FWD] Function Terminal [REV] Function Terminal [X1] to [X9] Functions ***(HLD)***	5-71 5-122

5.3.4 Starting/stopping the motor

Table 5.3-6

To		Function code	Name	Refer to page:
Starting frequency	Start the motor smoothly.	F23 F24	Starting Frequency 1 Starting Frequency 1 (Holding time)	5-96
Auto search	Search for the idling motor speed to restart the motor without stopping and shock.	H09 H49 H46 E01 to E09	Starting Mode (Auto search) (Auto search delay time 1) (Auto search delay time 2) Terminal [X1] to [X9] Functions ***(STM)***	5-184 5-122
Pre-excitation	Compensate for insufficient torque (due to magnetic flux lag) at startup to accelerate the motor promptly.	H84 H85 E01 to E09	Pre-excitation (Initial level) (Time) Terminal [X1] to [X9] Functions ***(EXITE)***	5-205 5-122
Stopping the motor	Stop the motor smoothly. Prevent torque from being insufficient in a low speed zone when stopping the motor.	F25 F38 F39	Stop Frequency Stop Frequency (Detection mode) Stop Frequency (Holding time)	5-96
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) (Operation level) (Braking time) (Braking response mode)	5-94
	Apply DC braking with a terminal command sent from external equipment.	E01 to E09	Terminal [X1] to [X9] Functions ***(DCBRK)***	5-122
Force to stop	Use the forced stop function for safety.	H56 E01 to E09	Deceleration Time for Forced Stop Terminal [X1] to [X9] Functions ***(STOP)***	5-76 5-122
Coast to a stop	Use the coast-to-stop function for safety.	E01 to E09	Terminal [X1] to [X9] Functions ***(BX)***	5-122

5.3.5 Specifying the acceleration/deceleration (time, mode, and pattern)

Table 5.3-7

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	5-76
Switch between ACC/DEC times	Switch the acceleration or deceleration time.	E01 to 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	5-122 5-76
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. Allow the motor to coast to a stop in order to prevent conflict with the mechanical brake.	H11	Deceleration Mode	5-186
S-curve acceleration/deceleration	Apply S-curve to the acceleration/deceleration pattern to gradually accelerate/decelerate 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)	5-76
Curvilinear acceleration/deceleration	Select the curvilinear acceleration/deceleration pattern to accelerate or decelerate the motor with its maximum performance.	H07	Curvilinear acceleration/deceleration	5-76

To		Function code	Name	Refer to page:
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 to E09 E20 to E24	Torque Limit Value 1-1 Torque Limit Value 1-2 Torque Limit Value 2-1 Torque Limit Value 2-2 Torque Limit (Operating conditions) Torque Limit (Frequency increment limit for braking) Terminal [X1] to [X9] Functions ***(TL2/TL1)*** Terminals [Y1] to [Y5A/C] Functions ***(IOL, IOL2)***	5-107 5-200 5-122 5-141

5.3.6 Adjusting the running performance

Table 5.3-8

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	5-104
	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)	5-72
Torque boost	Ensure a sufficient starting torque.	F09	Torque Boost 1	5-104
	Prevent the motor from over-excitation while assuring a sufficient starting torque.	F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1	5-104
Jump frequency	Skip resonance caused by the motor speed and natural frequency of the machinery (load) in running the motor.	C01 to C04	Jump Frequency 1 to 4	5-166
Current Fluctuation Damping	Stabilize motor current	H80	Output Current Fluctuation Damping Gain for Motor 1	5-202
Motor sound	Reduce an audible noise generated by the motor.	F26 F27	Motor Sound (Carrier frequency) (Tone)	5-99
Torque control	Improve the torque control stability under vector control without speed sensor *4	d82 d83	Magnetic flux weakening control (Vector control without speed sensor) Magnetic flux weakening lower limit (Vector control without speed sensor)	5-248

*4 Available for inverters with ROM version 3600 or later.

5.3.7 Controlling the motor

[1] Motor drive control to be selected

Table 5.3-9

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	5-114
Slip compensation	Improve the motor speed control accuracy by compensating for the decrease (slip) in motor rotation.	H68	Slip Compensation 1 (Operating conditions)	5-114
Speed control under vector control	Control the speed control sequence in normal operation.	d01 d02 d03 d04 d05 d06	Speed Control 1 (Speed command filter) (Speed detection filter) P (Gain) I (Integral time) (Feed forward gain) (Output filter)	5-235
	Apply a speed zero command.	d24	Zero Speed Control	5-96
	Apply a servo-lock command. *1 (Available only under vector control with speed sensor.)	E01 to E09	Terminal [X1] to [X9] Functions ***(LOCK)***	5-122
		E20 to E24	Terminal [X1] to [X9] Functions ***(SLG2)*** Terminal [Y1] to [Y5A/C] Functions ***(PSET)***	5-141
		J97 J98 J99 d27 d28	Servo-lock (Gain) (Completion timer) (Completion range) (Gain 2) (Gain switch time)	5-233
	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)	5-239
	Customize the speed feedback input. (Available only under vector control with speed sensor.)	d14 d15 d16 d17	Feedback Input (Pulse input format) (Pulse input format) (Encoder pulse resolution) (Pulse count factor 1) (Pulse count factor 2)	5-239

*1 Available for inverters with ROM version 0500 or later.

Table 5.3-10

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 d25 E01 to E09	Motor/Parameter Switching 2 ASR Switching Time Terminals [X1] to [X9] Functions ***(M2)***	5-211 5-122
		d01 d02 d03 d04 d05 d06	Speed Control 1 (Speed command filter) (Speed detection filter) P (Gain) I (Integral time) (Feed forward gain) (Output filter)	5-235
		A43 A44 A45 A46 A47 A48	Speed Control 2 (Speed command filter) (Speed detection filter) P (Gain) I (Integral time) (Feed forward gain) (Output filter)	-
	Decrease the speed loop gain only in the vicinity of the predetermined resonance points, suppressing the mechanical resonance. *2 (Only under vector control with speed sensor)	d07 d08	Speed Control 1 (Notch filter resonance frequency) (Notch filter attenuation level)	5-238
Speed Control Limiter	Specify a limiter for the PI value output calculated in speed control sequence. (Only under V/f control with speed sensor or dynamic torque vector with speed sensor)	d70	Speed Control Limiter	5-248
Torque control	Control the motor-generating torque according to a torque command sent from external sources.	H18 E01 to E09 E61 to E63 E98, E99	Torque Control (Mode selection) Terminal [X1] to [X9] Functions Terminal [12], [C1], [V2] Extended Functions Terminal [FWD], [REV] Functions	5-187 5-122 5-162 5-165

*2 Available for inverters with ROM version 1000 or later.

[2] Motor parameters to be set up

Table 5.3-11

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 P02 H03	Motor 1 Selection Motor 1 (Rated capacity) Data Initialization	5-180 5-175 5-181
Check the motor nameplate and specify the motor parameters.	P99 F04 F05 F06 F03 P01 P02 P03	Motor 1 Selection Base Frequency 1 Rated Voltage at Base Frequency 1 Maximum Output Voltage 1 Maximum Output Frequency 1 Motor 1 (No. of poles) (Rated capacity) (Rated current)	5-180 5-72 5-175 5-176
Perform motor parameter tuning (offline).	P04	Motor 1 (Auto-tuning)	5-177

To	Function code	Name	Refer to page:
Set up motor parameters according to tuning or the motor manufacturer's data sheet. (To use the data sheet, conversion is required.)	P06 P07 P08 P53,P54 P09 P10 P11 P12 P13 to P15 P16 to P20 P21 to P23	Motor 1 (No-load current) (%R1) (%X) (%X correction factor 1, 2) (Slip compensation gain for driving) (Slip compensation response time) (Slip compensation gain for braking) (Rated slip frequency) (Iron loss factor 1 to 3) (Magnetic saturation factor 1 to 5) (Magnetic saturation extension factor "a" to "c")	5-178 5-179 5-180
	P55 P56	Motor 1 (Torque current under vector control) (Induced voltage factor under vector control)	5-180
Identify a motor constant that has responded to changes in motor temperature (Online tuning), and minimize speed fluctuation of the motor. *3	P05	Motor 1 (Online tuning)	5-178

*3 Available for inverters with ROM version 3000 or later.

5.3.8 Setting up I/O terminals

Table 5.3-12

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 to E09	Terminal [X1] to [X9] Functions	5-122
Assignment of functions to general-purpose output terminals	Output inverter or motor running status to the transistor or contact output signals.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions	5-141
Input/Output signals	Apply negative logic to general-purpose input/output.	E01 to E09 E20 to E24	Terminal [X1] to [X9] Functions Terminal [Y1] to [Y5A/C] Functions	5-122 5-141

5.3.9 Outputting monitored data

Table 5.3-13

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 SW4 F30 F31	Analog Output [FMA] (Mode selection) <Voltage/current output switch for terminal [FMA]> (Gain to output voltage) (Function selection)	5-101 2-34
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 selection)	5-103

5.3.10 Keeping on running the motor

Table 5.3-14

To		Function code	Name	Refer to page:
Retry	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 to E24	Auto-reset (Times) (Reset interval) Terminal [Y1] to [Y5A/C] Functions ***(TRY)***	5-182 5-141
Restart after momentary power failure	Continue to run the motor even if a momentary power failure occurs.	F14 H13 H14 H15 H16	Restart Mode after Momentary Power Failure (Mode selection) (Restart time) (Frequency fall rate) (Continuous running level) (Allowable momentary power failure time)	5-83
	When the power is restored, restart the inverter at the frequency at which a momentary power failure occurred.			
	When the power is restored after a momentary power failure, restart the inverter at the starting frequency.	H92 H93 E20 to E24 E01 to E09	Continuity of Running (P) Continuity of Running (I) Terminal [Y1] to [Y5A/C] Functions ***(LU)*** Terminal [X1] to [X9] Functions ***(IL)***	5-141 5-122
	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)	5-184
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 to E24	Automatic Deceleration (Mode selection) Torque Limiter (Frequency increment limit for braking) Terminal [Y1] to [Y5A/C] Functions ***(IOL, IOL2)***	5-198 5-141
Improvement of the braking capability		H71 d90 *4	Deceleration Characteristics Magnetic flux level during deceleration under vector control	5-200 5-248
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 to E24	Overload Prevention Control Terminal [Y1] to [Y5A/C] Functions ***(OLP)***	5-199 5-141
Command loss detected	Detect an external frequency command potentiometer failure or a potentiometer wire break, output an alarm, and continue the inverter operation.	E65 E20 to E24	Reference Loss Detection (Continuous running frequency) Terminal [Y1] to [Y5A/C] Functions***(REF OFF)***	5-163 5-141
Light alarm	Let the inverter continue the current operation without tripping even if a particular minor alarm occurs.	H81 H82 E20 to E24	Light Alarm Selection 1 Light Alarm Selection 2 Terminal [Y1] to [Y5A/C] Functions ***(L-ALM)***	5-203 5-141

*4 Available for inverters with ROM version 3600 or later.

Chapter 5 Function Code

5.3.11 Detecting and outputting status signals

Table 5.3-15

To		Function code	Name	Refer to page:
Frequency detection	Detect the motor running speed level.	E31 E32 E36 E54 E20 to E24	Frequency Detection (Operation level) (Hysteresis width) Frequency Detection 2 (Operation level) Frequency Detection 3 (Operation level) Terminal [Y1] to [Y5A/C] Functions ***(FDT, FDT2, FDT3)***	5-153 5-141
Frequency arrival	Judge whether the motor speed arrives at the target value.	E30 E20 to E24	Frequency Arrival (Detection width) Terminal [Y1] to [Y5A/C] Functions ***(FAR, FAR3)***	5-152 5-141
Torque detection	Check that the output torque reaches the predetermined level and is not excessively large.	E78 E79 E20 to E24	Torque Detection 1 (Operation level) (Timer) Terminal [Y1] to [Y5A/C] Functions ***(B/D, TD1)***	5-164 5-141
Low torque output	Detect low torque (no-load state) to signal a belt break or other problems in the driven machinery.	E80 E81 E20 to E24	Torque Detection 2/Low Torque Detection (Operation level) (Timer) Terminal [Y1] to [Y5A/C] Functions ***(B/D, U-TL, TD2)***	5-164 5-141
Current detected	Check that the current more than the predetermined level flows and excessive current does not flow.	E34 E35 E55 E56 E20 to E24	Overload Early Warning/Current Detection (Operation level) (Timer) Frequency Detection 3 (Operation level) (Timer) Terminal [Y1] to [Y5A/C] Functions ***(ID, ID3, OL)***	5-153 5-141
Low current detected	Detect low torque (no-load state) to signal a belt break or other problems in the driven machinery.	E37 E38 E20 to E24	Current Detection 2/Low Current Detection (Operation level) (Timer) Terminal [Y1] to [Y5A/C] Functions ***(ID2, ITL, IDL)***	5-154 5-141
Undervoltage	Output low voltage status.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(LU)***	5-141
Low Voltage Detection	Detect low voltage status.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(U-EDC)***	

5.3.12 Running in various operation modes

Table 5.3-16

To		Function code	Name	Refer to page:
Jogging Operation	Jog (inch) the motor with the keys on the keypad.	C20 H54 H55	Jogging Frequency Acceleration Time (Jogging) Deceleration Time (Jogging)	5-168 5-76
	Jog (inch) the motor with signals sent to terminals [FWD] or [REV].	E01 to E09	Terminal [X1] to [X9] Functions ***(JOG)***	5-122
	Enable ***JOG*** from communication.	d99 *4	Extended Function 1	5-248
Auto energy saving operation	Enable auto energy saving operation.	F37 H67	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1 Auto Energy Saving Operation (Mode selection)	5-104
	Manage energy.	E51 E01 to E09	Display Coefficient for Input Watt-hour Data Terminal [X1] to [X9] Functions ***(SW50, SW60)***	5-160 5-122
Operation by commercial power supply	Switch to commercial-power operation for energy saving or backup power supply to be used when an alarm occurs in the inverter.	J22 H13 E01 to E09 E20 to E24	Commercial Power Switching Sequence Restart Mode after Momentary Power Failure (Restart time) Terminal [X1] to [X9] ***(ISW50, ISW60)*** Terminal [Y1] to [Y5A/C] ***(SW88, SW52-1, SW52-2)***	5-135 5-83 5-122 5-141
Switching between motors	Drive two or more motors with a single inverter by switching between those motors.	A42 b42 r42 E01 to E09 E20 to E24	Motor/Parameter Switching 2 to 4 (Mode selection) Terminal [X1] to [X9] Functions ***(M2, M3, M4)*** Terminal [Y1] to [Y5A/C] Functions ***(SWM1, 2, 3, 4)***	5-211 5-122 5-141

*4 Available for inverters with ROM version 3600 or later.

Table 5.3-17

To		Function code	Name	Refer to page:
Brake signal	Use brake signals available for vertical carrier machines.	J68 J69 J70 J71 J72 J95 J96 E20 to E24	Brake Signal (Brake-OFF current) (Brake-OFF frequency/speed) (Brake-OFF timer) (Brake-ON frequency/speed) (Brake-ON timer) (Brake-OFF torque) (Speed selection) Terminal [Y1] to [Y5A/C] Functions ***(BRKS)***	5-229 5-141
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 E01 to E09 E20 to E24 d25	Motor/Parameter Switching 2 to 4 (Mode selection) Terminal [X1] to [X9] Functions ***(M2, M3, M4)*** Terminal [Y1] to [Y5A/C] Functions ***(SWM1, 2, 3, 4)*** ASR Switching Time	5-211 5-122 5-141
SY Synchronous Operation	Perform synchronous operation using PG interface card (OPC-G1-PG/ OPC-G1-PG22). *3	E01 to E09 E20 to E24	Terminal [X1] to [X9] Functions ***(Hz2/Hz1)*** Terminal [Y1] to [Y5A/C] Functions ***(SY)***	5-122 5-141
		d14 d15 d16 d17	Feedback Input (Pulse input format) (Encoder pulse resolution) (Encoder pulse resolution) (Encoder pulse resolution)	5-239
		d41	Application-defined control	5-245
		d59 d60 d61 d62 d63	Command (Pulse Rate Input) (Pulse input format) (Encoder pulse resolution) (Filter time constant) (Pulse count factor 1) (Pulse count factor 2)	5-62
		d71 d72 d73 d74 d75 d76 d77 d78	Synchronous operation (Main ASR gain) (APR P gain) (APR output + side limitter) (APR output - side limitter) (Z phase agreement gain) (Synchronous offset angle) (Synchronization completion detection angle) (Deviation excess detection width)	5-247
Battery-driven operation *4	Run the inverter in an undervoltage status with a battery power supply.	E01 to E09 U81 to U85	Terminal [X1] to [X9] Functions ***(BATRY)*** Customizable Logic Output Signals 1 to 5 (Function selection)	5-122 5-249
Pattern operation *5	Perform pattern operation with predetermined run time, rotation direction, ACC/DEC time, and reference frequency.	F01/C30 C21 C22 to C28 C82 to C88	Select frequency command 1/2 Pattern operation (Mode selection) (Stage 1 to 7 run time) (Stage 1 to 7 rotation direction; ACC/DEC time)	

*4 Available for inverters with ROM version 3600 or later.
*5 Available for inverters with ROM version 3800 or later.

5.3.13 Setting up controls suited for individual applications

[1] Droop control

Table 5.3-18

To	Function code	Name	Refer to page:
Eliminate load unbalance using droop control.	H28 E01 to E09	Droop Control Terminals [X1] to [X9] Functions ***(DROOP)***	5-190 5-122

[2] PID process control

Table 5.3-19

To		Function code	Name	Refer to page:
Exercise process control for pressure, flow, temperature, etc.		J01	PID Control (Mode selection)	5-214
Normal/inverse operation	Switch between normal/reverse operation for the PID output in cooling and heating.	J01 E01 to E09	PID Control (Mode selection) Terminal [X1] to [X9] Functions ***(IVS)***	5-214 5-122
PID command	Specify a PID command using the keypad.	J02	PID Control (Remote command)	5-215
	Specify a PID command with analog input.	J02 E61 E62 E63	PID Control (Remote command) Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-215 5-162
		C51 C52	Bias (PID command 1) (Bias value) (Bias base point)	5-174
		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)	5-173
		C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-173
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter) [C1] (Filter) [V2] (Filter)	5-173
		C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	5-173
	Specify a PID command with UP or DOWN command.	J02 E01 to E09 H61	PID Control (Remote command) Terminal [X1] to [X9] Functions ***(UP, DOWN)*** UP/DOWN Control (Initial frequency setting)	5-215 5-122 5-62
	Specify a PID command via a communications link.	J02	PID Control (Remote command)	5-215
	Define different PID commands beforehand and switch them with the multi-frequency selection signals.	J02 E01 to E09 C08 C12 C16	PID Control (Remote command) Terminal [X1] to [X9] Functions ***(SS4, SS8)*** Multi-frequency 4 Multi-frequency 8 Multi-frequency 12	5-215 5-122 5-166
PID feedback	Set up analog input feedback for PID control.	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-162
		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)	5-173

To		Function code	Name	Refer to page:
PID feedback	Set up analog input feedback for PID control.	C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-173
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter) [C1] (Filter) [V2] (Filter)	5-173
PID optimization	Optimize the PID processor.	J03 J04 J05 J06 J56	PID Control P (Gain) I (Integral time) D (Differential time) (Feedback filter) (Speed command filter for PID)	5-219 5-228
Anti reset windup	Suppress overshoot in control with the PID processor.	J10	PID Control (Anti reset windup)	5-225
Alarm output	Output an alarm signal associated with PID control (e.g., deviation alarm and absolute-value alarm).	J11 J12 J13 E20 to E24	PID Control (Select alarm output) (Upper level alarm ***(AH)***) (Lower level alarm ***(AL)***) Terminal [Y1] to [Y5A/C] Functions ***(PID-ALM)***	5-225 5-141
	PID Feedback Wire Break Detection	H91 E20 to E24	PID Feedback Wire Break Detection Terminal [Y] to [Y5A/C] Functions ***(C1OFF)***	5-207 5-141
Slow flowrate stop feature	Use the slow flowrate stop feature, enabling energy saving operation.	J15 J16 J17 E20 to E24 J08 J09	PID Control (Stop frequency for slow flowrate) (Slow flowrate level stop latency) (Starting frequency) Terminal [Y1] to [Y5A/C] Functions ***(PID-STP)*** PID Control (Pressurization starting frequency) PID Control (Pressurizing time)	5-223 5-141
Output limiter	Limit the PID output with the upper and lower limiters.	J18 J19	PID Control (Upper limit of PID process output) (Lower limit of PID process output)	5-227
PID control	Hold/reset the PID processor or cancel PID control from external equipment.	E01 to E09	Terminal [X1] to [X9] Functions ***(PID-HLD, Hz/PID, PID-RST)***	5-122
"Under PID control" signal output	Output the "Under PID control" signal from the specified output terminal.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(PID-CTL)***	5-141
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	5-155

[3] PID dancer control

Table 5.3-20

To		Function code	Name	Refer to page:
Exercise speed control for dancer positioning, etc.		J01 J62	PID Control (Mode selection) (PID control block selection)	5-214 5-228
PID command	Specify a PID command using the keypad.	J02 J57	PID Control (Remote command) (Dancer reference position)	5-215 5-228
PID command	Specify a PID command with analog input.	J02 E61 E62 E63	PID Control (Remote command) Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-215 5-162
		C51 C52	Bias (PID command 1) (Bias value) (Bias base point)	5-174
		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)	5-173
		C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-173
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter) [C1] (Filter) [V2] (Filter)	5-173
		C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	5-173
PID command	Specify a PID command with UP or DOWN command.	J02 E01 to E09 H61	PID Control (Remote command) Terminal [X1] to [X9] Functions ***(UP, DOWN)*** UP/DOWN Control (Initial frequency setting)	5-215 5-122 5-62
	Specify a PID command via a communications link.	J02	PID Control (Remote command)	5-215
	Define different PID commands beforehand and switch them with the multi-frequency selection signals.	J02 E01 to E09 C08 C12 C16	PID Control (Remote command) Terminal [X1] to [X9] Functions ***(SS4, SS8)*** Multi-frequency 4 Multi-frequency 8 Multi-frequency 12	5-215 5-122 5-166
PID feedback	Set up analog input feedback for PID control.	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-162
		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)	5-173

To		Function code	Name	Refer to page:
PID feedback	Set up analog input feedback for PID control.	C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-173
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter) [C1] (Filter) [V2] (Filter)	5-173
PID optimization	Optimize the PID processor.	J03 J04 J05 J06 J56	PID Control P (Gain) I (Integral time) D (Differential time) (Feedback filter) (Speed command filter for PID)	5-219 5-228
	Switch the PID processor constants if the dancer roll comes into the vicinity of the target position.	J58 J59 J60 J61	PID Control (Detection width of dancer position deviation) P (Gain) 2 I (Integral time) 2 D (Differential time) 2	5-228
Anti reset windup	Suppress overshoot in control with the PID processor.	J10	PID Control (Anti reset windup)	5-225
Alarm output	Output an alarm signal associated with PID control (e.g., deviation alarm and absolute-value alarm).	J11 J12 J13 E20 to E24	PID Control (Select alarm output) (Upper level alarm (AH)) (Lower level alarm (AL)) Terminal [Y1] to [Y5A/C] Functions ***(PID-ALM)***	5-225 5-141
	PID Feedback Wire Break Detection	H91 E20 to E24	PID Feedback Wire Break Detection Terminal [Y1] to [Y5A/C] Functions ***(C1OFF)***	5-207 5-141
Output limiter	Limit the PID output with the upper and lower limiters.	J18 J19	PID Control (Upper limit of PID process output) (Lower limit of PID process output)	5-227
PID control	Hold/reset the PID processor or cancel PID control from external equipment.	E01 to E09	Terminal [X1] to [X9] Functions ***(PID-HLD, Hz/PID, PID-RST)***	5-122
"Under PID control" signal output	Output the "Under PID control" signal from the specified output terminal.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(PID-CTL)***	5-141
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	5-155
Constant peripheral speed control	Select constant peripheral speed control that suppresses an increase in peripheral speed (line speed) resulting from the increasing radius of the take-up roll in a winder system. *2	d41 E01 to E09	Application-defined Control Terminal [X1] to [X9] Functions	5-245 5-122

*2 Available for inverters with ROM version 1000 or later.

5.3.14 Customizing the keypad

Table 5.3-21

To	Function code	Name	Refer to page:
Protect function code data from accidentally getting changed.	F00 E01 to E09	Data Protection Terminal [X1] to [X9] Functions ***(WE-KP)***	5-61 5-122
Revert function code data to the initial values.	H03	Data initialization	5-181
Initialize motor parameters.			
Remove restrictions on the menu display to use various checking functions on the keypad.	E52	Keypad (Menu display mode)	5-161
Suppress fluctuation of unstable, hard-to-read display on the keypad.	E42	LED Display Filter	5-156
Specify the running status item to be monitored and displayed on the LED monitor.	E43 E48	LED Monitor (Item selection) LED Monitor (Speed monitor item)	5-157
Display the output frequency even when the inverter is stopped.	E44	LED Monitor (Display when stopped)	5-158
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	5-162
	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-155
Display the load shaft speed and line speed.	E50	Coefficient for speed indication	5-160
Display the input watt-hour data (kWh) multiplied by a display coefficient.	E51	Display Coefficient for Input Watt-hour Data	5-160
Convert a PID command and its feedback into physical quantities to display.	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-155

5.3.15 Controlling the inverter via communications line

Table 5.3-22

To:	Function code	Name	Refer to page:
Specify communications conditions.	 y01 y02 y03 y04 y05 y06 y07 y08 y09 y10 SW3	RS-485 Communication 1 (Station address) (Communications error processing) (Timer) (Baud rate) (Data length) (Parity bit selection) (Stop bit selection) (No-response error detection time) (Response interval) (Protocol selection) < Switching the terminating resistor of the RS-485 communications port 1 >	5-272 2-34

To:	Function code	Name	Refer to page:
Specify communications conditions.	 y11 y12 y13 y14 y15 y16 y17 y18 y19 y20 SW2	RS-485 Communication 2 (Station address) (Communications error processing) (Timer) (Baud rate) (Data length) (Parity bit selection) (Stop bit selection) (No-response error detection time) (Response interval) (Protocol selection) < Switching the terminating resistor of the RS-485 communications port 2 >	5-272 2-34
Specify the sources of run and frequency commands.	H30 y98 y99	Communications Link Function (Mode selection) Bus Link Function (Mode selection) Loader Link Function (Mode selection)	5-191 5-276
Change function code data frequently via the communications link.	y97	Communication Data Storage Selection	5-275
Switch between frequency or run commands via the communications link.	E01 to E09	Terminal [X1] to [X9] Functions ***(LE)***	5-122
Use inverter input/output signals as general-purpose DI/DO.	E01 to E09	Terminal [X1] to [X9] Functions ***(U-DI)***	5-122
	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(U-DO)***	5-141

5.3.16 Using the customizable logic

Table 5.3-23

To:	Function code	Name	Refer to page:
Enable the sequence configured by the customizable logic function. *2	U00	Customizable Logic (Mode selection)	5-249
Form a logic circuit for digital input/output signals, modify them arbitrarily, and configure a simple relay sequence inside the inverter. *2	U01 to U50 U71 to U75 U81 to U85 U91	Customizable Logic: Steps 1 to 10 (Mode selection) Customizable Logic Output Signals 1 to 5 (Output selection) Customizable Logic Output Signals 1 to 5 (Function selection) Customizable Logic Timer Monitor (Step selection)	
	E01 to E09	Terminal [X1] to [X9] Functions	5-122
	E20-E27	Terminal [Y1] to [Y4] Functions Terminal [Y5A/C] Function Terminal [30A/B/C] Function (Relay output)	5-141
	E98, E99	Terminal [FWD], [REV] Functions	5-122 5-165

*2 Available for inverters with ROM version 1000 or later.

5.3.17 Activating the protective functions

[1] Protection of machinery with limiters

Table 5.3-24

To:	Function code	Name	Refer to page:
Limit the frequency to protect the machinery.	F15 F16 H63	Frequency Limitter (High) (Low) Low Limiter (Mode selection)	5-93
	F03	Maximum Output Frequency 1	5-72
	H64	Low Limiter (Lower limiting frequency)	5-198
Limit the motor rotational direction to protect the machinery.	H08	Rotational direction limitation	5-184
Limit the motor output torque with the current limiter to protect the machinery.	F43 F44 E20 to E24	Current Limiter (Mode selection) (Operation level) Terminal [Y1] to [Y5A/C] Functions ***(IOL, IOL2)***	5-117 5-141
Limit the motor output torque with the torque limiter to protect the machinery.	F40 F41 E16 E17 E61 E62 E63 H73 H74 H75 H76 E01 to E09 E20 to E24	Torque Limiter 1-1 Torque Limiter 1-2 Torque Limiter 2-1 Torque Limiter 2-1 Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function Torque Limiter (Operating conditions) (Control target) (Target quadrants) (Frequency increment limit for braking) Terminal [X1] to [X9] Functions ***(TL2/TL1)*** Terminal [Y1] to [Y5A/C] Functions ***(IOL, IOL2)***	5-107 5-162 5-200 5-122 5-141
Limit the overspeed level with the speed limiter to protect the machinery.	E61 *4 E62 *4 E63 *4 d32 d33 d35 *4	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function Torque control (Speed limit 1) (Speed limit 2) Overspeed detection level	5-162 5-243

*4 Available for inverters with ROM version 3600 or later.

[2] Protection of motors

Table 5.3-25

To:		Function code	Name	Refer to page:
Electronic thermal overload	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)	5-80

To:		Function code	Name	Refer to page:
Overload early warning	Output an overload early warning before the inverter trips with the electronic thermal overload protection.	F10 F12 E34 E20 to E24	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics) (Thermal time constant) Overload Early Warning/Current Detection (Timer) Terminal [Y1] to [Y5A/C] Functions ***(OL)***	5-80 5-153 5-141
Motor overheat	Protect the motor from overheating with the PTC or NTC thermistor embedded in the motor. Use the Fuji VG motor (exclusively designed for vector control) having a built-in NTC thermistor.	H26 H27 SW5	Thermistor (for motor) (Mode selection) (Operation level) < Switching the terminal [V2] function >	5-189 2-34
Detection with thermistor	Detect the current voltage with the PTC thermistor embedded in the motor and issue an alarm.	H26 H27 SW5 E20 to E24	Thermistor (for motor) (Mode selection) (Operation level) < Switching the terminal [V2] function > Terminal [Y1] to [Y5A/C] Functions ***(THM)***	5-189 2-34 5-141
Dew condensation prevention	Prevent the motor being stopped from dew condensation in cold climates by feeding DC power, even during the inverter is stopped.	J21 F21 F22 E01 to E09	Dew Condensation Prevention (Duty) DC Braking 1 (Braking level) (Braking time) Terminal [X1] to [X9] Functions ***(DWP)***	5-227 5-94 5-122

[3] Using other protective and safety functions

Table 5.3-26

To:		Function code	Name	Refer to page:
Trip after momentary power failure (No restart)	Trip the inverter immediately if a momentary power failure occurs. 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.	F14 H15 H92 H93 E20 to E24 E01 to E09	Restart Mode after Momentary Power Failure (Mode selection) (Continuous running level) Continuity of Running (P) Continuity of Running (I) Terminal [Y1] to [Y5A/C] Functions ***(LU, IPF)*** Terminal [X1] to [X9] Functions ***(IL)***	5-83 5-141 5-122
External alarm	Shut down the inverter output immediately in the event of an abnormal situation in peripheral equipment.	E01 to E09	Terminal [X1] to [X9] Functions ***(THR)***	5-122
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)	5-208
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)	5-119
Braking transistor	Detect a breakdown of the braking resistor to protect the inverter.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(DBAL)***	5-141

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)	5-272
		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	5-207
Excessive speed deviation	Detect that a deviation between the reference speed and detected one is out of the specified range.	d21 d22 d23 E20 to E24	Speed Agreement/PG Error (Detection width) (Detection timer) PG Error Processing Terminal [Y1] to [Y5A/C] Functions ***(PG-ERR)***	5-241 5-141
PG wire break	Detect a PG error such as a PG wire break.	d21 d22 E20 to E24	Speed Agreement/PG Error (Detection width) (Detection timer) Terminal [Y1] to [Y5A/C] Functions ***(PG-ERR)***	5-241 5-141
	Ignore a PG wire break alarm.	E01 to E09	Terminal [X1] to [X9] Functions ***(PG-CCL)***	5-122
Force to stop	Use the forced stop function for safety.	H56 E01 to E09	Deceleration Time for Forced Stop Terminal [X1] to [X9] Functions ***(STOP)*** Terminal [X1] to [X9] Functions ***(STOP-T)***	5-76 5-122
Coast to a stop	Use the coast-to-stop function for safety.	E01 to E09	Terminal [X1] to [X9] Functions ***(BX)***	5-122
STOP key priority	Always enable the STOP key for safety.	H96	STOP key priority/Start check function	5-202
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	5-202
Heat sink overheat early warning	Issue a heat sink overheat early warning before an overheat trip actually happens.	E20 to E24	Terminal [Y1] to [Y5A/C] Functions ***(OH)***	5-141
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)	5-117
Alarm	Clear alarm history and relevant information stored in the inverter.	E01 to E09 H97 E20 to E24	Terminal [X1] to [X9] Functions Clear Alarm Data Terminal [Y1] to [Y5A/C] Functions	5-122 5-208 5-141
	Cause the inverter to generate a mock alarm.	H45	Mock alarm	5-197

5.3.18 Maintenance

[1] Maintenance of inverters

Table 5.3-27

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	5-193
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)	5-208
Cooling fan ON/OFF control	Prolong the service life of the inverter cooling fans and reduce fan noise during the inverter stop.	H06 E20 to E24	Cooling Fan ON/OFF Control Terminal [Y1] to [Y5A/C] Functions ***(FAN, LIFE)***	5-183 5-141

[2] Maintenance of machinery

Table 5.3-28

To:		Function code	Name	Refer to page:
Cumulative motor run time	Check the cumulative motor run time.	H94	Cumulative Motor Run Time 1	5-201
	Count the cumulative motor run time even when the motor is driven by commercial power.	E01 to E09	Terminal [X1] to [X9] Functions ***(CRUN-M1, M2, M3, M4)***	5-122
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	5-196
Maintenance timer	Signal the need of the maintenance, based on the cumulative motor run time.	H78 E20 to E24	Maintenance Interval ***(M1)*** Terminal [Y1] to [Y5A/C] Functions ***(MNT)***	5-201 5-141
	Signal the need of the maintenance, based on the inverter startup count.	H79 E20 to E24	Preset Startup Count for Maintenance ***(M1)*** Terminal [Y1] to [Y5A/C] Functions ***(MNT)***	5-202 5-141
Switching between remote and local modes	Separate the inverter from the system and drive it with commands entered from the keypad, for maintenance.	E01 to E09 E20 to E24	Terminal [X1] to [X9] Functions ***(LOC)*** Terminal [Y1] to [Y5A/C] Functions ***(RMT)***	5-122 5-141

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 iteself) and digital reference data (such as frequency command and PID command) from accidentally getting changed by pressing the ⋀/⋁ keys on the keypad.

Table 5.4-1

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+⋀ or of STOP+⋁ 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.

Table 5.4-2

WE-KP	Changing function code data	
	From the keypad	Via communications link
OFF	Not allowed	Allowed
ON	Follow the F00 setting	

Note

- If you mistakenly assign the terminal command ***WE-KP***, you can no longer edit or modify function code data. In such a case, temporarily short circuit this ***WE-KP***-assigned terminal with the terminal [CM], 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 ⋀ and ⋁ keys.

F01	**Frequency Command 1** Related function codes: 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]) C40 (Range Selection 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))

Select a command source for frequency setting. F01 or C30 sets the command source that specifies reference frequency 1 or reference frequency 2, respectively.

Table 5.4-3

Data for F01, C30	Command sources
0	Frequency setting on the keypad (See below for specific setting steps)
1	Enable the voltage input to terminal [12] (0 to ±10 VDC, maximum output frequency obtained at ±10 VDC).
2	Enable the current input to terminal [C1] (+4 to +20 mA DC, maximum output frequency obtained at +20 mA DC).
3	Enable the sum of voltage (0 to ±10 VDC, maximum output frequency obtained at ±10 VDC) and current inputs (+4 to +20 mA DC, maximum output frequency obtained at +20 mA DC) given to terminals [12] and [C1], respectively. (If the sum exceeds the maximum output frequency, the maximum output 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). (E01 to E09)
8	Frequency command source is switched to the keypad (balanceless-bumpless switching available).
10	Enable pattern operation.
11	Enable a digital input interface card (optional). (For details, refer to the Instruction Manual.)
12	Enable the "Pulse train input" ***PIN*** command assigned to digital input terminal [X7] (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." When the inverter is in Program mode or Alarm mode, reference frequency cannot be specified by using the ⌃/⌄ key. In order to enable frequency setting by the ⌃/⌄ key, switch to Running mode.

(2) By pressing the ⌃/⌄ key, the reference frequency is indicated on the LED monitor and its lowest digit blinks.

(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 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 the / key just displays the current reference frequency.

Tip

- When you start specifying the reference frequency or any other parameter with / key, the least significant digit on the display blinks, and can be changed. You can move ahead to more significant digits as you hold down the key.
- While the least significant digit is blinking by pressing the / key, holding down the key for more than 1 second moves the cursor from the least significant digit to more significant digits. This cursor movement allows you to easily move the cursor to the desired digit and change the data in higher digits. This operation is called "cursor movement".
- 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.

Table 5.4-4 Adjustable elements of frequency command 1

Data for F01	Input terminal	Input range	Bias		Gain		Polarity	Input range	Filter time constant	Offset
			Bias	Base point	Gain	Base point				
1	[12]	0 to +10 V, -10 to +10 V	F18	C50	C32	C34	C35	-	C33	C31
2	[C1]	4 to 20 m, 0 to 20 mA	F18	C50	C37	C39	-	C40	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 0 to 20 mA	F18	C50	C37	C39	-	C40	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 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 machinery 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.

Table 5.4-5

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)

■ Range selection for terminal [C1] (C40)

C40 specifies the input range for analog input current.

Table 5.4-6

Data for C40	Terminal input specifications
0	4 to 20 mA
1	0 to 20 mA

■ Gain and bias

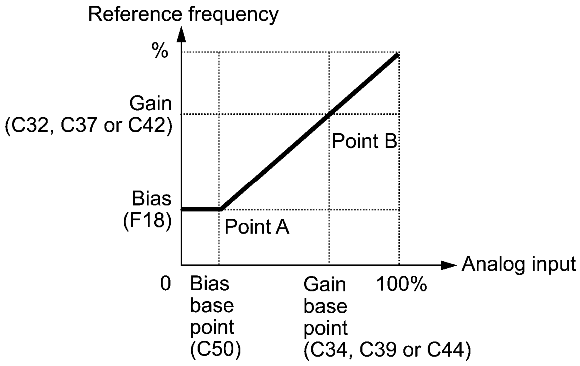


Figure 5.4-1

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.

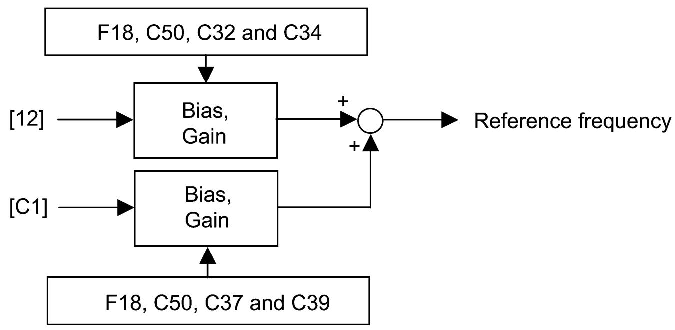


Figure 5.4-2

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). 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.

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)

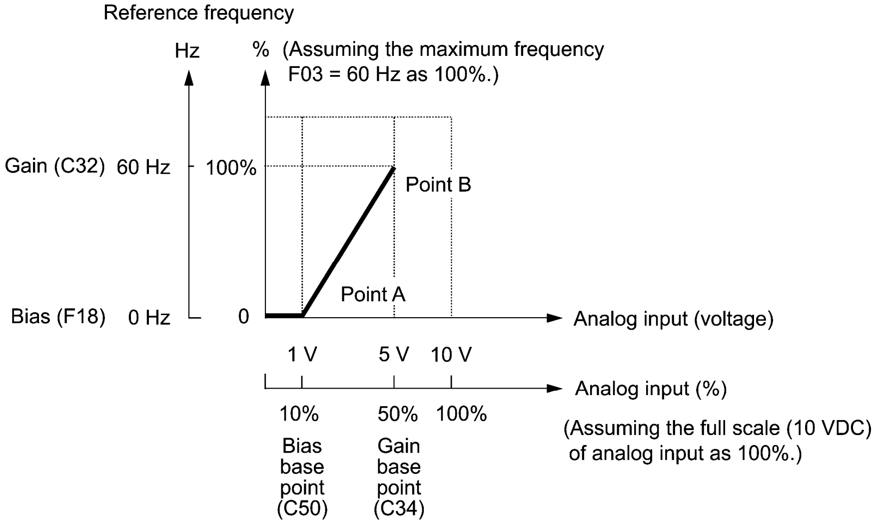


Figure 5.4-3

(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.

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.

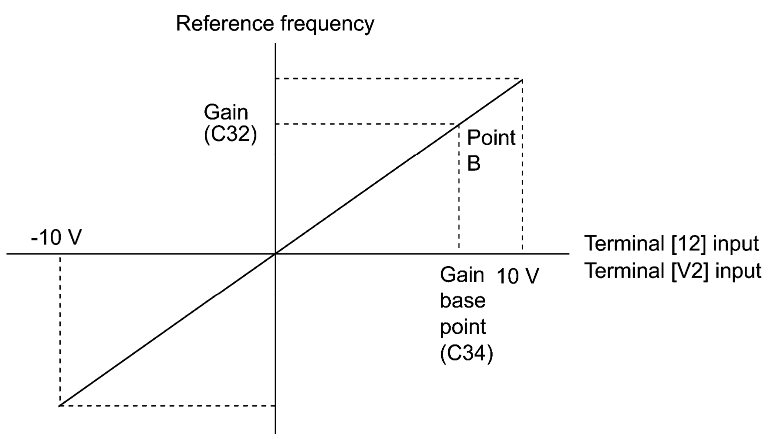


Figure 5.4-4

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.

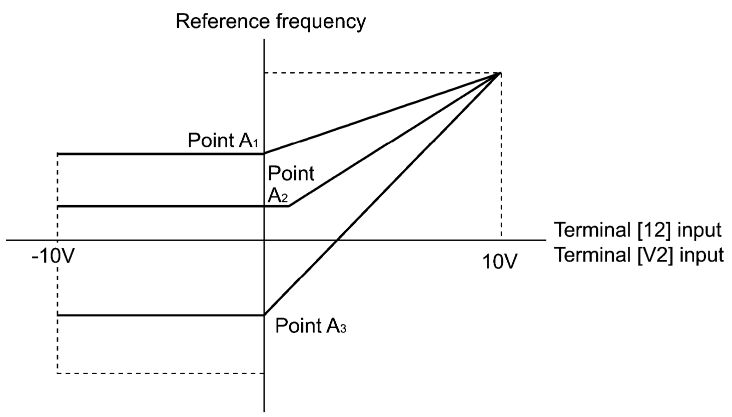


Figure 5.4-5

- 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 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 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. (📖 E01 to E09, data = 17, 18)

Table 5.4-7

Input signal ***UP***	Input signal ***DOWN***	Enable
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.

■ Specifying the initial value for UP/DOWN control

Specify the initial value for reference frequency to start UP/DOWN control.

Table 5.4-8

Data for H61	Initial value for reference frequency to start 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 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 output frequency into the memory and starts UP/DOWN control with the new frequency. Pressing one of these keys overwrites the frequency held in the inverter.

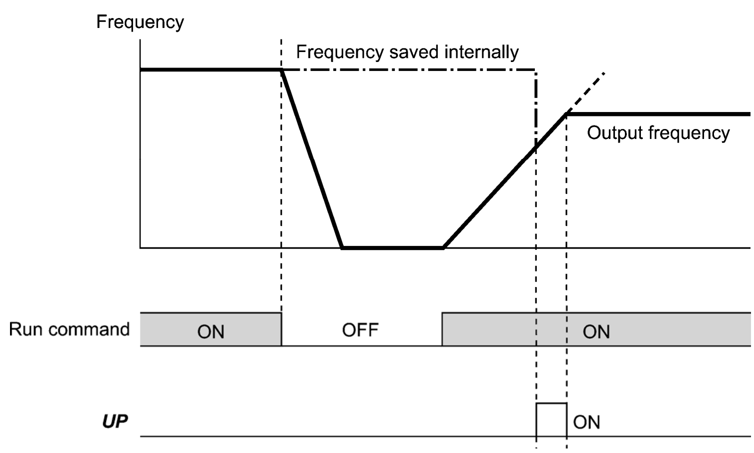


Figure 5.4-6

<Initial frequency for UP/DOWN control when the frequency command source is switched>

When the frequency command source is switched to UP/DOWN control from other sources, the initial frequency for UP/DOWN control is as listed below:

Chapter 5 Function Code
Details of Function Codes
F01
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U codes
y codes

Table 5.4-9

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	Reference frequency given by the frequency command source used just before switching	
PID control	Cancel PID control	Reference frequency given by PID control (PID processor output)	
Multi- frequency	Multi-frequency selection	Reference frequency given by the frequency command source used just before switching	Reference frequency at the time of previous UP/DOWN control
Communications link	Select link operation.		

[4] Using pulse train input (F01 = 12)

■ Selecting the pulse train input format (d59)

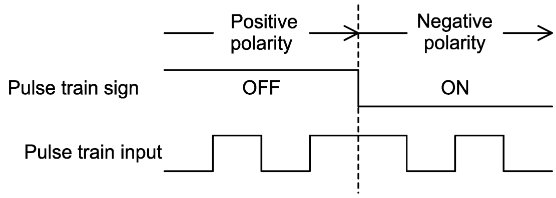
A pulse train in the format selected by the function code d59 can give a frequency command to the inverter. Three types of formats are available; the pulse train sign/pulse train input, the forward rotation pulse/reverse rotation pulse, and the A and B phases with 90 degree phase difference. If no optional 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.

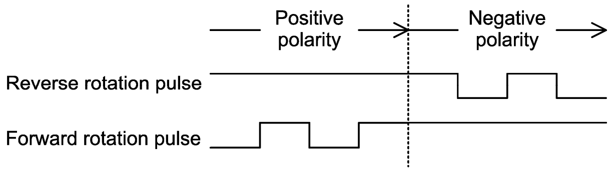
Table 5.4-10

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.

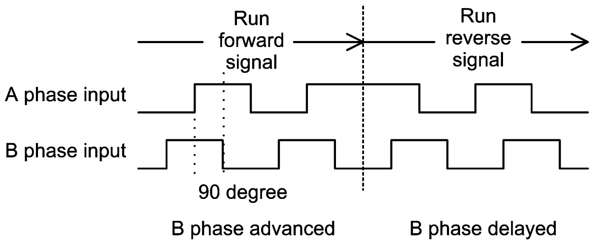
For details of operations using the optional PG interface card, refer to the Instruction Manual.



Pulse train sign/Pulse train input



Forward rotation pulse/Reverse rotation pulse



A and B phases with 90 degree phase difference

Figure 5.4-7

■ 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).

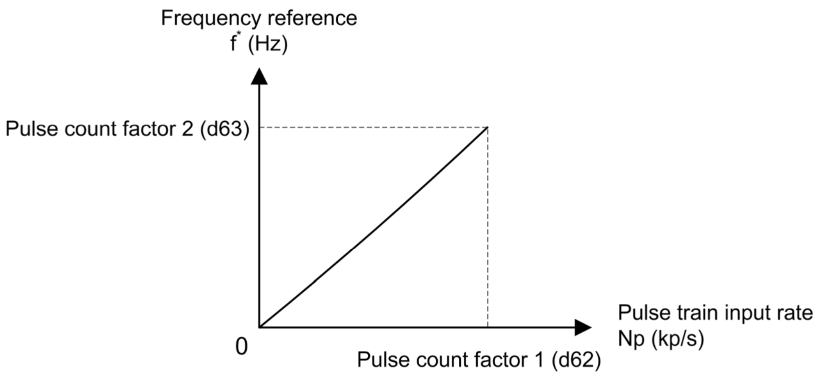


Figure 5.4-8 Relationship between the Pulse Train Input Rate and Frequency Command

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 equation below.

$$f^* \text{ (Hz)} = Np \text{ (kp/s)} \times \frac{\text{Pulse count factor 2 (d63)}}{\text{Pulse count factor 1 (d62)}}$$

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.

Table 5.4-11 Relationship between the polarity of the pulse train input and the motor rotational direction.

Pulse train polarity	Run command	Motor rotational direction
+	***FWD*** (Run forward command)	Forward
+	***REV*** (Run reverse command)	Run reverse
-	***FWD*** (Run forward command)	Run reverse
-	***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 appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. When the reference frequency fluctuates due to a small number of pulses, specify a larger time constant.

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).

Table 5.4-12

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/stop command sources and the rotational directions of the motor.

Table 5.4-13

Data for F02	Run Command	
	Running/Stopping	Rotational direction command
0: Keypad (Rotational direction specified by the terminal block)	RUN / STOP keys	***FWD, REV***
1: External signals (Digital input terminal commands)	***FWD, REV***	
2: Keypad (Forward rotation)	RUN / STOP keys	Note that this run command enables only the forward rotation. There is no need to specify the rotational direction.
3: Keypad (Reverse rotation)	RUN / STOP keys	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

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. When ***HLD*** is ON, the ***FWD*** or ***REV*** signal is self-held, which is cancelled when ***HLD*** becomes OFF. If ***HLD*** is not assigned, two-wire operation with ***FWD*** and ***REV*** only is applied.

📖 For details about ***HLD***, refer to E01 to E09 (data = 6).

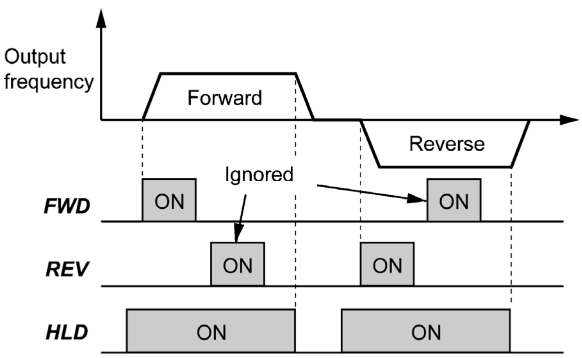


Figure 5.4-9

In addition to the run command sources described above, higher priority command sources including remote and local modes (see Section 3.3.6 of Chapter 3) and communications link are provided.

F03	Maximum Output 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)

Table 5.4-14

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 (10 V/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.

Injury may 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** Related function codes: 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.

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.

Table 5.4-15

V/f point	Function Code		Remarks
	Frequency	Voltage	
Maximum output 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	

<Setting examples>

■ Normal (linear) V/f pattern

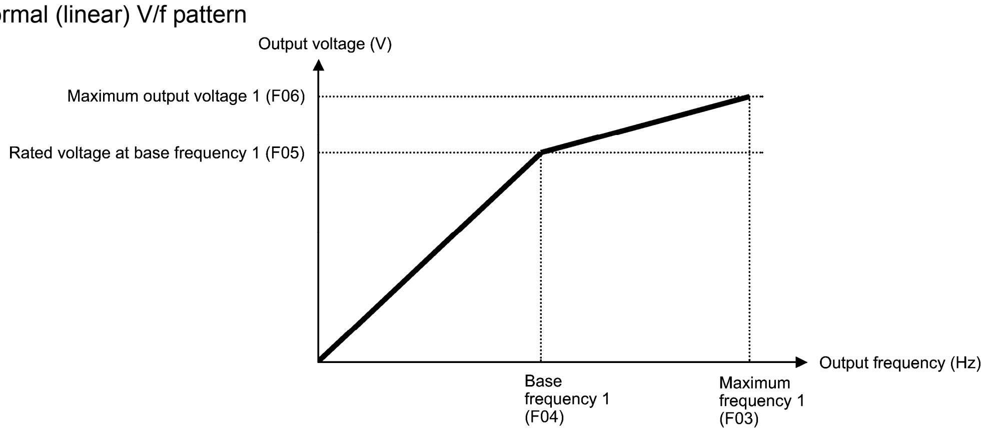


Figure 5.4-10

■ V/f pattern with three non-linear points

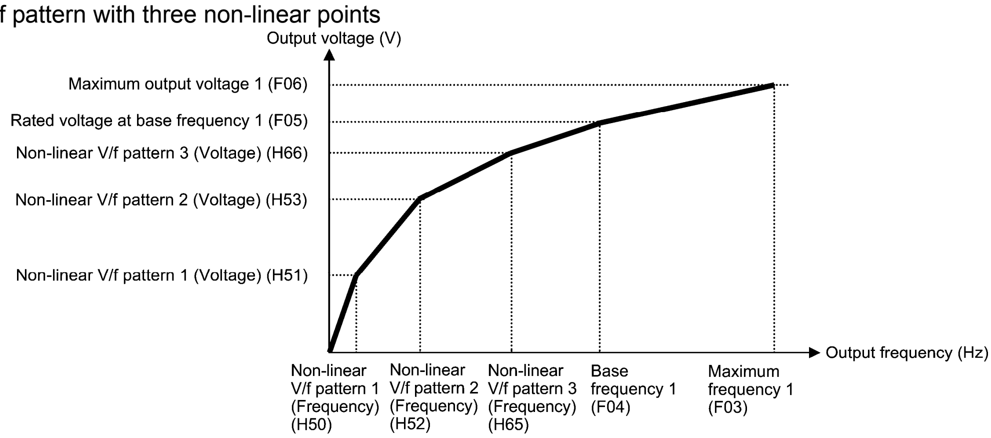


Figure 5.4-11

■ Base Frequency (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 (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).

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 vector control without speed sensor for 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.

Table 5.4-16

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) 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.)

F07, F08	**Acceleration Time 1, Deceleration Time 1**
	Related function codes: 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 (Acceleration/Deceleration rate for the 1st and 2nd S-curve) d86 (Acceleration/Deceleration filter time constant)

F07 specifies the acceleration time, the length of time the frequency increases from 0 Hz to the maximum output frequency. F08 specifies the deceleration time, the length of time the frequency decreases from the maximum output frequency down to 0 Hz.

• Data setting range: 0.00 to 6000 (s)

V/f control

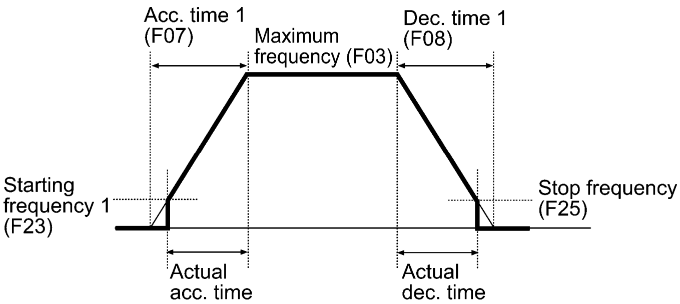


Figure 5.4-12

Vector control without speed sensor

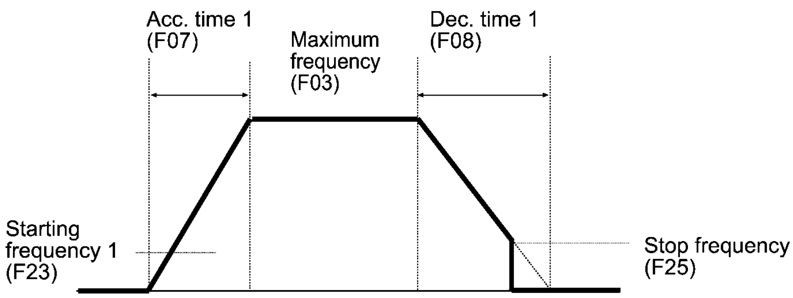


Figure 5.4-13

Vector control with speed sensor

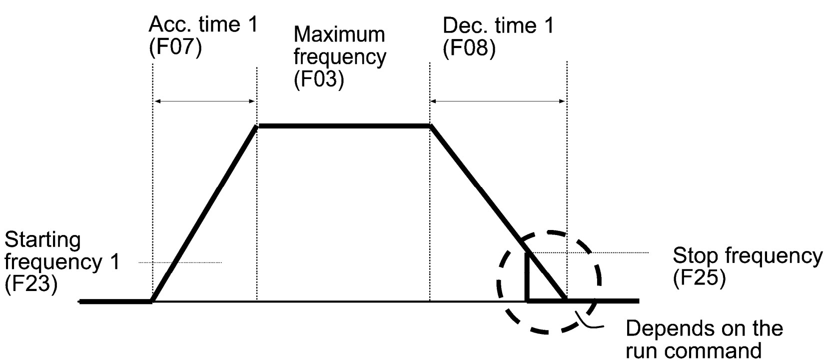


Figure 5.4-14

■ Acceleration/deceleration time

Table 5.4-17

Acceleration/deceleration time	Function Code: Acceleration time	Function Code: Deceleration time	Switching factor of acceleration/deceleration time (Refer to the descriptions of E01 to E09.)		
			RT2	***RT1***	
Acceleration/deceleration time 1	F07	F08	OFF	OFF	The combinations of ON/OFF states of the two terminal commands ***RT1*** and ***RT2*** 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.
Acceleration/deceleration time 2	E10	E11	OFF	ON	
Acceleration/deceleration time 3	E12	E13	ON	OFF	
Acceleration/deceleration time 4	E14	E15	ON	ON	
At jogging operation	H54	H55	When the terminal command JOG is ON, jogging operation becomes possible. (Data = 10) (Refer to the descriptions of C20.)		
At forced stop	-	H56	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)		

■ Acceleration/Deceleration pattern (H07)

H07 specifies the acceleration and deceleration patterns (patterns to control output frequency).

Table 5.4-18

Data for H07	Acceleration/ deceleration pattern	Description		Function code
0	Disabled (Linear acceleration/ deceleration)	The inverter runs the motor with the constant acceleration and deceleration.		-
1	S-curve (Weak)	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.	Weak: The acceleration/ deceleration rate to be applied to all of the four inflection zones is fixed at 5% of the maximum frequency.	-
2	S-curve (Arbitrary)		Arbitrary: The acceleration/ deceleration rate can be arbitrarily specified for each of the four inflection zones.	H57, H58 H59, H60
3	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 the maximum performance of the motor.		-

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.

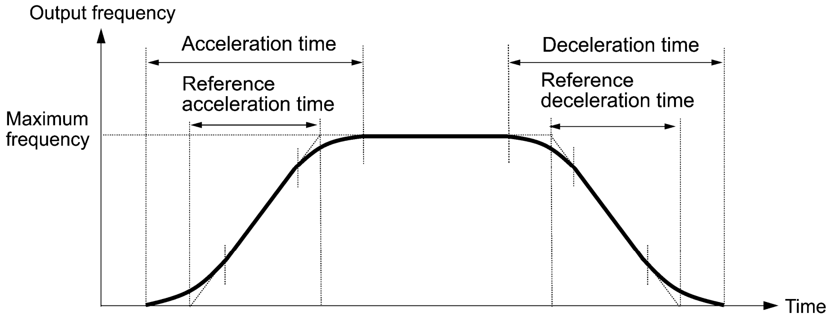


Figure 5.4-15

Table 5.4-19

	Acceleration	Deceleration	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)

Acceleration/deceleration time

<S-curve acceleration/deceleration (weak): when the frequency change is 10% or more of the maximum output 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 output 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)

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.

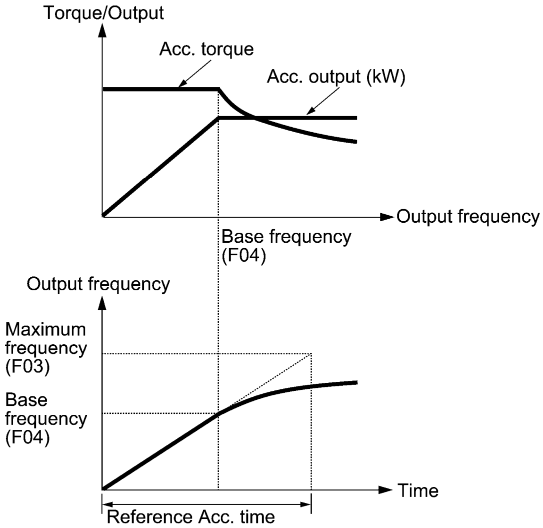


Figure 5.4-16

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.

■ Filter time constant during acceleration/deceleration (d86) (under V/f control only)

d8 specifies the time constant for the first order delay filter corresponding to output frequency lump function output during acceleration/deceleration. This should be specified when overshooting or undershooting occurs at frequency arrival or stop, causing a mechanical problem. While a large specified value stabilizes the output frequency change rate, it slows down the response.

This setting is only enabled under V/f control (F42 = 0 to 2). In cases other than V/f control (F42 = 0 to 2), use a reference speed filter (d01,A43, b43, r43) in speed control.

- Data setting range: 0.000: Filter disabled, 0.001 to 5.000 (s)

F09	Torque Boost 1	(Refer to F37)

Refer to the description of F37 for Torque Boost 1 settings.

F10 to F12	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics, Overload detection level, Thermal time constant)

F10, F11 and F12 respectively specify motor thermal characteristics, overload detection level, and thermal time constant, for the motor's electronic thermal overload protection that is used to detect overload conditions of the motor inside the inverter.

Upon detection of overload conditions of the motor, the inverter shuts down its output and issues a motor overload alarm OL1 to protect motor 1.

Note Thermal characteristics of the motor are also used for the overload early warning ***OL***. Thermal characteristics of the motor specified by F10 and F12 are also used for the overload early warning. (Refer to the description of E34.)
To disable the electronic thermal overload protection, set F11 data to "0.00 (Disable)."

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.

Table 5.4-20

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 or high-speed 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 theircorresponding output frequencies f2 and f3 differ depending on the characteristics of the motor.

The tables below list the factors specified based on motor characteristics, as selected by motor capacity and motor selection (P99).

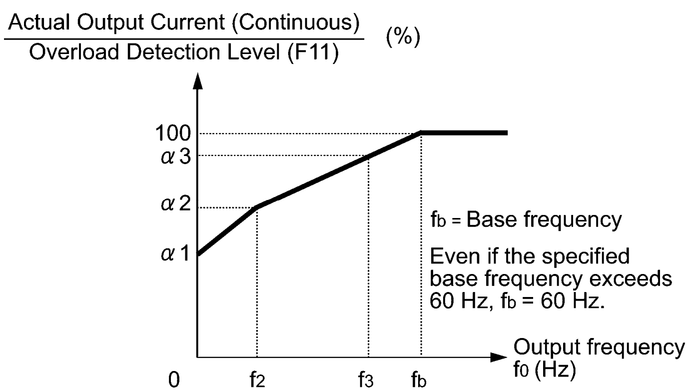


Figure 5.4-17 Cooling Characteristics of Motor

Table 5.4-21 Case where P99 = 0 or 4 (motor characteristics 0 or Others)

Motor capacity (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 kW	5 min	Allowable continuous drive current x 150%	5 Hz	7 Hz	75%	85%	100%
1.5 to 3.7 kW					85%	85%	100%
5.5 to 11 kW				6 Hz	90%	95%	100%
15 kW				7Hz	85%	85%	100%
18.5, 22 kW				5Hz	92%	100%	100%
30 to 45 kW	10 min		Base frequency x 33%	Base frequency x 83%	54%	85%	95%
55 to 90 kW					51%	95%	95%
110 kW or above					53%	85%	90%

Table 5.4-22 Case where P99 = 1 or 3 (motor characteristics 1 or 3)

Motor capacity (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 kW	5 min	Allowable continuous drive current x 150%	Base frequency x 33%	Base frequency x 33%	69%	90%	90%
30 to 45 kW	10 min			Base frequency x 83%	54%	85%	95%
55 to 90 kW					51%	95%	95%
110 kW 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 (Disable)."

■ 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 below, the electronic thermal overload protection is activated to detect an alarm condition (alarm code OL1) when the output current of 150% of the overload detection level 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.

< Example of Thermal Overload Detection Characteristics >

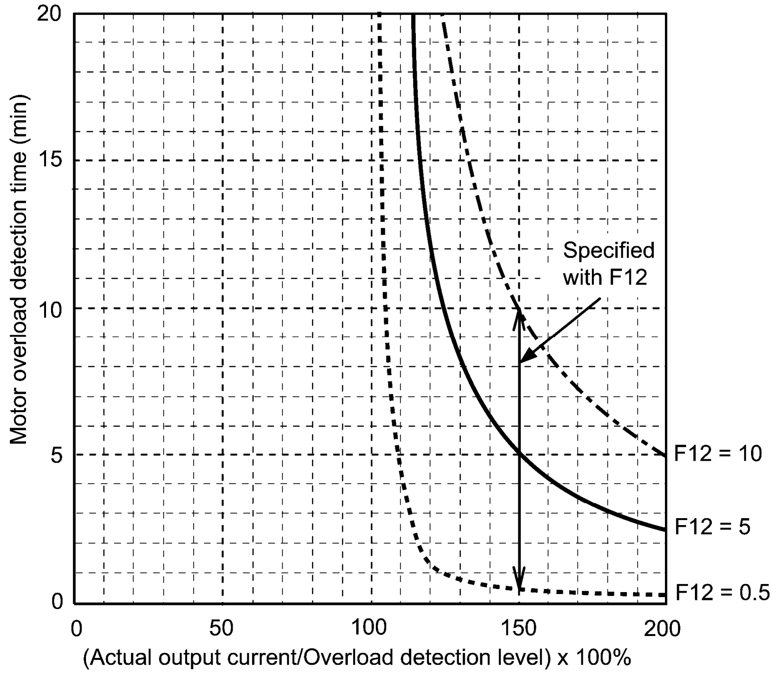


Figure 5.4-18

F14	**Restart Mode after Momentary Power Failure (Mode selection)** Related function codes: H13 (Restart time) H14 (Frequency fall rate) H15 (Continuous running level) H16 (Allowable momentary power failure time) H92 (Continuity of Running, P) H93 (Continuity of Running, 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 5.4-23

<table>
<tr><th rowspan="2">Data for F14</th><th colspan="2">Description</th></tr>
<tr><th>Auto search disabled</th><th>Auto search enabled</th></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 issue undervoltage alarm LU.
The moment the power is restored, an undervoltage alarm lu is issued.</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>
<tr><td rowspan="3">5: Restart at the starting frequency</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 starting frequency specified by function code F23.</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 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.</td></tr>
<tr><td colspan="3">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).</td></tr>
</table>

- Under vector control without speed sensor

Table 5.4-24

<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 issue undervoltage alarm LU.
The moment the power is restored, an undervoltage alarm lu is issued.</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="2">3: Continuity of running
4: Restart at the frequency at which the power failure occurred</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.
Even if the F14 data is set to "3," the "Continue to run" function is disabled.</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 rowspan="3">5: Restart at the starting frequency</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 starting frequency specified by function code F23.</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 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.</td></tr>
<tr><td colspan="3">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).</td></tr>
</table>

- Under vector control with speed sensor

Table 5.4-25

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 issue undervoltage alarm LU. The moment the power is restored, an undervoltage alarm LU is issued.
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: Continuity of running 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 inverterenters the ready-to-run state.

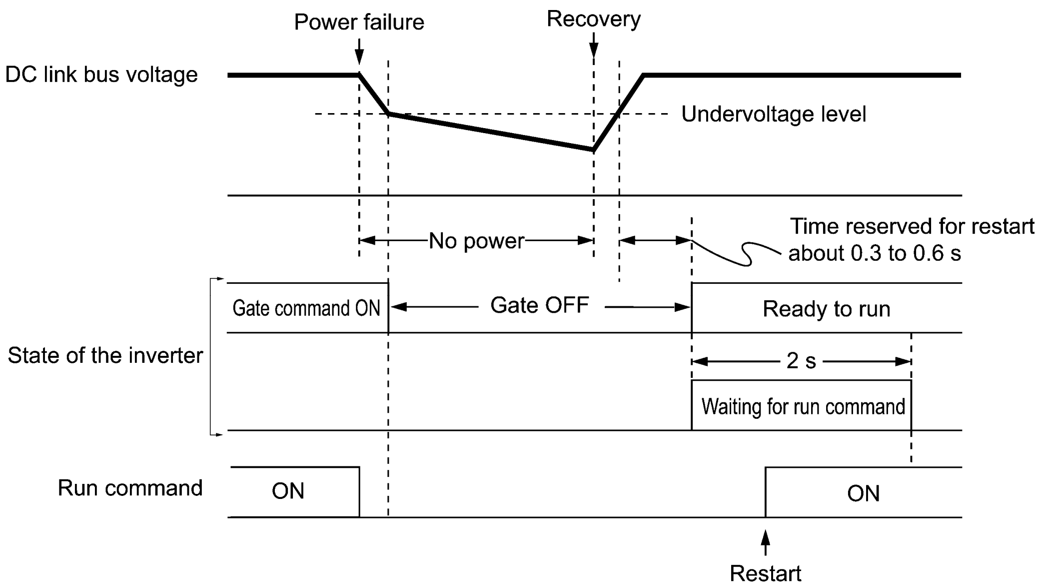


Figure 5.4-19

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. 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.

Table 5.4-26 E01 to E09, data = 22

Terminal command ***IL***	Description
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

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).

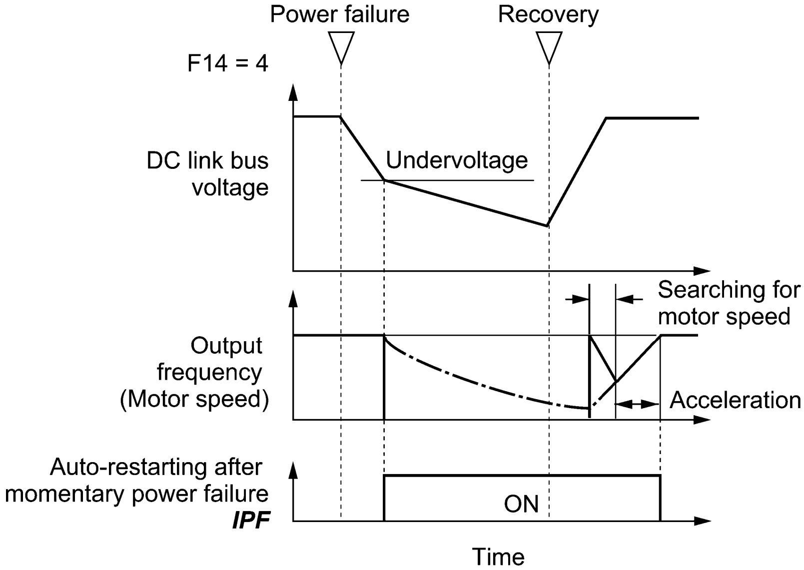


Figure 5.4-20

• 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. (Refer to the descriptions of E01 through E09, data = 6.)

■ Restart mode after momentary power failure (Basic operation: Auto search enabled)

Auto search 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. The inverter starts after the auto search delay time has elapsed. (For details, refer to H09 and d67.)

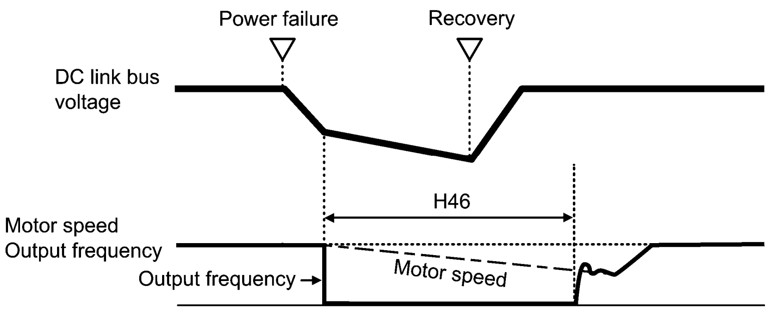


Figure 5.4-21

Note

- To use auto search, it is necessary that auto-tuning has been performed 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.

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 performance depending on load conditions, motor parameters, wiring length, and other external factors.
- 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. 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.

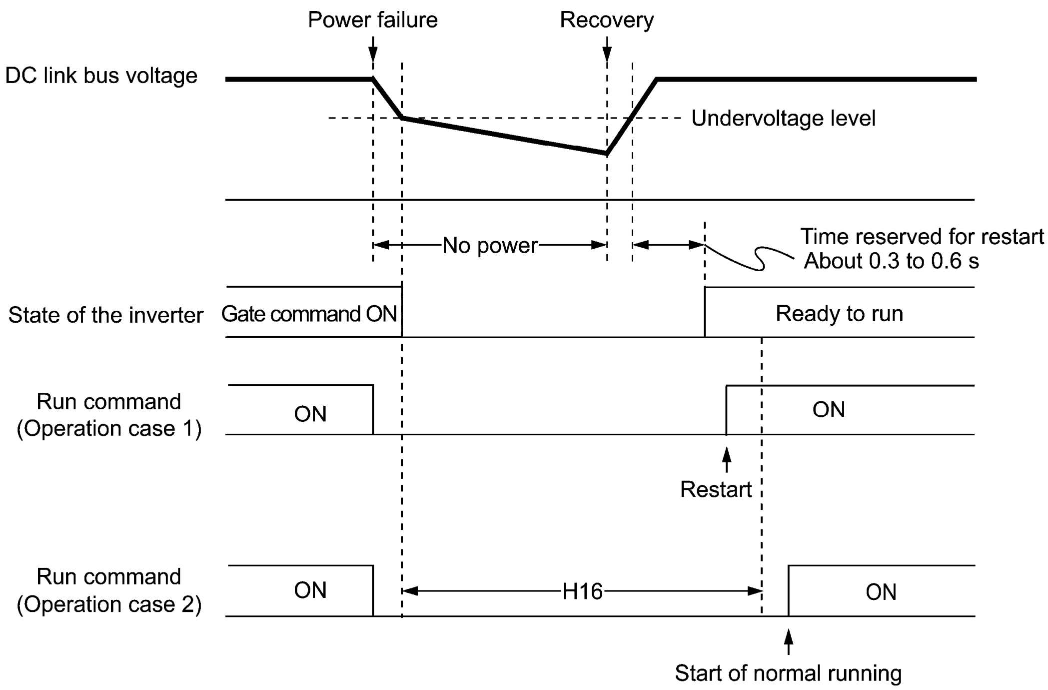


Figure 5.4-22

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 voltage drops to below the allowable voltage for restart, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode but restarts for normal running.

Table 5.4-27

Power supply voltage	Allowable voltage for restart after momentary power failure
200 V	50 V
400 V	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.

■ 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.

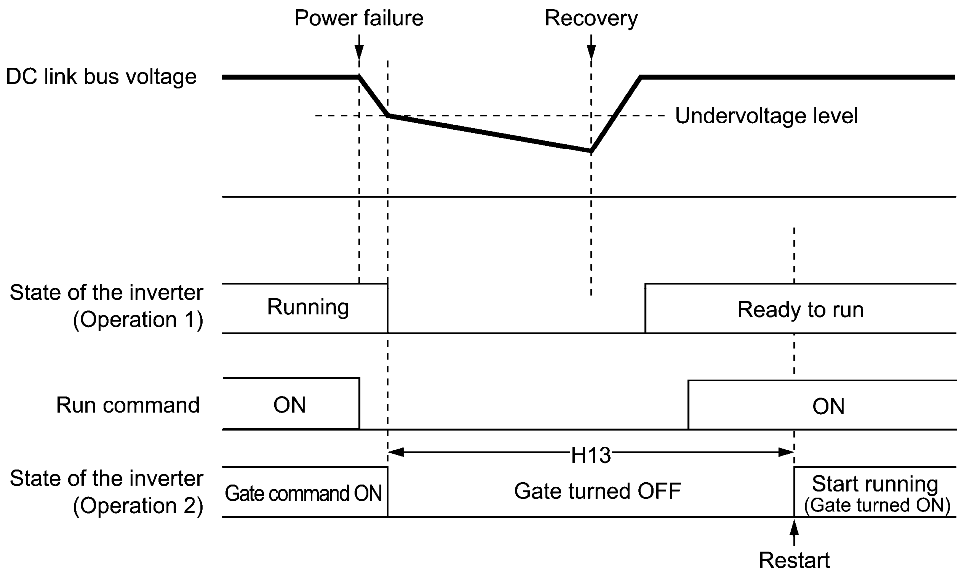


Figure 5.4-23

Factory default By factory default, H13 is set to the value suitable for the standard motor (see Table 5.2-17 given on the last page of "5.2 Function Code Tables"). Basically, there is no need to modify the default setting. 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 between line and inverter. (Refer to E01 through E09.)

■ 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.

Table 5.4-28

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.

■ Restart after momentary power failure (Continuous running level) (H15) Continuity of running (P and I) (H92, H93)

- Trip after decelerate-to-stop

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.

The DC link bus voltage level at which the decelerate-to-stop control should be started is specified by H15.

Under 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

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.

The continuous running level at which the continuous running control should be started is 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.

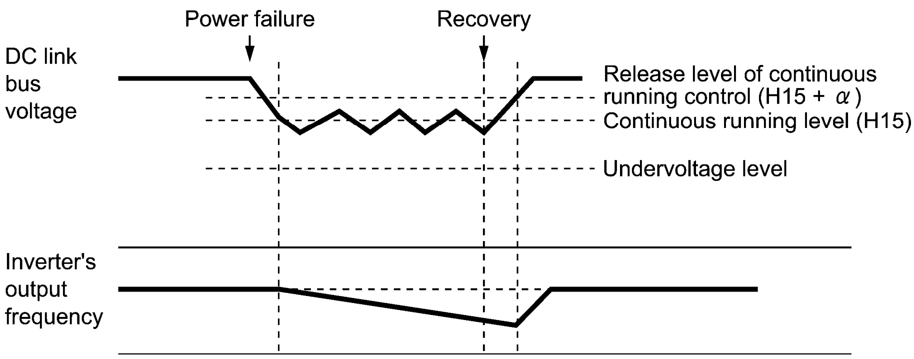


Figure 5.4-24

Table 5.4-29

Power supply voltage	α	
	22 kW or less	30 kW or above
200 V	5 V	10 V
400 V	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 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.

- Momentary power failure during deceleration ***IPF2*** (E20 to E27 = 79)

With F14 set to "2" or "3", ***IPF2*** turns ON if the DC link bus volutage falls below the Continuous running level specified by H15, and the invereter enters the continuous running state. ***IPF2*** goes OFF when power is restored, and the DC link bus voltage exceeds the voltage specified by H15 plus +10 V. Even if F14 is set to "4" or "5", ***IPF2*** turns ON if the DC link bus voltage falls below the specified undervoltage level. It goes OFF when the DC link bus voltage exceeds the specified undervoltage level plus +10 V. (Refer to F14 and F15.)

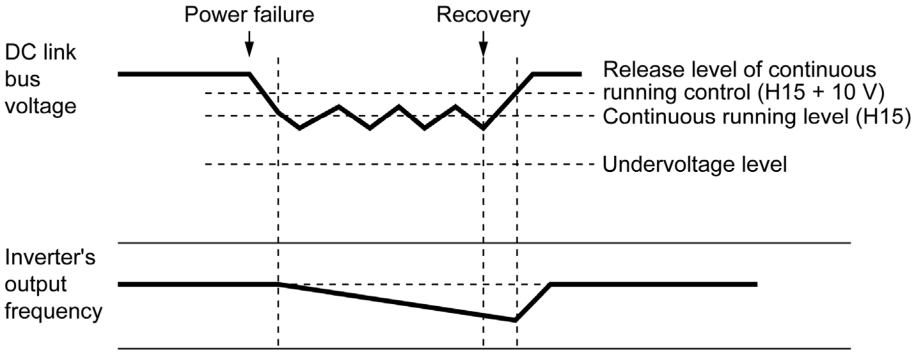


Figure 5.4-25

F15 and F16	**Frequency Limiter (High and Low)** Related function codes: H63 (Low Limiter, Mode selection)

■ 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.

Table 5.4-30

Frequency limiter		Object to which the limit is applied	
		V/f control	Vector control with/without speed sensor
Frequency Limiter (High)	F15	Output frequency	Reference speed (reference frequency)
Frequency Limiter (Low)	F16	Reference frequency	Reference speed (reference frequency)
Note When the limit is applied to the reference frequency or reference 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:

Table 5.4-31

Data for H63	Enable
0	The output frequency will be held at the low level specified by F16.
1	The inverter decelerates to stop the motor.

See the figure below.

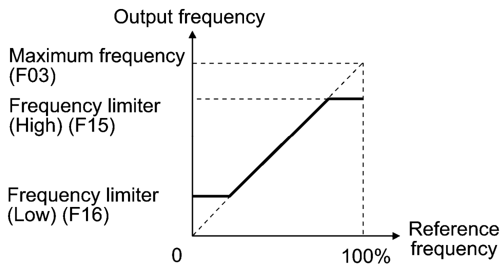


Figure 5.4-26 (H63 = 0)

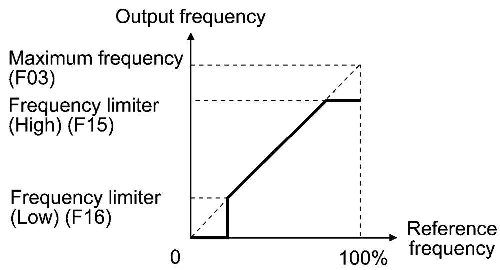


Figure 5.4-27 (H63 = 1)

Note

- When you change the frequency limiter (High) (F15) in order to raise the reference frequency, be sure to change the maximum output frequency (F03) accordingly.
- Maintain the following relationship among the data for frequency control:
  - F15 > F16, F15 > F23, 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.

F18	**Bias (Frequency command 1)** (Refer to F01.)

Refer to the description of F01 for detailed settings of Bias (Frequency command 1).

Chapter 5 Function Code
Details of Function Codes
F14 to F18
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U codes
y codes

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 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 when the output frequency goes down to the DC braking starting frequency. Specify the DC braking starting frequency (F20), the braking level (F21), and the braking time (F22).

Setting the function code F22 (braking time) to "0.00" 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: 0.00 (Disable) 0.01 to 30.00 (s)

■ Braking response mode (H95)

H95 specifies the DC braking response mode. Under vector control with/without speed sensor, the response is constant.

Table 5.4-32

Data for H95	Features	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.

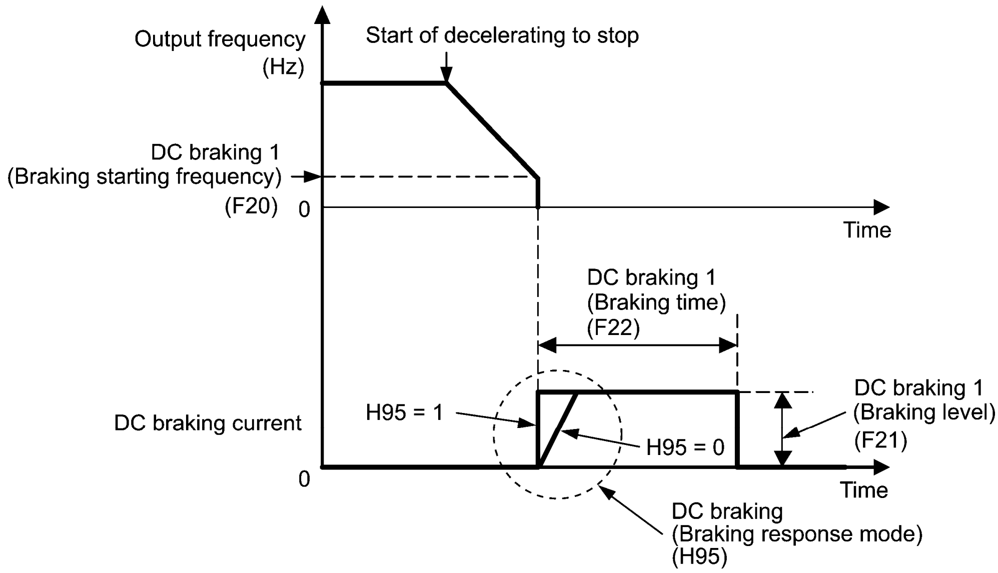


Figure 5.4-28

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 with/without 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 stop 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. **Injury may occur.**

F23 to F25	**Starting Frequency 1, Starting Frequency 1 (Holding time) and Stop Frequency** Related function codes: F38 and F39 (Stop Frequency, Detection mode and Holding time) H92 and H93 (Continuity of Running, P and I) d24 (Zero Speed Control)

Under V/f control

At the startup of an inverter, the initial output frequency is equal to the starting frequency. The inverter stops its output when the output frequency reaches the stop frequency. 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.

Specifying the holding time for the starting frequency compensates for the delay time for the establishment of a magnetic flux in the motor; specifying that for the stop frequency stabilizes the motor speed at the stop of the inverter.

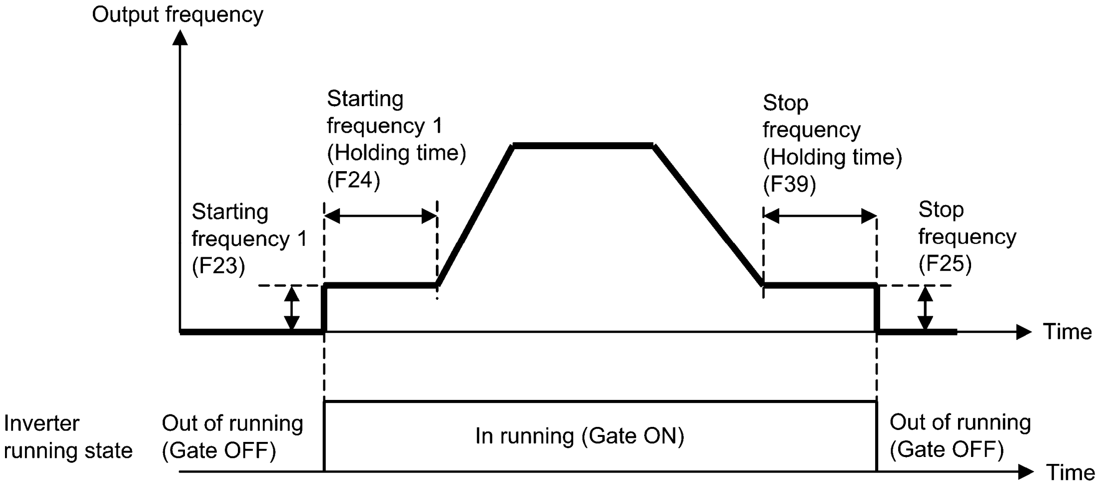


Figure 5.4-29

■ 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 stop frequency is set at 0.0 Hz, the inverter stops its output at 0.1 Hz.

■ Starting Frequency 1 (Holding time) (F24)

F-24 specifies the holding time for continued operation at the starting frequency.

- 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 does not output any power as long as the reference frequency does not exceed the stop frequency.

Under vector control with/without 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 reference speed according to the specified acceleration time. The inverter stops its output when the reference speed or detected one (specified by F38 under vector control with speed sensor only) reaches the stop frequency.
Specifying the holding time for the starting frequency compensates for the delay time for the establishment of a magnetic flux in the motor; specifying that for the stop frequency stabilizes the motor speed at the stop of the inverter.

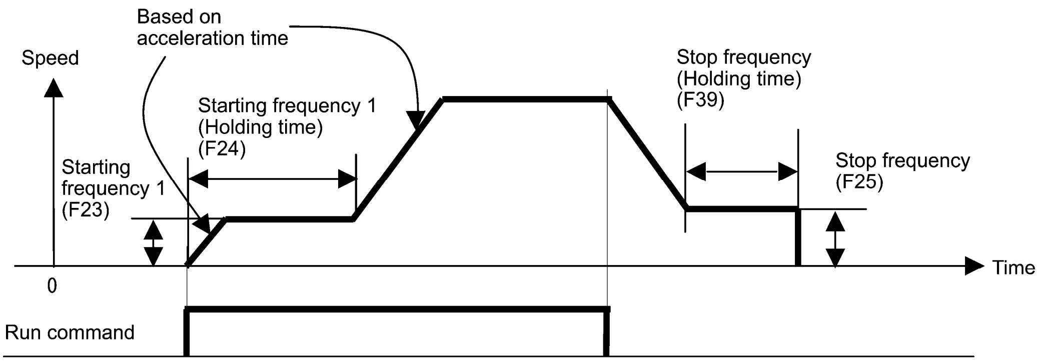


Figure 5.4-30

■ 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)

F-24 specifies the holding time for continued operation at the starting frequency.

• 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 (s)

■ 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) below the starting and stop frequencies. If the starting and stop frequencies are 0.0 Hz, however, zero speed control is enabled only when the speed command is 0.00 Hz. d24 specifies the operation for zero speed control at the startup of the inverter.

Table 5.4-33

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 zero speed control. To enable 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 zero speed control.

The table below shows the conditions for zero speed control to be enabled or disabled.

Table 5.4-34

	Speed command	Run command	Data for d24	Enable
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	0N	-	Zero Speed Control
		OFF	-	Stop (Gate OFF)

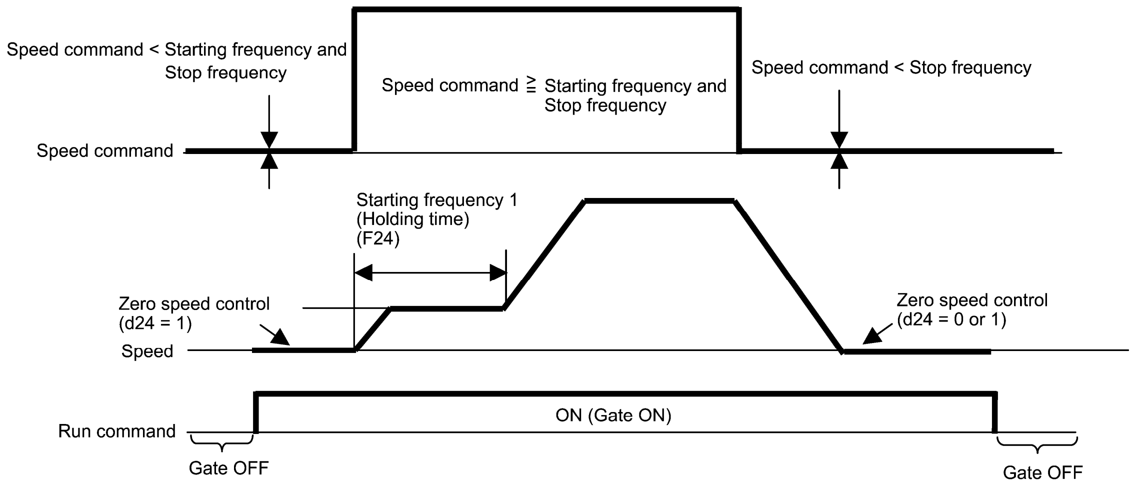


Figure 5.4-31

■ Stop Frequency (Detection mode) (F38) (Under vector control with speed sensor only)

F38 specifies whether to use the detected speed or reference one as a decision criterion to shut down the inverter output. Usually the inverter uses the detected speed. However, if the inverter undergoes a load exceeding its capability, e.g., an external excessive load, it cannot stop because the motor cannot stop so that the detected speed may not reach the stop frequency level. When such a situation could arise, select the reference speed that can reach the stop frequency level even if the detected speed does not, in order to stop the inverter without fail for general fail-safe operation.

• Data setting range: 0 (Detected speed), 1 (Reference speed)

F26 and F27	**Motor Sound (Carrier frequency and Tone)** Related function codes: 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.

Table 5.4-35

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 400 kW (HD mode) 22 to 55 kW (LD mode)
	0.75 to 6 kHz	500 to 630 kW (HD mode) 75 to 500 kW (LD mode)
	0.75 to 4 kHz	630 kW (LD mode)
	0.75 to 2 kHz	90 to 400 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 (many harmonics components). 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 a surrounding temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overload alarm OLU. 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 with/without 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.

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.
This function is disabled under vector control.

Table 5.4-36

Data for F27	Function
0	Disable (Tone level 0)
1	Enable (Tone level 1)
2	Enable (Tone level 2)
3	Enable (Tone level 3)

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 12 "SPECIFICATIONS."

Table 5.4-37

Data for F29	[FMP] 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
2	Current (0 to +20 mA DC)	

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%.

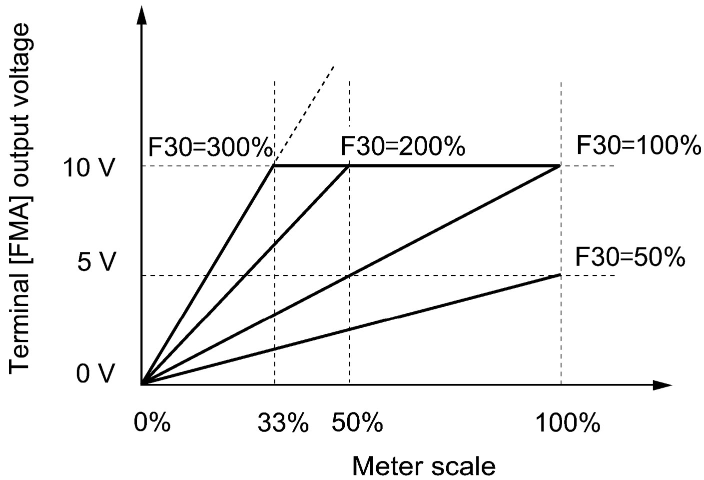


Figure 5.4-32

Chapter 5 Function Code
Details of Function Codes
F26 to F31
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U codes
y codes

■ Function (F31)

F31 specifies what is output to analog output terminal [FMA].

Table 5.4-38

Data for F31	[FMA] output	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 output frequency (F03)
1	Output frequency 2 (after slip compensation)	Output frequency of the inverter	Maximum output 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	250V for 200 V class series, 500V for 400 V class series
4	Output torque	Motor shaft torque	Twice the rated motor torque
5	Load factor	Load factor	Twice the rated motor load
6	Power consumption	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 amount (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.)	20,000 / 100%
13	Motor output	Motor output (kW)	Twice the rated motor output
14	Analog output test	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 output frequency (F03)
17	Synchronous angle deviation	Position deviation during synchronous operation	Monitor amount: 0% to 50% to 100% Position deviation: -180 deg to 0 deg to +180 deg

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.

Table 5.4-39

[FMP] output form	Data for F33	Data for F34	Pulse duty	Pulse rate
Pulse output	25 to 6000 p/s	0	Around 50%	Variable
Average voltage	-	1 to 300%	Variable	2000 p/s

■ 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

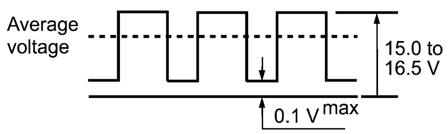


Figure 5.4-33

FMP output circuit

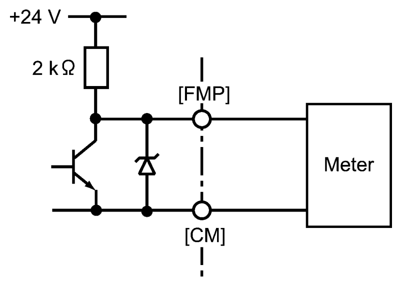


Figure 5.4-34

■ 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** Related function codes: 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.

Table 5.4-40

<table>
<tr><th>Data for F37</th><th>V/f pattern</th><th>Torque boost</th><th>Auto energy saving operation</th><th>Applicable load</th></tr>
<tr><td>0</td><td>Variable torque V/f pattern</td><td rowspan="2">Torque boost specified by F09</td><td rowspan="3">Disable</td><td>Variable torque load (General-purpose fans and pumps)</td></tr>
<tr><td>1</td><td rowspan="2">Linear V/f pattern</td><td>Constant torque load</td></tr>
<tr><td>2</td><td>Auto torque boost</td><td>Constant torque load (To be selected if a motor may be over-excited at no load.)</td></tr>
<tr><td>3</td><td>Variable torque V/f pattern</td><td rowspan="2">Torque boost specified by F09</td><td rowspan="3">Enable</td><td>Variable torque load (General-purpose fans and pumps)</td></tr>
<tr><td>4</td><td rowspan="2">Linear V/f pattern</td><td>Constant torque load</td></tr>
<tr><td>5</td><td>Auto torque boost</td><td>Constant torque load (To be selected if a motor may be over-excited at no load.)</td></tr>
</table>

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).

Tip
- Under 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.)

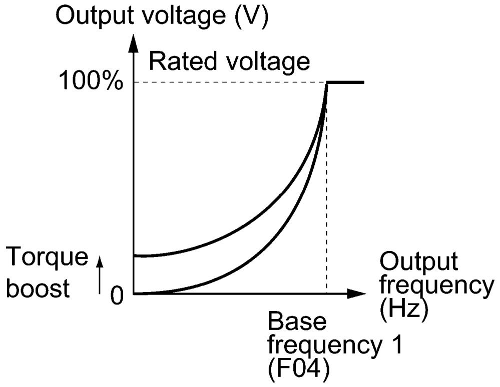
Table 5.4-41

Data for F37	Enable
0 to 2	Auto energy saving operation OFF
3 to 5	Auto energy saving operation ON

- Under vector control without speed sensor, both F37 and F09 are disabled. The auto energy saving operation is also disabled.

■ V/f pattern

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.



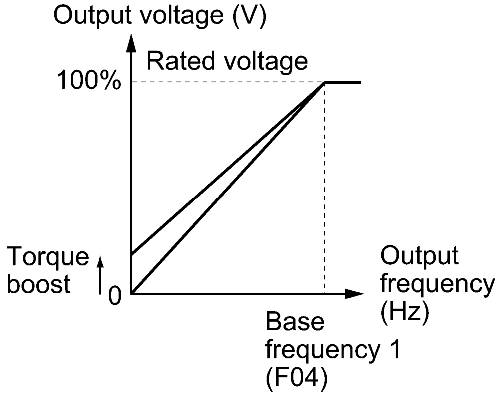


Figure 5.4-35 Variable torque V/f pattern (F37 = 0) ure 5.4-36 Linear V/f pattern (F37 = 1)

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

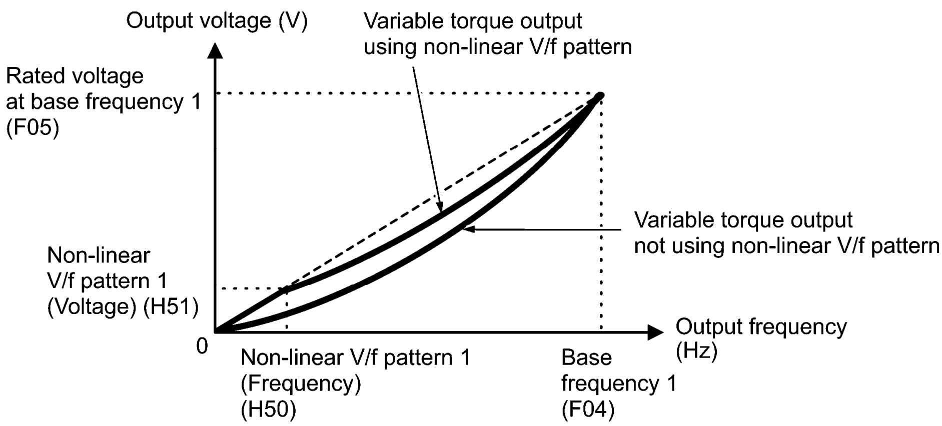


Figure 5.4-37

■ 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. 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.

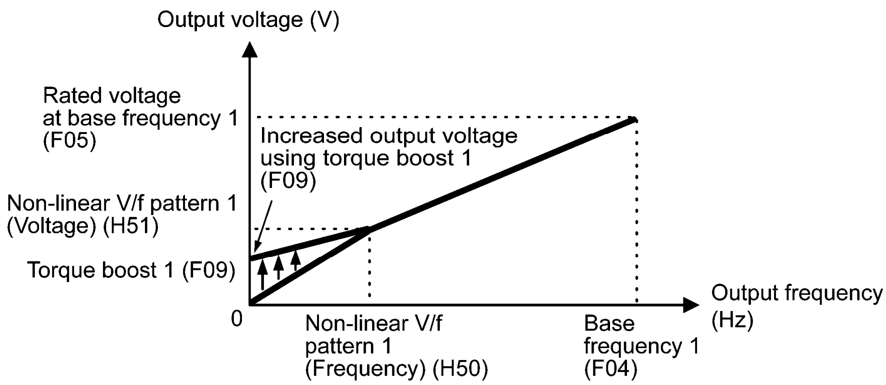


Figure 5.4-38

• 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 guarantee the output torque of the motor.

Note

- This function is controlled in accordance with the motor characteristics. 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).

■ 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.
- This function is controlled in accordance with the motor characteristics. 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 vector control without speed sensor, the auto energy saving operation is disabled.

F38 and 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 and F41 | **Torque Limiter 1-1, 1-2**

Related function codes: E16 and E17 (Torque Limiter 2-1, 2-2)
H73 (Torque Limiter, Operating conditions)
H76 (Torque Limiter, Frequency increment limit for braking)

Under V/f control

If the inverter's output torque exceeds the specified levels of the torque limiters (F40, F41, E16, E17, and E61 to E63), the inverter controls the output frequency and limits the output torque for preventing a stall.

To use the torque limiters, it is necessary to configure the function codes listed in the table below.

Note 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. H76 (Frequency increment limit for braking) is provided to limit the increasing frequency component.

Related function codes

Table 5.4-42

Function Code	Name	V/f control	Remarks
F40	Torque limiter 1-1	Y	
F41	Torque limiter 1-2	Y	
E16	Torque limiter 2-1	Y	
E17	Torque limiter 2-2	Y	
H73	Torque Limiter (Operating conditions)	Y	
H74	Torque Limiter (Control target)	N	
H75	Torque Limiter (Target quadrants)	N	
H76	Torque Limiter (Frequency increment limit for braking)	Y	
E61 to E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	Y	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 the relationship between the torque and the output frequency at the constant torque current limit.

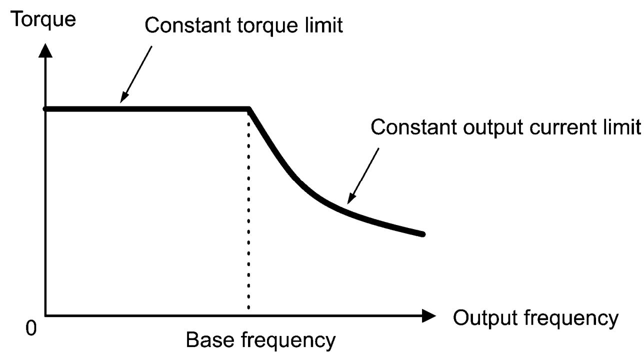


Figure 5.4-39

■ Torque limiters (F40, F41, E16 and E17)   Data setting range: -300 to 300 (%), 999 (Disable)

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Table 5.4-43

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. Specifying a negative value causes the inverter to interpret it as an absolute value.

The torque limiter determined depending on the overload current actually limits the torque current output. Therefore, the torque current output is automatically limited at a value lower than 300%, the maximum setting value.

■ 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.

Table 5.4-44

Data for E61, E62, or E63	Function	Description
7	Analog torque limit value A	Used when analog inputs are used as torque limiters. Input specifications: 200% / 10 V or 20 mA
8	Analog torque limit value B	

If these terminals have been set up to have the same data, the operation priority is given in the following order: 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.

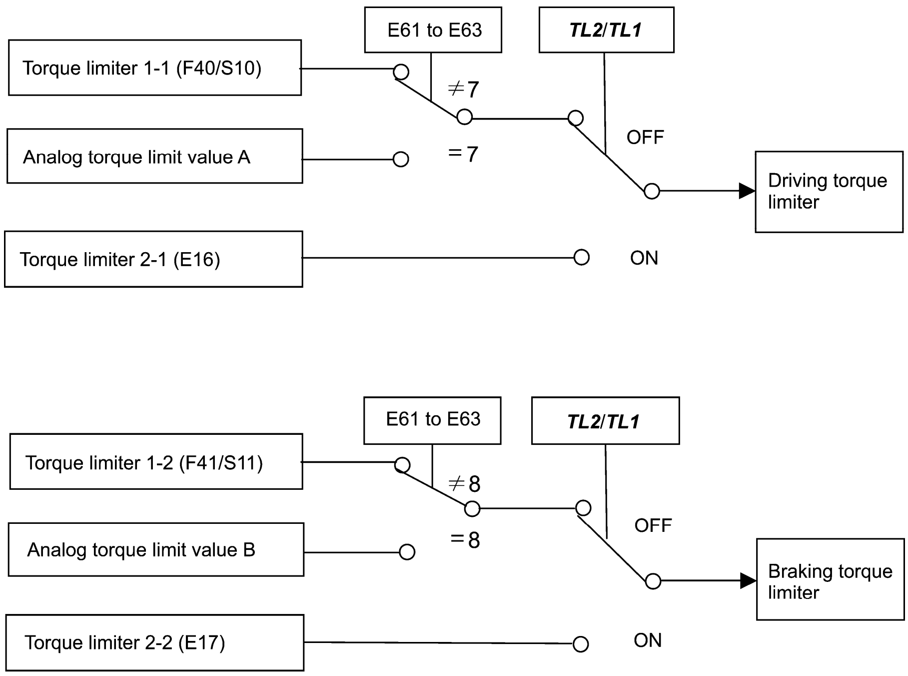


Figure 5.4-40

■ Torque limiter (Operating conditions) (H73)

H73 specifies whether the torque limiter is enabled or disabled during acceleration/deceleration and running at constant speed.

Table 5.4-45

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) Data setting range: 0.0 to 500.0 (Hz)

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.

Note 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.

Under vector control with/without speed sensor

If the inverter's output torque exceeds the specified levels of the torque limiters (F40, F41, E16, E17, and E61 to E63), the inverter controls the speed regulator's output (torque command) in speed control or a torque command in torque control in order to limit the motor-generating torque.

To use the torque limiters, it is necessary to configure the function codes listed in the table below.

Related function codes

Table 5.4-46

Function Code	Name	Vector control	Remarks
F40	Torque limiter 1-1	Y	
F41	Torque limiter 1-2	Y	
E16	Torque limiter 2-1	Y	
E17	Torque limiter 2-2	Y	
H73	Torque Limiter (Operating conditions)	Y	
H74	Torque Limiter (Control target)	Y	
H75	Torque Limiter (Target quadrants)	Y	
H76	Torque Limiter (Frequency increment limit for braking)	N	
E61 to E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	Y	7: Analog torque limit value A 8: Analog torque limit value B

■ Torque Limiter (Control target) (H74)

Under vector control, the inverter can limit motor-generating torque or output power, as well as a torque current (default).

Table 5.4-47

Data for H74	Control target
0	Motor-generating torque limit
1	Torque current limit
2	Output power limit

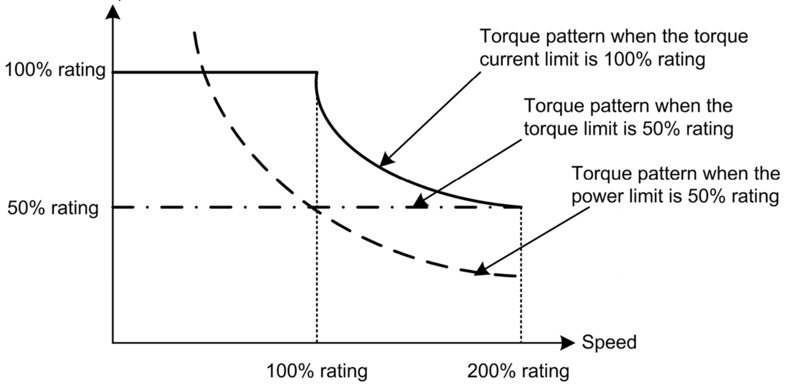
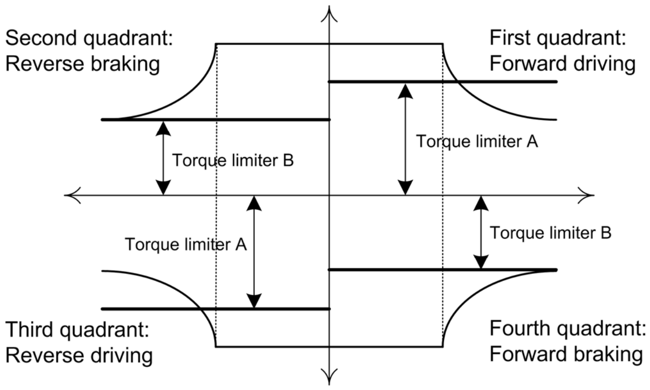
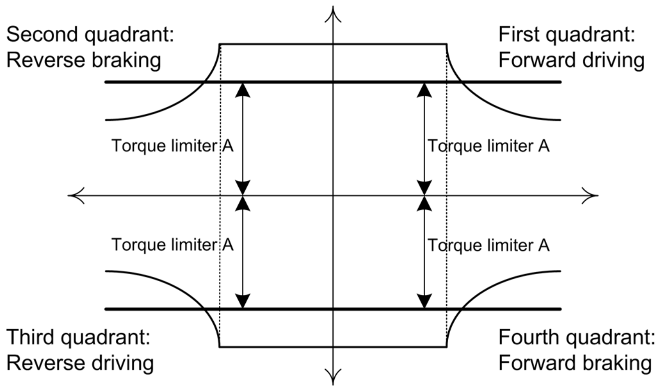


Figure 5.4-41

■ Torque Limiter (Target quadrants) (H75)

H75 selects the configuration of target quadrants (Drive/brake, Forward/reverse rotation) in which the specified torque limiter(s) is activated, from "Drive/brake torque limit," "Same torque limit for all four quadrants," and "Upper/lower torque limits" shown in the table below.

Table 5.4-48

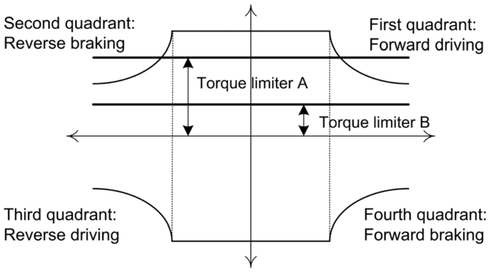
Data for H75	Target quadrants
0: Drive/brake	Torque limiter A applies to driving (both of forward and reverse), and torque limiter B to braking (both of forward and reverse). 
1: Same for all four quadrants	Torque limiter A applies to all four quadrants; that is, the same torque limit applies to both driving and braking in the forward and reverse rotations. 

Chapter 5 Function Code

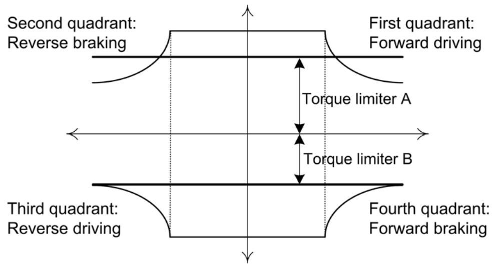
Details of Function
F29 to F31
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U codes
y codes

<table>
<tr><th>Data for H75</th><th>Target quadrants</th></tr>
<tr><td>2: Upper/lower limits</td><td>
Torque limiter A applies to the upper limit, and torque limiter B to the lower limit.
Depending upon the polarity of torque limiters A and B, the following patterns are available.
Table 5.4-49

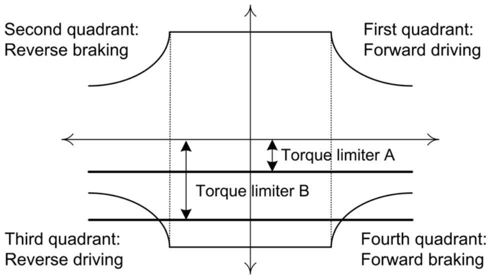
<table>
<tr><th></th><th>Torque limiter A</th><th>Torque limiter B</th></tr>
<tr><td>Pattern 1</td><td>Positive</td><td>Positive</td></tr>
<tr><td>Pattern 2</td><td>Positive</td><td>Negative</td></tr>
<tr><td>Pattern 3</td><td>Negative</td><td>Negative</td></tr>
</table>



Pattern 1



Pattern 2



Pattern 3

Note

If the value of torque limiter A is less than that of torque limiter B, torque limiter A applies to both the upper and lower limits.
Selecting the "Upper/lower torque limits" may cause reciprocating oscillation between the upper and lower limit values, depending upon a small difference between the upper and lower limits, a slow response from the speed control sequence, and other conditions.

</td></tr>
</table>

■ Torque limiters (F40, F41, E16 and E17)   Data setting range: -300 to 300 (%), 999 (Disable)

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Table 5.4-50

Function Code	Name
F40	Torque limiter 1-1
F41	Torque limiter 1-2
E16	Torque limiter 2-1
E17	Torque limiter 2-2

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 except when the "Upper/lower torque limits" (H75 = 2) is selected. Specifying a negative value causes the inverter to interpret it as an absolute value.

The torque limiter determined depending on the overload current actually limits the torque current output. Therefore, the torque current output is automatically limited at a value lower than 300%, the maximum setting value.

■ 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.

Table 5.4-51

Data for E61, E62, or E63	Function	Description
7	Analog torque limit value A	Used when analog inputs are used as torque limiters. Input specifications: 200% / 10 V or 20 mA
8	Analog torque limit value B	

If these terminals have been set up to have the same data, the operation priority is given in the following order: 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.

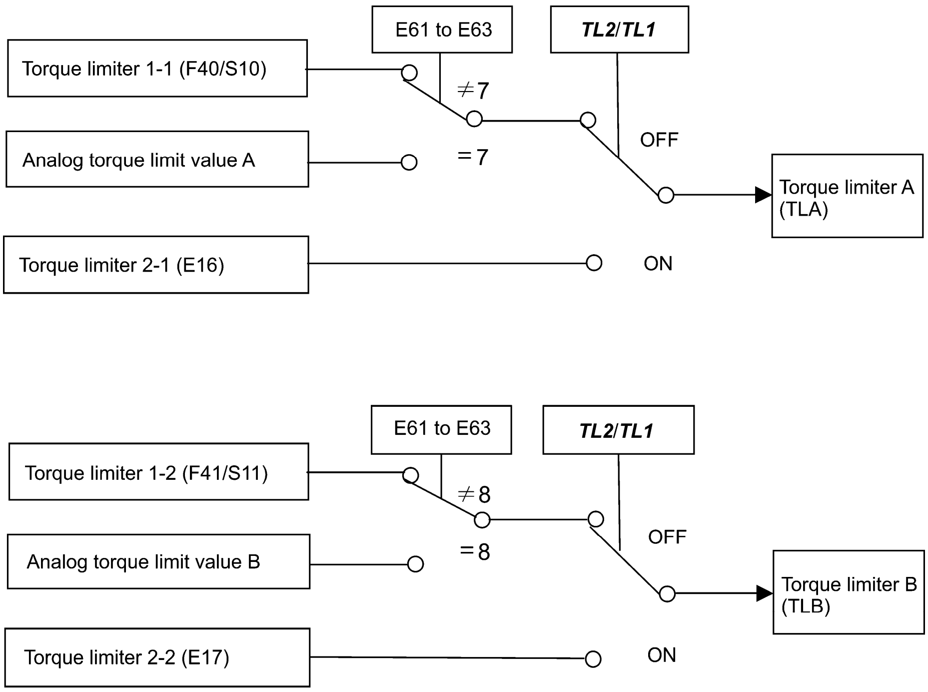


Figure 5.4-42

■ Torque limiter (Operating conditions) (H73)

H73 specifies whether the torque limiter is enabled or disabled during acceleration/ deceleration and running at constant speed.

Table 5.4-52

Data for H73	During accelerating/decelerating	During running at constant speed
0	Enable	Enable
1	Disable	Enable
2	Enable	Disable

Note 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.

F42	**Drive Control Selection 1** Related function code: H68 (Slip Compensation 1, Operating conditions)

F42 specifies the motor drive control.

Table 5.4-53

Data for F42	Drive control	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)			Frequency control with slip compensation
2	V/f control with slip compensation active			
3	V/f control with speed sensor		Enable	Frequency control with automatic speed regulator (ASR)
4	Dynamic torque vector control with speed sensor			
5	Vector control without speed sensor	Vector control	Disable (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.

■ 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.

Table 5.4-54

Function Code		Enable
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 setting.

To improve the accuracy of slip compensation, perform auto-tuning.

H68 enables or disables the slip compensation function according to the motor driving conditions.

Table 5.4-55

Data for H68	Motor driving conditions		Motor driving frequency zone	
	Accl/Decel	During constant speed	Base frequency or below	Above the base frequency
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 matched to the load applied and uses it to optimize the voltage and current vector output.

Selecting the dynamic torque vector control automatically enables the auto-torque boost and slip compensation. This control is effective for improving the system response to external disturbances such as load fluctuations, and the motor speed control accuracy.

Note that the inverter may not respond to a rapid load fluctuation since this control is an open-loop V/f control that does not perform current control, unlike vector control. Other advantage of this control is that the maximum torque per output current is larger than that of vector control.

■ V/f control with speed sensor

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. Under V/f control with speed sensor, the inverter detects the motor rotation using the encoder mounted on the motor shaft and compensates for the decrease in slip frequency by the PI control to match the motor rotation with the reference speed. This improves the motor speed control accuracy.

■ Dynamic torque vector control with speed sensor

The difference from "V/f control with speed sensor" stated above is to calculate the motor torque matched to the load applied and use it to optimize the voltage and current vector output for getting the maximal torque out of a motor. 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. It also 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 control regulating the motor current requires some voltage margin between the voltage that the inverter can output and the induced voltage of the motor. Usually a general-purpose motor is so designed that the voltage matches the commercial power. Under the control, therefore, it is necessary to suppress the motor terminal voltage to the lower level in order to secure the voltage margin required. However, driving the motor with the motor terminal voltage suppressed to the lower level cannot generate the rated torque even if the rated current originally specified for the motor is applied. To ensure the rated torque, it is necessary to increase the rated current. (This also applies to vector control with speed sensor.)

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

■ 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 according to PG feedback signals and uses them for speed control. It also decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

It is possible to obtain the desired response by adjusting the control constants (PI constants) using the speed regulator (PI controller).

The control enables speed control with higher accuracy and quicker response than vector control without speed sensor.

(A recommended motor for the control is a Fuji VG motor exclusively designed for vector control.)

Note Since slip compensation, dynamic torque vector control, and vector control with/without speed sensor use motor parameters, the following conditions should be satisfied to obtain full control performance. Otherwise, adequate control performance may not be achieved.

- A single motor is controlled per inverter.
- Motor parameters P02, P03, P06 to P23, P55 and P56 are properly configured. Or, auto-tuning (P04) is performed. (Using a Fuji VG motor under vector control with speed sensor requires just selecting a Fuji VG motor with function code (P99 = 2) and does not require auto-tuning.)
- Under dynamic torque vector control, the capacity of the motor to be controlled is two or more ranks lower than that of the inverter; under vector control with/without speed sensor, it is the same as that of the inverter. Otherwise, the inverter may not control the motor due to decrease of the current detection resolution.
- The wiring distance between the inverter and motor is 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 if 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 and F44	Current Limiter (Mode Selection and Level)
	Related function codes: 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 of the current limiter 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 overload current, 160% (145% or 130%) or more of the current limit level, flows instantaneously so that an output frequency decrease problem arises due to the current limiter, consider increasing the current limit level.

If F43 = 1, the current limiter is enabled only during constant speed operation. If F43 = 2, it 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 becomes active.

Table 5.4-56

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)

■ 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.

Table 5.4-57

Data for H12	Function
0	Disable (An overcurrent trip occurs at the instantaneous overcurrent limiting level.)
1	Enable (Instantaneous current limiting enabled)

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 or activating the inverter overvoltage trip. When specifying the acceleration time, therefore, you need to take into account machinery characteristics and moment of inertia of the load.

Note

- 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.
- 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 11, Section 11.4.1 "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. When using a braking resistor of any other manufacturer, confirm the corresponding values with the manufacture 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 dbh 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] or [REV], and connect that terminal and its common terminal to braking resistor's terminals 2 and 1.

<u>Calculating the discharging capability and allowable average loss of the braking resistor and configuring the function code data</u>

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 to calculate the discharging capability and the allowable average loss.

<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 to calculate the discharging capability and the allowable average loss.

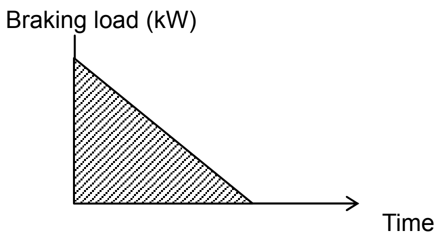


Figure 5.4-43

Applying braking load during deceleration

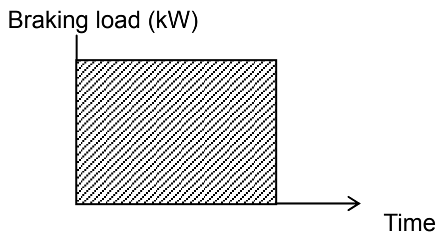


Figure 5.4-44

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.

Table 5.4-58

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

$$\text{Discharging capability (kWs)} = \frac{\text{Braking time (s)} \times \text{Motor rated capacity (kW)}}{2} \qquad (1)$$

$$\text{Discharging capability (kWs)} = \text{Braking time (s)} \times \text{Motor rated capacity (kW)} \qquad (2)$$

Tip When the F50 is set to "0" (For the braking resistor built-in type), no specification of the discharging capability is required.

■ 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).

Table 5.4-59

Data for F51	Function
0.001 to 99.99	0.001 to 99.99 (kW)

$$\text{Allowable average loss (kWs)} = \frac{\frac{\%\text{ED (\%)}}{100} \times \text{Motor rated capacity (kW)}}{2} \qquad (3)$$

$$\text{Allowable average loss (kWs)} = \frac{\%\text{ED (\%)}}{100} \times \text{Motor rated capacity (kW)} \qquad (4)$$

■ 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 ∨ + keys (simultaneous keying).

Table 5.4-60

Data for F80	Drive mode	Application	Continuous current rating level	Overload capability	Maximum output frequency
0	HD (High Duty) mode	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 is lower than that of the HD mode. For the rated current level, see Chapter 12 "SPECIFICATIONS."

The MD- and LD-mode inverters are subject to restrictions on the function code data setting range and internal processing as listed below.

Table 5.4-61

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 (Operation 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 output 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	

The rated capacity of motor 1 (P02) is not automatically changed to the one for the motor with one rank higher capacity, so configure the P02 data to match the applied motor rating as required.

5.4.2 E codes (Terminal functions)

E01 to E09	**Terminal [X1] to [X9] (Function Select)** Related Function Codes: E98 Terminal [FWD] (Function Select) E99 Terminal [REV] (Function Select)

Terminals [X1] to [X9], [FWD], and [REV] are programmable general-purpose digital input terminal. Assignment of functions by using E01 to E09, E98, and E99 is possible.

With the negative logic setting, switching between active ON and active OFF of each signal is possible. The factory default setting is normal logic system "Active ON." The following functions can be assigned to digital input terminals [X1] to [X9], [FWD], and [REV]. Explanations of each function are given in Active ON logic (normal logic). Explanation of each signal is provided in an order of assigned data. However, highly relevant signals are collectively explained. See the function codes in the "Related function codes" column, if any.

In FRENIC-MEGA, selection of the control method is possible from V/f control, dynamic torque vector control, V/f control with speed sensor, dynamic torque vector control with speed sensor, vector control without speed sensor, and vector control with speed sensor. Some functions apply exclusively to the specific drive control. In the control system field, "○: Valid" or "X: Invalid" is indicated for each function. (See page 5-3.)

⚠CAUTION

- Digital input terminal has functions such as run and stop commands including Run command ***FWD***, Coast-to-stop command ***BX***, and frequency setting change command. Depending on the digital input terminal status, modifying the function code setting may cause a sudden motor start or an abrupt change in speed. Change the setting of function code after thoroughly checking the safety.
- To the digital input terminal, the function to switch the operation method of run command and command method of frequency setting (***SS1, 2, 4, 8***, ***Hz2/Hz1***, ***Hz/PID***, ***IVS***, and ***LE***) can be assigned. When switching these signals, operation may suddenly starts or the speed changes rapidly under some conditions.

An accident or injuries could occur.

Table 5.4-62

Data		Defined Function	Signal Name	Control Method					Related Function Code
Active ON	Active OFF			V/f	PG V/f	PG less	PG	Torque Control	
0	1000	Multi-frequency selection (0 to 15 steps)	***SS1***	○	○	○	○	X	C05 to C19
1	1001		***SS2***	○	○	○	○	X	
2	1002		***SS4***	○	○	○	○	X	
3	1003		***SS8***	○	○	○	○	X	
4	1004	Acceleration/deceleration select (2 steps)	***RT1***	○	○	○	○	X	F07, F08, E10 to E15
5	1005	Acceleration/deceleration select (4 steps)	***RT2***	○	○	○	○	X	
6	1006	Self-hold select	***HLD***	○	○	○	○	○	F02
7	1007	Coast-to-stop command	***BX***	○	○	○	○	○	—
8	1008	Alarm (error) reset	***RST***	○	○	○	○	○	—
1009	9	External alarm	***THR***	○	○	○	○	○	—
10	1010	Jogging operation	***JOG***	○	○	○	○	X	C20 H54, H55, d09 to d13
11	1011	Frequency command 2/Frequency command 1	***Hz2/Hz1***	○	○	○	○	X	F01, C30
12	1012	Motor select 2	***M2***	○	○	○	○	○	A42
13	-	Enable DC braking	***DCBRK***	○	○	○	○	X	F20 to F22

Table 5.4-63

Data		Defined Function	Signal Name	Control Method					Related Function Code
Active ON	Active OFF			V/f	PG V/f	PG less	PG	Torque Control	
14	1014	Torque limit 2/Torque limit 1	***TL2/TL1***	○	○	○	○	○	F40, F41 E16, E17
15	—	Switch to commercial power (50 Hz)	***SW50***	○	○	X	X	X	—
16	—	Switch to commercial power (60 Hz)	***SW60***	○	○	X	X	X	—
17	1017	UP command	***UP***	○	○	○	○	X	Frequency setting: F01, C30 PID command: J02
18	1018	DOWN command	***DOWN***	○	○	○	○	X	
19	1019	Edit accept command (data change possible)	***WE-KP***	○	○	○	○	○	F00
20	1020	Cancel PID control	***Hz/PID***	○	○	○	○	X	J01 to J19, J56 to J62
21	1021	Switch normal/inverse operation	***IVS***	○	○	○	○	X	C53, J01
22	1022	Interlock	***IL***	○	○	○	○	○	F14
23	1023	Cancel torque control	***Hz/TRQ***	X	X	X	X	○	H18
24	1024	Link operation select (RS-485, BUS option)	***LE***	○	○	○	○	○	H30, y98
25	1025	Universal DI	***U-DI***	○	○	○	○	○	—
26	1026	Select starting mode	***STM***	○	○	○	X	○	H09, d67
1030	30	Forcible stop	***STOP***	○	○	○	○	○	F07, H56
32	1032	Pre-excitation	***EXITE***	X	X	○	○	X	H84 and H85
33	1033	Reset PID integral and differential components	***PID-RST***	○	○	○	○	X	J01 to J19, J56 to J62
34	1034	Hold PID integral component	***PID-HLD***	○	○	○	○	X	
35	1035	Local (keypad) command select	***LOC***	○	○	○	○	○	(See Item 3.3.6.)
36	1036	Motor select 3	***M3***	○	○	○	○	○	A42, b42
37	1037	Motor select 4	***M4***	○	○	○	○	○	A42, r42
39	—	Dew condensation prevention	***DWP***	○	○	○	○	○	J21
40	—	Commercial power switching integrated sequence (50 Hz)	***ISW50***	○	○	X	X	X	J22
41	—	Commercial power switching integrated sequence (60 Hz)	***ISW60***	○	○	X	X	X	
47	1047	Servo-lock command	***LOCK***	X	X	X	○	X	J97 to J99
48	—	Pulse train input (available only on terminal [X7])	***PIN***	○	○	○	○	○	F01, C30 d62, d63
49	1049	Pulse train sign (available on terminals except [X7])	***SIGN***	○	○	○	○	○	
59	1059	Battery run effective command	***BATRY***	○	○	○	○	○	
70	1070	Cancel constant peripheral speed control	***Hz/LSC***	○	○	○	○	X	d41
71	1071	Constant periphery speed control frequency memory	***LSC-HLD***	○	○	○	○	X	
72	1072	Input during commercial driving (Motor 1)	***CRUN-M1***	○	○	X	X	○	H44, H94
73	1073	Input during commercial driving (Motor 2)	***CRUN-M2***	○	○	X	X	○	
74	1074	Input during commercial driving (Motor 3)	***CRUN-M3***	○	○	X	X	○	
75	1075	Input during commercial driving (Motor 4)	***CRUN-M4***	○	○	X	X	○	
76	1076	Droop select	***DROOP***	○	○	○	○	X	H28

Data		Defined Function	Signal Name	Control Method					Related Function Code
Active ON	Active OFF			V/f	PG V/f	PG less	PG	Torque Control	
77	1077	Cancel PG alarm	***PG-CCL***	X	○	X	○	○	—
80	1080	Cancel customizable logic	***CLC***	○	○	○	○	○	E01 to E09, U81 to U85
81	1081	Clear all customizable logic timers	***CLTC***	○	○	○	○	○	
98	—	Normal operation, Stop command (Setting possible to terminals [FWD] and [REV] only by E98 and E99)	***FWD***	○	○	○	○	○	F02
99	—	Inverse operation, Stop command (Setting possible to terminals [FWD] and [REV] only by E98 and E99)	***REV***	○	○	○	○	○	
100	—	No function	***NONE***	○	○	○	○	○	U81 to U85
110	1110	Select servo lock gain	***SLG2***	X	X	X	○	X	d27, d28
1111	111	Forcible stop (terminal block only)	***STOP-T***	○	○	○	○	○	

Note Functions that has "-" in the data active OFF field, negative logic setting is not possible.

The external alarm and forcible stop have the fail-safe setting as default. For example, take note that data = 9 is "Active OFF" (alarm is triggered when OFF), and data = 1009 is "Active ON" (alarm is triggered when ON).

Terminal function assignment and data setting

■ Assignment of multi-frequency selection ***SS1***, ***SS2***, ***SS4***, and ***SS8*** (Function code data = 0, 1, 2, and 3)

16-stage speed operation is possible by turning on/off ***SS1***, ***SS2***, ***SS4***, and ***SS8*** signals.

(Function code C05 to C19)

■ Assignment of accelerate/decelerate select ***RT1*** and ***RT2*** (Function code data = 4 and 5)

Accelerate/decelerate time 1 to 4 (F07, F08, and E10 to E15) can be switched by ***RT1*** and ***RT2*** signals.

(Function code F07, F08)

■ Assignment of Self-hold select ***HLD*** (Function code data = 6)

This function can be used as the self-hold signal in the 3-wire operation by ***FWD***, ***REV***, ***HLD*** signals.

(Function code F02)

■ Assignment of coast-to-stop order ***BX*** (Function code data = 7)

With ***BX*** ON, this function immediately block the inverter output. Motor becomes coast-to-stop (no alarm indication).

■ Assignment of alarm (error) reset ***RST*** (Function code data = 8)

Turning ***RST*** from OFF to ON cancels bulk alarm output ***ALM***. Turning it off erases the alarm display and clears the alarm hold state. When turning ***RST*** on, keep it on for 10 ms or longer. This command should be kept off during the normal operation.

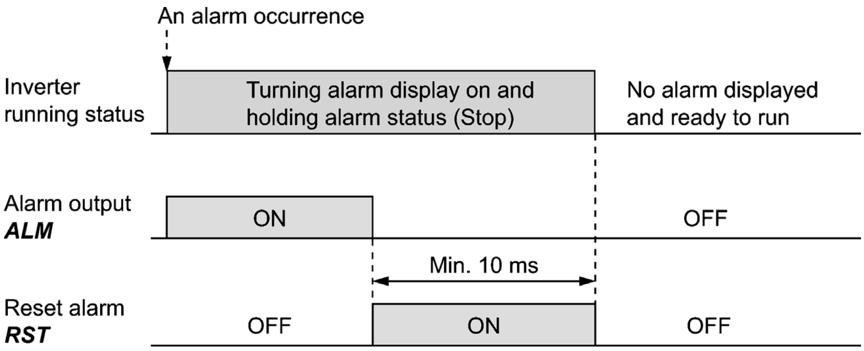


Fig. 5.4-45

■ Assignment of external alarm ***THR*** (Function code data = 9)

Turning ***THR*** off immediately block the inverter output (so that the motor coasts to a stop), displays the alarm OH2, and outputs the bulk alarm ***ALM***. This signal is self-held inside and is canceled by alarm reset.

Tip Use the external alarm function when immediate block down of the inverter output is necessary while peripheral equipment is in abnormal situation.

■ Assignment of jogging operation ***JOG*** (Function code data = 10)

This function is used to jog or inch the motor in situations such as positioning of a workpiece.

Turning JOG on enables the jogging operation.
(📖 Function code C20)

■ Assignment of frequency command 2/frequency command 1 ***Hz2/Hz1*** (Function code data = 11)

Hz2/Hz1 signal switches the frequency setting methods selected by frequency command 1 (F01) and frequency command 2 (C30) is possible.

(📖 Function code F01)

■ Assignment of motor select 2/3/4 ***M2/M3/M4*** (Function code data = 12, 36 and 37)

With this function, motor selection of No. 1 to No. 4 motors is possible by ***M2***, ***M3***, and ***M4*** signals, and parameter switching on the control by function code switching for No. 1 motor to No. 4 motor are possible.

(📖 Function code A42)

■ Assignment of DC braking command ***DCBRK*** (Function code data = 13)

The DC braking command ***DCBRK*** is turned on, the DC braking starts operating.

(Requirements for DC braking must be satisfied.)

(📖 Function code F20 to F22)

■ Assignment of torque limit 2/torque limit 1 ***TL2/TL1*** (Function code data = 14)

With ***TL2/TL1*** signal, switching between torque limit value 1-1 and 1-2 (F40 and F41) and torque limit value 2-1 and 2-2 (E16 and E17) is possible.

(📖 Function code F40, F41)

■ Assignment of commercial switching (50 Hz) ***SW50***/(60 Hz) ***SW60*** (Function code data = 15, 16)

When switching between the commercial driving/inverter driving from the external sequence, input the ***SW50*** or ***SW60*** signals from outside according to the following operation chart. Then, starting from the commercial power frequency becomes possible regardless of the set frequency of the inverter. In this way, the motor in commercial driving can be smoothly switched to the inverter driving.

See the sequence example and the operation chart on the following page.

Table 5.4-64

Assignment	Operation	
Commercial switching (50 Hz) ***SW50***	Starts at 50 Hz.	Note: Do not concurrently set both ***SW50*** and ***SW60***.
Commercial switching (60 Hz) ***SW60***	Starts at 60 Hz.	

<Operation chart>

- When the motor speed remains almost the same during coast-to-stop

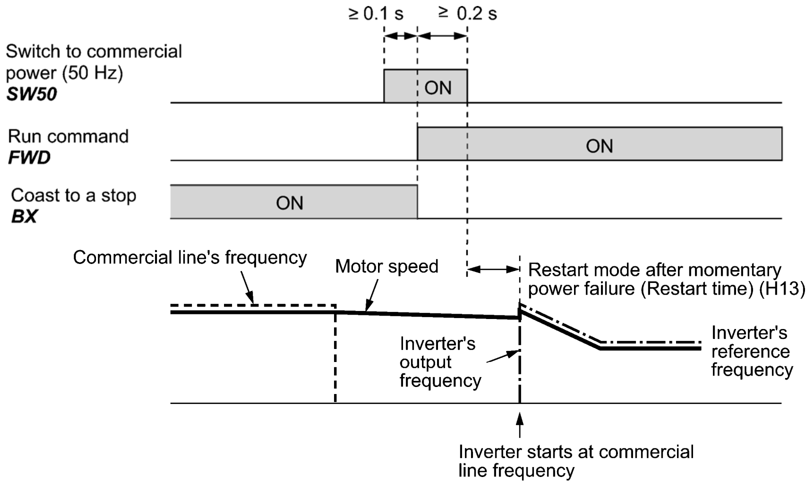


Fig. 5.4-46

- When the motor speed decreases significantly during coast-to-stop (with the current limiter activated):

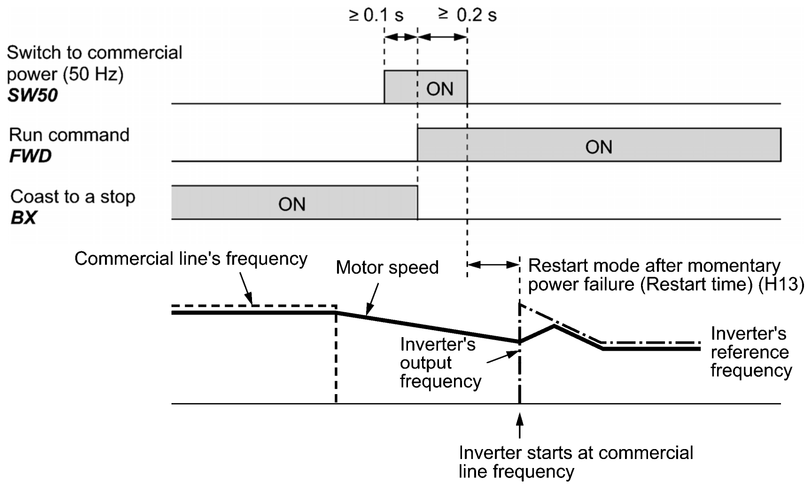


Fig. 5.4-47

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 when both the "Switch to commercial power" signal and run command are concurrently 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.
  When switching from the motor drive source from the commercial power to the inverter, be sure to reset ***BX*** before the "Switch to commercial power" signal turns off.
- When switching the motor drive source from the inverter to commercial power, adjust the inverter's set 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 protected by installing appropriate equipment for this inrush current.
- When "Restart after momentary power failure" (F14 = 3, 4, 5) is selected, keep ***BX*** on to prevent the inverter from restarting after a momentary power failure during commercial power driven operation.

<Example of Sequence Circuit>

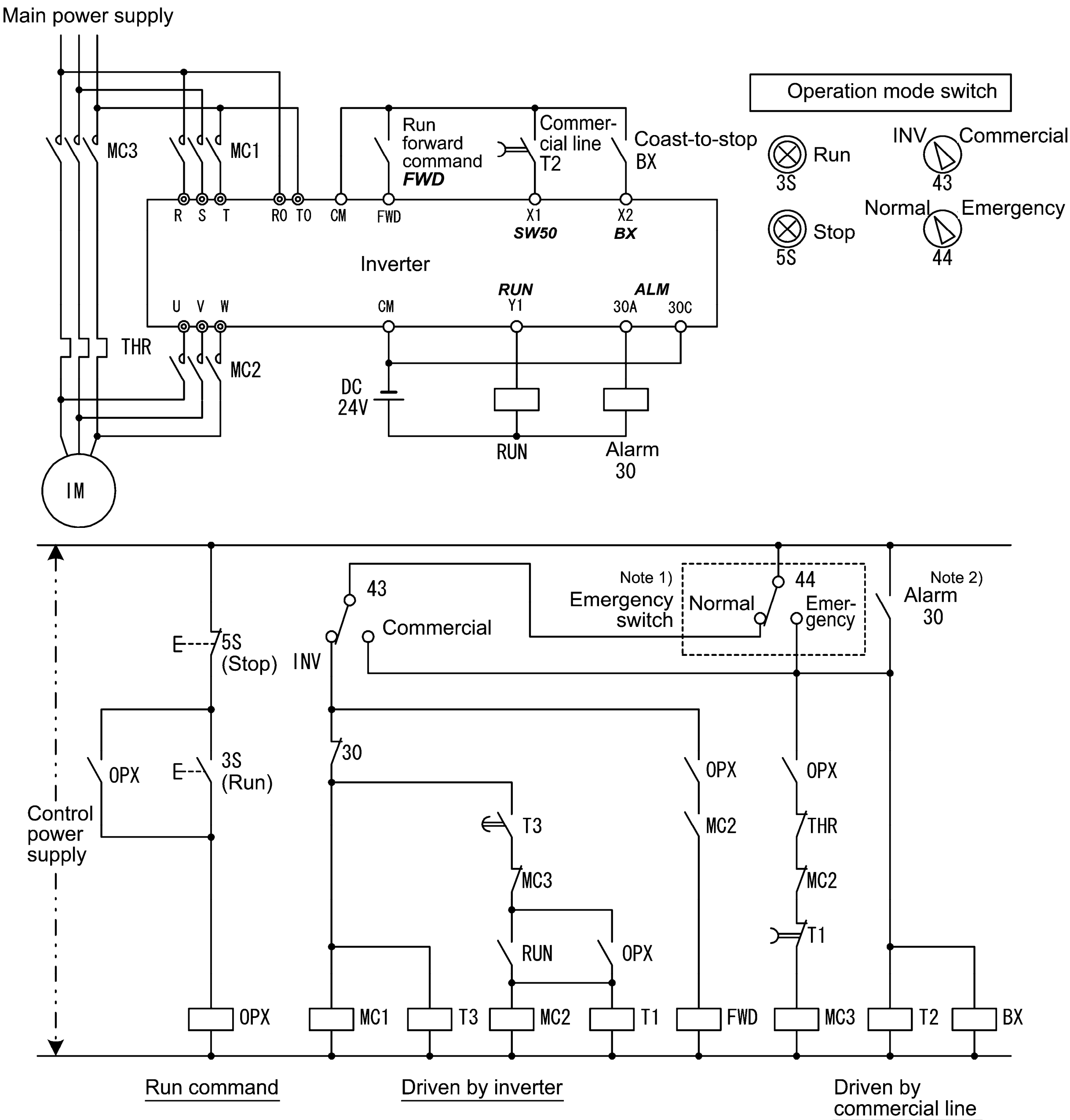


Fig. 5.4-48

(Note 1) Emergency switching

Manual switching 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 the inverter alarm is output, it automatically switches to the commercial power.

<Example of Operation Chart>

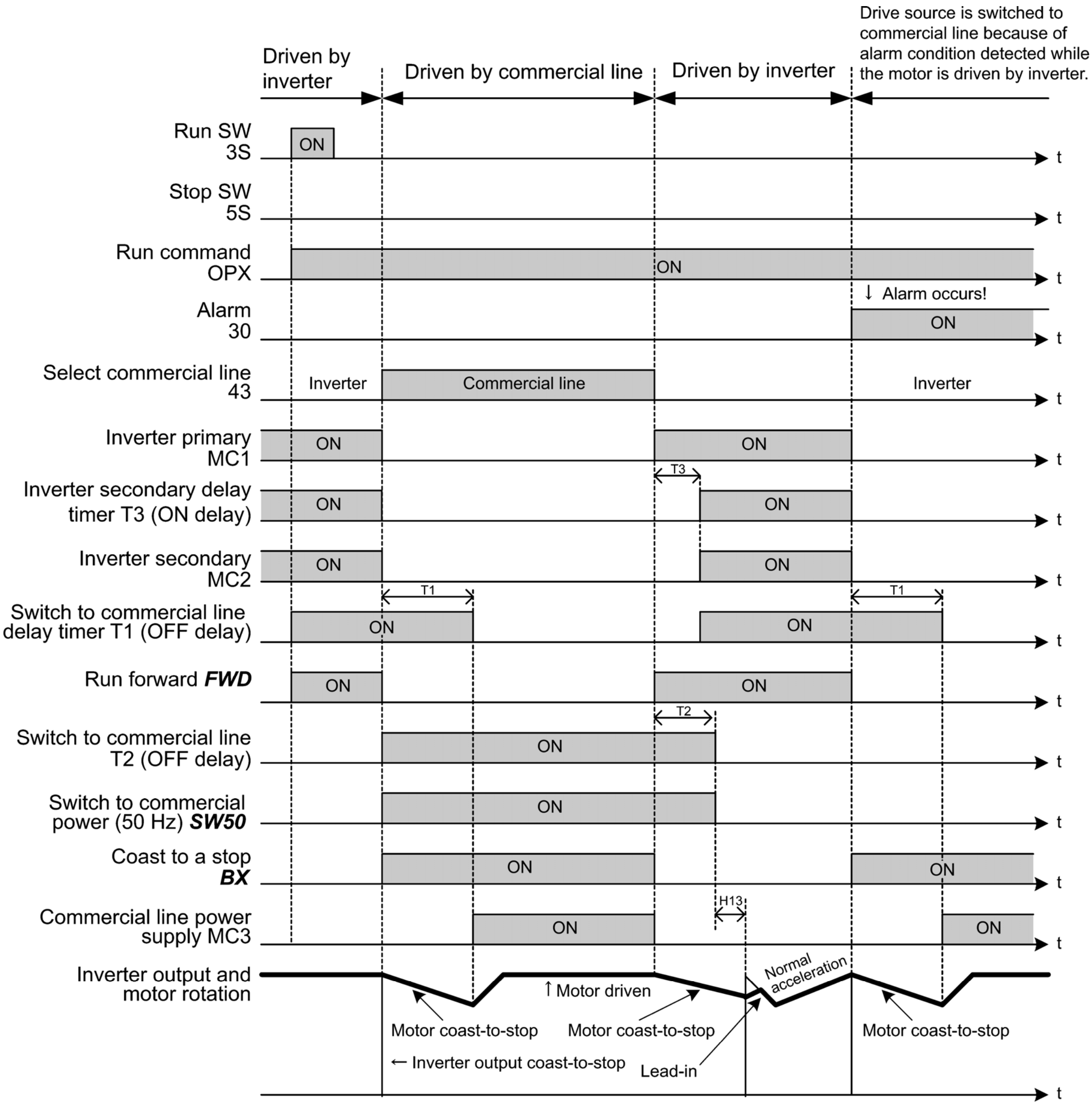


Fig. 5.4-49

Tip

Alternatively, you may use the integrated sequence by which some of the actions above are automatically performed by the inverter itself.
For details, see the description of ***ISW50*** and ***ISW60***.

■ Assignment of UP/DOWN command ***UP***/***DOWN*** (Function code data = 17 and 18)

- Frequency command: When turning on ***UP*** or ***DOWN***, the output frequency increases or decreases respectively, within the range from 0 Hz to the maximum frequency. (Function code F01 Data = 7)
- PID command: When turning on ***UP*** or ***DOWN***, the PID control command value increases or decreases respectively, within the range from 0 to 100%. (Function code J02 Data = 3)

■ Assignment of edit accept command (data change accept) ***WE-KP*** (Function code data = 19)

This function enables to edit only when ***WE-KP*** is input in order to prevent erroneous changing of the function code data by incorrect operation on the keypad. (Function code F00)

■ Assignment of PID control cancel ***Hz/PID*** (Function code data = 20)

When ***Hz/PID*** is on, switching to the manual frequency setting (driven with the frequency selected by the multi-frequency, keypad, and analog input) is by the PID control is possible.

Table 5.4-65

Input Signal ***Hz/PID***	Selected Function
OFF	Enable PID Control
ON	PID control invalid (Manual frequency setting)

(📖 Function code J01 to J19, J56 to J62)

■ Assignment of normal/inverse switching ***IVS*** (Function code data = 21)

This function switches the normal/inverse operation of the output signal (frequency setting) of PID control or frequency setting.

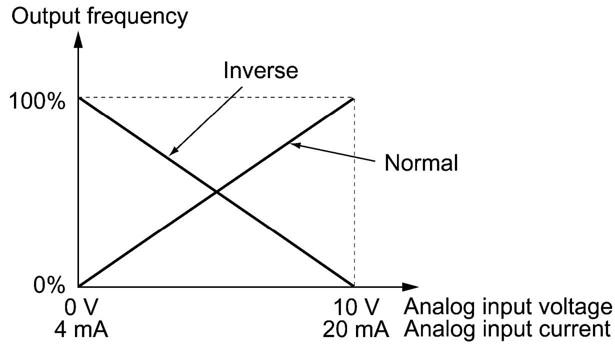


Fig. 5.4-50

Tip The normal/inverse switching operation is useful for air-conditioners that require switching between cooling and heating. The cooler increases the speed of the fan motor (output frequency of the inverter) in order to lower the temperature. The heater decreases the speed of the fan motor (output frequency of the inverter) in order to lower the temperature. This switching is executed by the normal/inverse switching function.

- When the inverter is driven by an external analog frequency command (terminals [12], [C1] and [V2]):

Switching normal/inverse operation can apply only to the analog frequency command (terminals [12], [C1], and [V2]) in frequency command 1 (F01) and does not affect frequency command 2 (C30) or UP/DOWN control. The combinations of normal/inverse operation selection (frequency command 1) (C53) and normal operation/inverse operation switching ***IVS*** signals result the operations as shown in the following table.

Table 5.4-66

Data for C53	Input signal ***IVS***	Enable
0: Normal operation	OFF	Normal operation
0: Normal operation	ON	Inverse operation
1: Inverse operation	OFF	Inverse operation
1: Inverse operation	ON	Normal operation

- When process control is executed by the PID control function integrated in the inverter

In the mode that the process is controlled by the PID control function integrated in the inverter, PID cancel ***Hz/PID*** signal can switch between the PID control valid (operation by the PID controller) and PID control invalid (operation by the manual frequency setting). In either case, the combination of the inverse operation select (Frequency command 1) (C53), PID control operation selection (J01), and normal/inverse operation switching ***IVS*** signal. The normal/inverse operation is determined as shown in the following table.

- When PID control is valid: The normal/inverse operation for output of the PID controller (frequency setting)

Table 5.4-67

PID Control Operation Select (J01)	Input Signal ***IVS***	Operation
1: For processing (normal operation)	OFF	Normal operation
	ON	Inverse operation
2. For processing (inverse operation)	OFF	Inverse operation
	ON	Normal operation

- When PID control is invalid: The normal/inverse operation for the manual frequency setting

Table 5.4-68

Selection of Normal/Inverse Operation (Frequency Command 1) (C53)	Input Signal ***IVS***	Operation
0: Normal operation	-	Normal operation
1: Inverse operation	-	Inverse operation

Note When process control is performed by the PID control function integrated in the inverter, switching the normal operation/inverse operation ***IVS*** is used for switching of normal operation/inverse operation of output of the PID controller (frequency setting). It is irrelevant to switching the normal operation/inverse operation of the manual frequency setting.
(Function code J01 to J19, J56 to J62)

■ Assignment of interlock ***IL*** (Function code data = 22)

In a configuration where a magnetic contactor is installed in the power output (secondary) circuit of the inverter, the momentary power failure may not be detected accurately only by the momentary power failure detection function in the inverter. In this case, using the interlock signal ***IL*** and inputting the digital signal can restart the operation smoothly after momentary power failure. (Function code F14)

Table 5.4-69

Input Signal ***IL***	Meaning
OFF	No momentary power failure has occurred.
ON	Momentary power failure has occurred. (Restart after a momentary power failure is valid)

■ Assignment of link operation select ***LE*** (Function code data = 24)

When LE is on, operate the motor by following the frequency command or operation command from the communication (RS-485 communication or field bus) set by the link function (operation select) (H30) or bus function (operation select) (y98).

When ***LE*** is not assigned, it is same as when ***LE*** is on. (Function code H30, y98)

■ Assignment of universal DI ***U-DI*** (Function code data = 25)

This function enables monitoring of digital signals from the periphery equipment of the inverter via RS-485 communication or field bus by connecting to the digital input of the inverter. Digital signals assigned to the universal DI can be used as a simple monitor regardless of the inverter operation.

Accessing to universal DI via the RS-485 communication or fieldbus communication, see the respective instruction Manuals.

■ Assignment of activation property select ***STM*** (Function code data = 26)

This function enables to select whether auto search is executed or not at the time of start (auto search executed without stopping the motor).
(Function code H09)

■ Assignment of forcible stop ***STOP*** (Function code data = 30)

When ***STOP*** is turned off, the motor decelerates to a stop in accordance with the forcible stop deceleration time (H56). After the motor stops, the inverter enters the alarm state with the alarm Er6 displayed.

(Function code F07)

■ Assignment of pre-excitation ***EXITE*** (Function code data = 32)

When ***EXITE*** is turned on, the pre-exciting feature activates. Even if this function is not set, 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 function is applied to the vector control with/without the speed sensor.)

(Function code H84, H85)

■ Assignment of PID integral and differential components reset ***PID-RST*** (Function code data = 33)

When ***PID-RST*** is turned on, the integral and differential components of the PID controller are reset.

(Function code J01 to J19, J56 to J62)

■ Assignment of PID integral component hold ***PID-HLD*** (Function code data = 34)

When ***PID-HLD*** is turned on, hold the integral components of the PID controller.

(Function code J01 to J19, J56 to J62)

■ Assignment of local (keypad) command select ***LOC*** (Function code data = 35)

When ***LOC*** signal is used, switching between remote/local is possible for the operation command and the setting method of the frequency setting.

For details of switching between remote and local, see Chapter 3, Section 3.3.6 "Remote and Local Modes."

■ Assignment of dew condensation prevention ***DWP*** (Function code data = 39)

When the dew condensation prevention ***DWP*** is turned on in a stopped state, the DC power is applied, increases the motor temperature, and prevent dew condensation. (Function code J21)

■ Assignment of commercial power switching sequence (50 Hz) ***ISW50***,
Commercial power switching sequence (60 Hz) ***ISW60*** (Function code data = 40, 41)

This function enables to control the magnetic contactor for switching commercial power operation /inverter operation according to the integrated sequence by ***ISW50*** or ***ISW60*** signals from external sources.

This control is valid only when ***ISW50*** or ***ISW60*** has been assigned and the commercial power -> inverter operation switching ***SW88*** and ***SW52-2*** are assigned to output terminal.

Use ***ISW50*** or ***ISW60*** depending on the frequency of the commercial power.

See <Circuit Diagrams and Configuration> and <Operation chart>.

Table 5.4-70

Assignment	Operation (When Activating Commercial Power -> Inverter)
Commercial power switching sequence (50 Hz) ***ISW50***	Start at 50 Hz.
Commercial power switching sequence (60 Hz) ***ISW60***	Start at 60 Hz.

Note: Do not assign both ***ISW50*** and ***ISW60*** at the same time. Doing so cannot guarantee the result.

<Circuit Diagram and Configuration>

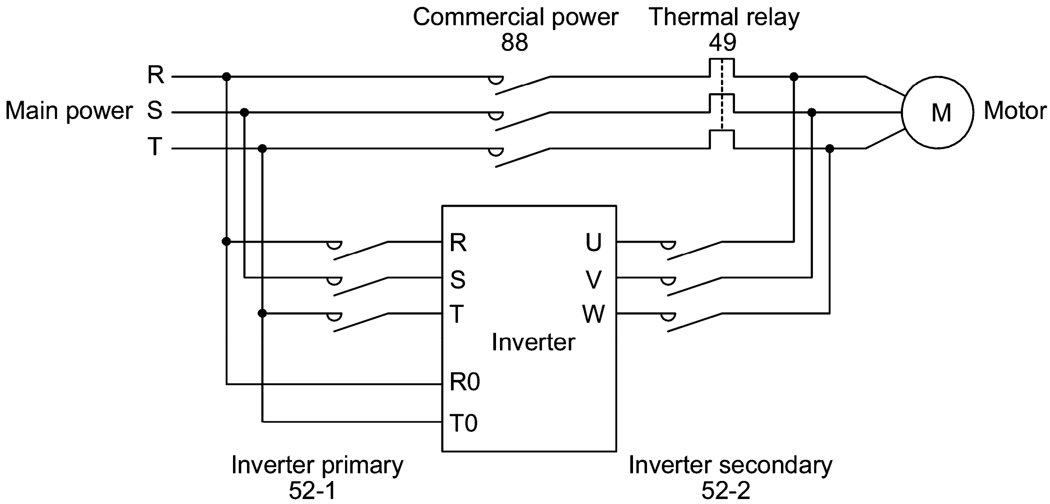


Fig. 5.4-51 Main circuit Configuration drawing

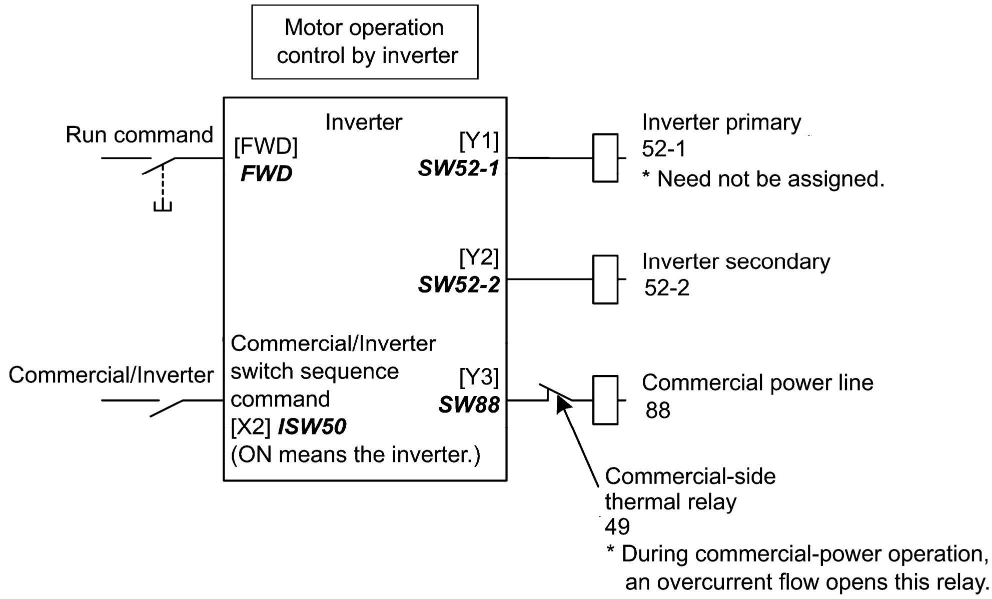


Fig. 5.4-52 Control circuit Configuration drawing

Table 5.4-71 Table of Input/Output Relations

Input		Output (Magnetic Contactors)			Inverter Operation
ISW50 / ***ISW60***	Run Command	***SW52-1***	***SW52-2***	***SW88***	
OFF (Commercial power)	ON	OFF	OFF	ON	OFF
	OFF			OFF	
ON (Inverter)	ON	ON	ON	OFF	ON
	OFF				OFF

<Operation Chart>

From inverter operation to commercial power operation (***ISW50***/***ISW60***: ON -> OFF)

(1) The inverter output is immediately blocked (Gate OFF)

(2) ***SW52-1***: Inverter primary side circuit, and ***SW52-2***: Inverter secondary circuit are turned off immediately.

(3) After t1 (Set time of 0.2 sec. + function code H13) is elapsed, if the operation command is on, ***SW88***: turning on the commercial power circuit.

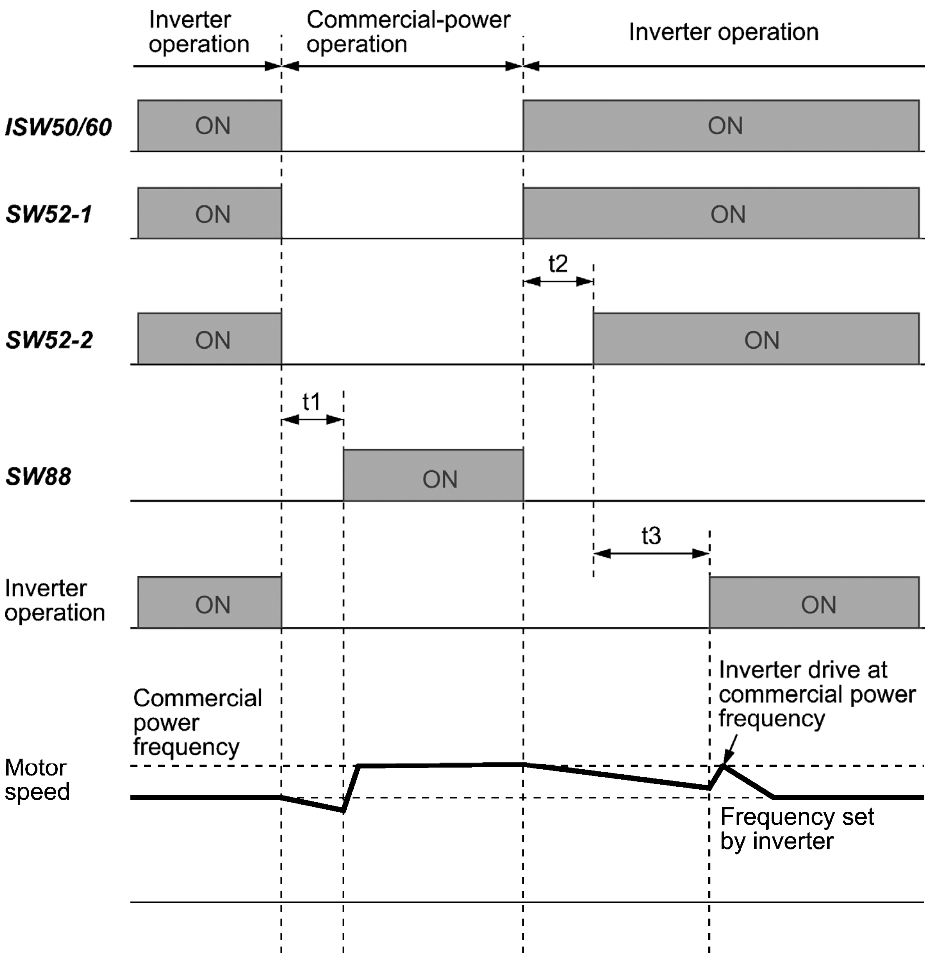
From commercial power operation to inverter operation (***ISW50***/***ISW60***: OFF -> ON)

(1) ***SW52-1***: The inverter primary side circuit is turned on immediately.

(2) ***SW88***: The commercial power circuit 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 the function code H13) from when ***SW52-2*** is turned on, the inverter harmonizes from the commercial frequency, and recovers to the operation with the frequency set by the inverter.



t1: 0.2 sec + H13 (Re-start wait time after momentary power failure)

t2: 0.2 sec + Time required for the main circuit to get ready

t3: 0.2 sec + H13 (Wait time before restart after momentary power failure)

Fig. 5.4-53

<Selection of Commercial Power Switching Sequence>

With the function code J22, whether switching to the commercial power driving automatically when an inverter alarm occurs can be selected.

Table 5.4-72

Data for J22	Sequence (when an alarm is output)
0	Keep inverter-operation (Alarm stop)
1	Automatic switching to commercial power driving

Note
- The sequence operates normally also when ***SW52-1*** is not used and the main power of the inverter is supplied at all times.
- When ***SW52-1*** is used, connect the auxiliary input terminals [R0] and [T0] to the control power supply. When ***SW52-1*** is cut without using [R0] and [T0], the control power supply turns off.
- 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.
- When both commercial side contactor (88) and the inverter output side (secondary side) contactor (52-2) are simultaneously turned on, the main power is input from the inverter output side (secondary side). In some cases, the inverter gets damaged. To prevent it, be sure to set up an interlocking logic outside the inverter.

<Sequence Example>

1) Standard sequence

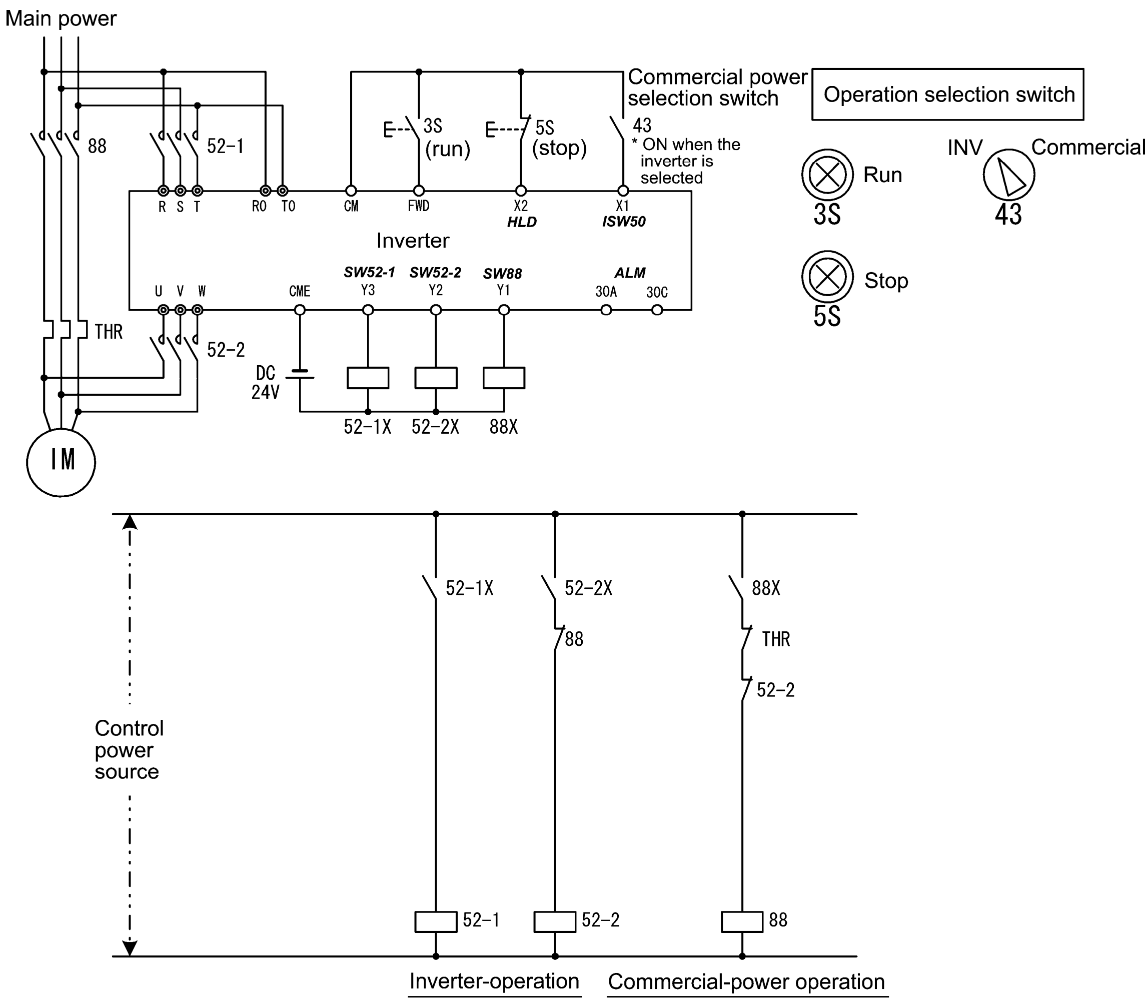


Fig. 5.4-54

2) Sequence with an emergency switching function

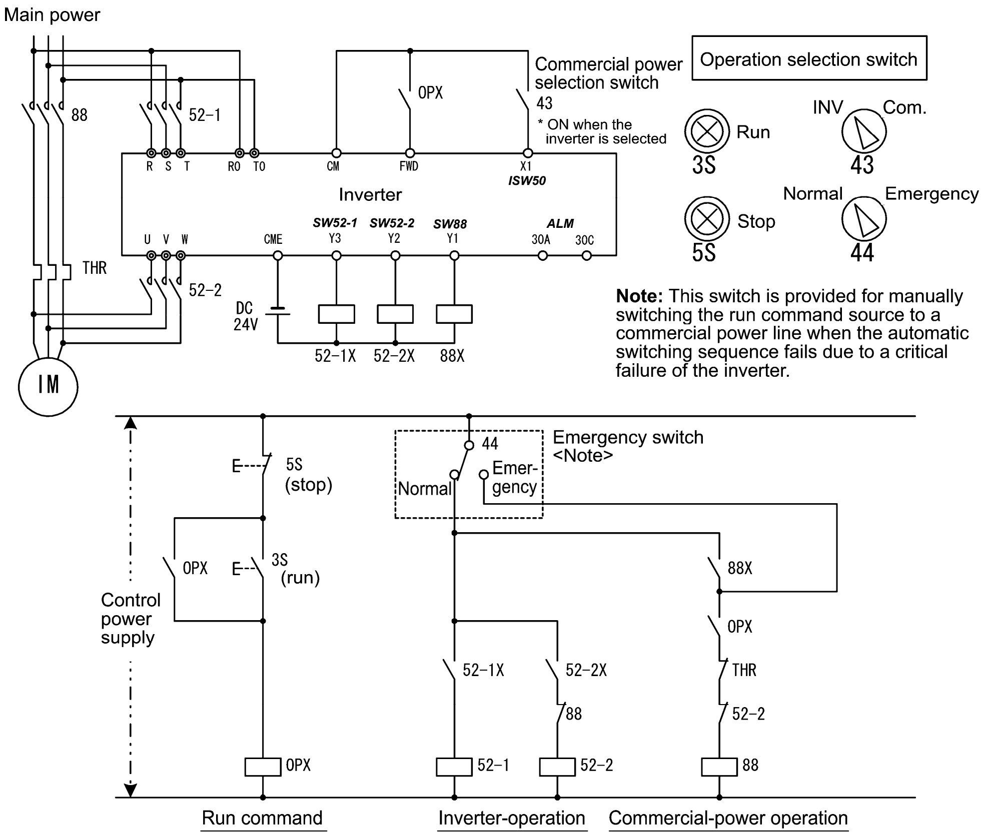


Fig. 5.4-55

3) Sequence 2 with an emergency switching function (Automatic switching by the alarm output issued by the inverter)

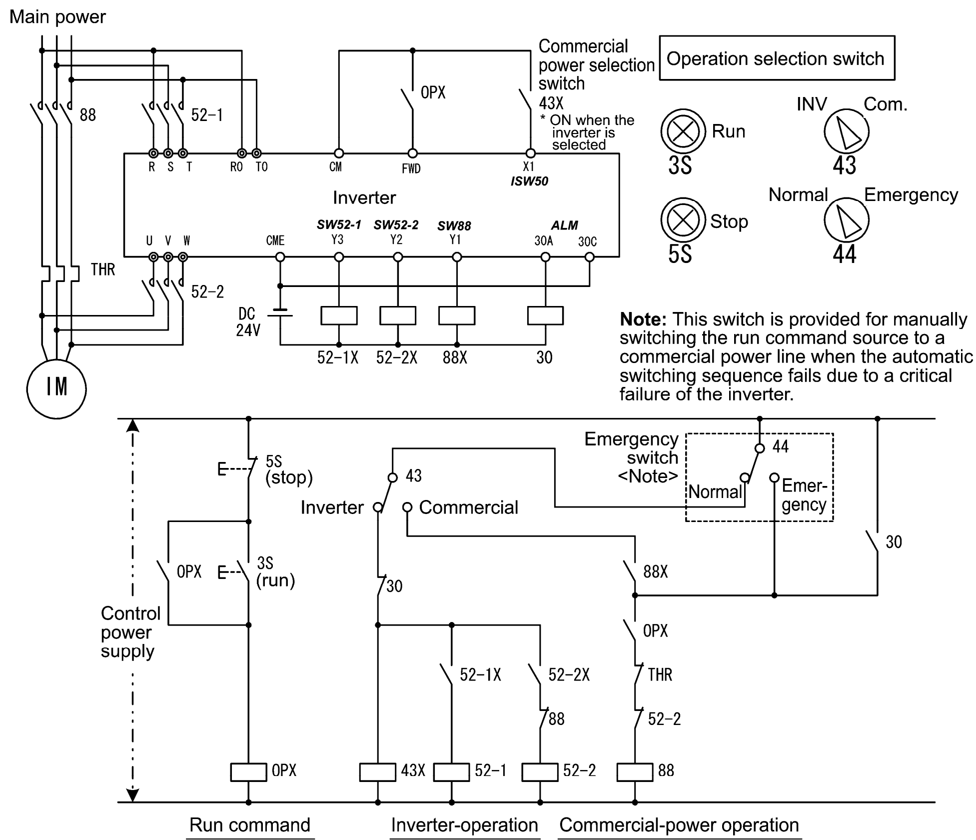


Fig. 5.4-56

■ Assignment of servo lock command ***LOCK*** (Function code data = 47)

When ***LOCK*** is on, servo-lock command is valid. When ***LOCK*** is off, the servo-lock command is invalid.

(📖 Function code J97 to J99)

■ Assignment of pulse train input ***PIN*** and pulse train code ***SIGN*** (Function code data = 48, 49)

Frequency setting is possible by the pulse train input with terminal [X7]. Assignment of pulse train input ***PIN*** to terminal [X7] is necessary. In addition, assigning pulse train code ***SIGN*** (other than terminal [X7] is valid) enables specifying the polarity of frequency setting by pulse train code.

(📖 Function code F01)

■ Battery operation valid command ***BATRY*** (Function code data = 59)

When this terminal command is turned on, the undervoltage protection is invalidated. In that case, the motor can be operated by the inverter with undervoltage status by the battery power.

When ***BATRY*** is assigned to the digital input terminal, the operation becomes same as F14 = 1 regardless of F14 setting, and the inverter trips after the power shortage is recovered.

When ***BATRY*** is on, the input open phase protection operation becomes invalid regardless of the function code H98 bit 1 setting.

In addition, the main power down detection also becomes invalid regardless of H72 setting.

Note **Prerequisite of battery operation**

(1) Terminal order ***BATRY*** (data = 59) can be assigned to any digital input terminal.

(2) As shown in Fig. A and Fig. B, DC link bus voltage is supplied from the battery to the main circuit (L1/R-L3/T or L2/S-L3/T).

(3) The specified voltage (sinusoidal waveform or DC voltage) is input to auxiliary power terminal (R0-T0).

(4) In case of 200 V/37 kW or higher or 400 V/75 kW, input the specified power supply (sinusoidal waveform) to the fan power supply auxiliary input (R1-T1) as shown in Fig. B, and change the fan power supply switching connector as shown in Fig. C in order to execute the battery operation.

(5) The terminal that ***BATRY*** (data = 59) is assigned has to be turned on simultaneously with the MC2.

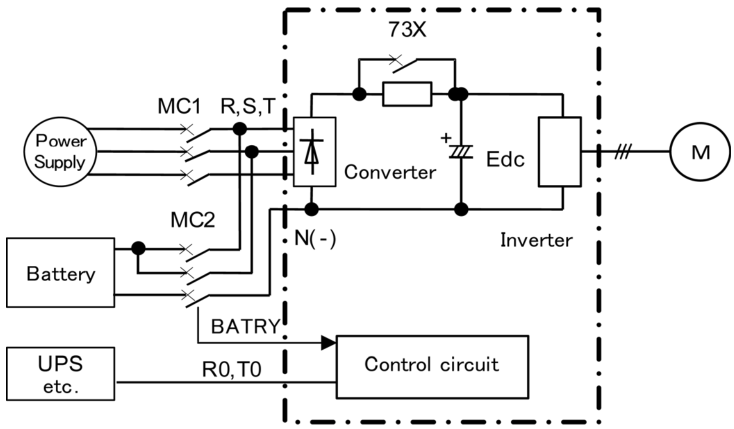


Fig. 5.4-57 Connection diagram example (200 V/30 kW or lower, 400 V/55 kW or lower)

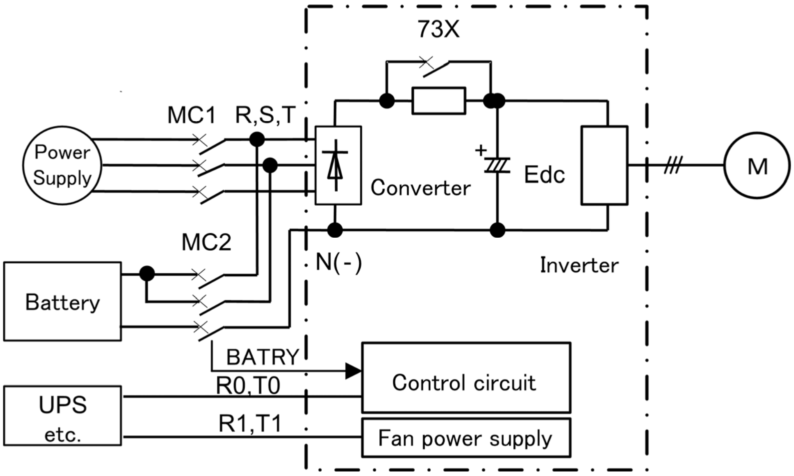


Fig. 5.4-58 Connection diagram example (200 V/37 kW or higher, 400 V/75 kW)

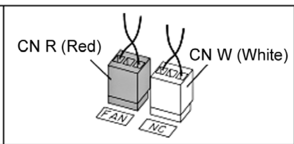
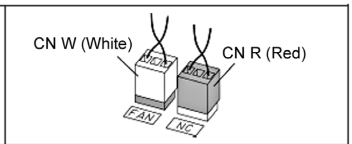
Setting		
Application	When the terminals R1 and T1 are not used	When the terminal R1, T1 is used (Battery operation)

Fig. 5.4-59 Fan power supply switching

Note

Battery operation (When *BATRY* = ON)

(1) Undervoltage protection function ($\angle\angle\!\!/$) becomes non-operating status.

(2) The inverter can operate the motor even under the undervoltage condition.

(3) Operation ready complete ***RDY*** signal is forcibly turned off.

(4) The circuit of charging resistor is shorted after the delay time T1 from the ***BATRY*** terminal being turned on. (73X = ON) In addition, after the delay time T2 (max. 0.1 sec.), the battery operation starts. For T1 specifications, see the table on the next page.

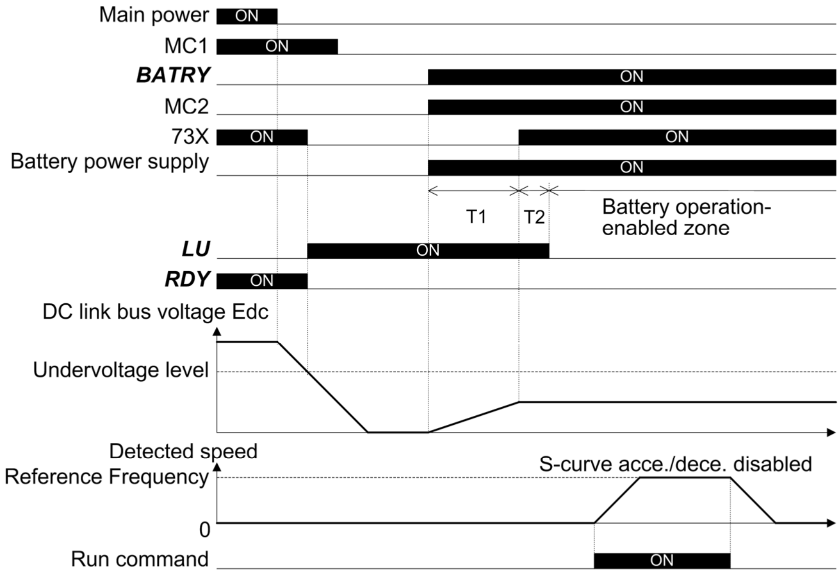


Fig. 5.4-60 Battery operation timing chart

Table 5.4-73 Time from ***BATRY*** ON to 73X ON: T1

Power supply condition	30 kW or below	37 kW or above
Time required for turning on the control power supply, switching to the power supply from the battery, and then to turning on the charging resistor short circuit 73X	100 ms	500 ms
Time required from the occurrence of momentary power failure in the control power supply ON status, switching to the power supply from the battery, and turning on of the short circuit 73X for the charging resistor	205 ms	

(5) S-curve acceleration/deceleration becomes invalid.

(6) The operable speed during the battery operation is calculated by using the following expression.

$$\text{Frequency command during rescue operation in power failure} \leq \frac{\text{Battery voltage - 5 [V]}}{\sqrt{2} \times \text{Base voltage (F05)}} \text{ x Base frequency (F04) x k}$$

Here,

Battery voltage: 24 VDC or higher (200 V class)
48 VDC or higher (400 V class)

Rated frequency: F04

Rated voltage: F05 (Motor rated voltage (V))

k: Safety factor (Lower than 1 Approx. 0.8)

Note

(1) Connect the battery power supply before or simultaneously with turning on the ***BATRY*** signal.

(2) Between the period from turning on of the ***BATRY*** signal and MC2 (and power supply start from the battery) to the state that the battery operation is possible, the delay time "T1" + "T2" indicated in the above "time chart" occurs.

(3) Do not turn on the ***BATRY*** signal when the voltage is same or higher than the specified undervoltage (before LU is indicated after the power failure). If the ***BATRY*** signal is turned on with the voltage same or higher than the undervoltage value, the specified amount, the short circuit for charging resistor 73X remains on.

(4) During the battery operation, avoid driving with application of the heavy load. Operate with no load or braking load.

(Sufficient torque cannot be obtained by the battery voltage, and the motor may stall in such case.)

(5) Operate the battery in a low speed, and pay attention to the battery capacity.

In addition, when the high voltage is supplied (such as when 300 VDC power supply at 200 V class inverter and 600 VDC power supply at 400 V class inverter), operate normally without the battery.

(6) During the normal operation, it is required to turn off the ***BATRY*** signal. If the main power is turned on with the ***BATRY*** signal on, the 73X remains ON, causing the rectifier diode getting damaged.

■ Assignment of input during commercial driving (motor 1 to motor 4) ***CRUN-M1*** to ***CRUN-M4***

(Function code data = 72, 73, 74, 75)

With this function, the cumulative run time of motors can be integrated not only during the inverter drive but also during the commercial power drive.

While the ***CRUN-M1*** to ***CRUN-M4*** are ON, the inverter judges that each motor is driven by commercial power, and integrates the run time of the corresponding motor.

■ Assignment of droop select ***DROOP*** (Function code data = 76)

With the ***DROOP*** signal, turning on/off the droop control become possible.

Table 5.4-74

Input signal ***DROOP***	Droop control
ON	Valid
OFF	Invalid

(📖 Function code H28)

■ Assignment of PG alarm cancel ***PG-CCL*** (Function code data = 77)

When the PG alarm cancel ***PG-CCL*** is ON, the inverter ignores a PG wire break alarm. This function cancels the alarm when switching PG wires in switching motors in order to prevent the situation to be detected as a broken wire.

■ Assignment of Run forward and stop command ***FWD*** (Function code data = 98)

When ***FWD*** is on, the motor runs forward, and when ***FWD*** is off, the motor decelerates and stops.

Tip Run forward and stop command ***FWD*** can be set only by E98 and E99.

■ Assignment of run reverse and stop command ***REV*** (Function code data = 99)

When ***REV*** is on, the motor runs backward, and when ***REV*** is off, the motor decelerates and stops.

Tip Run reverse and stop command ***REV*** can be set only by E98 and E99.

■ Assignment of servo lock gain select ***SLG2*** (Function code data = 110)

When ***SLG2*** is on and when the servo lock gain 2 is selected, the servo lock 1 gets selected when ***SLG2*** is off.

■ Assignment of forcible stop (terminal block only) ***STOP-T*** (Function code data = 111)

When ***STOP-T*** is off, the forcible stop becomes active. However, the command by communication is ignored, and it becomes possible only on the actual terminal block. The forcible stop operation is same as the ***STOP*** terminal.

E10 to E15	**Acceleration Time 2 to 4, Deceleration Time 2 to 4** (See F07)

For detailed descriptions of settings of acceleration/deceleration time 2 to 4, see the section describing the function code F07.

E16, E17	**Torque Limit Value 2-1, 2-2** (See F40)

For details of settings of torque limit values 2-1, 2-2, see the section describing the function code F40.

E20 to E23 E24, E27	**Terminal [Y1] to [Y4] (Function Select)** **Terminal [Y5A/C] and [30A/B/C] (Relay Output)**

Terminals [Y1] to [Y4], [Y5A/C] and [30A/B/C] are programmable general-purpose output terminal. functions can be assigned by using E20 to E24 and E27. With the negative logic setting, switching between active ON and active OFF of each signal is possible.

The factory default setting is normal logic system "Active ON." Terminals [Y1] to [Y4] are transistor outputs and terminals [Y5A/C] and [30A/B/C] are relay contact outputs. Generally, in terminal [30A/B/C] output, when an alarm is output, the relay is energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. However, in the negative logic setting, when an alarm is output, the relay is de-energized but [30A] and [30C] can be opened, and [30B] and [30C] can be closed and used as a fail-safe.

Note

- In the negative logic setting, each signal becomes active (ex.: alarm generate side) while the inverter power is blocked. This may be useful for the implementation of failsafe power systems. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds (for 22 kW or below) or approx. 3 seconds (for 30 kW or above) after power-ON. During this period, take appropriate procedure such as masking them outside.
- Contact output (terminals [Y5A/C] and [30A/B/C]) are mechanical contacts. Frequent ON/OFF switching cannot be accepted. 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] to [Y4]) instead.
  The service life of a relay is approximately 200,000 times if it is switched on and off at one-second intervals. Output the signals, which are switched on/off highly frequently, from the terminal [Y1] to [Y4].

The tables given on the following pages list functions that can be assigned to terminals [Y1] to [Y4], [Y5A/C], and [30A/B/C]. Explanation of each signal is provided in an order of assigned data. However, highly relevant signals are collectively described where one of them first appears. See the function codes or signals in the "Related function codes/signals (data)" column, if any.

The FRENIC-MEGA runs under V/f control, dynamic torque vector control, V/f control with speed sensor, dynamic torque vector control with/without speed sensor, or "vector control with speed sensor." Some functions are effective only to specified control method. In the control system field, "○: Valid" or "X: Invalid" is indicated for each function. (See page 5-3.)

Explanations of each function are given in normal logic system "Active ON."

Table 5.4-75

Data		Defined Functions	Signal Name	Control Method					Related Function Code/ Related Signal (Data)
Active ON	Active OFF			V/f	PG V/f	PG Less	PG	Torque Control	
0	1000	Running	***RUN***	○	○	○	○	○	—
1	1001	Frequency (speed) arrival	***FAR***	○	○	○	○	X	E30
2	1002	Frequency (speed) detected	***FDT***	○	○	○	○	○	E31, E32
3	1003	Stopping due to undervoltage	***LU***	○	○	○	○	○	—
4	1004	Torque polarity detected	***B/D***	○	○	○	○	○	—
5	1005	Inverter output limiting	***IOL***	○	○	○	○	○	—
6	1006	Auto-restarting after momentary power failure	***IPF***	○	○	○	○	○	F14
7	1007	Motor overload early warning	***OL***	○	○	○	○	○	E34, F10, F12
8	1008	Keypad operating	***KP***	○	○	○	○	○	—
10	1010	Inverter ready output	***RDY***	○	○	○	○	○	—
11	-	Switch between commercial power/inverter operation (Magnetic contactor at commercial power supply side)	***SW88***	○	○	X	X	X	E01 to E09 ***ISW50*** (40) ***ISW60*** (41) J22
12	-	Switch between commercial power/inverter operation (For inverter output side)	***SW52-2***	○	○	X	X	X	
13	-	Switch between commercial power/inverter operation (For inverter output side)	***SW52-1***	○	○	X	X	X	
15	1015	AX terminal function (For magnetic contactor at inverter input side)	***AX***	○	○	○	○	○	—
16	1016	Shifting to pattern operation stage	***TU***	○	○	○	○	X	
17	1017	Pattern operation cycle complete	***TO***	○	○	○	○	X	
18	1018	Pattern operation stage No. 1	***STG1***	○	○	○	○	X	
19	1019	Pattern operation stage No. 2	***STG2***	○	○	○	○	X	
20	1020	Pattern operation stage No. 4	***STG4***	○	○	○	○	X	
22	1022	Inverter output limiting (With delay)	***IOL2***	○	○	○	○	○	***IOL*** (5)
25	1025	Cooling fan ON/OFF control	***FAN***	○	○	○	○	○	H06
26	1026	Retrying	***TRY***	○	○	○	○	○	H04, H05
27	1027	Universal DO	***U-DO***	○	○	○	○	○	—
28	1028	Cooling fin overheat early warning	***OH***	○	○	○	○	○	—
29	1029	Simultaneous complete signal	***SY***	X	○	X	○	X	For details, see the PG Interface Card Instruction Manual.
30	1030	Lifetime warning	***LIFE***	○	○	○	○	○	H42
31	1031	Frequency (speed) detected 2	***FDT2***	○	○	○	○	○	E32, E36
33	1033	Command loss detected	***REF OFF***	○	○	○	○	○	E65
35	1035	Inverter outputting	***RUN2***	○	○	○	○	○	***RUN*** (0)
36	1036	Under overload prevention control	***OLP***	○	○	○	○	X	H70

Data		Defined Functions	Signal Name	Control Method					Related Function Code/ Related Signal (Data)
Active ON	Active OFF			V/f	PG V/f	PG Less	PG	Torque Control	
37	1037	Current detected	***ID***	○	○	○	○	○	E34, E35, E37, E38, E55, E56
38	1038	Current detected 2	***ID2***	○	○	○	○	○	
39	1039	Current detected 3	***ID3***	○	○	○	○	○	
41	1041	Low current detected	***IDL***	○	○	○	○	○	
42	1042	PID alarm output	***PID-ALM***	○	○	○	○	X	J11 to J13
43	1043	Under PID control	***PID-CTL***	○	○	○	○	X	J01
44	1044	PID small water amount stopping	***PID-STP***	○	○	○	○	X	J08, J09
45	1045	Low torque detected	***U-TL***	○	○	○	○	○	E78 to E81
46	1046	Torque detected 1	***TD1***	○	○	○	○	○	
47	1047	Torque detected 2	***TD2***	○	○	○	○	○	
48	1048	Motor 1 switched	***SWM1***	○	○	○	○	○	A42, b42, r42
49	1049	Motor 2 switched	***SWM2***	○	○	○	○	○	
50	1050	Motor 3 switched	***SWM3***	○	○	○	○	○	
51	1051	Motor 4 switched	***SWM4***	○	○	○	○	○	
52	1052	Running forward signal	***FRUN***	○	○	○	○	○	—
53	1053	Running reverse signal	***RRUN***	○	○	○	○	○	—
54	1054	In remote mode	***RMT***	○	○	○	○	○	(See Section 3.3.6.)
56	1056	Thermistor detection	***THM***	○	○	○	○	○	H26, H27
57	1057	Brake signal	***BRKS***	○	○	○	○	X	J68 to J72
58	1058	Frequency (speed) detected 3	***FDT3***	○	○	○	○	○	E32, E54
59	1059	C1 terminal wire break detected	***C1OFF***	○	○	○	○	○	—
70	1070	Speed valid	***DNZS***	X	○	○	○	○	F25, F38
71	1071	Speed agreed	***DSAG***	X	○	○	○	X	d21, d22
72	1072	Frequency (speed) arrival 3	***FAR3***	○	○	○	○	X	E30
76	1076	PG error detected	***PG-ERR***	X	○	○	○	X	d21 to d23
77	1077	Low and medium voltage detected	***U-EDC***	○	○	○	○	○	E76
78	1078	Momentary power failure decelerating	***IPF2***	○	○	○	○	○	E76
82	1082	Positioning completion signal	***PSET***	X	X	X	○	X	J97 to J99
84	1084	Maintenance timer	***MNT***	○	○	○	○	○	H44, H78, H79
90	1090	Alarm details 1	***AL1***	○	○	○	○	○	
91	1091	Alarm details 2	***AL2***	○	○	○	○	○	
92	1092	Alarm details 4	***AL4***	○	○	○	○	○	
93	1093	Alarm details 8	***AL8***	○	○	○	○	○	
98	1098	Light alarm	***L-ALM***	○	○	○	○	○	H81, H82
99	1099	Batch alarm	***ALM***	○	○	○	○	○	—
105	1105	Braking transistor broken	***DBAL***	○	○	○	○	○	H98
111	1111	Customizable logic output signal 1	***CLO1***	○	○	○	○	○	U71 to U75, U81 to U85
112	1112	Customizable logic output signal 2	***CLO2***	○	○	○	○	○	

Data		Defined Functions	Signal Name	Control Method					Related Function Code/ Related Signal (Data)
Active ON	Active OFF			V/f	PG V/f	PG Less	PG	Torque Control	
113	1113	Customizable logic output signal 3	***CLO3***	○	○	○	○	○	
114	1114	Customizable logic output signal 4	***CLO4***	○	○	○	○	○	
115	1115	Customizable logic output signal 5	***CLO5***	○	○	○	○	○	

Note Functions that has "-" in the data active OFF field, the negative logic setting is not possible.

■ Assignment of running ***RUN*** and inverter outputting ***RUN2*** (Function code data = 0, 35)

This function is used as a signal that tells whether the inverter is running or not. If assigned in Active OFF, these signals can be used as the in-stop signal.

Output Signal	Basic Function	Remarks
RUN	These signals turn on when the inverter is running. Under V/f control, these signals come on if the output frequency exceeds the starting frequency, and go off if it drops below the stop frequency. The ***RUN*** signal can also be used as a "Speed valid" signal.	Turns off during DC braking or dew condensation prevention
RUN2		Turns on during DC braking, pre-exciting, zero speed control, or dew condensation prevention

Under vector control, both ***RUN*** and ***RUN2*** come on also when zero speed control or servo-lock function is enabled.

■ Frequency (speed) arrival signal ***FAR*** and Frequency (speed) arrival signal 3 ***FAR3*** (Function code data = 1, 72)

The ON signal is output when the difference between the output frequency (detected speed) and set frequency (speed command) comes within the frequency arrival detected width (function cede E30). (📖 Function code E30)

■ Assignment of Frequency (speed) detected FDT, Frequency (speed) detected 2 FDT2, and Frequency (speed) detected 3 FDT3 (Function code data = 2, 31, 58)

The ON signal is output when the output frequency (speed detected value) becomes higher than the detected level set to the operation level of the frequency detection, and it goes OFF when the output frequency becomes below the [frequency detected value (operation level) - hysteresis width]. (📖 Function code E31, E32)

■ Assignment of Undervoltage stopping LU (Function code data = 3)

This output signal comes on when the DC link bus voltage of the inverter drops to equal or below the undervoltage level, the ON signal is output. When this signal is on, the inverter cannot run even if a run command is given. When the voltage recovers and exceeds the undervoltage detected level, the signal turns off. 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).

■ Assignment of torque polarity detected ***B/D*** (Function code data = 4)

The inverter outputs the driving or braking torque judgment signal by the torque calculated value or torque instruction value calculated in the inverter inside. In case of the driving torque, the off signal is output. In case of the braking torque, the on signal is output.

■ Assignment of inverter output limiting ***IOL*** and inverter output limiting (with delay) ***IOL2*** (Function code data = 5, 22)

The ON signal is output when the inverter is executing the following limitation operation. (Minimum output signal width: 100 ms). The ***IOL2*** signal turns on the limiting operation continues for 20 ms or longer.

- Torque limiting operation (F40, F41, E16, E17, internal maximum value)
- Current limiting by software (F43 and F44)
- Current limiting by hardware (H12 = 1)
- Regenerative avoidance control (H69)

Note When the inverter output limiting ***IOL*** signal is on, the output frequency of the inverter is automatically controlled by the above limiting process, which may cause the frequency value other than the set value.

■ Assignment of power recovery after momentary power failure ***IPF*** (Function code data = 6)

During the operation continuation control by the momentary power failure, or while the inverter detects the undervoltage, blocks output, waits for the completion of power recovery (reaching to the set frequency), the ON signal is output.
(📖 Function code F14)

■ Assignment of motor overload early warning ***OL*** (Function code data = 7)

This function is used to preliminarily detects the motor overload (alarm code OL1) to take appropriate preventive measures. (📖 Function code E34)

■ Assignment of keypad operation ***KP*** (Function code data = 8)

This ON signal is output when the operation command (RUN, STOP keys) are valid.

■ Assignment of run preparation output ***RDY*** (Function code data = 10)

This ON signal is output when the inverter becomes ready to run by completing hardware preparation such as initial charging of the main circuit and initialization of the control circuit and no protective functions are activated.

■ Assignment of switching between commercial power / inverter operation ***SW88***, ***SW52-2***, and ***SW52-1*** (Function code data = 11, 12, and 13)

By ISW50 or ISW60 commands from external equipment, the magnetic contactor for switching the motor drive source between the commercial power and the inverter output is controlled according to the integrated sequence. (📖 Function code E01 to E09, data = 40, 41)

■ Assignment of AX terminal function ***AX*** (Function code data = 15)

In response to the operation command, this function controls the magnetic contactor at the inverter input side. The magnetic contactor turns on when the operation command is input. The magnetic contactor turns off after the inverter decelerates and stops when the stop command is input. When the coast-to-stop command is input, or during the alarm operation, this signal immediately turns off.

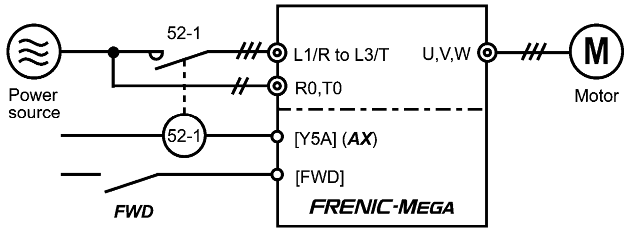


Fig. 5.4-61

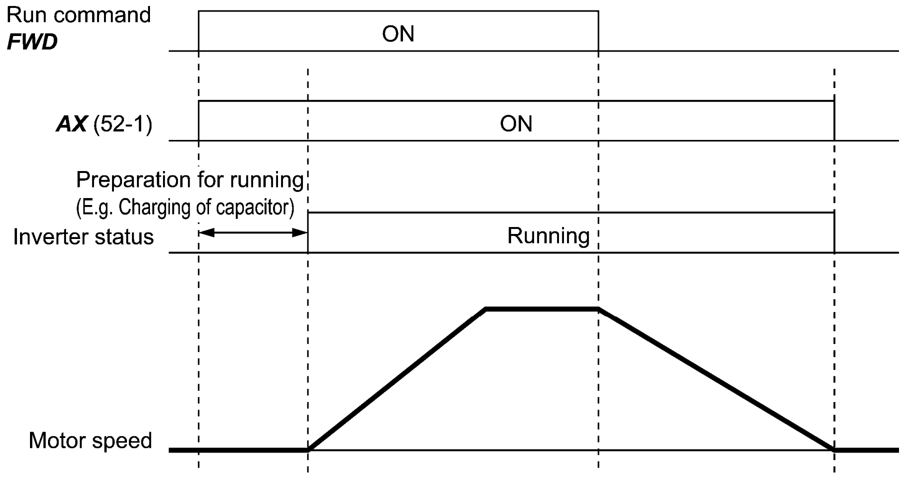


Fig. 5.4-62

■ Assignment of pattern operation stage change ***TU*** (Function code data = 16)

During the stage change in the pattern operation, the ON signal of one shot (100 ms) is output to indicate that the stage has been changed. Used by the customizable logic.

■ Assignment of pattern operation cycle operation complete ***T0*** (Function code data = 17)

When all stages from 1 to 7 in the pattern operation are completed, the ON signal of one shot (100 ms) is output. Used by the customizable logic.

■ Assignment of pattern operation stages No.1, 2, 4 ***STG1***, ***STG2,*** and ***STG4*** (Function code data = 18, 19, 20)

During the pattern operation, the currently-operating stage is output.

Table 5.4-76

Operation Pattern Stage No.	Output Terminal Signal		
	STG1	STG2	STG4
Stage 1	ON	OFF	OFF
Stage 2	OFF	ON	OFF
Stage 3	ON	ON	OFF
Stage 4	OFF	OFF	ON
Stage 5	ON	OFF	ON
Stage 6	OFF	ON	ON
Stage 7	ON	ON	ON

■ Assignment of Cooling fan ON-OFF control ***FAN*** (Function code data = 25)

While the cooling fan ON-OFF control is valid (H06 = 1), this output signal is on while the cooling fan is in operation, and off while the cooling fan is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control.
(📖 Function code H06)

■ Assignment of retry operating ***TRY*** (Function code data = 26)

This function outputs ON signal during the retry operation (alarm auto resetting).
(📖 Function code H04, H05)

■ Assignment of universal DO ***U-DO*** (Function code data = 27)

This function enables to connect the output terminal of the inverter assigned to the universal DO to the digital signal input of the inverter periphery device and give commands to the periphery equipment via RS-485 or fieldbus. The universal DO can be used as a simple digital output independent of the inverter operation.
📖 For the access to the universal DO via the RS-485 or fieldbus, see the respective instruction manuals.

■ Assignment of Cooling fin overheat early warning ***OH*** (Function code data = 28)

This function detects the early warning before the overheat trip (*0H1*) is output, and used as an appropriate procedure.

The signal turns on when [(overheat trip (*0H1*) temperature) - 5°C] or higher

The signal turns off when [(overheat trip (*0H1*) temperature) - 8°C] or lower

This signal turns on when the locked status of 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 detected.

■ Assignment of synchronous completion signal ***SY*** (Function code data = 29)

When the control target comes into the synchronous completion detect angle during the synchronous operation, the signal outputs the ON signal.

For details, see the PG Interface Card Instruction Manual.

■ Assignment of lifetime alarm ***LIFE*** (Function code data = 30)

This function outputs an ON signal 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. If this signal is output, use the specified maintenance procedure to check the service life of the parts and determine whether the parts should be replaced or not. (📖 Function code H42)

This output signal turns on when the locking status of the internal air circulation DC fan (45 kW or above for 200 V class series, 75 W or above for 400 V class series) has been detected.

■ Assignment of reference loss detected ***REF OFF*** (Function code data = 33)

This function outputs an ON signal when an analog input is used as a frequency command source, and when the broken wire of the analog input (reference loss) is detected. This signal turns off when the normal operation under the regular frequency reference is resumed.

(📖 Function code E65)

■ Assignment of Overload prevention control operating ***OLP*** (Function code data = 36)

This function outputs an ON signal when overload prevention control is activated. (The minimum output signal range: 100 ms)

(📖 Function code H70)

■ Assignment of Current detect ***ID*** Current detect 2 ***ID2***, and Current detected 3 ***ID3*** (Function code data = 37, 38, 39)

When the inverter output current is same or above the set level of the current detect (operation level) and when the current detect (timer) continues same or longer than the set time, this function outputs the ON signal. (The minimum output signal range: 100 ms)
(📖 Function code E34)

■ Assignment of Low current detected ***IDL*** (Function code data = 41)

This function outputs an ON signal when the output current of the inverter decreases below the set level of the current detection (operation level) or lower, when the current detect (timer) continues longer than the set time. (The minimum output signal range: 100 ms)

(📖 Function code E34)

■ Assignment of PID alarm output ***PID-ALM*** (Function code data = 42)

This function can output absolute value alarm and deviation alarm as the PID alarm.

(📖 Function code J11 to J13)

■ Assignment of Under PID controlling ***PID-CTL*** (Function code data = 43)

This function outputs an ON signal when the PID control is valid and when the run command is on.

(Function code J01)

Note When PID control is enabled, the inverter may stop due to the slow flowrate stopping function or other reasons even during the control. Even in that case, ***PID-CTL*** signal remains on. The PID control is valid while ***PID-CTL*** signal is on. Therefore, the operation may resume suddenly depending on the PID feedback amount.

⚠WARNING

When the PID function is selected, there are cases that the inverter stops by the signal from the sensor even during the operation. In that case, however, the inverter automatically resumes. Design your machinery so that safety is ensured for people even in a case of automatic resuming.

Otherwise an accident could occur.

■ Assignment of Stopping due to slow flowrate under PID control ***PID-STP*** (Function code data = 44)

This function outputs an ON signal while the inverter is at stop due to the slow flowrate stopping function under PID control.
(Function codes J08, J09)

■ Assignment of Low torque detected ***U-TL*** (Function code data = 45)

This function outputs an ON signal when the torque value calculated by the inverter or torque command value decreases to the low torque detect (operation level) setting level or lower, and when the low torque detect (timer) continues for the set time or longer. (Min. output signal width 100 ms) (Function code E78 to E81)

■ Assignment of Torque detected 1 ***TD1*** and Torque detected 2 ***TD2*** (Function code data = 46, 47)

This function outputs an ON signal when the torque value calculated by the inverter or torque command value increases to the torque detect (operation level) setting level or higher, and when the torque detect (timer) continues for the set time or longer. (Min. output signal width 100 ms) (Function code E78 to E81)

■ Assignment of Motor 1, 2, 3 and 4 switch -- ***SWM1***, ***SWM2***, ***SWM3*** and ***SWM4*** (Function code data = 48, 49, 50 and 51)

This function turns on the signal corresponding to the motor or parameter switched by the motor select signal ***M2*** to ***M4***. (Function code A42)

■ Assignment of Running forward ***FRUN***, Running reverse ***RRUN*** (Function code data = 52, 53)

Table 5.4-77

Output Signals	Assigned Data	Running Forward	Running Reverse	Stopping
FRUN	52	ON	OFF	OFF
RRUN	53	OFF	ON	OFF

■ Assignment of In remote mode ***RMT*** (Function code data = 54)

This function outputs an ON signal when switching between Remote and Local.

For details of switching between remote/local, see Chapter 3 Section 3.3.6 "Remote and Local Modes."

■ Assignment of Thermistor detected ***THM*** (Function code data = 56)

This function can output an alarm (***THM***) without setting an alarm 0H4 in the temperature detection by the PTC thermistor of the motor and can continue the operation (Function code H26 = 2) (Function code H26, H27)

■ Assignment of Brake signal ***BRKS*** (Function code data = 57)

This function outputs an signal for brake release and activation. (Function code J68 to J72)

■ Assignment of C1 terminal wire break detected ***C1OFF*** (Function code data = 59)

This function outputs an ON signal when the input of the terminal [C1] decreases to 2 mA or lower, and the broken wire is judged.

■ Assignment of Speed valid ***DNZS*** (Function code data = 70)

This function outputs an ON signal when the speed command value/speed detect value is same or higher than the stop speed set by the stop frequency. The signal turns off when the speed lower than the stop speed continues for 100 ms or longer.

Under vector control with speed sensor, Function code F38 enables switching the decision criterion between the sped command value and the speed detect value. In case of the speed sensor-less vector control, judge by using the speed command value. (Function code F25, F38)

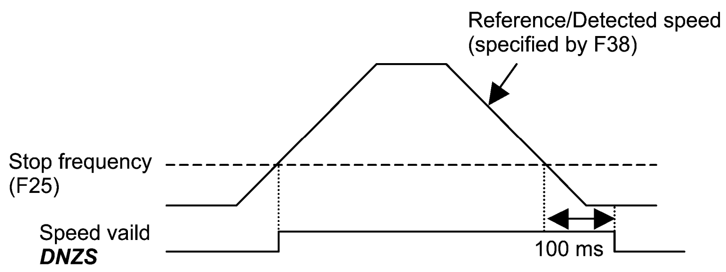


Fig. 5.4-63

■ Assignment of Speed agreement ***DSAG*** (Function code data = 71)

This function outputs an ON signal to the output speed command of the acceleration/deceleration processor while the deviation with the detected speed is within the set range. The signal turns off when the status is beyond the set range for longer than the set period. This feature allows you to check whether the speed controller is working correctly. (Function code d21, d22)

■ Assignment of PG error detected ***PG-ERR*** (Function code data = 76)

When the operation continuation is set by the PG error and the PG error is detected, an alarm is not output, and the operation continues. However, the ON signal is output as the PG error signal. (Function code d21 to d23)

■ Assignment of low medium voltage detected ***U-EDC*** (Function code data = 77)

When the DC medium voltage decreases to E76 "DC medium voltage detect level" or lower, this signal turns on. When it increases to E76 or higher, the signal turns off. (Function code E76)

■ Assignment of Momentary power failure decelerating ***IPF2*** (Function code data = 79)

When F14 is 2 or 3, the DC medium voltage decreases to H15 "Continuous running level" or lower, and the signal turns on when the conditions turns to continuous running level. After restoration of power, when the DC medium voltage increases to "set voltage of H15 + 10 V or higher," the signal turns off. Even when F14 is 4 or 5, the signal turns on when the DC medium voltage decreases to the undervoltage detected level or lower, the signal turns on. The signal turns off when the voltage becomes "Undervoltage level + 10 V or higher." (📖 Function code F14, H15)

■ Assignment of positioning completion signal ***PSET*** (Function code data = 82)

This output signal comes on as a positioning completion signal. (📖 Function code J97 to J99)

■ Assignment of maintenance timer ***MNT*** (Function code data = 84)

This function outputs an ON signal when the cumulative run time of the motor 1 exceeds the preset time or when the startup time of the motor 1 exceeds the preset count.
(📖 Function code H78, H79)

■ Assignment of alarm details signals ***AL1***, ***AL2***, ***AL4***, and ***AL8*** (Function code data = 90, 91, 92, 93)

This function outputs the operation status of the inverter protection function.

Table 5.4-78

Alarm Content (Inverter Protection Function)	Alarm Code	Output Terminal			
		AL1	AL2	AL4	AL8
Instantaneous overcurrent protection, ground fault protection, and melting fuse	OC1-OC2-OC3 EF-FUS	ON	OFF	OFF	OFF
Overvoltage protection	OU1-OU2-OU3	OFF	ON	OFF	OFF
Undervoltage protection, input open phase protection	LU-Lin	ON	ON	OFF	OFF
Motor overload, electric thermal (motor 1 to 4)	OL1-OL2-OL3-OL4	OFF	OFF	ON	OFF
Inverter overload	OLU	ON	OFF	ON	OFF
INV overheat protection, Inverter overheat	OH1-OH3	OFF	ON	ON	OFF
External alarm, DB resistor overheat, Motor overheat	OH2-dbH-OH4	ON	ON	ON	OFF
Memory abnormal, CPU error, save error in undervoltage, hardware error	Er1-Er3-ErF-ErH	OFF	OFF	OFF	ON
Keypad communication error, option communication error	Er2-Er4	ON	OFF	OFF	ON
Option abnormal	Er5	OFF	ON	OFF	ON
Charger circuit fault, Operation procedure error, EN circuit fault, DB transistor malfunction detect	PbF-Er6-ECF-dbA	ON	ON	OFF	ON
Tuning error, output phase loss protection	Er7-OPL	OFF	OFF	ON	ON
RS485 communication error	Er8-ErP	ON	OFF	ON	ON
Overspeed protection, PG Error, excessive position deviation, speed mismatch (excessive speed deviation), Position control error	OS-PG-ErE-do-Ero	OFF	ON	ON	ON
NTC thermistor (motor) breaking detect, PID feedback breaking detect, Mock alarm	nrb-CoF-Err	ON	ON	ON	ON

* In the normal condition, signals are not output from any terminal.

■ Assignment of light alarm ***L-ALM*** (Function code data = 98)

This function outputs an ON signal when a light alarm occurs. (📖 Function code H81, H82)

■ Assignment of bulk alarm ***ALM*** (Function code data = 99)

This function outputs an ON signal when any of alarms is output.

■ Assignment of braking transistor broken ***DBAL*** (Function code data = 105)

When the braking transistor malfunction is detected, this function outputs the braking transistor broken (alarm dbA), and outputs an ON signal to ***DBAL*** simultaneously. To invalidate the detection of the braking transistor broken, use the function code H98. (22 kW or lower for 200/400 V class series)
(📖 Function code H98)

Note: A breakdown of the braking transistor could lead to a damage of the braking resistor or inverter's internal units. To detect the integrated braking transistor broken status and to prevent the secondary damage, use DBAL to turn off the magnetic contactor at the input side of the inverter.

E30 — Frequency Arrival Detection Width (Detection Width)

This function sets the operation level (detection range) of the Frequency (speed) arrival ***FAR*** and the Frequency (speed) arrival 3 ***FAR3***.

Table 5.4-79

Output Signal	Assigned Data	Operating Condition 1	Operating Condition 2
FAR	1	Both signals turn on when the difference between the output frequency (speed detection value) and the set frequency (speed command) is within the frequency arrival detection range.	This signal always turns off when the run command is off or the speed command is "0."
FAR3	72		When the run command is off, the speed command is taken as 0. When the output frequency is within 0 +/- frequency arrival detection range, an on signal is output.

- Data setting range: 0.0 to 10.0 (Hz)

The operation timings of each signal are as shown below.

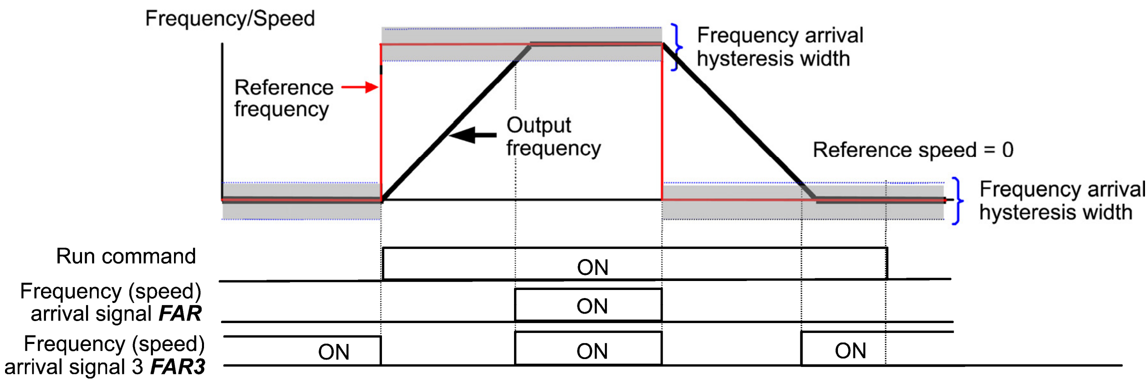


Fig. 5.4-64

E31, E32	**Frequency Detection (Operation Level and Hysteresis Width)** Related Function Code: E36, E54 Frequency Detection 2, 3 (Operation Level)

This function outputs an ON signal when the output frequency is same or above the operation level set by the frequency detection. When the output frequency decreases to below the [frequency detect operation level - hysteresis width], the signal turns off.

The following three settings are available by the frequency detect 2 and 3.

Table 5.4-80

Name	Output Signal	Assignment Data	Operation Level Range: 0.0 to 500.0 Hz	Hysteresis Width 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	

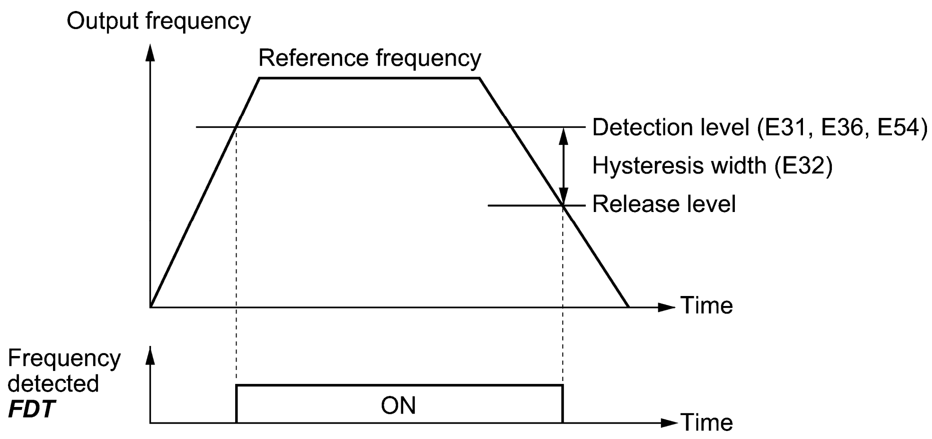


Fig. 5.4-65

E34 and E35	**Overload Early Warning/Current Detection (Operation Level and Timer)** Related Function Code: E37, F38 Current Detect 2 / Low Current Detect (Operation Level, Timer) E55, E56 Current Detect 3 (Operation Level, Timer)

This function sets the operation level and timer of the Motor overload early warning ***OL***, Current detected ***ID***, Current detected 2 ***ID2***, Current detected 3 ***ID3***, and Low current detected ***IDL*** signals.

Table 5.4-81

Output Signal	Assignment Data	Operation Level Range: See below	Timer Period Range: 0.01 to 600.00 s	Motor Characteristics Range: See below	Thermal Time Constant 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: Operation (for auto-cooling fan, general-purpose motor)

2: Operation (for separately-excited fan, inverter (FV))

■ Motor overload early warning ***OL***

This function is used to preliminarily detect the presage before the motor overload detect (alarm OL1) occurs in order to execute the process properly. The motor overload early warning operates at the current or higher that is set by the overload preliminary operation level. In typical cases, E34 data is set to 80 to 90% of the current value of the electric thermal (operation level). Set the thermal characteristics of the motor is set with the electric thermal (motor characteristics select and thermal time constant).

■ Current detected ***ID***, Current detected 2 ***ID2***, and Current detected 3 ***ID3***

When the inverter output current exceeds the level set by the current detect (timer) or higher, and when the current continues for the set time or longer, an ON signal is output. When the output current decreases below 90% of the rated operation level of the output current. The minimum output signal range: 100 ms)

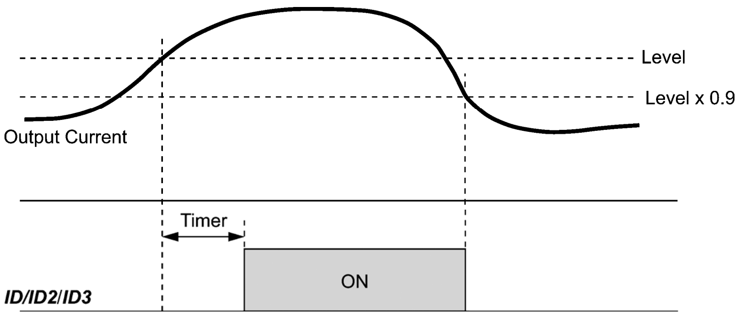


Fig. 5.4-66

■ Low current detected ***IDL***

This function outputs an ON signal when the inverter output current decreases to the set level of the current detect (operation level) and the current continuous to the set time of the current detect (timer) or longer. This signal turns off when the output current exceeds the "Operation level + +5% of the inverter rated current." (The minimum output signal range: 100 ms)

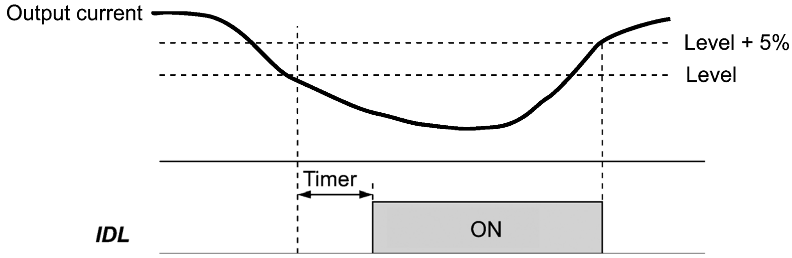


Fig. 5.4-67

E36	Frequency Detection 2	(See E31)

For the setting of frequency detect 2, see the section describing the function code E31.

E37, E38	Current Detect 2/Low Current Detect (Operation Level, Timer)	(See E34)

For the setting of current detect 2/low current detect (operation level) (timer), see the section describing the function code E34.

E40, E41	PID Display Coefficient A, B

This function displays the PID command (process/dancer basic position), PID feedback value, or analog input monitor by converting to the easy-to-understand physical quantities to display.

- Data setting range: (PID display coefficients A and B, -999 to 0.00 to 9990

■ Display coefficients for PID process command and PID feedback (J01 = 1 or 2)

E40 sets the PID display coefficient A "display when PID process command/PID feedback value is 100%," and E41 sets coefficient B "display when PID process command/PID feedback value is 0%."

The display value is determined as follows:

Display value = (PID process command value or PID feedback value (%))/100 x (Display coefficient A - B) + B

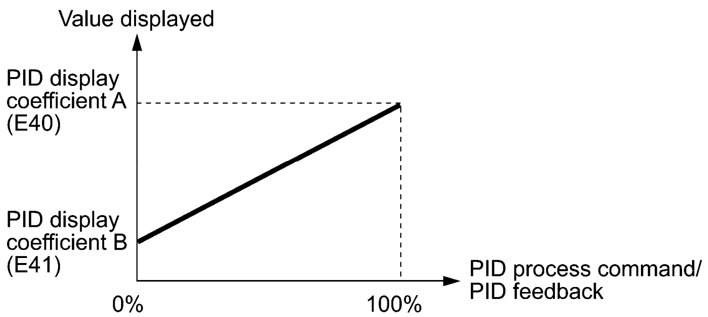


Fig. 5.4-68

Ex.) When the pressure sensor is 1 to 5 V output and can detect 0 to 30 kPa, and when willing to control the pressure at 16 kPa (sensor output 3.13 V)

Select terminal [12] as a feedback terminal and set the gain to 200% so that 5 V corresponds to 100%.

PID process command, display of PID feedback value at 100% = PID display coefficient A (E40) = 30.0

PID process command, display of PID feedback value at 0% = PID display coefficient B (E41) = -7.5

By setting as above, the monitor and keypad setting of the PID process command value and PID feedback value can be recognized as the pressure values. To control the pressure at 16 kPa on the keypad, set the value to 16.0.

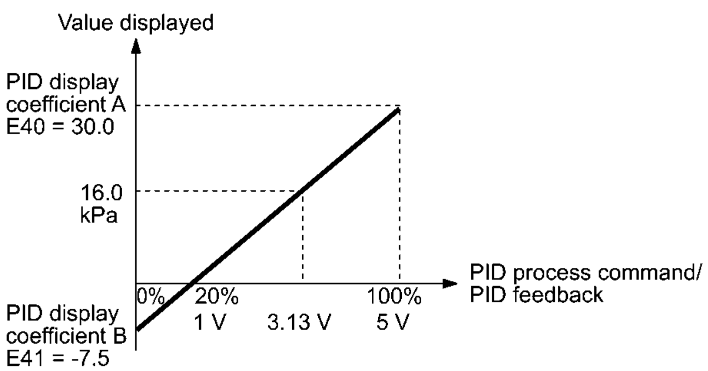


Fig. 5.4-69

Chapter 5 Function Code

Details of Function Codes
F codes
E34 to E41
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U codes
y codes

■ PID dancer basic position command, display of PID feedback (J01 = 3)

During the dancer control, the PID command value and PID feedback value operate within the ±100% control range. Therefore, specify the value at +100% of the PID dancer basic position command/feedback value as PID display coefficient A with E40, and the value at -100% as PID display coefficient B with E41.

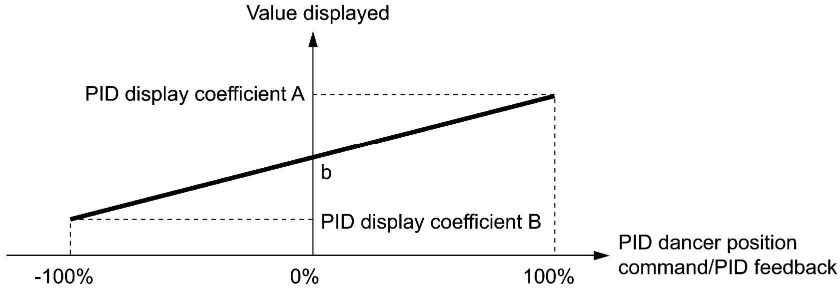


Fig. 5.4-70

If the sensor output is unipolar, PID dancer control operates within the range from 0 to +100%. Therefore, setting the display coefficient B for virtual -100% is necessary.

That is, suppose "b" = "Display value at 0%," then:

Set that

coefficient B = 2b - A.

For details of PID control, see the explanation of the function code J01 or later.

For the displaying method of PID command and PID feedback, see the description of the function code E43.

■ 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 display various values converted to physical values such as temperature and pressure.

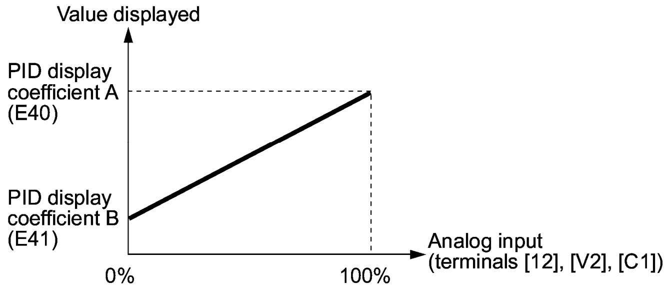


Fig. 5.4-71

To set up the analog input monitor, use function codes E61 through E63. Use E43 to choose the item to be displayed.

E42	Display Filter

E42 specifies a filter time constant to be applied for displaying the various running status monitored on the keypad except for the speed monitor (E43 = 0). If the display varies unstably due to load fluctuation or other causes, and it is hard to see the displayed contents, increase the setting.

- Data setting range: 0.0 to 5.0 (s)

E43	**LED Monitor (Display Select)** Related Function Code: E48 LED Monitor Details (Speed Monitor Select)

This function selects the monitoring information of operation status displayed by the keypad LED.
Selecting the speed monitor with E43 provides a choice of speed-monitoring formats selectable with E48 (LED Monitor Details).

Table 5.4-82

Monitor Item		Display Sample	LED Indicator	Unit	Meaning of Displayed Value	E43 data
Speed monitor		With the function code E48, selecting following display form is possible.				0
	Output frequency 1 (before slip compensation)	50.00	■ Hz -> □A -> □kW	Hz	Display value = Output frequency (Hz)	(E48 = 0)
	Output frequency 2 (after slip compensation)	50.00	■Hz -> □A -> □kW	Hz	Display value = Output frequency (Hz)	(E48 = 1)
	Set frequency	50.00	■ Hz -> □A -> □kW	Hz	Display value = Set frequency (Hz)	(E48 = 2)
	Motor speed	1500	■Hz -> ■A -> □kW	r/min	Display value = Output frequency (Hz) $\times \frac{120}{\text{P01}}$	(E48 = 3)
	Loaded rotation speed	300.0	■Hz -> ■A -> □kW	r/min	Display value = Output frequency (Hz) x E50	(E48 = 4)
	Line speed	300.0	□Hz -> ■A -> ■kW	m/min	Display value = Output frequency (Hz) x E50	(E48 = 5)
	Speed (%)	50.0	□Hz -> □A -> □kW	%	Display value = $\frac{\text{Output frequency}}{\text{Maximum frequency}} \times 100$	(E48 = 7)
Output current		12.34	□Hz -> ■A -> □kW	A	Inverter output current effective value	3
Output voltage		200V	□Hz -> □A -> □kW	V	Inverter output voltage effective value	4
Calculated torque		50	□Hz -> □A -> □kW	%	Motor output torque (Calculated value)	8
Power consumption		10.25	□Hz -> □A -> ■kW	kW	Inverter input power value	9
PID command		10.00.	□Hz -> □A -> □kW	-	PID command value or PID feedback value is converted into a physical quantity of the object to be controlled and displayed See the function codes E40 and E41.	10
PID feedback value		9.00.	□Hz -> □A -> □kW	-		12
PID output		100.0.	□Hz -> □A -> □kW	%	Displays PID output in % as the maximum output frequency (F03) being at 100%	14
Load factor		50L	□Hz -> □A -> □kW	%	Displays load factor of the motor in % as the rated output being at 100%	15
Motor output		9.85	□Hz -> □A -> ■kW	kW	Motor output (kW)	16
Analog input monitor		82.00	□Hz -> □A -> □kW	-	An analog input to the inverter is converted to a desired format and displayed. See the function codes E40 and E41.	17
Torque current		48	□Hz -> □A -> □kW	%	Displays torque current command value or calculated torque current	23
Magnetic flux command value		50	□Hz -> □A -> □kW	%	Displays magnetic flux command value (Available under vector control)	24
Integral power consumption		100.0	□Hz -> □A -> □kW	kWh	Display value = $\frac{\text{Integral power consumption (kWh)}}{100}$	25

■ Light on, □ Light off

E44 — LED Monitor (Display When Stopped)

This function selects the monitoring information displayed by the keypad LED while the inverter is at stop. When E44 = 0, the set frequency is displayed, and when E44 = 1, output frequency is displayed. The display form is as selected in the speed monitor E48.

Table 5.4-83

E48 Data	Monitor Selection	While Stopping	
		E44 = 0: Displays the set frequency	E44 = 1: Displays the output frequency
0	Output frequency 1 (before slip compensation)	Set frequency	Output frequency 1 (before slip compensation)
1	Output frequency 2 (after slip compensation)	Reference frequency	Output frequency 2 (after slip compensation)
2	Set frequency	Set frequency	Set frequency
3	Rotation speed	Rotation speed set value	Rotation speed
4	Loaded rotation speed	Loaded rotation speed set value	Loaded rotation speed
5	Line speed	Line speed set value	Line speed
7	Speed (%)	Speed set value	Speed

E48 — Details of LED Monitor (Speed Monitor Selection) (See E43)

For details of the LED monitor (speed monitor selection), see the section describing the function code E43.

E49 Torque Monitor (Polarity Select)

When using the calculated torque of V/f control and torque command value of the vector control, generally, the driving side of the torque polarity is at positive, and the braking side is at negative. When the rotation changes from normal to inverse by the lifting load, etc., the torque also changes from the driving side to the braking side, and the polarity inverses. When the torque data is traced by the PC loader, the polarity of the torque command value changes, and the data do not become the consecutive data. When 0 is selected for this function code, the forward drive and reverse braking are handled at positive, and forward braking and reverse braking are handled as negative. Therefore, the continuity of the torque data can be secured.

Table 5.4-84

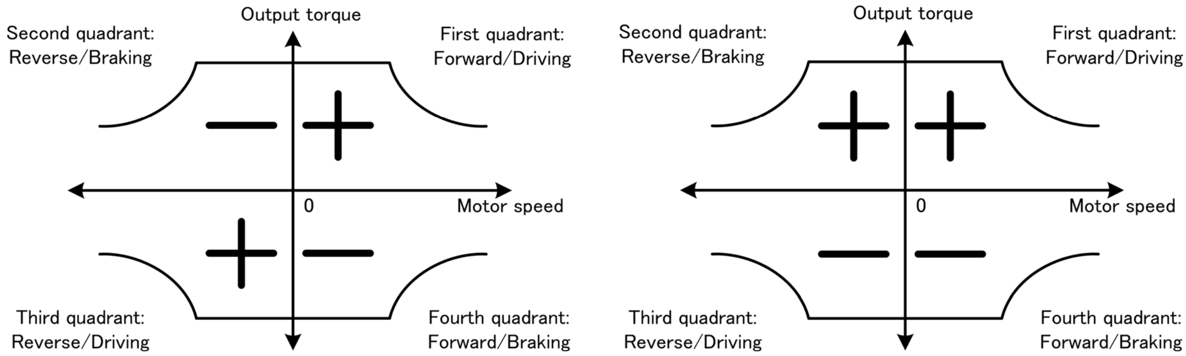
E49 Data	Torque Monitor Polarity
0	Torque polarity (forward drive and reverse braking are +, forward braking and reverse drive are -.)
1	Drive is +, Brake is - (default value)

Related data are as follows. All of these are displayed or transferred with the polarities. Judge the meanings of signs by using the set values of E49.

Table 5.4-85

Monitor, Output Data	Setting	Related Data
Isolated keypad / Multi-purpose keypad LED monitor	E43 = 8	Calculated torque
	E43 = 23	Torque current
Isolated keypad / Multi-purpose keypad Operation monitor	3_04	Calculated torque
Isolated keypad / Multi-purpose keypad Alarm data	6_03	Torque calculated value in alarm (Latest value to the third value from the latest one)
OPC-G1-AIO	o71 = 4 *	Output torque
Monitor code	M02	Torque command (latest command)
	M03	Torque current command (latest command)
	M07	Output torque
	M08	Torque current
	M28	Torque command in alarm (latest command)
	M29	Torque current command in alarm (latest command)
	M33	Output torque in alarm
	M34	Torque current in alarm
	W07	Torque actual value
	W24	Torque current
	X23	Latest data in alarm (calculated torque value)
	X63	One data before the latest one in alarm (calculated torque value)
	Z03	Two data before the latest one in alarm (calculated torque value)
	Z53	Three data before the latest one in alarm (calculated torque value)
	Z81	Output torque

* When the terminal Ao (polarity select) (o73) setting is 0: only in case of both polarity, the output data of E49 polarity is obtained.



E49 = 0: "+" when forward driving and reverse braking, and "-" when forward braking and reverse driving, E49 = 1: "+" when driving, and "-" when braking.

Fig. 5.4-72

E50	Speed Indication Coefficient

E50 is used as a coefficient when the loaded rotation speed and line speed of LED monitor (see the function code E43) are displayed.

Load rotation speed [r/min] = E50 speed indication coefficient x frequency (Hz)

Line speed [m/min] = E50 speed indication coefficient x frequency (Hz)

- Data setting rage: 0.01 to 200.00

E51	Coefficient for Integrated Power Data Indication

E51 is used as the coefficient of data to be displayed on the maintenance information display 5- 10 (integrated power factor) on the keypad.

Displays integrated power data = E51 integrated power data display coefficient x integrated power amount (kWh)

- Data setting range: 0.000 (cancel and reset) 0.001 to 9999

Note Setting E51 = 0.000 clears the integrated power amount and integrated power data to "0." After clearing, be sure to restore to the previous value; otherwise, integrating operation cannot be executed with E51 = 0.000.

E52	Keypad Menu Select

With the function code E52 setting, displaying menu can be limited.

Table 5.4-86

E52 Data	Mode	Menus to be Displayed
0	Function code data setting mode	Menu #0, Menu #1, Menu #7
1	Function code data check mode	Menus #2, Menu #7
2	Full-menu mode	Menu #0 through Menu #7

Selects the menu to be displayed on the standard keypad. Eight menus available on the standard keypad are described below.

Table 5.4-87

Menu #	LED Monitor Display	Function	Display Contents
0	0.FnC	Quick setup	Quick setup function code
1	1.F_ _	Data setting F to o	F to o group function code
2	2.rEP	Data check	Changed function code
3	3.oPE	Operation monitor	Operation status display
4	4. I_o	I/O check	DIO, AIO status display
5	5.CHE	Maintenance	Maintenance information display
6	6.AL	Alarm information	Alarm Information display
7	7.CPY	Data copy	Data copy operation type

For the menu contents, see "Chapter 3 Keypad Functions."

E54	Frequency Detection 3 (Operation Level) (See E31)

For details, see the description of E31.

E55, E56	Current Detection 3 (Operation Level, Timer) (See E34)

For setting of current detection 3 (operation level) and current detection 3 (timer), see the description of E34.

E61 to E63 — Terminal [12], [C1], [V2] (Extended Function Select)

This function selects functions of terminals [12], [C1], and [V2], respectively.

(When it is used for the frequency setting, setting is not required.)

Table 5.4-88

E61, E62, E63 Data	Function	Description
0	No Assignment of extension function	-
1	Auxiliary frequency command 1	Auxiliary frequency input to be added to the frequency command 1 (F01). Will not be added to any settings other than frequency command 1 (frequency command 2 and multi-frequency commands, etc.).
2	Auxiliary frequency command 2	Auxiliary frequency input added to all frequency settings. Auxiliary frequency is added to Frequency command 1, 2, and multi-frequency commands.
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 value	Inputs feedback amounts such as temperature and pressure under PID control.
6	Ratio setting	It is used for line speed constant control by the diameter calculation of winder and ratio operation of multiple inverters. Therefore, it is integrated to the latest frequency command as a ratio.
7	Analog torque limit value A	Used when analog inputs are used as torque limiters. (Function code F40)
8	Analog torque Limit value B	Used when analog inputs are used as torque limiters. (Function code F40)
10	Torque command	Analog inputs to be used as torque commands under torque control. (Function code H18)
11	Torque current command	During the torque control, analog input is used as the torque current command. (Function code H18)
17	Forward (FWD) side speed limit value	Under torque control, the motor speed limit value can be set with [12], [C1], and [V2] terminals. To limit the motor speed to the maximum frequency (F02, A01, b01, and r01), set the analog input (max. input) to the maximum value. When using this function, it is recommended to use d35 (overspeed detect level) together. Note: The function codes C31 to C45 (analog input adjustment) are applied to these analog inputs.
18	Reverse (REV) side speed limit value	
20	Analog 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 display various values converted to physical quantities such as temperature and pressure.

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 (F01, C30 = 7) is selected as the frequency setting, the auxiliary frequency commands 1 and 2 are disabled.

E64	Saving of Digital Reference Frequency

With this function, the saving method of frequency set by the ⌃/⌄ keys on the keypad can be selected.

Table 5.4-89

E64 Data	Saving Method
0	Auto saving when the main power is turned off. When the power is turned on, the frequency setting, which was obtained at when the main power was shut down in the last time, can be applied for restarting.
1	Saving is possible by pressing the FUNC/DATA key. If the key is left un-pressed, if the control power is turned off, the data get lost. When the power is turned on, the frequency setting, which was obtained at when the FUNC/DATA key was pressed the last time, can be applied for restarting.

E65	Command Loss Detection (Continuous Running Frequency)

When the analog frequency setting (frequency setting through terminals [12], [C1], [V2]) drops to 10% or lower of the frequency setting 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 set by E65 to the frequency setting. Then, the inverter outputs the command loss detect ***REF OFF*** signal.
(📖 Function code E20 to E24, E27 data = 33)

When the frequency setting returns to a level equal to or higher than the one specified by E65, the inverter presumes that the broken wire has been fixed and continues to run with the regular frequency setting.

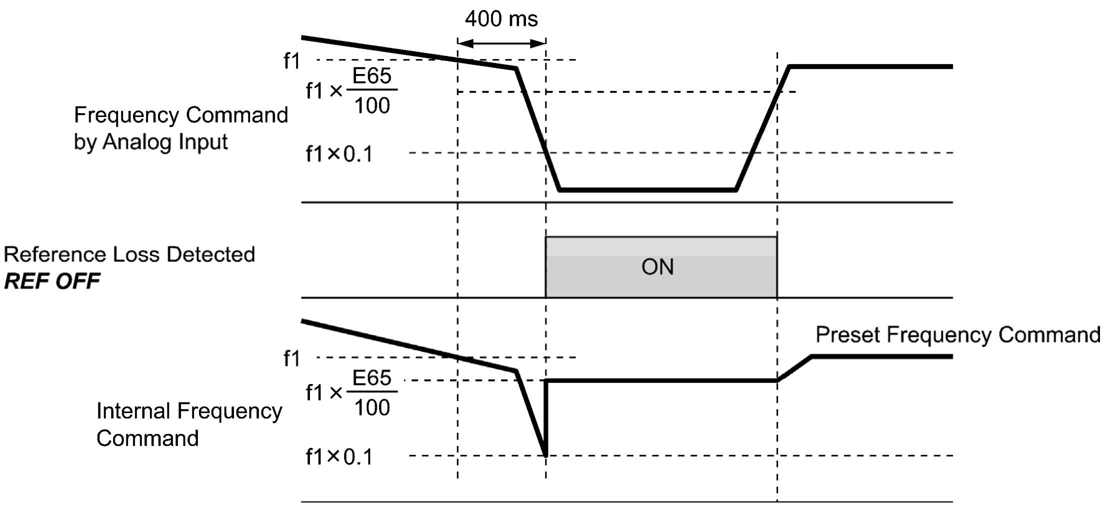


Fig. 5.4-73

f1 is an analog frequency setting sampled at any given time. The sampling is updated repeatedly to judge the wore breakage.

- Data setting range: 0 (decelerate and stop), 20 to 120 (%), 999 (cancel)

Note Avoid an abrupt voltage or current change for the analog frequency command. An abrupt change may be interpreted as a wire breakage.
When E65 = 999 (cancel) is set, the setting frequency does not switch even when the command loss detection ***REF OFF*** signal is output. (The operation proceeds as the input frequency setting.)
When E65 = 0 or 999, the recovery level from the wire breakage is "f1 x 0.2."
When E65 = "100"% or higher, the recovery level from the wire breakage is "f1 x 1."
The command loss detection is not affected by the analog input adjustment (filter: C33, C38, and C43).

E76 DC Medium Voltage Detection Level

When the DC medium voltage decreases to the set voltage level or lower, ***U-EDC*** is output. The DC medium voltage of the inverter is proportional to the input voltage. Therefore, when the DC medium voltage is monitored, the power supply voltage error can be detected.
- E76 setting range 200 V line 200 V to 400 V, 400 V line 400 V to 800 V

■ Assignment of low medium voltage detected ***U-EDC*** (Function code E20 to E24, E27 data = 77)

E78, E79 E80, E81 Torque Detect 1 (Operation Level, Timer) Torque Detect 2/Low Torque Detect (Operation Level, Timer)

This function sets the operation level and timer for the torque detect 1 ***TD1***, torque detect 2 ***TD2***, and low torque detect ***U-TL***.

Table 5.4-90

Output Signal	Assignment 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 detect 1 ***TD1***, Torque detect 2 ***TD2***

The output signal TD1 or TD2 comes on when the torque value calculated by the inverter or torque command value exceeds the level specified by the torque detect (operation level) set level, and when that condition continues for the set period of torque detect (timer) or longer. The signal turns off when the calculated torque drops to equal to or lower than 5% of the set level - motor rated torque. (The minimum output signal range: 100 ms.)

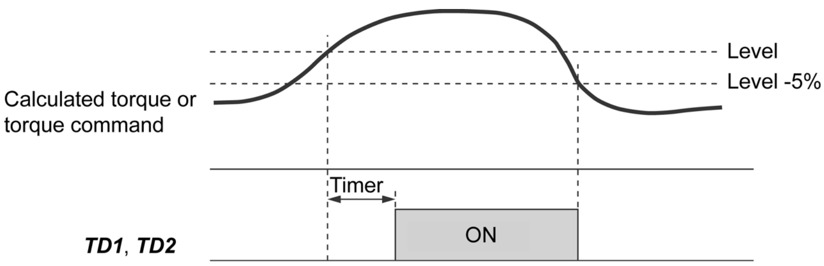


Fig. 5.4-74

■ Low torque detected ***U-TL***

This output signal comes on when the torque value calculated by the inverter or torque command value drops to equal to or below the level set for the low torque detect (operation level), and when the condition continues for the set period of low torque detect (timer). The signal turns off when the calculated torque increases to equal to or higher than 5% of the set level + motor rated torque. The minimum output signal range: 100 ms.)

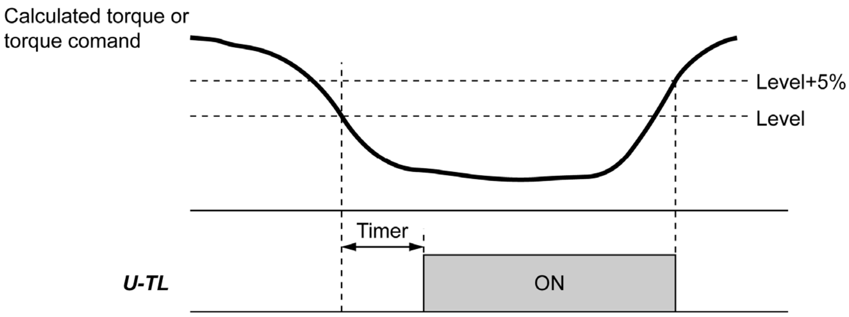


Fig. 5.4-75

Under low frequency operation, the error in torque calculation becomes large. Therefore, no low torque can be detected within the operation range at lower than 20% of the base frequency (F04). (In this case, the result of recognition before entering this operation range is retained.) The low torque detect goes off when the inverter operation is at stop.

Since the motor constants are used in the torque calculation, it is recommended that auto-tuning be applied by function code P04 to achieve higher accuracy.

E98, E99	**Terminal [FWD] (Function Select), Terminal [REV] (Function Select)** (See E01 to E09)

For settings of terminals [FWD] and [REV], see the description of function codes E01 to E09.

5.4.3 C codes (Control functions)

C01 to C04	Jump Frequencies 1 to 3, Jump Frequencies (width)

In order to prevent resonance of the motor operation frequency and the fixed vibration frequency of the machinery, up to three jump frequency bands can be set to the output frequency.

- When the set frequency is increased, if the set frequency is within the jump frequency band, the internal set frequency is kept constant at the lower limit of the jump frequency. When the set frequency exceeds the upper limit of the jump frequency band, the internal set frequency becomes the value of the set frequency. When the set frequency is decreased, the situation will be reversed. See the figure on the lower left.
- When two or more jump frequency bands overlap to each other, the minimum and maximum frequencies become the lower limit and upper limit frequencies of the actual jump frequency band respectively. See the figure on the lower right.

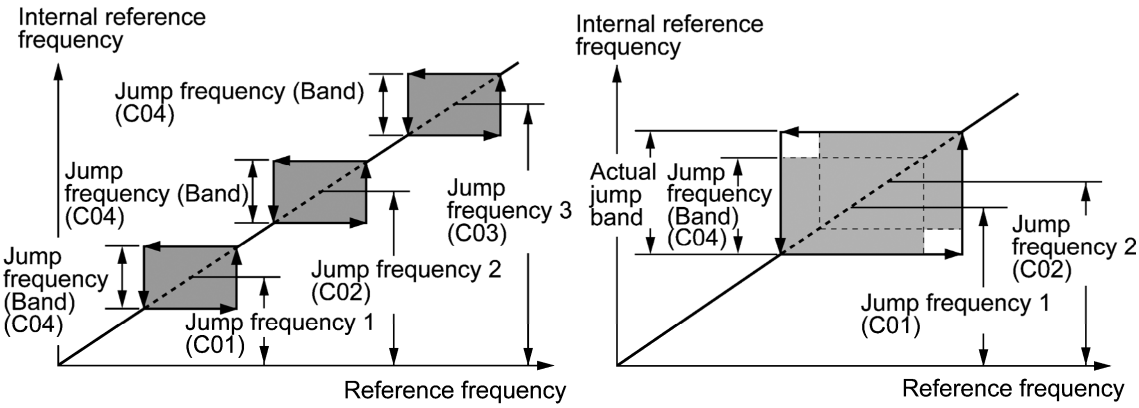


Fig. 5.4-76

■ Jump frequencies 1, 2 and 3 (C01, C02, and C03)

Sets the jump frequencies.

- Data setting range: 0.0 to 500.0 (Hz) (No jump occurs at 0.0.)

■ Jump frequency width (C04)

Sets the jump frequency width.

- Data setting range: 0.0 to 30.0 (Hz) (No jump occurs at 0.0.)

C05 to C19	Multi-frequency1 to 15

■ These functions set multi-frequencies 1 to 15 that operate by switching several frequencies.

Switching between multi-frequencies 1 to 15 is possible by turning on/off the ***SS1***, ***SS2***, ***SS4*** and ***SS8*** terminal functions. It is necessary to assign the multi-frequency selection ***SS1***, ***SS2***, ***SS4,*** and ***SS8*** (data = 0, 1, 2, and 3) to the digital input terminals (E01 to E09).

■ Multi-frequency 1 to 15 (C05 to C19)

- Data setting range: 0.00 to 500.0 (Hz)

Frequencies that can be selected by combinations of ***SS1***, ***SS2***, ***SS4*** and ***SS8*** are as follows.

Table 5.4-91

SS8	***SS4***	***SS2***	***SS1***	Selected frequency
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 frequency setting input method excluding multi-frequency commands.

■ When enabling PID control (J01 = 1 to 3)

The PID control command can be set as the preset value (3-stage). In addition, multi-frequency (3-stages) can be also used for the manual speed command and dancer control in the PID control cancel (***Hz/PID*** = ON).

- PID control command

Table 5.4-92

SS8	***SS4***	***SS1***, ***SS2***	Selected command
OFF	OFF	-	Command specified by J02
OFF	ON	-	C08
ON	OFF	-	C12
ON	ON	-	C16

C08, C12, and C16 can be set in increments of 1 Hz. Convert the PID control command and the set data by using the following conversion formula .

Setting data = PID control command (%) x Maximum output frequency (F03)/100

$$\text{PID control command (\%)} = \frac{\text{Setting data}\left(\text{C08, C12, C16}\right)}{\text{Maximum output frequency}\left(\text{F03}\right)} \times 100$$

- Manual speed command

Table 5.4-93

SS8, ***SS4***	***SS2***	***SS1***	Selecting frequency
-	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** Related Function Code: H54, H55 Accelerate/Decelerate Time (Jogging Operation) d09 to d13 Speed Control (JOG)

C20 sets the operating condition in jogging operation.

Table 5.4-94

Function code		Setting range	Description
C20	Jogging frequency	0.00 to 500.00 (Hz)	Operation frequency in 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 (Jog) Speed command filter	0.000 to 5.000 s	Adjustment factor of the speed control system in the jogging operation in the vector control with/without speed sensor For adjustments, see the descriptions of d01 to d06.
d10	Speed control (Jog) Speed detection filter	0.000 to 0.100 s	
d11	Speed control (JOG) P (Gain)	0.1 to 200.0 times	
d12	Speed control (JOG) I Integral time	0.001 to 1.000 s	
d13	Speed control (JOG) Output filter	0.000 to 0.100 s	

For details about jogging operation, see Chapter 3, "3.3.5 Jogging Operation."

C21 C22 to C28 C82 to C88	**Pattern Operation (Operation Selection)** **(Stage 1 to 7 Operation Time)** **(Stage 1 to 7 Rotation Direction Accelerate/Decelerate Time)** Related Function Codes: C05 to C11 Multi-frequency 1 to 7 E20 to E24, E27: Terminal Y1 to 7, 30ABC

Automatic operation is executed in an order of stage 1 to 7 according to the preset operation time, rotation direction, accelerate/decelerate time, and frequency for each stage. In FRENIC-MEGA, operations same as FRENIC5000G11S/P11S pattern operation can be executed. Set F01: Frequency command 1 (C30: Frequency command 2) to Set value: 10 (pattern operation). Set the operation time to C22 to C28, rotating direction and acceleration/deceleration time to C82 to C88, and set frequency to C05 to C11.

With C21, the pattern operation method can be selected from the one-time operation, repeated operation, and final setting hold after one-time operation. Be careful that the running direction is as set with C82 to C88 even with the reverse command. In addition, OPR command selfhold function by the HLD terminal does not operate. In order to use the switch, apply the alternate type.

When the operation command is turned off halfway, the system decelerates and stops in F08 deceleration time and turns into the pause status. When the run command is input again, the operation resumes from the stage, where the operation paused. In order to start the operation from Stage 1, press PRG/RESET key while pausing or turn on the RST terminal. Operation starts from Stage 1 when a run command is input for the next time.

When an alarm trip occurs during an operation, the system also pauses. Therefore, when the run command is input after resetting an alarm, the operation resumes from middle of the stage, where an alarm occurred. In order to resume the operation from Stage 1 after stopping an alarm, press PRG/RESET key after resetting an alarm or turn on the RST terminal.

Pattern operation is not available in the torque control.

When the pattern operation is validated with F01/C30, multi-frequency command becomes invalid.

Relationship between each stage and function code

Table 5.4-95

Stage No.	Operation time setting	Rotation direction, accelerate/decelerate time	Setting frequency
1	C22	C82	C05
2	C23	C83	C06
3	C24	C84	C07
4	C25	C85	C08
5	C26	C86	C09
6	C27	C87	C10
7	C28	C88	C11

■ Pattern operation (operation selection) (C21)

The next operation pattern can be selected.

Table 5.4-96

C21: Setting Value	Operation Pattern
0	Perform a pattern operation cycle, then stop operation
1	Perform pattern operation repeatedly. Immediate operation stop by stop command.
2	Perform one cycle of pattern operation cycle, then continue operation with the last frequency set.

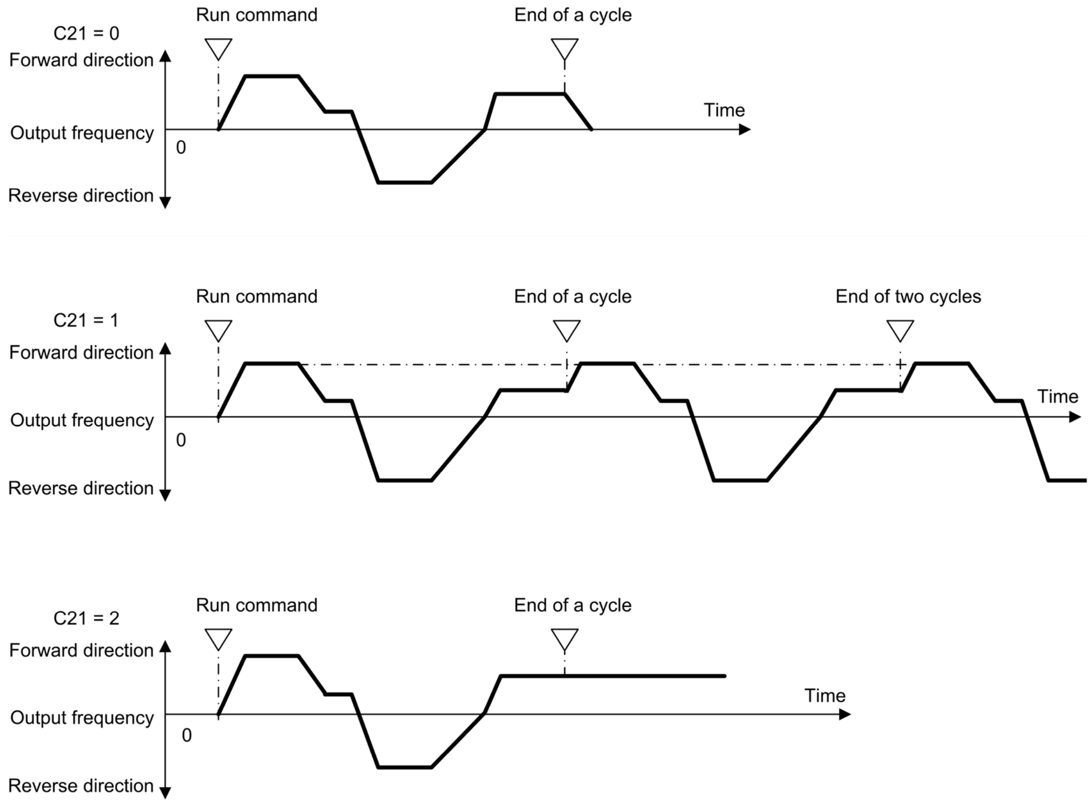


Fig. 5.4-77

⚠CAUTION

When a pattern operation is started with C21 = 0 and the FWD (REV) terminal = ON, the motor stops after the final stage completes even the FWD (REV) terminal is remained ON.

At this time, when the values of F01 and/or C30 is changed or ON/OFF status of the control terminal "Hz2/Hz1" is switched without turning off the FWD (REV) terminal, the operation immediately resumes according to the changed set frequency.

An accident or injuries could occur.

■ Pattern operation (Stage 1 to Stage 7 operation time) (C22 to C28)

Set the operation time of stage 1 to 7.

Set 0 to the operation time of the stage, which is not used. Set 00. The stage is skipped and shifted to the next stage.

- Data setting range: 0.0 to 6000 (s)

■ Pattern operation (Stage 1 to 7 Rotation direction, accelerate/decelerate time) (C82 to C88)

Set the rotation direction and accelerate/decelerate time of stages 1 to 7.

Table 5.4-97

C82 to C88: Set value	Rotational direction	Acceleration time	Deceleration time
1	Forward	F07 Acceleration Time 1	F08 Deceleration Time 1
2		E10 Acceleration Time 2	E11 Deceleration Time 2
3		E12 Acceleration Time 3	E13 Deceleration Time 3
4		E14 Acceleration Time 4	E15 Deceleration Time 4
11	Run reverse	F07 Acceleration Time 1	F08 Deceleration Time 1
12		E10 Acceleration Time 2	E11 Deceleration Time 2
13		E12 Acceleration Time 3	E13 Deceleration Time 3
14		E14 Acceleration Time 4	E15 Deceleration Time 4

■ **Multi-frequency 1 to 7 (Stage 1 to 7 Set Frequency) (C05 to C11)**

Set the frequency of Stages 1 to 7.

When validating the pattern operation with F01/C30, multi-frequency command becomes invalid.

- Data setting range: 0.00 to 500.0 (Hz)

■ Pattern operation stage change ***TU*** (Function code E20 to E24, E27 data = 16)

During the stage change in the pattern operation, the ON signal of one shot (100 ms) is output to indicate that the stage has been changed. Used by the customizable logic.

■ Pattern operation cycle operation complete ***T0*** (Function code E20 to E24, E27 data = 17)

When all stages from 1 to 7 in the pattern operation are completed, the ON signal of one shot (100 ms) is output. Used by the customizable logic.

■ Pattern operation stages No. 1, 2, 4 ***STG1***, ***STG2,*** and ***STG4*** (Function codes E20 to E24, E27 data = 18, 19, 20)

During the pattern operation, the currently-operating stage is output.

Table 5.4-98

Operation Pattern Stage No.	Output Terminal Signal		
	STG1	STG2	STG4
Stage 1	ON	OFF	OFF
Stage 2	OFF	ON	OFF
Stage 3	ON	ON	OFF
Stage 4	OFF	OFF	ON
Stage 5	ON	OFF	ON
Stage 6	OFF	ON	ON
Stage 7	ON	ON	ON

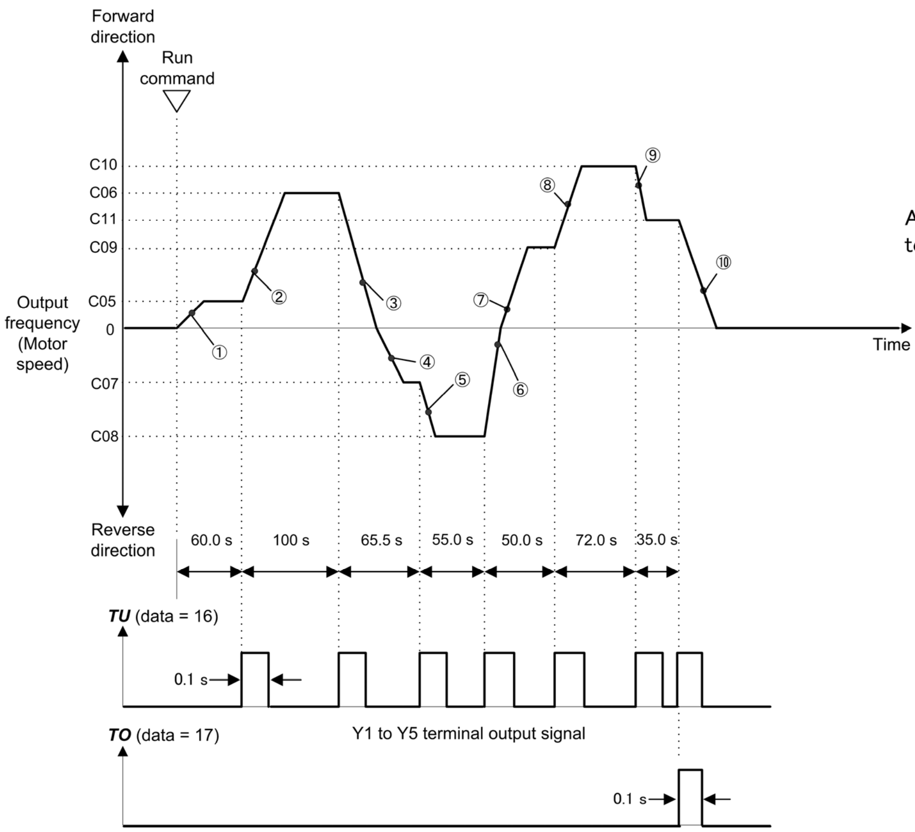
◆ Pattern operation setting example

C21 = 0: Perform a pattern operation for one cycle, then stop after the operation completion

Table 5.4-99

Stage No.	Operation Time		Rotation Direction, Accelerate/Decelerate Time		Operation (Setting) Frequency
	Setting Data		Setting Data		
Stage 1	C22	60.0 s	C82	2: Forward, E10, E11	C05 multi-frequency 1
Stage 2	C23	100 s	C83	1: Forward, F07, F08	C06 multi-frequency 2
Stage 3	C24	65.5 s	C84	14: Reverse, E14, E15	C07 multi-frequency 3
Stage 4	C25	55.0 s	C85	13: Reverse, E12, E13	C08 multi-frequency 4
Stage 5	C26	50.0 s	C86	2: Forward, E10, E11	C09 multi-frequency 5
Stage 6	C27	72.0 s	C87	4: Forward, E14, E15	C10 multi-frequency 6
Stage 7	C28	35.0 s	C88	2: Forward, E10, E11	C11 multi-frequency 7

When expressed in the figure, the pattern operation becomes as follows.



Acceleration/deceleration time to apply at points ① to ⑩

①	Acceleration time 2 (E10)
②	Acceleration time 1 (F07)
③	Deceleration time 4 (E15)
④	Acceleration time 4 (E14)
⑤	Acceleration time 3 (E12)
⑥	Deceleration time 2 (E11)
⑦	Acceleration time 2 (E10)
⑧	Acceleration time 4 (E14)
⑨	Deceleration time 2 (E11)
⑩	Deceleration time 1 (F08)

Fig. 5.4-78

For the deceleration time after completion of one cycle, the set deceleration and stopping values of "F08 Deceleration time 1" is applied.

C30	Frequency Command 2 (See F01)

For details of frequency command 2, see the description of the function code F01.

C31 to C35 C36 to C40 C41 to C45	**Analogue Input Adjustment (Terminal [12]) (Offset Gain Filter Gain Base Point and Polarity Selection)** **Analogue Input Adjustment (Terminal [C1]) (Offset Gain Filter Gain Base Point and Range Selection)** **Analogue Input Adjustment (Terminal [V2]) (Offset Gain Filter Gain Base Point Polarity Selection)** For Frequency Setting, (See F01)

Setting the frequency using analog input

Gain, polarity selection, filter, and offset adjustment are possible to the analog input (voltage to be input to terminal [12] and terminal [V2] and current to be input to terminal [C1]).

Adjustable items for analog inputs

Table 5.4-100

Input terminal	Input range	Gain		Polarity Selection /Range Selection	Filter	Offset
		Gain	Base point			
[12]	0 to +10 V, -10 to +10 V	C32	C34	C35	C33	C31
[C1]	4 to 20 mA, 0 to 20 mA	C37	C39	C40	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 input voltage/current. The offset of the signal from external equipment can be also corrected.

- Data setting range: -5.0 to +5.0 (%)

■ Filter (C33, C38, C43)

C33, C38, or C43 sets the filter time constant for the analog input voltage/current. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, set a large time constant.

- Data setting range: 0.00 to 5.00 (s)

■ Polarity selection (C35, C45)

C35 or C45 sets the input range for analog input voltage.

Table 5.4-101

Data for C35 and C45	Terminal input specifications
0	-10 to +10 V
1	0 to +10 V (negative voltage value is regarded as 0 V)

■ Gain

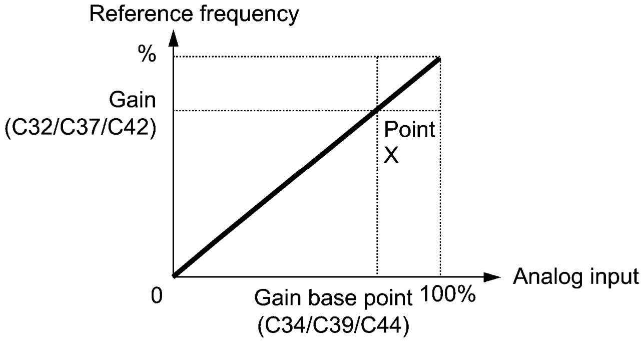


Fig. 5.4-79

Note To input the analog voltage to both polarities (DC0 to ±10 V) by the analog input (terminal [12] and terminal [V2]), set the function codes C35 and C45 to "0." When C35 and C45 data are "1," only 0 to +10 VDC is possible and the negative polarity input of 0 to -10 VDC is interpreted as 0 V.

■ Terminal [C1] range selection (C40)

Selects the range of current input terminal [C1].

Table 5.4-102

C40 data	Terminal [C1] range selection
0	DC 4 to 20 mA
1	DC 0 to 20 mA

C50	Bias (For Frequency Command 1) (Bias Basic Point) (See F01)

For settings of bias basic points of the frequency setting 1, see the description of function code F01.

C51, C52	Bias (PID Command 1) (Bias Value and Bias Base Point)

When the gain and the bias are set to the analog input as PID command 1, the relationship of the analog input and the PID command can be set freely.

The actual setting is the same as that of the function code F18. For details, see F18 given in the description of function code F01.

Note Function codes C32, C34, C37, C39, C42, and C44 are shared by frequency commands.

■ Bias (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 normal operation and inverse operations of the frequency setting 1 (F01).

For details of the operation, see normal/inverse operations switching ***IVS*** (data = 21) of function codes E01 to E09.

C82 to C88	Pattern Operation (Stage 1 to 7 Rotation Direction, Accelerate/Decelerate Time)

For the pattern operation (acceleration/deceleration time of stage 1 to 7 rotation direction), details are explained in the section describing the function code C20.

5.4.4 P codes (Motor 1 parameters)

With FRENIC-MEGA, the motor control method can be selected such as V/f control, vector control with/without speed sensor, and motor control method. To use the integrated automatic control functions such as the auto torque boost, torque calculation monitoring, auto energy saving operation, torque limiter, automatic deceleration, auto search, slip compensation, torque vector control, droop control, and overload stop, it is necessary to specify proper motor constants to build and control the motor model in the inverter. Therefore, it is necessary to correctly set various constants in addition to the motor capacity and rated current.

The FRENIC-MEGA provides the Fuji-standard motors 8-series, 6-series, and special motor constant for Fuji vector. To use these Fuji motors, it is enough to set the motor selection (P99). 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, see "Chapter 4 Operation" in "FRENIC-MEGA Instruction Manual."

When using a motor made by other manufacturers or a Fuji non-standard motor, obtain the test report of the motor and set the motor constant or perform auto-tuning.

P01	Motor 1 (No. of poles)

Set a number of poles of the motor (write on the motor nameplate). It is used for display of the motor rotation speed and the speed control. The relationship between the motor rotation speed and the inverter output frequency is as shown in the following conversion expression.

Motor rotation speed (r/min) = 120/number of poles x frequency (Hz)

- Data setting range: 2 to 22 (poles)

P02	Motor 1 (Capacity)

P02 sets the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.

Table 5.4-103

Data for P02	Unit	Function
0.01 to 1000	kW	When P99 (Motor 1 Selection) are 0, 2 to 4
	HP	When P99 (Motor 1 Selection) is 1

Change P02 on the key pad. Then, P03, P06 to P23, P53 to P56, and H46 are automatically rewritten. Please pay close attention.

Note When P02 is changed from the communication, other function codes are not automatically re-written.

P03	Motor 1 (Rated current)

P03 sets 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)

P04	Motor 1 (Auto-tuning)

The inverter automatically measures the motor constants and saves them as the motor parameter. When the Fuji standard motor is used with the standard method, basically, tuning is not necessary.

There are following three types of auto-tuning. Select appropriate tuning method according to the limiting and controlling method of the machinery.

Table 5.4-104

P04 Data	Tuning Method	Operation	Motor Constant Objective for Tuning
0	Disable	---	---
1	Stop tuning	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, P54)
2	For V/f control Rotation tuning	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 to P20) Magnetic saturation extension factors "a" to "c" (P21 to P23) %X correction factors 1 and 2 (P53 and P54)
3	For vector control Rotation tuning	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 to P20) Magnetic saturation extension factors "a" to "c" (P21 to P23) %X correction factors 1 and 2 (P53, P54)

For details of auto-tuning procedure, see the "FRENIC-MEGA Instruction Manual," "Chapter 4 OPERATION."

Note In any of the following cases, the motor constants are different from the standard motors. Therefore, sufficient performance may not be able to be obtained. In that case, execute auto tuning.
- When the motor to be driven is a non-Fuji motor or a non-standard motor
- When the wire between the inverter and the motor is long (generally, 20 m or longer)
- When a reactor is inserted between the motor and the inverter.

Etc.

■ Functions in which the motor parameters affect the running capability

Table 5.4-105

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 limit	F40
Anti-regenerative control	H69
Auto search	H09
Slip compensation	F42

Function	Related Function Codes (Representative)
Dynamic torque vector control	F42
Droop control	H28
Torque detection	E78 to E81
Vector control with/without speed sensor	F42
Brake signal (Brake-off torque)	J95

P05	Motor 1 (Auto-tuning)

When a long-time operation is executed by applying the dynamic torque vector control and slip compensation control, the motor constant changes as the motor temperature increases.

When the motor constant changes, the motor speed correction amount changes. As a result, the motor speed may deviate from the initial rotation number.

When the on-line tuning is validated, the motor constant that corresponds to the motor temperature change, and minimize the motor speed change.

When this function is used, execute the set value "2" of the auto tuning (P04).

Note The on-line tuning operates only when F42 = 1 (dynamic torque vector control) or when F42 = 2 (V/f control: with slip compensation), and when F37 = 2.5 (auto torque boost)is active.

P06 to P08	Motor 1 (No-Load Current, %R1, %X)

P06 to P08 set no-load current of the motor, %R1, and %X respectively. Obtain the appropriate values from the test report of the motor or by contacting the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

- No-load current: Enter the value obtained from the motor manufacturer.
- %R1: Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + Cable\ \ R1}{V\ /(\sqrt{3} \times I)} \times 100\ \ (\%)$$

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: Enter the value calculated by the following expression.

$$\%X = \frac{X1 + X2 \times XM/(X2 + XM) + Cable\ \ X}{V\ /(\sqrt{3} \times I)} \times 100\ (\%)$$

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 side 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 (Drive), Slip Compensation Response Time, and Slip Compensation Gain (Brake))

P09 and P11 adjust the correction amount and internal calculation slip amount applied in case of the slip compensation. Settings are necessary both for drive mode and brake mode respectively. Specification of 100% fully compensates for the rated slip of the motor. Excessive compensation (100% or higher) may cause hunting, so carefully check the operation on the actual machine.

Constants for the Fuji vector control and for exclusive motor, the slip of the drive/brake mode is adjusted by P09/P11 in order to improve the torque accuracy.

P10 determines the response for slip compensation. Basically, there is no need to modify the default setting. If you need to modify it, consult your Fuji Electric representatives.

Table 5.4-106

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 (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 (braking)
P10	Slip compensation response time	Sets the slip compensation response time. Basically, there is no need to modify the setting.

For details of slip compensation control, see the description of F42.

P12	Motor 1 (Rated slip frequency)

P12 sets rated slip frequency. Obtain the appropriate values from the test report of the motor or by contacting 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 and input.
(Note: The motor rating given on the nameplate sometimes shows a larger value.)

$$\text{Rated slip frequency (Hz)} = \frac{\text{Synchronous speed} - \text{Rated speed}}{\text{Synchronous speed}} \times \text{Base frequency}$$

For details about slip compensation control, see the description of F42.

P13 to P15	Motor 1 (Iron loss factors 1 to 3)

P13 to P15 compensates the iron loss occurred inside the motor under vector control with speed sensor, in order to improve the torque control accuracy.

For iron loss coefficients 1 to 3 (P13 to P15), standard values are set by the motor 1 select (P99) and motor 1 (capacity) (P02).

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)

Characteristics of exciting current to create magnetic flux generated motor inside and characteristics of the magnetic flux are input.
By the motor 1 selection (P99) and motor 1 (capacity) (P02), the standard value is set.
Performing auto-tuning while the motor is rotating (P04 = 2 or 3) specifies these factors automatically.

P53, P54 — Motor 1 (%X correction factors 1 and 2)

P53 and P54 specify the factors to correct fluctuations of leakage reactance (%X). There is no need to modify the setting.

P55 — Motor 1 (Torque current under vector control)

P55 sets the rated torque current under vector control with/without speed sensor.
By the motor 1 selection (P99) and motor 1 (capacity) (P02), the standard value is set.
Basically, there is no need to modify the setting.

P56 — Motor 1 (Induced voltage factor under vector control)

P56 sets the induced voltage factor under vector control with/without speed sensor.
By the motor 1 selection (P99) and motor 1 (capacity) (P02), the standard value is set.
Basically, there is no need to modify the setting.

P99 — Motor 1 Selection

P99 sets the motor type to be used.

Table 5.4-107

Data for P99	Function
0	Motor characteristics 0 (Fuji standard motors, 8-series)
1	Motor characteristics 1 (HP representative motors, representative model)
2	Motor characteristics 2 (Fuji motors exclusively designed for vector control)
3	Motor characteristics 3 (Fuji standard motors, 6-series)
4	Others

When executing automatic controls such as motor control method, auto torque boost, torque calculation monitor, etc., it is necessary to specify the motor parameter correctly.

First select the motor type with P99 from Fuji standard motors 8-series, 6-series, and Fuji motors exclusively designed for vector control. Next specify the motor capacity with P02, and then initialize the motor parameters with H03. This process automatically configures the necessary motor parameters (P01, P03, P06 through P23, P53 through P56, and H46).
The data of Torque boost (F09), Restart after Momentary Power Failure (Wait time) (H13), and Electronic thermal 1 for motor protection (operation level) (F11) depends on the motor capacity; however, these values do not change automatically. Change and adjust the data during a test run.

5.4.5 H codes (High performance functions)

H03	Data Initialization

Initialize function code data to the factory defaults. In addition, initialization of the motor parameter is executed.

To change the H03 data, it is necessary to press the "STOP key +∧/∨ keys" (simultaneous keying).

Table 5.4-108

Data for H03	Function
0	Manual setting value (no initialization executed)
1	Initial value (initializes all function code data to the factory defaults)
2	Initialize motor 1 parameters (according to motor 1 selection (P99) and motor capacity (P02)
3	Initialize motor 2 parameters (according to motor 2 selection (A39) and motor capacity (A16)
4	Initialize motor 3 parameters (according to motor 3 selection (b39) and motor capacity (b16)
5	Initialize motor 4 parameters (according to motor 4 selection (r39) and motor capacity (r16)

- To initialize the motor parameters, set the related function codes as follows.

Table 5.4-109

Step	Item	Contents	Function Code			
			1st motor (Default codes)	2nd motor	3rd motor	4th motor
(1)	Motor selection	Select the type of applying motor	P99	A39	b39	r39
(2)	Motor (capacity)	Set the capacity (kW) of the applying motor	P02	A16	b16	r16
(3)	Data initialization	Initialize motor parameters	H03 = 2	H03 = 3	H03 = 4	H03 = 5
Function code to be initialized		In "motor selection," when data = 0, 1, 3, and 4 is set	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
		In "motor selection," adding only when data = 2 is set	F04, F05	A02, A03	b02, b03	r02, r03

- Upon completion of the initialization, the function code H03 data reverts to "0" (factory default).

- If P02/A16/b16/r16 data is set to a value other than the standard motor capacity, data is automatically changed to the standard motor capacity (See Table 5.2-18 given on the last page of "5.2 Function Code Tables.").

- Motor parameters to be initialized are for motors listed below under V/f control. When a motor with a different base frequency, rated voltage, and number of poles is used, or when non-Fuji motors or motors with a different series are used, change the current to the one indicated on the motor nameplate.

Table 5.4-110

Motor selection		V/f setting
Data = 0, 4	Fuji standard motors, 8-series	4 poles 200 V/50 Hz, 400 V/50 Hz
Data = 2	Motors exclusively designed for Fuji 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 indication motors	4 poles 230 V/60 Hz, 460 V/60 Hz

Note When P02 is changed from the keypad, take note that P03, P06 through P23, P53 through P56, and H46 automatically change. Also, when A16, b16, or r16 for the 2nd to 4th motors are changed, take note that the related function codes are automatically changes.
When P02/A16/b16/r16 is changed from the communication, other function codes are not automatically re-written.

H04, H05	Retry (Times and Wait Time)

When the retry function is used, the protection function of the retry objective operates, and even when the inverter operation moves into the forcible stop status (tripped status), a bulk alarm is not output. Instead, trip status is automatically reset, and the operation resumes. If the protective function is activated in excess of the set retry times, a bulk alarm is output, and automatic reset operation does not starts.

Table 5.4-111 Protection function objective for retry

Protective function name	Alarm indication	Protective function name	Alarm indication
Overcurrent protection	OC1, OC2, OC3	Motor overheat	OH4
Overvoltage protection	OU1, OU2, OU3	Braking resistor overheat	dbH
Cooling fin overheat	OH1	Motor overload	OL1 to OL4
Inverter internal overheat	OH3	Inverter overload	OLU

■ Number of retry times (H04)

H04 sets the number of times to automatically reset the tripped state.

- Data set range: 0, 1 to 10 (times) (0: retry function disabled)

⚠CAUTION

If the retry function is selected, 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.

■ Retry wait time (H05)

- Data setting range: 0.5 to 20.0 (s)

H05 sets the time required until the trip state is automatically reset. See the following operation chart.

<Operation Chart>

- When a normal operation restarts in the 4th retry.

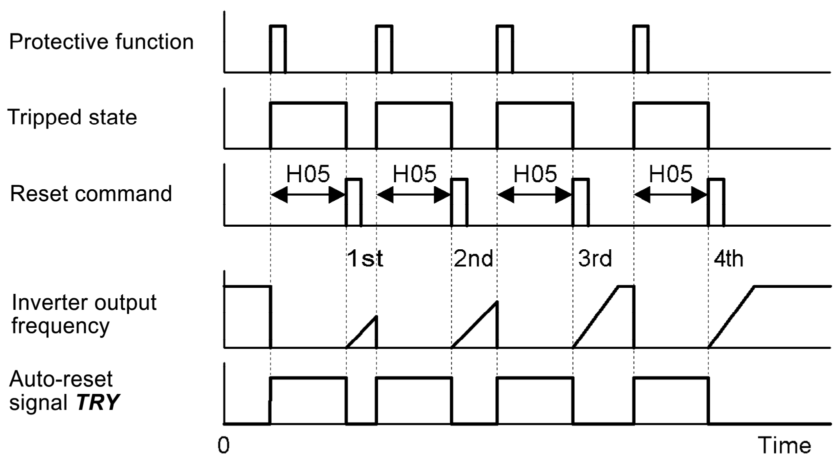


Fig. 5.4-80

- When the 3 retry times (H04 = 3) is exceeded and a bulk alarm is output.

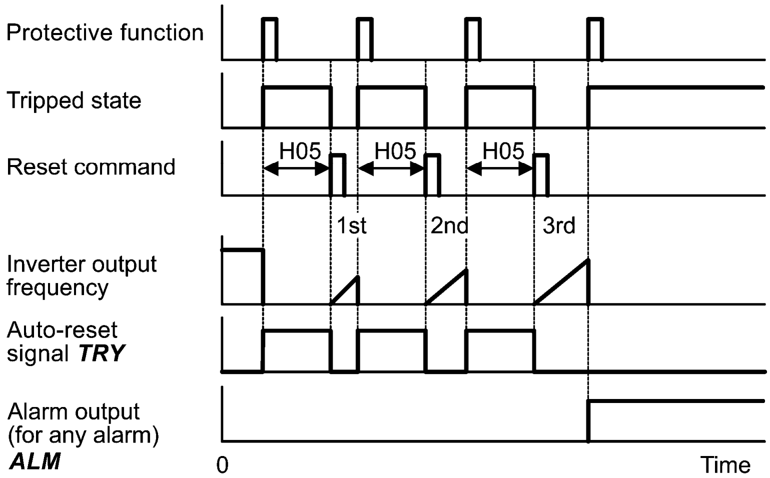


Fig. 5.4-81

- The retry function performance can be externally monitored via terminals [Y] to [Y4], [Y5A/C] or [30A/B/C]. Set the data of function codes E20 to E24 or E27 to [26] (during ***TRY*** retry).

Chapter 5 Function Code

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 sets whether to keep running the cooling fan all the time or to control its ON/OFF.

Table 5.4-112

Data for H06	Function
0	Disable (Always in operation)
1	Enable (cooling fan on/off control available)

Details of Function Codes
F codes
E codes
C codes
P codes
H04 to H07
A codes
b codes
r codes
J codes
d codes
U codes
y codes

■ Cooling fan ON-OFF control ***FAN*** (Function code E20 to E24, E27, data = 25)

With the cooling fan on/off control enabled (H06 = 1), on signal is output during the cooling fan operation, and off signal is output while the cooling fan is at stop. This signal can be used to make the cooling system of peripheral equipment interlocked for an on/off control.

H07	**Curve Accelerate and Decelerate Speed** (See F07)

For setting of the curve accelerate/decelerate speed, see the description of function code 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.

Table 5.4-113

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	**Start Characteristics (Auto Search Mode)** Related Function Code: H49 Start Characteristics (Auto Search Wait Time 1) H46 Start Characteristics (Auto Search Wait Time 2)

H09 sets 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. In addition, by assigning the starting characteristics selection ***STM*** to the general-purpose digital input signal, the starting characteristics can be switched. If ***STM*** is not assigned, the inverter interprets ***STM*** = off. (Data = 26)

■ Starting characteristics (auto search mode) (H09/d67) and Select starting characteristics ***STM***

Whether auto search is executed at the time of starting the operation can be selected by the starting characteristics H09/d67 and select starting characteristics ***STM*** signal.

Table 5.4-114

Function Code	Effective Mode	Default Setting
H09	V/f control (F42 = 0 to 2)	0: Auto search disable
d67	Vector control without speed sensor (F42 = 5)	2: Auto search enable

Table 5.4-115

H09/d67 Data	Select Starting Characteristics ***STM***	Starting Characteristics	
		For restart after momentary power failure (F14 = 3 to 5)	For normal startup
0: Disable	OFF	Auto search disable	Auto search disable
1: Enable	OFF	Auto search enable	Auto search disable
2: Enable	OFF	Auto search enable	Auto search enable
—	ON	Auto search enable	Auto search enable

When starting characteristics ***STM*** is assigned, auto search is enabled regardless of the H09/d67 setting. (📖 Function code E01 to E09, data = 26)

Auto search operation

During the starting up while the auto search is effective, the auto search is executed without stopping the idling monitor. Therefore, the speed at the startup is searched (Approx. max. 1.2 s). After completion of speed search, the speed accelerates to the set frequency according to the acceleration time setting.

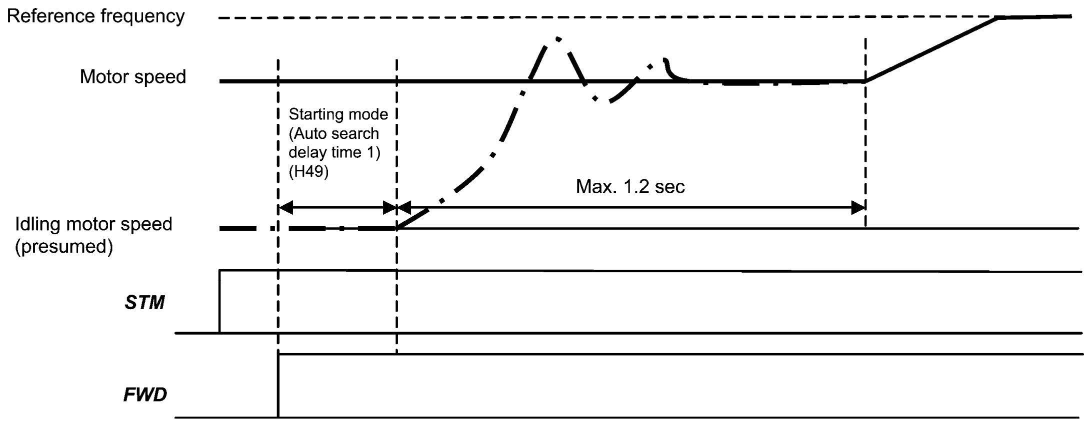


Fig. 5.4-82 Auto search operation

■ Starting characteristics (Auto search wait time 1) (H49)

- Data setting range: 0.0 to 10.0 (s)

Auto search 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.

At the startup triggered by a run command ON, auto search starts with the delay specified by the start characteristics (auto search wait time 1) (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 wait time 2) (H46)

- Data setting range: 0.1 to 10.0 (s) (ROM version earlier than 2000)
  0.1 to 20.0 (s) (ROM version 2000 or later)

At the restart after a momentary power failure, when turning on/off the coast to a stop command BX, and during execution of retry operation, secure the time necessary in the startup characteristics (auto search wait time 2) (H46). The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied. It starts up after the auto search wait time elapses.

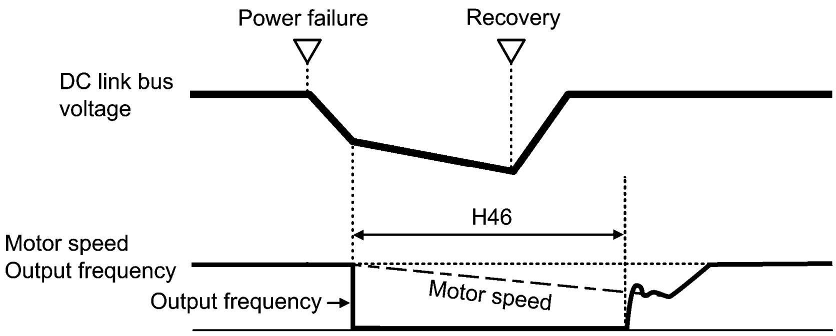


Fig. 5.4-83

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.

For the factory default of H46, proper values that match to general-purpose motors with different capacities are set. Basically, there is no need to modify the data.

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 double the factory default value allowing a margin.)

Note

- Be sure to execute the auto-tune before starting auto search.
- 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, run the retry operation (re-auto search operation).
- Perform auto search at 60 Hz or below.

Note Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.

H11 Deceleration Mode

H11 sets the deceleration mode to be applied when a run command is turned off.

Table 5.4-116

Data for H11	Enable
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 set frequency, the inverter decelerates the motor according to the deceleration commands even if H11 = 1 (Coast-to-stop) is set.

H12 Instantaneous Overcurrent Limiting (Operation selection) (See F43)

For instantaneous overcurrent limiting (operation selection), see the descriptions of function codes F43 and F44.

H13, H14 H15, H16 Restart Mode after Momentary Power Failure (Wait Time, Frequency Fall Rate), Restart Mode after Momentary Power Failure (Continuous Running Level and Allowable Momentary Power Failure Time) (See F14)

For how to set these function codes (Wait time, Frequency fall rate, Continuous running level and Allowable momentary power failure time), see the description of function code F14.

H18	**Torque Control (Operation Selection)** Related Function Code: d32, d33 Torque Control (Speed Limit 1,2)

When "vector control with/without speed sensor" is selected, the inverter can control the motor-generating torque according to a torque command sent from external sources.

■ Torque Control (Operation selection) (H18)

To enable the torque control, it is necessary to select the torque control by the function code H18. In addition, selection is possible whether the inverter is controlled by the torque current command or torque command.

Table 5.4-117

Data for H18	Available control
0	Disable (Speed control)
2	Operation (Torque Control: Torque current command)
3	Operation (torque control: Torque command)

■ Torque command

Torque commands can be given as analog voltage input (via terminals [12] and [V2]) or analog current input (via terminal [C1]), or via the communications link (communication dedicated function codes S02 and S03). To use analog voltage/current inputs, it is necessary to set E61 (for terminal [12]), E62 (for terminal [C1]), or E63 (for terminal [V2]) data to "10" or "11."

Table 5.4-118

Input	Command Form	Setting of Function Code	Specifications
Terminal [12] (-10 V to 10 V)	Torque command	E61 = 10	Motor rated torque ±200% / ±10 V
	Torque current command	E61 = 11	Motor rated torque current ±200% / ±10 V
Terminal [V2] (-10 V to 10 V)	Torque command	E63 = 10	Motor rated torque ±200% / ±10 V
	Torque current command	E63 = 11	Motor rated torque current ±200% / ±10 V
Terminal [C1] (4 to 20 mA)	Torque command	E62 = 10	Motor rated torque 200% / 20 mA
	Torque current command	E62 = 11	Motor rated torque current 200% / 20 mA
S02 (-327.68 to 327.67%)	Torque command	-	Motor rated torque / ±100.00%
S03 (-327.68 to 327.67%)	Torque current command	-	Motor rated torque current / ±100.00%

■ Polarity of Torque Commands

The polarity of a torque command switches according to the combination of the polarity of an external torque command and a run command on terminal [FWD] / [REV], as listed below.

Table 5.4-119

Polarity of torque command	Run command	Torque polarity
Positive	***FWD*** ON	Positive torque (Forward driving/Reverse braking)
	REV ON	Negative torque (Forward braking/Reverse driving)
Negative	***FWD*** ON	Negative torque (Forward braking/Reverse driving)
	REV ON	Positive torque (Forward driving/Reverse braking)

■ Cancel torque control signal - ***Hz/TRQ*** (Function Code E01 to E09, Data = 23)

When torque control is enabled (H18 = 2 or 3), switching between speed control and torque control is possible by setting data = 23 (torque control cancel) to the general-purpose digital input.

Table 5.4-120

Cancel torque control signal ***Hz/TRQ***	Operation
ON	Cancel torque control (Enable speed control)
OFF	Enable torque control

■ Torque control (Speed limit 1, 2) (d32, d33)

Torque control controls the motor-generating torque, not the speed. The speed is determined secondarily by torque of the load, inertia of the machinery, and other factors. To prevent a dangerous situation, therefore, the speed limit functions (d32 and d33) are provided inside the inverter.

Note There are cases that the motor unexpectedly starts rotating in high speed due to the regenerative load in droop control (which is not generated usually) or due to the incorrect setting of the function code. In order to protect the machinery, the overspeed level can be freely set.

- Forward overspeed level = Maximum output frequency (F03) x Speed limit 1 (d32) x 120 (%)
- Reverse overspeed level = Maximum output frequency (F03) x Speed limit 2 (d33) x 120 (%)

Note Running/stopping method

Under torque control, the inverter does not control the speed, so it does not perform acceleration or deceleration by soft-start and stop (acceleration/deceleration time) at the time of startup and stop. Turning on a run command starts the inverter to run and output the commanded torque. Turning off a run command stops the inverter so that the motor coasts to a stop.

At the start of torque control under the "Vector control without a sensor," the starting operation differs depending upon whether auto search is enabled or disabled by the function code d67 as shown below.

Table 5.4-121

Data for d67	Operation
0: Disable 1: Enable (Only at restart after momentary power failure)	At startup, the inverter starts from zero frequency. Then it accelerates according to a torque command. Select this operation for use in which the motor is surely stopped before startup.
2: Enable (At normal start and at restart after momentary power failure)	At startup, auto searches for idling motor are executed, and the torque control starts.

H26 and H27	Thermistor (for Motor) (Operation Selection and Level)

These function codes specify the PTC (Positive Temperature Coefficient)/NTC (Negative Temperature Coefficient) thermistor embedded in the motor. Set H26 and H27 for enabling the thermistor to protect the motor from overheating or output an alarm signal.

■ Thermistor (for motor) (Operation selection) (H26)

H26 selects the function operation mode (protection or alarm).

Table 5.4-122

Data for H26	Operation
0	Disable
1	When the voltage sensed by PTC thermistor exceeds the detection level, motor protective function (alarm 0H4) is triggered, causing the inverter to enter an alarm stop state.
2	When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. It is necessary to assign the thermistor detect (PTC) ***THM*** (Function code E20 to E24, E27 data = 56).
3	It is set when the NTC thermistor, which is integrated in the motor (VG motor) exclusively used for the Fuji vector control, is used. The motor temperature is detected, and it is used for control. If the motor overheats and the temperature exceeds the protection level, the inverter issues the Motor protection alarm 0H4 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 NTC thermistor is selected (H26 = 3) and any of the 2nd to 4th motors is selected, the inverter does not perform these functions.

■ Thermistor (operation level) (H27)

H27 sets the operation level of the PTC thermistor.

- Data setting range: 0.00 to 5.00 (V)

The protection temperature is determined according to the characteristics of the PTC thermistor. The internal resistance of the PTC thermistor will significantly change at the protection temperature. The detection level (voltage) is specified based on the change of the internal resistance.

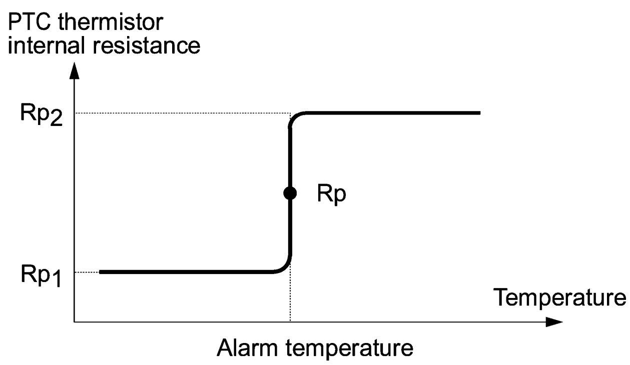


Fig. 5.4-84

Suppose that the resistance of the PTC thermistor at the alarm temperature is Rp, the detection level V_{v2} is calculated by the expression below. Set the calculation result to H27.

$$V_{V2} = \frac{Rp}{27000 + Rp} \times 10.5 \text{ (V)}$$

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 set detection level voltage (H27).

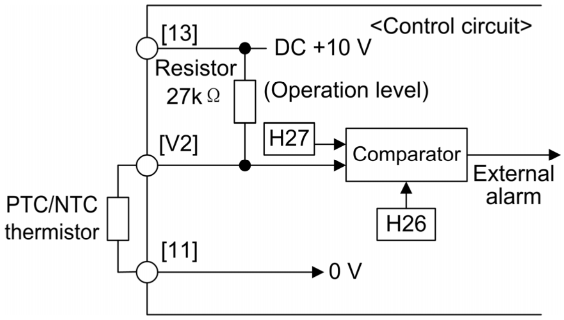


Fig. 5.4-85

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, see Chapter 12, "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. 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: Droop disabled)

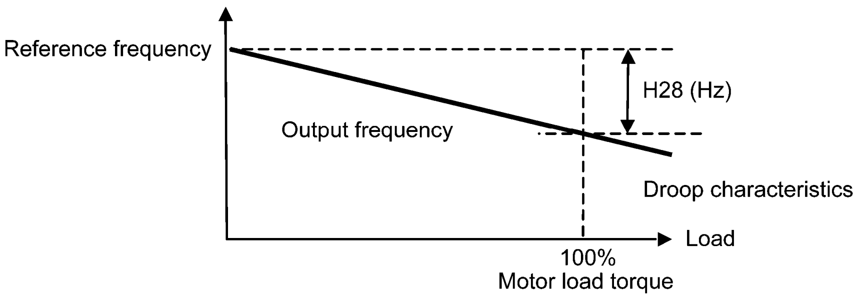


Fig. 5.4-86

■ Select droop ***DROOP*** (Function code E01 to E09, data = 76)

Switching between enable/disable of the droop control is possible.

Table 5.4-123

Input signal ***DROOP***	Droop control
ON	Valid
OFF	Invalid

Note: To use droop control, be sure to auto-tune the inverter for the motor.

Under V/f control, to prevent the inverter from tripping even at an abrupt change in load, droop control applies the acceleration/deceleration time to the frequency obtained as a result of droop control. This may delay reflection of the frequency compensated during droop control on the motor speed, thereby running the inverter as if droop control is disabled.

By contrast, under vector control with/without speed sensor, the current control system works so that the inverter does not trip even at an abrupt change in load. No acceleration/deceleration time is applied to the frequency obtained as a result of droop control. It is, therefore, possible to balance the load even during acceleration/deceleration by using droop control.

H30	**Link Function (Operation Selection)** Related Function Code: y98 Bus Function (Operation Selection)

From a computer or the PLC, data monitoring of the operation information and function code, setting of frequency command, and operation of the operation command are possible via RS-485 communications link and field bus (option). H30 and y98 set the methods to set frequency command and operation command. H30 is for the RS-485 communications link; y98 for the fieldbus.

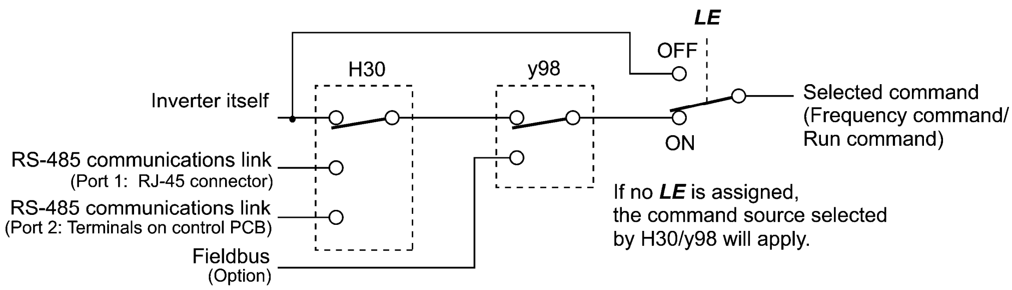


Fig. 5.4-87

Table5.4-124 Setting method type

Setting Method	Contents
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 terminal block set by F02
RS-485 communication port 1	Via the standard RJ-45 connector for keypad connection
RS-485 communication port 2	Via the terminal block (DX+, DX- and SD)
Fieldbus (option)	Via fieldbus (DeviceNet or PROFIBUS DP)

Table 5.4-125 Content of H30 link function (Selection of set method)

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)

Table 5.4-126 Content of y98 bus function (operation selection) (Selection of set method)

Data for y98	Frequency Command	Run Command
0	Follow H30 data	Follow H30 data
1	Via fieldbus	Follow H30 data
2	Follow H30 data	Via fieldbus
3	Via fieldbus	Via fieldbus

Table 5.4-127 H30 and y98 settings by combination of each setting method

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="4">Frequency Command</th></tr>
<tr><th>Inverter itself</th><th>RS-485 communication Port 1</th><th>RS-485 communication Port 2</th><th>Fieldbus (option)</th></tr>
<tr><td rowspan="4">Run command</td><td>Inverter itself</td><td>H30 = 0
y98 = 0</td><td>H30 = 1
y98 = 0</td><td>H30 = 4
y98 = 0</td><td>H30 = 0 (1, 4)
y98 = 1</td></tr>
<tr><td>RS-485
communication port 1</td><td>H30 = 2
y98 = 0</td><td>H30 = 3
y98 = 0</td><td>H30 = 5
y98 = 0</td><td>H30 = 2 (3, 5)
y98 = 1</td></tr>
<tr><td>RS-485
communication port 2</td><td>H30 = 6
y98 = 0</td><td>H30 = 7
y98 = 0</td><td>H30 = 8
y98 = 0</td><td>H30 = 6 (7, 8)
y98 = 1</td></tr>
<tr><td>Fieldbus
(option)</td><td>H30 = 0 (2, 6)
y98 = 2</td><td>H30 = 1 (3, 7)
y98 = 2</td><td>H30 = 4 (5, 8)
y98 = 2</td><td>H30 = 0 (1 to 8)
y98 = 3</td></tr>
</table>

📖 For details, see the RS-485 Communication User's Manual or the Field Bus (option) Instruction Manual.

- When ***LE*** is assigned to the digital input terminal, turning ***LE*** on sets the function codes H30 and y98 settings enabled, and turning ***LE*** off sets disabled. (When disabled, the mode becomes both frequency command and operation command become the mode that are sent from the inverter body (terminal block, etc.)
  (Function code E01 through E09, Data = 24.)
  When ***LE*** is not assigned, it is same as when ***LE*** is on.

H42, H43, H48	**Main Circuit Capacitor Measurement Value, Cooling Fan Cumulative Run Time Printed Circuit Board Capacitor Cumulative Run Time** Related Function Code: H47 (Initial Capacitance of DC Link Bus Capacitor) H98 (Protection/Maintenance Function)

■ **Life Prediction Function**

The inverter has the life prediction function for the parts with lifetime. The lifetime prediction information can be checked on the LED monitor. (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.

Table 5.4-128

Objective Parts	Life Prediction Method	End-of-life Criteria	Prediction Timing	LED Monitor Display
Main circuit capacitor	<u>Main circuit capacitor capacity calculation</u> Measures the discharging time of the main circuit capacitor during shut-down of the main power and calculates the capacitance.	End of life is judged when the capacitance is 85% or lower compared to the initial capacitance at shipment (See "[1] Measuring the capacitance of main circuit capacitor in comparison with initial one at shipment" on the next page.)	At periodic inspection (H98: Bit 3 = 0)	5_05 (Capacitance)
		End of lifetime is judged when the capacitance is 85% or lower when compared with the capacitance of the main circuit capacitor under user's standard operation conditions (necessary to measure at the time of start-up). (See "[2] Measuring method of the capacitance of the main circuit capacitor at the power shut-down under standard operating status" on page 5-195.)	During ordinary operation H98: Bit 3 = 1	5_05 (Capacitance)
	<u>Voltage-applied time count to the main circuit capacitor</u> Counts the time that the voltage is applied to the main circuit capacitor (main power on time). In addition, the time can be corrected by the capacitance of measurement of main circuit capacitor.	End of lifetime is judged when the operating time exceeds 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	It counts the period when the voltage is applied to the electrolytic capacitors on the printed circuit boards. In addition, the elapsing time can be corrected with the surrounding temperature.	End of lifetime is judged when the operating time exceeds 87,600 hours (10 years)	During ordinary operation	5_06 (Operation time)
Cooling fans	Counts the run time of the cooling fans.	End of lifetime is judged when the operating time exceeds 87,600 hours (10 years)	During ordinary operation	5_07 (Operation time)

■ **Capacitance Measurement of the Main Circuit Capacitor (H42)**

<u>Calculating the Capacitance of the Main Circuit Capacitor</u>

- The discharging time of the main circuit 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 limited for stabilization of the load only. Therefore, actual operating conditions are usually different, and measurement of discharge time is not automatically executed at the time of power shut-off. In this case, execute the measurement in the periodical inspection by applying the capacitance measurement condition of the capacitor at the shipment. See "[1] Method to compare the default value and current value of the capacitance of the main circuit capacitor" given below.

- To measure the capacitance of the main circuit capacitor under ordinary operating conditions when the power is turned off, it is necessary to set up the load conditions at the power down and measure the capacitance (initial setting) when the inverter is introduced. See "[2] Measuring method of the capacitance of the main circuit capacitor at the power shut-down under standard operating status" on the next page.

  However, when the setting is executed as shown above, setting bit = 3 for H98 can return the setting that is to compare with the capacity of the capacitor at the factory default value.

  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 by setting bit4 = 0 in the function code H98 in order to prevent unintended measuring. (For details, see H98.)

ON-time Counting of Main Circuit Capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. Therefore, the function that judges service life by counting the time, when the voltage is applied to the main circuit capacitor (main power on time), is also operated. If the capacitance measurement of the main circuit capacitor is executed, elapsed time is calculated by the capacitance deceasing rate, and the main power on time is corrected. Two indication types are provided, which are "elapsed time" and "remaining time before the end of service life."

[1] Method to compare the default value and current value of the capacitance of the main circuit capacitor

When bit 3 of H98 data is 0, the measuring procedure given below measures the capacitance of main circuit 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 from the inverter, if the card is used.
   - 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 power 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 ([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/C], [30A/B/C]) will not be turned ON.

   - Disable the RS-485 communications link of the inverter.

   Note: If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. In that case, change the settings.

- Keep the surrounding temperature at 25°C±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 main circuit 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 the LED monitor indication turns off, the power is turned on again.
7) Move to the program mode menu No. 5 "Maintenance information" and check the electrostatic capacitance ratio (%) of the main circuit capacitor.

----

[2] Measuring method of the capacitance of the main circuit capacitor at the power shut-down under standard operating status

When bit 3 of H98 data is 1, the inverter automatically measures the capacitance of the main circuit capacitor under ordinary operating conditions when the power is turned off. To execute this measurement, it is necessary to measure the reference capacitance of the capacitor in the following setting procedure.

Table 5.4-129

Function Code	Name	Contents
H42	Capacitance of main circuit capacitor	- Measured value when the capacitance of the main circuit capacitor is measured - Start of initial value measurement mode under standard operation (0000) - Measurement failure (0001)
H47	Initial value of main circuit capacitor	- Initial value of main circuit capacitor - Start of initial value measurement mode under standard operation (0000) - Measurement failure (0001)

When replacing parts, clear or modify the H42 and H47 data. For details, see the maintenance related documents.

-- Reference capacitance setup procedure --

1) Change the function code H98 (Criteria for end of service life of main circuit capacitor) to the user measurement standard (bit 3 = 1).
2) Turn the inverter to the stop state.
3) Make the inverter to the power shut-off status under the standard operation status.
4) Set both function codes H42 (measurement value of the main circuit capacitor) and H47 (initial value of the main circuit capacitor) to "0000."
5) Turn off the inverter power supply (the following operations are automatically executed when the power is turned off).
   The inverter measures the discharging time of the main circuit capacitor and saves the result in function code H47 (initial capacitance of main circuit 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 function code H42 (capacitance of main circuit capacitor) and H47 (initial capacitance of main circuit capacitor) hold right values. Shift to Menu #5 of the program mode "Maintenance Information" and confirm that the electrostatic capacitance ratio (%) of the main circuit capacitor is 100%.

Note: If the measurement has failed, "0001" is set to both function codes H42 (capacitance of main circuit capacitor) and H47 (initial capacitance of main circuit capacitor). 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 main circuit capacitor if the above conditions are met. Periodically shift to the program mode menu #5 "Maintenance Information" and check the electrostatic capacitance ratio (%) of the main circuit capacitor.

Note: The condition given above tends to produce a rather large measurement error. When the service life is predicted in this mode, the main circuit capacitor service life judgment criteria is returned to the factory default, measure again according to the conditions for shipping from the factory.

■ Cumulative Run Time of Electrolytic Capacitors on Printed Circuit Boards (H48)

Table 5.4-130

Function Code	Name	Contents
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, see the maintenance related documents.

■ Cumulative Run Time of Cooling Fan (H43)

Table 5.4-131

Function Code	Name	Contents
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, see 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 start-up count on the maintenance screen of the keypad and use the number as a guide for maintenance timing for parts such as belts. To start the counting over again, e.g. after a belt replacement, set "0000."

H45	**Mock Alarm** Related Function Code: H97 Clear Alarm Data

During the setup, a mock alarm can be generated in order to check the external sequence. Setting the H45 data to "1" displays mock alarm Err. It also issues a bulk alarm ***ALM*** (if ***ALM*** is assigned to a general-purpose digital output terminal E20 to E24 and E27).

To change the H45 data, it is necessary to press the "STOP key + ∧ key" (simultaneous keying). 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.

After completion of the setup, when deleting the mock alarm data, use H97 as when deleting alarm data occurred during operations. (Changing 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 Characteristics (Auto Search Wait Time 2)** (See H09)

For details of the starting characteristics (auto search wait time 2), see the section of the function code H09.

H47, H48	**Main Circuit Capacitor Initial Value, Cumulative Run Time of Capacitors on Printed Circuit Boards** (See H42)

For details of initial capacitance of main circuit capacitor and cumulative run time of capacitor on the printed board, see the section of the function code H42.

H49	**Starting Characteristics (Auto Search Wait Time 1)** (See H09)

For details of starting characteristics (auto search wait time 1), see the section of the function code H09.

H50, H51 H52, H53	**Non-linear V/f1 (Frequency, Voltage)** (See F04) **Non-linear V/f2 (Frequency, Voltage)**

For details of non-linear V/f pattern setting, see the section of the function code F04.

H54, H55 H56 H57 to H60	**Acceleration/Deceleration Speed Time (Jogging)** (See F07) **Forcible Stop Deceleration Time** **Acceleration/Deceleration Time 1st to 2nd S-curve Range**

For details of acceleration/deceleration time (jogging), forcible stop deceleration time, 1st and 2nd S-curve in acceleration/deceleration, see the section of the function code F07.

H61	**UP/DOWN Control, Initial Value Selection** (See F01)

For details of UP/DOWN control, initial value selection, see the section of the function code F01.

H63 — Low Limiter (Operation Selection) (See F15)

For the lower limiter (operation selection) setting, see the section describing the function code F15.

H64 — Low Limiter (Lower Limiting Frequency)

H64 sets 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. Basically, there is no need to modify the default setting.

- Data setting range: 0.0 to 60.0 (Hz)

H65, H66 — Non-linear V/f3 (Frequency and Voltage) (See F04)

For setting of non-linear V/f pattern, details, see the description of function code F04.

H67 — Auto Energy Saving Operation (Mode Selection) (See F37)

For setting of auto energy saving operation (mode select), see the description of function code F37.

H68 — Slip Compensation 1 (Operating Conditions Selection) (See F42)

For the setting of slip compensation 1 (operation condition selection), see the section describing the function code F42.

H69 — Anti-regenerative Control (Operation Selection)

Related Function Code: H76 Torque Limiter (Brake) (Increasing Frequency Limiter)

H76 is set when enabling the anti-regeneration control. In the inverter not equipped with an anti-regeneration function (PWM converter or braking unit), if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs.

When anti-regeneration control is selected, the output frequency is controlled, anti-regeneration energy is kept low, and overvoltage trip is avoided.

Table 5.4-132

Data for H69	Function	
	Control Method	Force-to-stop with actual deceleration time exceeding three times the specified one
0	Disables anti-regenerative control	-
2	Torque limit	Valid
3	DC link bus voltage control	Valid
4	Torque limit	Invalid
5	DC link bus voltage control	Invalid

The 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.

Table 5.4-133

Control Method	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 (braking) (increasing frequency limiter) (H76)

- Data setting range: 0.0 to 500.0 (Hz)

In the torque limit method, the output frequency is increased, and the torque is limited. The increasing frequency limiter (H76) is provided because the output frequency, which is too high, is dangerous. Due to this limiter, the output frequency does not increase to "set frequency + H76" or higher. Note that the torque limiter activated restrains anti-regenerative control, resulting in an overvoltage trip in some cases. Increasing the H76 data improves the anti-regenerative control capability.

In addition, when the operation command is turned off, the frequency increases due to anti-regenerative control and may not stop according to the load status. For safety measure, H69 provides a choice of cancellation of anti-regenerative control to apply when three times the specified deceleration time is elapsed, thus decelerating the motor forcibly. Selection of valid/invalid of the function is possible by the H69 setting.

Note
- Due to anti-regenerative control, there are cases that the deceleration time automatically become long.
- When a braking unit is connected, disable anti-regenerative control. 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 sets the decelerating rate of the output frequency in overload prevention control. 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 OH1 or OLU , 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.

Table 5.4-134

Data for H70	Function
0.00	Follow the deceleration time set in F08 or E11.
0.01 to 100.0	Decelerate by deceleration rate from 0.01 to 100.0 (Hz/s)
999	Disable overload prevention control

■ Overload prevention control ***OLP*** (Function code E20 to E24, E27 data = 36)

This output signal comes on when overload prevention control ***OLP*** is activated and the output frequency changed.

Note Even when the output frequency decreases, the effect cannot be expected with the equipment, where the load does not decrease. Do not use this function.

H71	Deceleration Characteristics

Set this function when validating the 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, and increases the deceleration torque.

Table 5.4-135

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. When anti-regenerative control (H69 = 2, 4) of the torque limit method is effective, the deceleration characteristics become invalid.

H72	Main Power Down Detection (Operation Selection)

H72 monitors the inverter alternate-current input power source, and disables the inverter operation if it is not established.

Table 5.4-136

Data for H72	Function
0	Main power down not detected
1	Main power down detected

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. Therefore, setting the data for H72 to "1" disables the inverter operation. In such cases, change H72 to "0."

Note If case of single-phase power supply, contact your Fuji Electric representative.

H73 to H75	Torque Limit (Operating Conditions Selection, Control Object, Objective Target Quadrants) (See F40)

For details about the operating conditions, see the description of function code F40.

H76	Torque Limit (Brake) (Increasing Frequency Limiter) (See H69)

For setting of torque limit (braking) (increasing frequency limiter), see the description of H69.

H77	Service Life of Main Circuit Capacitor (Remaining time)

H77 displays the remaining time before the service life of main circuit capacitor expires in units of ten hours. At the time of a printed circuit board replacement, transfer the service life data of the main circuit capacitor to the new board.

- Data setting range: 0 to 8760 (in units of ten hours, 0 to 87,600 hours)

H78 H94	Maintenance Setting Time (M1) Motor Cumulative Run Time 1

H78 sets the maintenance interval (M1) (H78) in units of ten hours.
The maximum setting is 9999 x 10 hours in units of 10 hours.

- Data setting range: 0 (Disable) 1 to 9999 (in units of ten hours)

■ Maintenance timer ***MNT*** (Function code: E20 to E24 and E27, data = 84)

When Motor Cumulative Run Time 1 (H94) reaches the set maintenance set time (H78), the signal to start the maintenance ***MNT*** is output.

■ Motor Cumulative Run Time 1 (H94)

Operating the keypad can display the motor cumulative run time. This feature is useful for management and maintenance of the machinery. When the desired time is set to motor cumulative run time 1 (H94), the motor cumulative run time can be set to desired value. Rewriting to the initial data that is used as a target for the machine parts and inverter is possible. Specifying "0" clears the motor cumulative run time.

<Biannual maintenance>

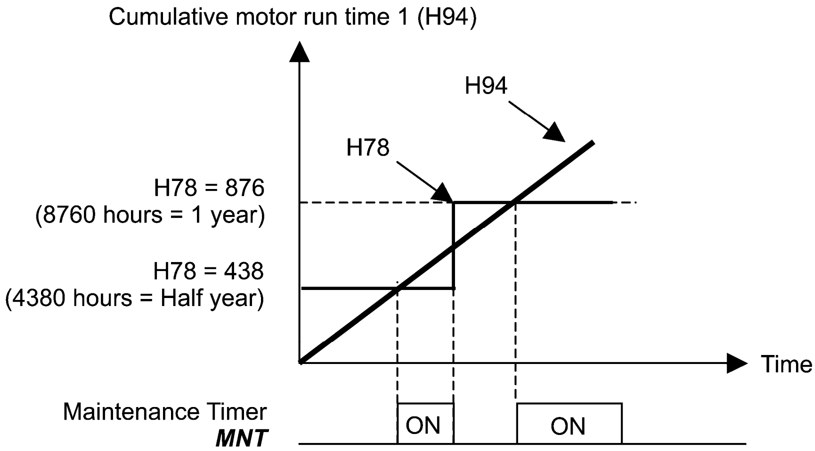


Fig. 5.4-88

Note: If the maintenance interval counter reaches the specified value, set a new value for the next maintenance in H78 and press the FUNC/DATA key to reset the output signal and restart counting.
This function is exclusively applied to the 1st motor.

■ Input during commercial running (motor 1 to 4) ***CRUN-M1*** to ***4*** (Function code E01 to E09 data = 72 to 75)

Even when a motor is driven by commercial power, not by the inverter, it is possible to count the motor cumulative 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 motor cumulative run time with 5_23 on "Maintenance Information" of the keypad.

H79	Maintenance Setting Start Count (M1) — Related Function Code: H44 Startup Count 1

H79 sets 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*** (Function code E20 to E24, E27 data = 84)

When the startup number 1 (H44) reaches the value set by the maintenance set startup count (H79), the maintenance call signal ***MNP*** is output.

< Maintenance every 1,000 times of startups >

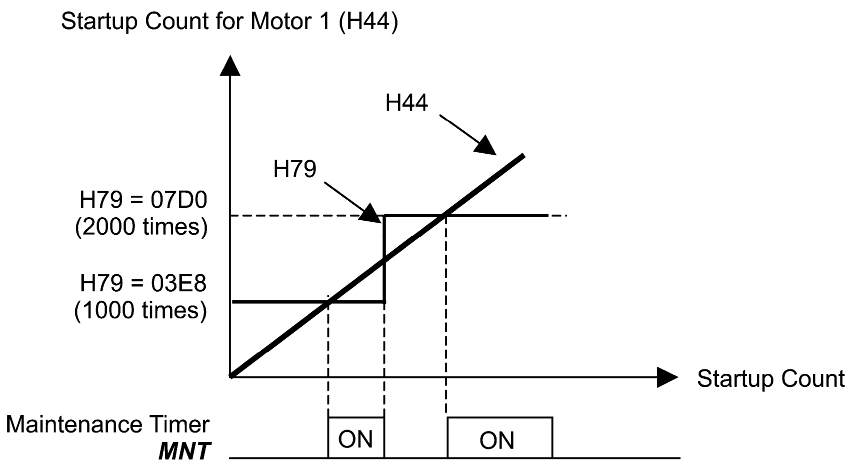


Fig. 5.4-89

Note: If the startup counter reaches the specified value, set a new value for the next maintenance in H79 again and press the FUNC/DATA key to reset the output signal and restart counting.
This function is exclusively applied to the 1st motor.

H80	Current Fluctuation Damping Gain 1

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 s (ROM version earlier than 2000)
  0.00 to 1.00 s (ROM version 2000 or later)

H81, H82 Light Alarm Selection 1 and 2

If the inverter detects a minor abnormal state, 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."

Table 5.4-137

Code	Name	Overview
OH1	Cooling fin overheat	Cooling fin temperature increased to the trip level.
OH2	External alarm	An error occurs in peripheral equipment, and external alarm ***THR*** signal turns 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 (detection)	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 communication error (Communication port 1, 2)	RS-485 communications error between the COM ports 1 and 2.
Er-E	Speed mismatch or excessive speed deviation	The deviation of the speed controller (speed command and detected speed) is out of the set range (d21) for a period longer than the set time (d22).
CoF	PID feedback wire break detection	The PID feedback signal wire is broken.
FAL	DC fan lock detection	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 alarm output
OH	Cooling fin overheat warning	Early warning before a cooling fin overheat trip
LiF	Lifetime warning	It was judged that the service life of either one of main circuit capacitor, electrolytic capacitor of printed board, 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.)
rEF	Command loss	Analog frequency command was broken.
PiD	PID alarm output	Warning related to PID control (absolute-value alarm or deviation alarm)
UTL	Low torque detection	Output torque drops below the low torque detection level for the specified period.
PTC	Thermistor detection (PTC)	The PTC thermistor on the motor detected a temperature.
rTE	Machinery life (Motor cumulative run time)	The motor cumulative run time reached the maintenance time set by the motor cumulative run time.
CnT	Machinery life (Number of startups)	Number of startups reached the specified level.
Ero	Positioning deviation over	When the second bit of H82 is set to 1, the excessive position deviation in simultaneous operation is set to an objective of light alarm. For details of the position deviation over, see the PG interface card instruction manual. Note: The excessive position deviation in the servo lock cannot be set to light alarm object.

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 (in Hex.)

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■ Selection Method of Light alarms object

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 5.4-138 and 5.4-139. Set the bit that corresponds to the desired light alarm factor to "1." Table 5.4-140 shows the relationship between each of the light alarm factor assignments and the LED monitor display.

Table 5.4-141 gives the conversion table from 4-bit binary to hexadecimal.

Table 5.4-138 H81 Light Alarm Selection 1, Bit Assignment of Selectable Factors

Bit	Code	Contents	Bit	Code	Contents
15	-	-	7	OL3	Motor 3 overload
14	-	-	6	OL2	Motor 2 overload
13	Er-P	RS-485 communications error (COM port 2)	5	OL1	Motor 1 overload
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	OL4	Motor 4 overload	0	OH1	Cooling fin overheat

Table 5.4-139 H82 Light Alarm Selection 2, Bit Assignment of Selectable Factors

Bit	Code	Contents	Bit	Code	Contents
15	-	-	7	LiF	service life warning
14	-	-	6	OH	Cooling fin overheat warning
13	CnT	Machinery life (Number of startups)	5	OL	Motor overload early warning
12	rTE	Inverter life (Cumulative motor run time)	4	FAL	DC fan lock detection
11	PTC	Thermistor detection (PTC)	3	CoF	PID feedback wire break detection
10	UTL	Low torque output	2	Ero	Positioning deviation over
9	PId	PID alarm	1	-	-
8	rEF	Command loss	0	Er-E	Speed mismatch or excessive speed deviation

Table 5.4-140 Display of Light Alarm Factor

(Ex.) H81 "RS-485 communication error (communication port 2)", "RS-485 communication error (communication port 1)", "Option communication error," "Motor 1 overload," "Cooling fin overheat" is selected

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	OL1	dbH	-	OH3	OH2	OH1
Example	Binary	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1
	Hexadecimal * See the following conversion table.	3				4				2				1			
	Hex. LED Monitor	LED4 LED3 LED2 LED1 3 4 2 1															

■ Hexadecimal conversion table

A 4-bit binary number can be expressed in hexadecimal format. The table below shows the conversion table.

Table 5.4-141 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 (thermistor (operation select)) data is set to "1" (PTC: 0H4 trips, and the inverter stops), the light alarm is not output, and the inverter stops regardless of the setting of bit 11 (thermistor detect (PTC)).

■ Assignment of light alarm ***L-ALM*** (Function code E20 to E24, E27 data = 98)

When a light alarm occurs, light alarm ***L-ALM*** turns on.

H84 and H85	Pre-excitation (Initial level, Time)

A motor generates torque with magnetic flux and torque current. The rise of magnetic flux has the delay element. Therefore, the torque does not happen sufficiently at the time of startup. To obtain enough torque even at the moment of motor start, enable the pre-excitation so that magnetic flux is established before a motor start.

■ Pre-excitation (Initial level) (H84)

H84 sets 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 sets the pre-excitation time before starting operation.

- Data setting range: 0.00 (Disable), 0.01 to 30.00 (s)

When a run command is input, the pre-excitation starts.

After the pre-excitation time elapses, 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.

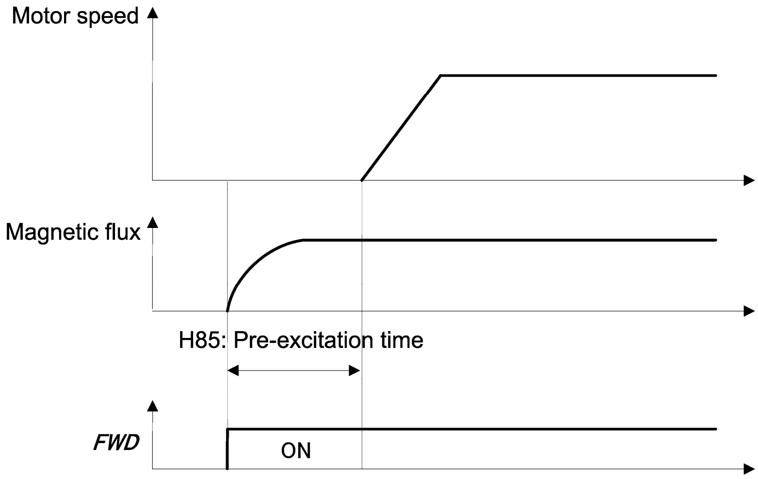

Fig. 5.4-90

■ Assignment of pre-excitation ***EXITE*** (Function code E01 to E09, data = 32)

Turning this input signal ***EXITE*** on starts pre-excitation. After the delay time for establishing magnetic flux has elapsed, a run command is inputted. Inputting the run command terminates pre-excitation and starts acceleration.

Use an external sequence to control the time for establishing magnetic flux.

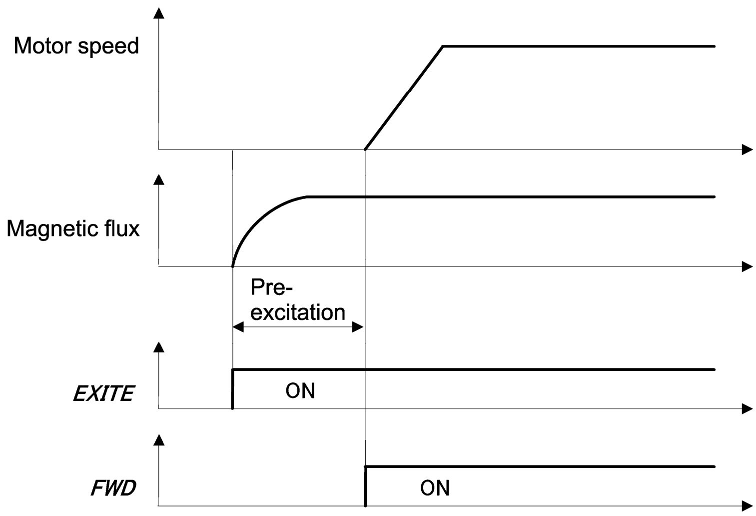

Fig. 5.4-91

Note: In V/f control (including auto torque boost and torque vector), pre-excitation function is not operable. Substitute by using DC brake and starting frequency continue.

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 stops due to pre-excitation, voltage is output to inverter's output terminals [U], [V], and [W]. **Electric shock may occur.**

H86 to H90	**Reserved for particular manufacturers**

H86 to H90 are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

H91	PID feedback wire break

Using the terminal [C1] (current input) for PID control feedback signal enables wire break detection and alarm (CoF alarm) issuance. Function code H91 sets 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 (CoF alarm) within the set time)

H92, H93	Operation Continuation (P, I) (See F14)

For setting of operation continuation (P, I), see the description of the function code F14.

H94	Motor Cumulative Run Time 1 (See H78)

For setting of motor cumulative run time 1, see the description of the function code H78.

H95	DC Braking (Characteristics Selection) (See F20 to F22)

For DC braking, see the descriptions of function codes F20 through F22.

H96	STOP Key Priority/Start Check Function

H96 sets a functional combination of "STOP key priority" and "Start check function" as listed below.

Table 5.4-142

Data for H96	STOP Key priority function	Start check function
0	Invalid	Invalid
1	Valid	Invalid
2	Invalid	Valid
3	Valid	Valid

■ STOP key priority function

Even when run commands are entered from the digital input terminals or via the RS-485 communications link (link operation), pressing the STOP key on the keypad forces the inverter to decelerate and stop the motor. After that, Er6 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 any operation command is on, the inverter does not start the operation but displays alarm code Er6 on the LED monitor.

- When the power is turned on.
- When the PRG/RESET key is pressed to release an alarm status or when the digital input alarm (abnormal) reset ***RST*** is input.
- When the link operation select ***LE*** of the digital input or local command select ***LOC*** is input, and when the operation command setting method is switched.

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H97	Alarm Data Clear — Related Function Code: H45 Mock Alarm

H97 clears alarm data (alarm history and relevant information) of the alarm output during machinery adjustment and returns to the status, where the alarm is not occurring.

To clear alarm data, simultaneous keying of "STOP key + ∧ key" is required.

Table 5.4-143

Data for H97	Function
0	Disable
1	Clear (Setting "1" clears alarm data and then returns to "0.")

H98	Protection/Maintenance Function (Operation Selection)

H98 sets whether to enable or disable automatic lowering of carrier frequency, input phase loss protection, output phase loss protection, judgment criteria of service life of main circuit capacitor, judgment on the life of main circuit capacitor, DC fan lock detection, braking transistor error detection, and IP20/IP40 switching, in combination.

Carrier frequency automatic lowering function (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 surrounding 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: Output Phase Loss) (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 criteria on the service life of main circuit capacitor (Bit 3)

Bit 3 is used to select the threshold for judging the life of the main circuit 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. (Function code H42)

Judgment on the life of main circuit capacitor (Bit 4)

Whether the main circuit 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 main circuit capacitor and the load inside the inverter. Therefore, when the load condition inside of the inverter fluctuate largely, correct measurement is not possible. In some conditions, end of lifetime is judged wrongly. To avoid such an error, you can disable the judgment based on the discharging time from the main circuit capacitor. (Even if it is disabled, the judgment based on the "ON-time counting" while the voltage is applied to the main circuit capacitor is continued.)

For details about the life prediction function, see 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 OH1 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 OH1, even if the internal air circulation DC fan is locked due to a failure etc. (When re-operated, the fan operation command is output, and ***LIFE*** or ***OH*** signals turns on, or OH1 alarm is output.)

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 (dbA 22 kW or below) (bit 6)

Upon detection of an integrated 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 (bit 7) (for basic type of inverters with a capacity of 22 kW or below)

In case of an inverter with 22 kW or lower, the protective structure can be switched from IP20 to IP40 as an option. However, in that case, it is necessary to switch to protective levels that match to IP40 in the protection level adjustment.

For details, see the instruction manual of the IP40 option.

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. See the assignment of each function to each bit and a conversion example below.

Table 5.4-144

Bit	Function	Data = 0	Data = 1	Factory default
Bit 0	Lower the carrier frequency automatically	Invalid	Valid	1: Enable
Bit 1	Input phase loss protection	Continue to run	Alarm processing	1: Alarm processing
Bit 2	Output phase loss protection	Continue to run	Alarm processing	0: Continue to run
Bit 3	Select service life criteria for main circuit capacitor	Factory default	User-defined setting	0: Factory default
Bit 4	Service life criteria of main circuit capacitor	Invalid	Valid	1: Enable
Bit 5	DC fan lock detection	Alarm processing	Continue to run	0: Alarm processing
Bit 6	Detect braking transistor error	Continue to run	Alarm processing	1: Alarm processing
Bit 7	Switch IP20/IP40 enclosure	IP20	IP40	0: IP20

Conversion between decimal/binary

Decimal = bit 7 x 2^7 + bit 6 x 2^6 + bit 5 x 2^5 + bit 4 x 2^4 + bit 3 x 2^3 + bit 2 x 2^2 + bit 1 x 2^1 + bit 0 x 2^0
= bit 7 x 128 + bit 6 x 64 + bit 5 x 32 + bit 4 x 16 + bit 3 x 8 + bit 2 x 4 + bit 1 x 2 + bit 0 x 1
= 0 x 128 + 1 x 64 + 0 x 32 + 1 x 16 + 0 x 8 + 0 x 4 + 1 x 2 + 1 x 1
= 64 + 16 + 2 + 1
= 83 (Ex. Factory default)

5.4.6 A code (Motor 2 parameter)
b code (Motor 3 parameter)
r code (Motor 4 parameter)

In FRENIC-MEGA, changing the control method during an operation is possible, which includes the operation of one inverter with switching operations between four motors, and on/off of energy-saving operations accompanied by switching stages by changing inertia moment of the machine by gear switching of one motor.

Table 5.4-145

Function Code	Type	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 the function codes of motor 2 to 4, see the function codes of corresponding motor 1 on Table 5.4-148 on the next page. However, function codes of motor/parameter switching 2 to 4 (A42/b42/r42) are excluded.

A42, b42 r42	Motor/Parameter Switching 2, 3, 4 (Operation Selection) Related Function Code: 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).

Table 5.4-146

Data for A42, b42 or r42	Function	Switching is possible:
0	Motor switching: Switch to the 2nd motor to 4th motor	Only when the inverter is stopped
1	Parameter switching: Switching of controlling function code data on the same motor such as turning on/off of the energy-saving operation and PI change in the speed control system	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.

Table 5.4-147

Input Signal			Selected Motor	Output Signal			
M2	***M3***	***M4***		***SWM1***	***SWM2***	***SWM3***	***SWM4***
OFF	OFF	OFF	1st motor	ON	OFF	OFF	OFF
ON	-	-	2nd motor (A code effective)	OFF	ON	OFF	OFF
OFF	ON	-	3rd motor (b code effective)	OFF	OFF	ON	OFF
OFF	OFF	ON	4th motor (r code effective)	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 the motor switching is set, the function codes in Table 5.4-148 are switched. Note that the function codes listed in Table 5.4-149 are unavailable when any of the 2nd to 4th motors are selected.

When the parameter switching is set, function codes with "○" marks, which are objective for parameter switching, switch. For other parameters, ones in the 1st motor column remain effective, and there is no function code that are cancelled in the 2nd to 4th motors.

Table 5.4-148 Function Codes to be Switched

Name	Function Code				Object of parameter switching
	1st motor	2nd motor	3rd motor	4th motor	
Maximum output frequency	F03	A01	b01	r01	
Base frequency	F04	A02	b02	r02	
Base frequency voltage	F05	A03	b03	r03	
Maximum output voltage	F06	A04	b04	r04	
Torque boost	F09	A05	b05	r05	
Electronic Thermal Motor Protect (Characteristics Selection)	F10	A06	b06	r06	
(Operation level)	F11	A07	b07	r07	
(Thermal Time Constant)	F12	A08	b08	r08	
DC brake -> (Start Frequency)	F20	A09	b09	r09	
(Operation level)	F21	A10	b10	r10	
(Time)	F22	A11	b11	r11	
Starting frequency	F23	A12	b12	r12	
Load selection/Auto torque boost /Auto energy saving operation	F37	A13	b13	r13	○
Select control method	F42	A14	b14	r14	
Motor constant (No. of poles)	P01	A15	b15	r15	
(Capacitance)	P02	A16	b16	r16	
(Rated current)	P03	A17	b17	r17	
(Auto-tuning)	P04	A18	b18	r18	
(Online tuning)	P05	A19	b19	r19	
(No-load current)	P06	A20	b20	r20	
(%R1)	P07	A21	b21	r21	
(%X)	P08	A22	b22	r22	
(Slip compensation gain [drive])	P09	A23	b23	r23	○
(Slip compensation response time)	P10	A24	b24	r24	○
(Slip compensation gain [brake])	P11	A25	b25	r25	○
(Rated slip)	P12	A26	b26	r26	
(Iron loss coefficient 1)	P13	A27	b27	r27	
(Iron loss coefficient 2)	P14	A28	b28	r28	
(Iron loss coefficient 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	
Motor selection	P99	A39	b39	r39	
Slip Compensation (Operating conditions selection)	H68	A40	b40	r40	○
Current Fluctuation Damping Gain	H80	A41	b41	r41	○
Speed control (Speed command filter)	d01	A43	b43	r43	○
(Speed detection filter)	d02	A44	b44	r44	○
P (Gain)	d03	A45	b45	r45	○

Name	Function Code				Object of parameter switching
	1st motor	2nd motor	3rd motor	4th motor	
I (Integral time)	d04	A46	b46	r46	○
(Feed forward gain)	d05	A47	d47	r47	○
(Output filter)	d06	A48	b48	r48	○
(Notch filter resonance frequency)	d07	A49	b49	r49	
(Notch filter attenuation level)	d08	A50	b50	r50	
Motor cumulative run time	H94	A51	b51	r51	
Startup count for motor	H44	A52	b52	r52	
Motor constant (%X correction factor 1)	P53	A53	b53	r53	
(%X correction factor 2)	P54	A54	b54	r54	
(Torque current for vector control)	P55	A55	b55	r55	
(Induced voltage factor for vector control)	P56	A56	b56	r56	
For manufacturers	d51	d52	d53	d54	
	P57	A57	b57	r57	

Table 5.4-149 Functions unavailable in the 2nd and further motors

Contents	Function codes	Operation in 2nd to 4th motors
Non-linear V/f pattern	H50 to H53, H65, H66	Disable
Starting frequency continuation time	F24	Disable
Stop frequency continuation time	F39	Disable
Motor overload early warning	E34 and E35	Disable
Droop control	H28	Disable
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	Disable
Dew condensation prevention	J21, F21, F22	Disable
Brake signal	J68 to J72, J95 and J96	Disable
Current limiter	F43 and F44	Disable
Rotational direction limitation	H08	Disable
Pre-excitation	H84 and H85	Disable
Maintenance Interval/Startup Count	H78 and H79	Disable
NTC thermistor	H26 and H27	Disable

■ ASR Switching Time (d25)

Parameter switching is possible even during operation. For example, speed control P (Gain) and I (Integral time) listed in Table 5.4-148 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).

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, PID control operates to eliminate the deviation. Namely, the closed loop control method is taken, which matches the control amount (feedback amount) to the target value.

Process controls such as flow control, pressure control, temperature control, and the speed control such as dancer control are possible.

If PID control is enabled (J01 = 1, 2 or 3), the frequency setting block changes to the PID control block.

■ Mode Selection (J01)

J01 selects the PID control operation and the control block.

Data for J01	Function
0	Disable
1	Process control (normal operation)
2	Process control (inverse operation)
3	Speed control (Dancer)

<PID process control outline block diagram>

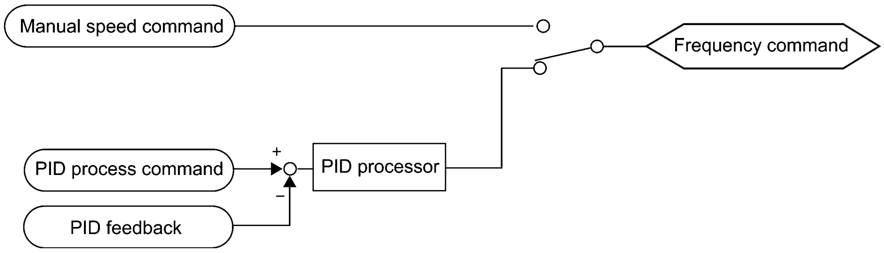


Fig. 5.4-92

<PID dancer control outline block diagram>

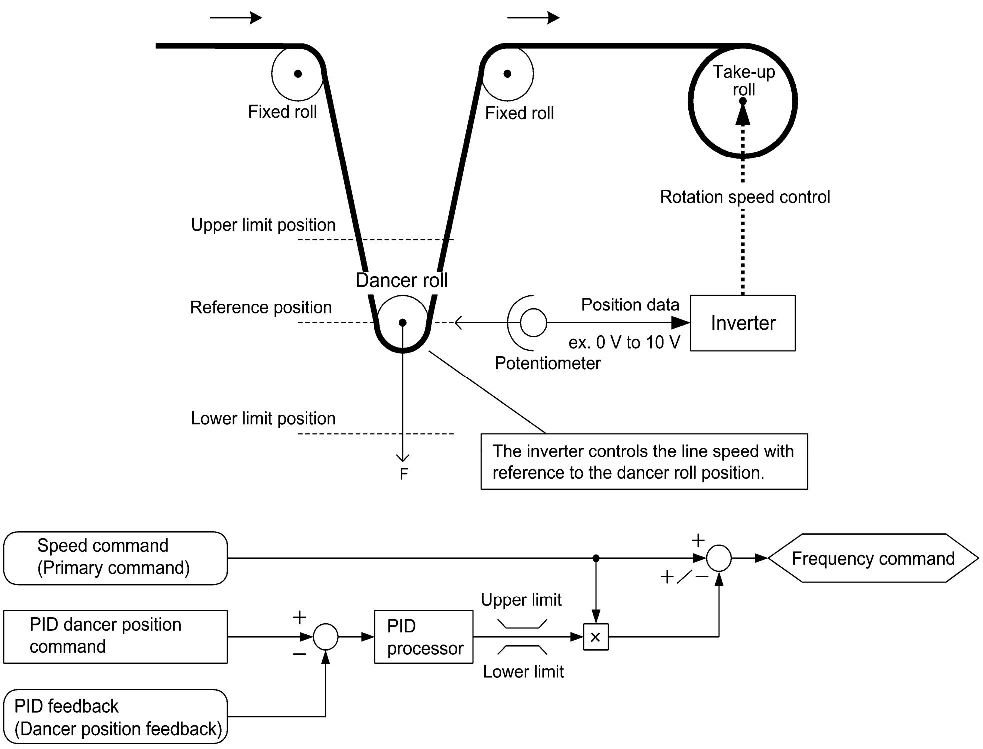


Fig. 5.4-93

- 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 external signal ***IVS*** can also switch operation between normal and inverse.

For details about the switching of normal/inverse operation, see the description of the function codes E01 to E09, switching normal/inverse operation ***IVS*** (data = 21).

J02 PID Control (Remote Command)

J02 selects the source that sets the command value of PID control.

Table 5.4-150

Data for J02	Function
0	PID command by keypad PID command by using the ∧/∨ key on the keypad.
1	PID command 1 (Analog input: Terminals [12], [C1] and [V2]) Setting by voltage to be input to terminal [12] (DC0 to ±10 V, PID100% command/DC±10 V) Setting by current to be input to terminal [C1] (DC4 to 20 mA, PID100% command/DC20 mA) Setting by voltage to be input to terminal [V2] (DC0 to ±10 V, PID100% command/DC±10 V)
3	PID command by UP/DOWN Command Using the ***UP*** or ***DOWN*** command in conjunction with PID display coefficients (E40, E41) with which the command value is converted into a physical quantity, etc., you can specify 0 to 100% of the PID command.
4	Command via communications link Function code (S13) for communication: Send data 20000d/100% PID command

[1] PID command 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, see Chapter 3, "3.3.3 Setting up frequency and PID commands."

[2] PID command 1 by analog inputs (J02 = 1)

Multiply gain to the PID command values of analog input (voltage to be input to terminal [12] and [V2], current value to be input to terminal [C1]), and add bias. Then, setting of PID command value freely become possible. The polarity can be selected, and the filter 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 function codes E61 to E63). For details, see the descriptions of function codes E61 through E63.

Adjustable elements of PID command

Table 5.4-151

Input terminal	Input range	Bias		Gain		Polarity Selection	Filter	Offset
		Bias	Base point	Gain	Base point			
[12]	0 to +10 V, -10 to +10 V	C51	C52	C32	C34	C35	C33	C31
[C1]	4 to 20 mA	C51	C52	C37	C39	-	C38	C36
[V2]	0 to +10 V, -10 to +10 V	C51	C52	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

Offset can be set to the analog input voltage and current. The offset also applies to signals sent from the external equipment.

■ Filter (C33, C38, C43)

Filter time constant can be set to analog input voltage/current. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity selection (C35, C45)

Input range of analog input voltage can be set.

Table 5.4-152

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

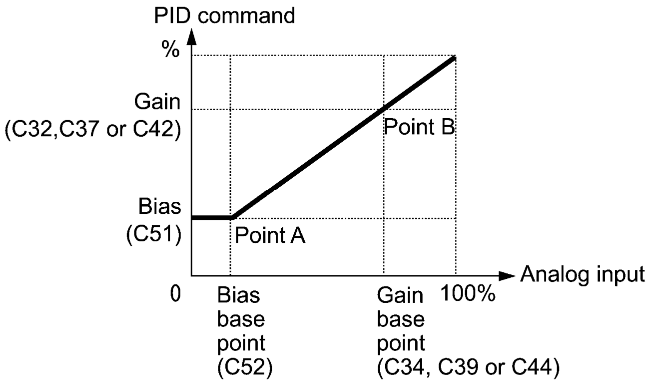


Fig. 5.4-94

(Example) Mapping the range of 1 through 5 V at terminal [12] to 0 through 100%

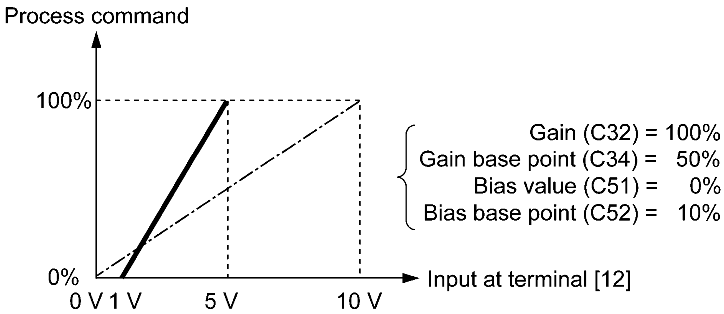


Fig. 5.4-95

[3] PID command with UP/DOWN control (J02 = 3)

When UP/DOWN control is selected as a PID control command, turning the terminal command ***UP*** or ***DOWN*** ON causes the PID control command to change within the range from 0 to 100%.

By using the PID display coefficients, setting is possible with the physical quantities units.

To set UP/DOWN control as a PID command, the ***UP*** and ***DOWN*** should be assigned to the digital input terminals. (Function code E01 to E09, data = 17, 18)

Table 5.4-153

UP	***DOWN***	Enable
Data = 17	Data = 18	
OFF	OFF	Retain command value of current PID control.
ON	OFF	Increase PID control command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
OFF	ON	Decrease PID control command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
ON	ON	Retain current PID speed command value.

Note The inverter internally holds the PID command value set by UP/DOWN control and applies the held value at the next restart (including powering ON).

[4] PID command via communication (J02 = 4)

Function code (S13) for communication: send data 20000 d/100% PID command For details of the communications format, see the RS-485 Communication User's Manual.

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 following expression.

$$\text{PID command data (\%)} = \frac{\text{Preset multi frequency}}{\text{Maximum frequency}} \times 100$$

- In dancer control (J01 = 3), the setting from the keypad interlocks with the function code J57 PID control (dancer basic position) and saved as the function code data.

Chapter 5 Function Code

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 the terminal [V2].

For details, see E61, E62, and E63.

<Application example: Process control> Major application: 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 setting.

(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) at 200% in order to make the maximum value (5 V) of the external sensor's output corresponds to 100%. The input specification of terminal [12] is 0 to 10 V for 0 to 100%. Therefore, due to the ratio of 10 V/5 V, the specification becomes 200% setting. (The bias setting of the feedback is invalid.)

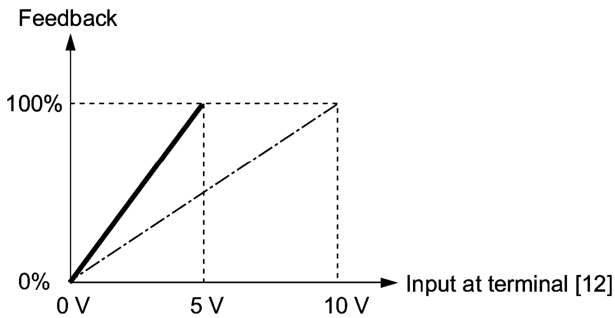


Fig. 5.4-96

<Application examples: Dancer control> Major application: Winding system

(Example 1) When the output level of the external sensor is ±7 V

- Use terminal [12] designed for voltage input to both polarities.
- When the external sensor's output is of bipolar, the inverter controls the speed within the range of 100%. The external sensor ±7 V is set to ±100%; therefore, the gain setting (C32) is set to

$$\frac{10\text{ V}}{7\text{ V}} \approx 143\%.$$

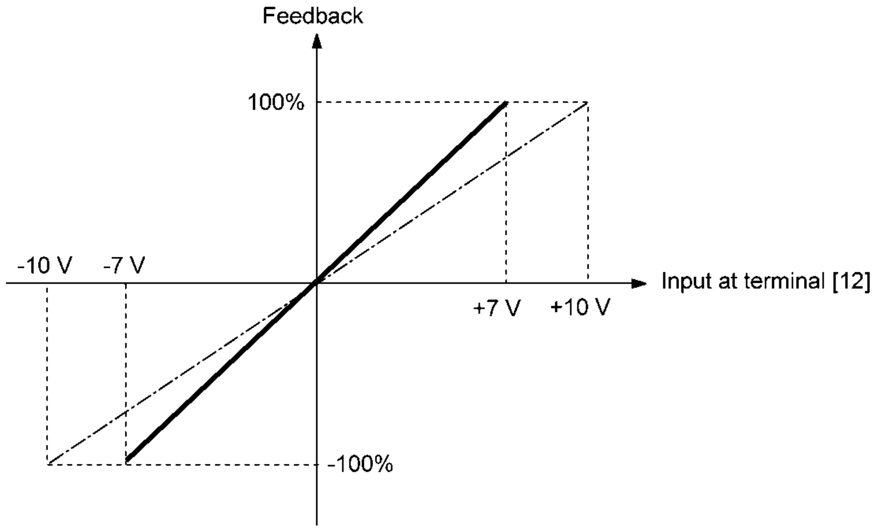


Fig. 5.4-97

(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%.

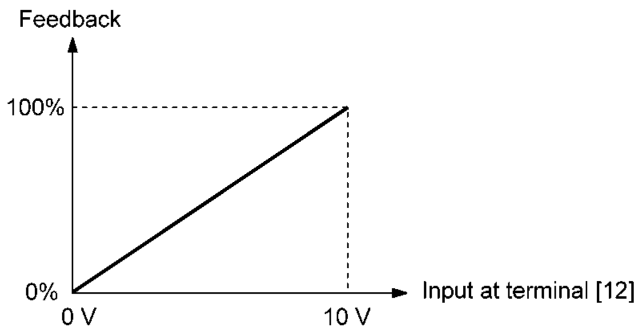


Fig. 5.4-98

In this example, it is recommended that the dancer base position be set around the 5 V (50%).

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).

See 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)

P gain sets the PID controller.

- Data setting range: 0.000 to 30.000 (multiplication)

P (Proportional) action (Proportional operation)

When the operation amount (output frequency) and the deviation are in a proportional relationship, that is called a P action. P action outputs the operation amount that is proportional to the deviation. However, the P action 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.

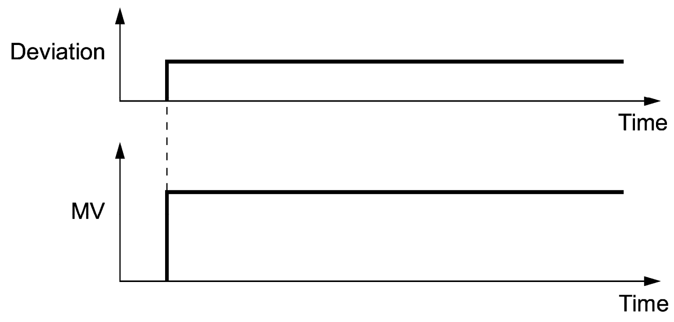


Fig. 5.4-99

■ I integral time (J04)

J04 specifies the integral time for the PID controller.

- Data setting range: 0.0 to 3600.0 (sec)
  0.0 means that the integral component is ineffective.

I (Integral) action (Integral operation)

When the operation amount (output frequency) change speed is proportional to the integral value of deviation, that is called an I action. In I action, the operation amount that the deviation is integrated is output. Therefore, I action is effective in bringing the feedback amount close to the commanded value. However, for the system whose deviation rapidly changes, this action cannot react quickly.

The effectiveness of I action is expressed by integral time as parameter. 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.

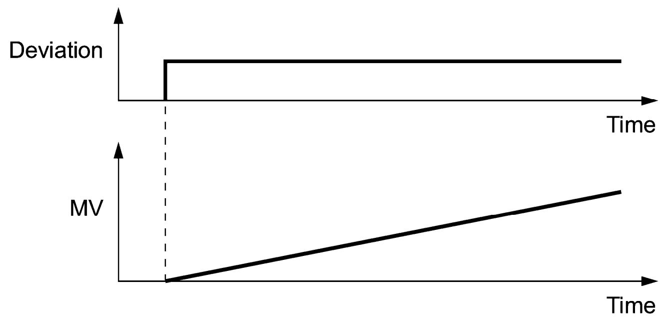


Fig. 5.4-100

■ D differential time (J05)

J05 specifies the differential time for the PID controller.

- Data setting range: 0.00 to 600.00 (sec)
  0.00 means that the integral component is ineffective.

D (Differential) action (Differential operation)

When the operation amount (output frequency) is proportional to the differential value of deviation, that is called the D action. 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. 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.

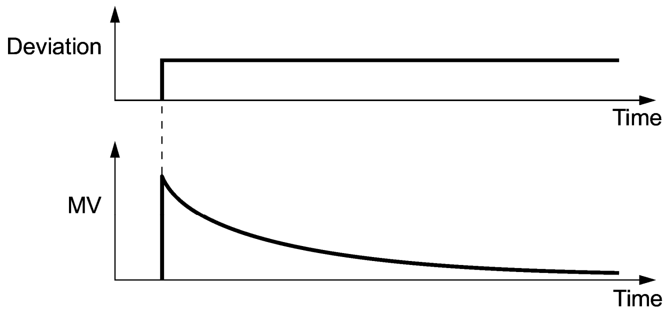


Fig. 5.4-101

The combined control 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 executing only 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 of I action, 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, when a deviation occurs, the operation amount that is larger than the operation amount of only D operation suddenly occurs, and increase of the deviation can be kept low. 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 case, PD control is used to reduce the oscillation caused by P action, for keeping the system stable. Therefore, 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 set value.

- Increase the data of J03 for PID control (Gain) within the range where the feedback signal does not oscillate.
- Decrease the data of J04 for PID control (Integral time) within the range where the feedback signal does not oscillate.
- Increase the data of J05 for PID control (Differential time) within the range where the feedback signal does not oscillate.

Adjustment method of the response waveforms are as follows.

1) When controlling the overshoot

Increase the data of J04 for integral time and decrease that of J05 differential time.

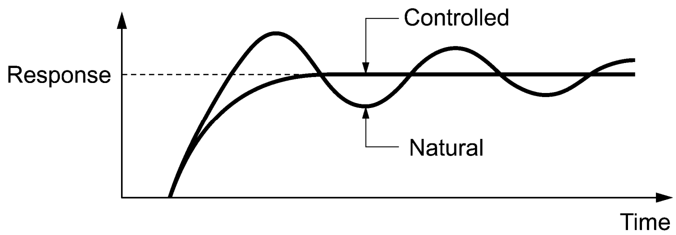


Fig. 5.4-102

2) Quick stabilizing (moderate overshoot allowable)

Decrease the data of J03 for Gain and increase that of J05 in Differential time.

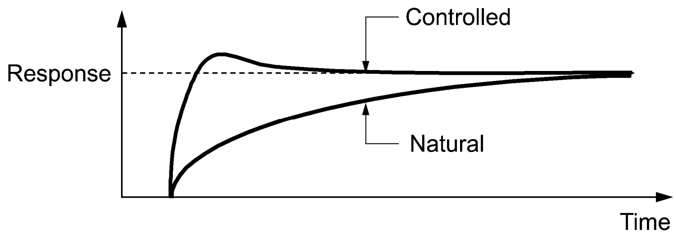


Fig. 5.4-103

3) Suppressing oscillation whose period is longer than the integral time specified by J04

Increase the data of J04 (Integral time).

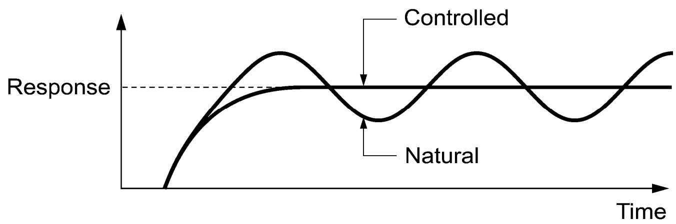


Fig. 5.4-104

4) Suppressing oscillation whose period is approximately the same as the time specified by J05

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.

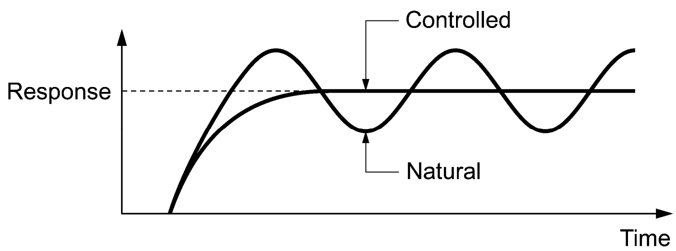


Fig. 5.4-105

■ 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 (sec)
- This setting is used to stabilize the PID control. 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 Frequency, Pressurizing Time)** Related Function Code: J15 (Slow flowrate level stop operation frequency level) J16 (Slow flowrate level stop elapsed time) J17 (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 increases, the reference frequency (output of the PID controller) below the stop frequency for slow flowrate level (J15) for the period of slow flowrate level stop latency (J16), the inverter decelerates to stop. However, the PID control itself continues to operate. When the discharge pressure decreases, increasing the reference frequency (output of the PID controller) 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 controller drops below the specified starting frequency.

■ Assignment of PID slow flowrate stopping ***PID-STP*** (Function code: E20 to E24, E27, data = 44)

While the slow flowrate stopping, PID-STP outputs ON signal as the inverter stops due to the slow flowrate stopping function during the PID control. When the signal output that indicates the inverter stopping status is necessary, assignment of ***PID-STP*** is necessary.

For the slow flowrate stopping function, see the following chart.

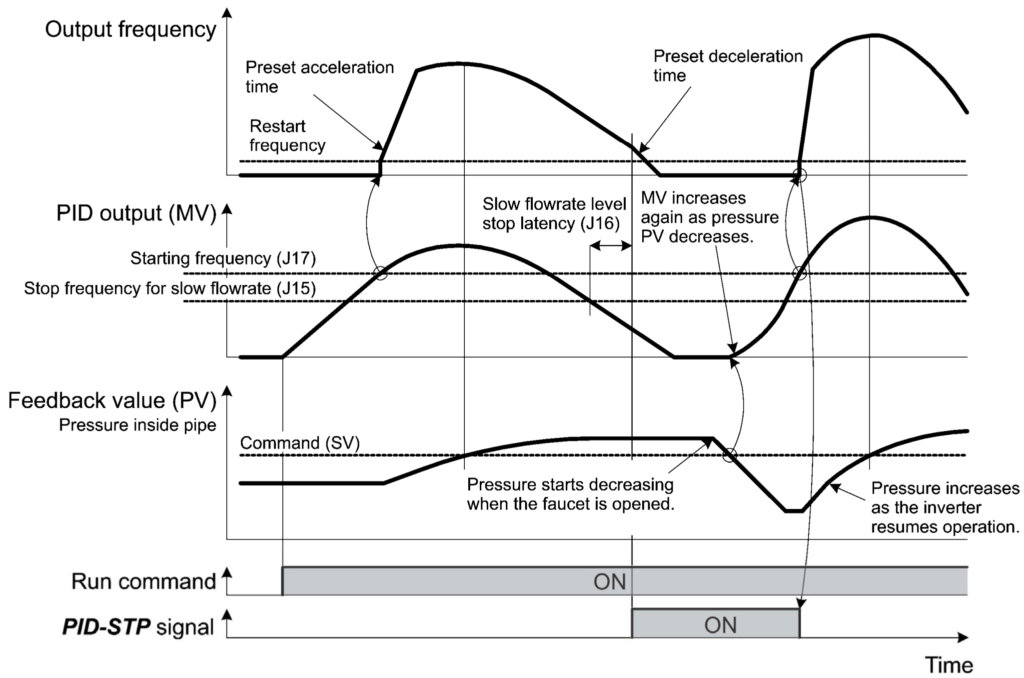


Fig. 5.4-106

Pressurization before slow flowrate stopping (J08 and J09)

Specifying Pressurization starting frequency (J08) and Pressurizing time (J09) enables pressurization control when the frequency drops below the level specified by Stop frequency for slow flowrate (J15) for the period specified by (J16). During the pressurization, 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 pressurization control, see the chart below.

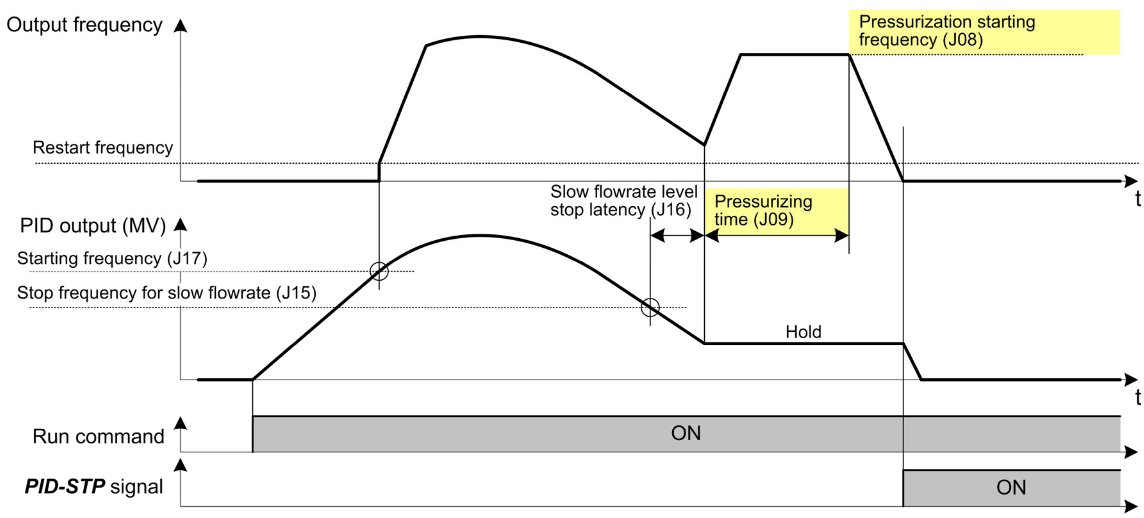


Fig. 5.4-107

J10 PID Control (Anti Reset Windup)

J10 suppresses overshoot in control with the PID controller. 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 action.

- Data setting range: 0 to 200 (%)

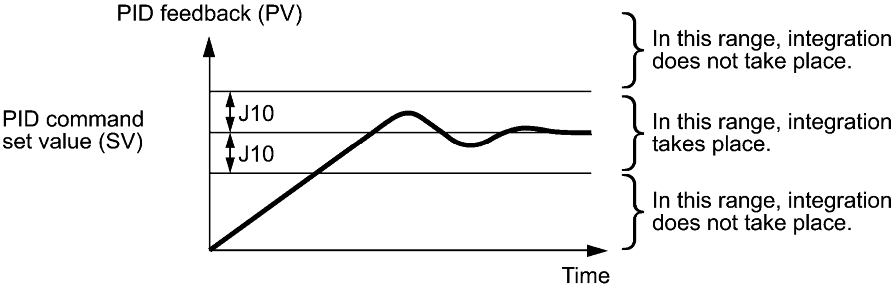


Fig. 5.4-108

J11 to J13 PID Control (Select Alarm Output, Upper Level Alarm (AH) and Lower Level Alarm (AL))

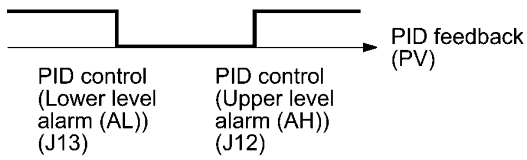
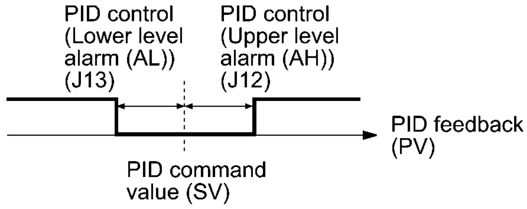
Outputting the absolute value alarm or deviation alarm is possible in the PID control. As an alarm output, setting of the digital output signal ***PID-ALM*** has to be set to E20 to E24, E27 (data = 42).

J11 specifies the alarm output types. J12 and J13 specify the upper and lower limits for alarms, respectively.

■ PID control (Select alarm output) (J11)

It sets the alarm type. J11 specifies one of the following alarms available.

Table 5.4-154

Data for J11	Alarm	Contents
0	Absolute-value alarm	When PV < AL or AH < PV, ***PID-ALM*** is ON.  Fig. 5.4-109
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.  Fig. 5.4-110
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. 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 output is turned on, the alarm will remain on even if it goes out of the alarm range. To release the latch, press the PRG/RESET key on the keypad or turning the terminal command ***RST*** on. Resetting can be done by the same way as resetting an alarm.

■ PID Control (Upper Level Alarm (AH)) (J12)

J12 sets the upper limit of the alarm (AH) in percentage (%) of the feedback amount.

■ PID Control (Lower level alarm (AL)) (J13)

J13 sets 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, 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.

Table 5.4-155

Alarm	Contents	How to handle the alarm	
		Select alarm output (J11)	Parameter setting
Upper limit absolute	ON when AH < PV	Absolute value alarm	AL = 0
Lower limit absolute	ON when PV < AL		AH = 100%
Upper limit deviation	ON when SV + AH < PV	Deviation alarm	AL = 100%
Lower limit deviation	ON when PV < SV - AL		AH = 100%
Upper/lower limit deviation	ON when |SV - PV| > AL		AL = AH
Upper/lower range limit deviation	ON when SV - AL < PV < SV + AL	Deviation alarm	A negative logic signal 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)** (See J08)

For PID control (slow flowrate stop operation frequency level), (slow flowrate level stop latency), and (starting frequency) functions, see the section describing the function code J08.

J18, J19 — PID Control (Upper Limit of PID Output Limiter, Lower Limit of PID Output Limiter)

The upper and lower limiters can be specified to the PID output, exclusively used for PID control. The settings are ignored when PID cancel ***Hz/PID*** is enabled and the inverter is operated at the standard frequency previously set.
(📖 Function code E01 to E09, data = 20)

■ PID Control (Upper limit of PID output limiter) (J18)

J18 sets the upper limit of the PID controller 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 output limiter) (J19)

J19 sets the lower limit of the PID controller 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 conditions

The dew condensation prevention function gets started when the terminal command ***DWP*** is set to ON while the inverter is stopped.
(📖 Function code E01 to E09, data = 39)

■ Dew Condensation Prevention (Duty) (J21)

The current to the motor is controlled in duty according to the DC brake 1 (operation level) (F21) and the ratio of the dew condensation prevention duty (J21) to the DC brake 1 (time) (F22).

$$\text{Dew condensation prevention duty (J21)} = \frac{\text{DC brake (time) (F22)}}{\text{T}} \times 100$$

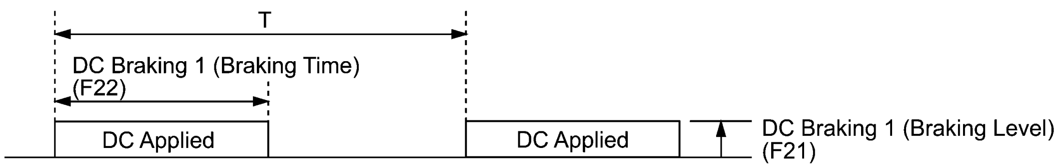


Fig. 5.4-111 Dew condensation prevention movement

J22 — Commercial Power Switching Sequence (See E01 to E09)

See the description of ***ISW50*** and ***ISW60*** (Enable integrated sequence to switch to commercial power) in E01 through E09.

J56 PID Control (Speed Command Filter for PID)

Not used.

J57 PID Control (Dancer Basic Position)

J57 specifies the dancer basic position in the range of -100% to +100% for dancer control. If J02 = 0 (keypad), this function code is enabled as the dancer basic position.

It is also possible to modify the PID command with the ⌃/⌄ keys on the keypad. If it is modified, the new command value is saved as J57 data.

For the setting procedure of the PID command, see Chapter 3, "3.3.3 Setting up frequency and PID commands."

J58 / J59 to J61 PID Control (Detection Width of Dancer Basic Position) / PID Control P (Gain) 2, I (Integral Time) 2, D (Differential Time) 2

When the dancer roll position (feedback) enters the "dancer basic position ± dancer basic position detection range (J58),"the PID controller can switch the PID parameter from J03, J04 and J05 to J59, J60, and J61. Set the gain high and increase the response to improve the accuracy.

■ PID control (dancer basic deviation detection width) (J58)

J58 specifies the bandwidth in the range of 1 to 100%. Specifying "0" does not switch PID parameters.

■ PID control P (Gain) 2 (J59)

■ PID control I (Integral time) 2 (J60)

■ PID control 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 controller output to or from the primary speed command. Also, it allows you to select either controlling the PID dancer controller output by the ratio (%) against the primary speed command or compensating the primary speed command by the absolute value (Hz).

Table 5.4-156

Data for J62			Block selection	
Decimal	Bit 1	Bit 0	Control value type	Operation for the primary setting
0	0	0	Ratio control	Addition
1	0	1	Ratio control	Subtraction
2	1	0	Absolute value control	Addition
3	1	1	Absolute value control	Subtraction

J68 to J70 J71, 72 J95, 96	**Brake Signal (Brake-OFF Current, Brake-OFF Frequency/Speed, Brake-OFF Timer)** **Brake Signal (Brake-ON Frequency/Speed, and Brake-ON Timer)** **Brake Signal (Brake-OFF Torque, Operation 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.

■ Assignment of brake signal ***BRKS*** (Function code: E20 to E24, 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 Brake signal (Brake-OFF timer) (J70), 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.

Table 5.4-157

Function Code	Name	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.
J96	Operation selection	Current response selection (bit 2) 0: Slow response 1: Quick response	Selects the response time of the judgment of Brake-OFF current. When the slow response is selected (factory default), the detection filter is inserted to the detected current. Therefore, the brake-off timing slows down a little to the rise of actual current. If this delay cannot be ignored in an adjustment, select the quick response.

Turning the Brake ON

When the run command is off and the output frequency drops below the level specified by Brake signal (Brake-ON frequency) (J71) and stays below the level for the period specified by Brake signal (Brake-ON timer) (J72), the inverter judges that the motor rotation is below a certain level and turns the signal ***BRKS*** off for activating the brake.

For the vector control, when the speed command or speed detection value decrease to load frequency (selected by J96 bit 3) or lower, and the status stays below the level for the period specified by Brake signal (Brake-ON timer) (J72), 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 service life of the brake.

Table 5.4-158

Function Code	Name	Setting Range	Remarks
J71	Brake-ON frequency/speed	0.0 to 25.0 Hz	
J72	Brake-ON timer	0.0 to 5.0 s	
J96	Operation selection	Speed detection/speed command selection (bit 0) 0: Speed detection value 1: Speed command value	Available only under vector control. It selects the speed data that is used for the braking judgment. When controlling the vector without a speed sensor, select "1: Speed command value."
		Applied frequency selection (bit 3) 0: Stop frequency (F25) 1: Braking frequency (J71)	Available only under vector control Selects the braking frequency. When the braking judgment speed is the speed detection value and when the applied frequency is the stop frequency (F25), the brake may be applied by the speed error after the stop frequency continuation. When braking is absolutely necessary during the stop frequency continuation, use the brake application frequency (J71) for judgment as the load frequency.
		Load condition selection (bit 4) 0: Operation command OFF invalid 1: Operation command OFF valid	Available only under vector control. Selection is possible from two patterns, which the brake signal is output regardless of the operation command, and which that the brake signal is output only when the operation command is off. When the reversed operation is executed, there are cases that the braking condition is satisfied at the vicinity of speed zero. In this case, select "1: Operation command OFF valid."

- Brake-on frequency selection (bit 3): 1 (Brake-on frequency) time chart

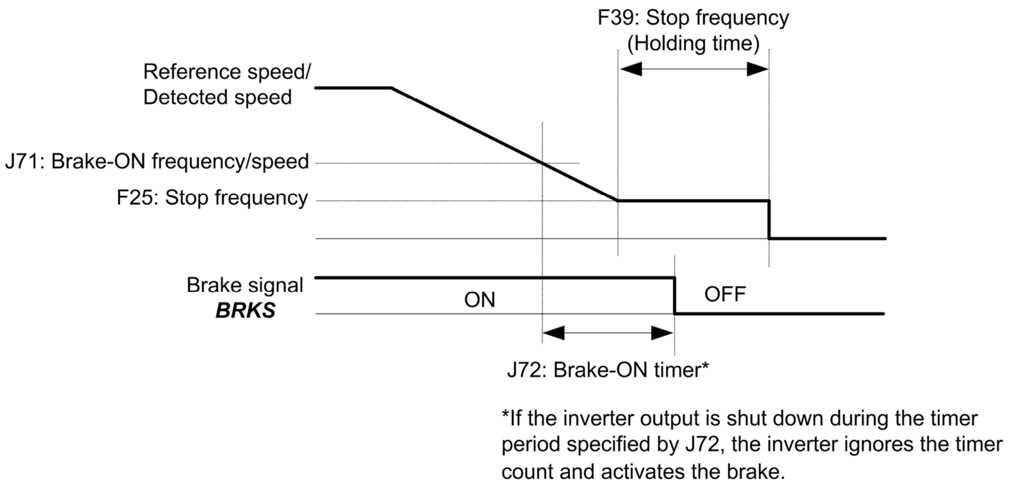


Fig. 5.4-112

• Load condition selection (bit 4): 1 (operation command OFF valid) time chart

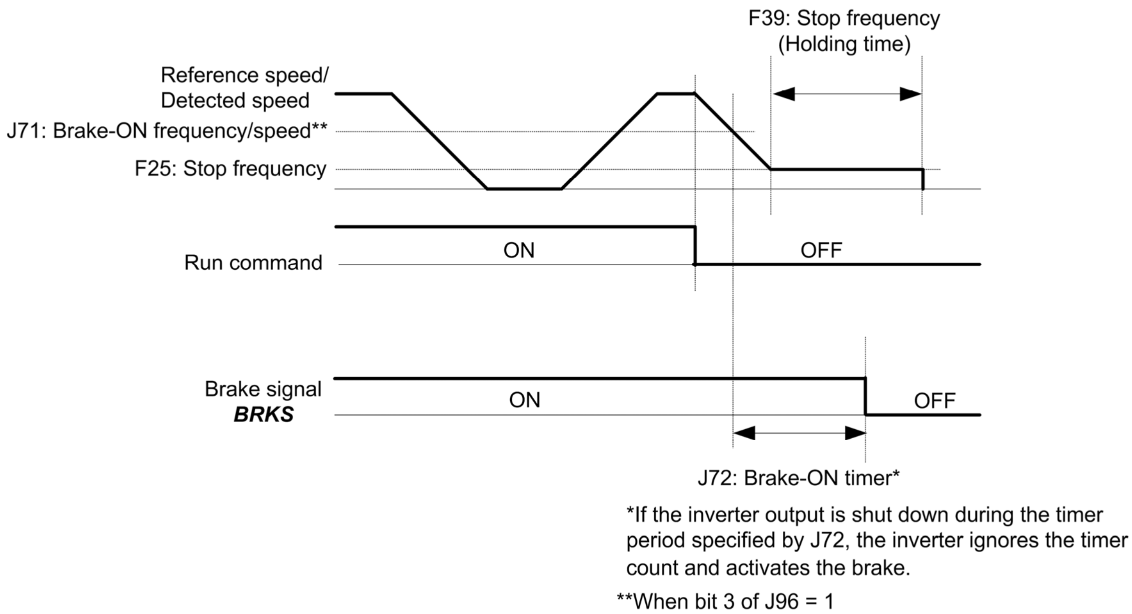


Fig. 5.4-113

Note

- The brake signal is only for the 1st motor. When the 2nd or further motors is selected by the motor switching, the brake signal becomes the load status.
- When the inverter is shut down by the alarm status or coast-to-stop command, the brake signal becomes the immediate turn-on status.
- Stoppage is judged when the output frequency (in case of vector control, the speed detect value or speed command value) exceeds "F25 stop frequency + E30 frequency reaching detect" and then the output frequency decreases to lower than F25.
  When inching operation is executed (repeating operation ON/OFF in a short time), F25 and E30 are adjusted.

Operation time chart under V/f control

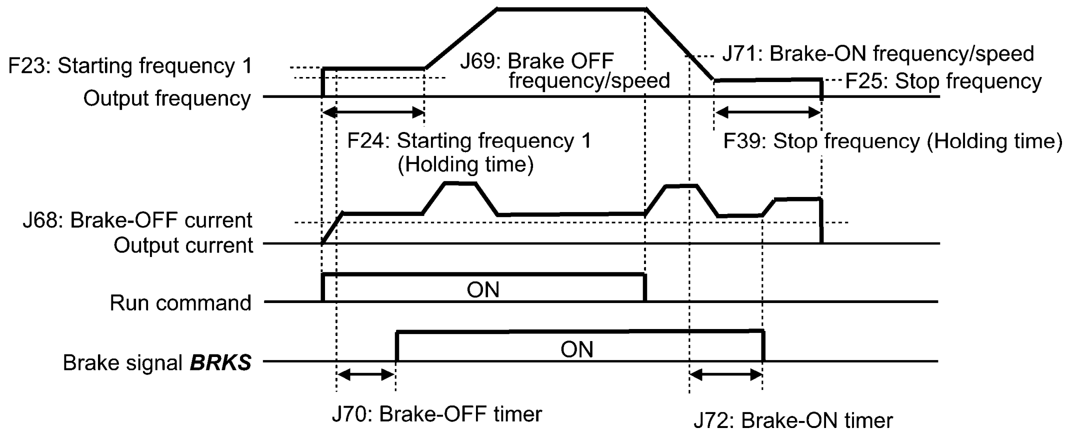


Fig. 5.4-114

Operation time chart under vector control without speed sensor

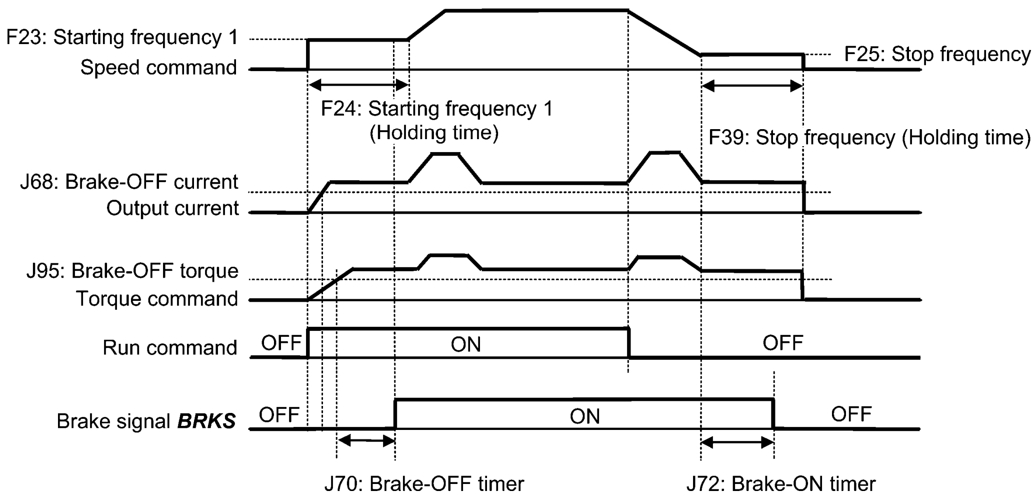


Fig. 5.4-115

Operation time chart under vector control with speed sensor

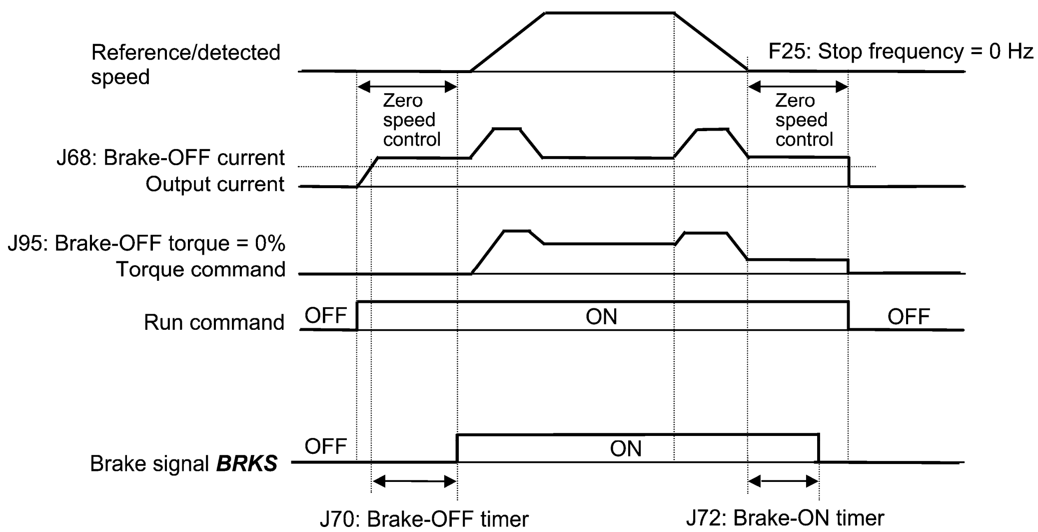


Fig. 5.4-116

Note

- If zero speed control is enabled under vector control with speed sensor, set J95 Brake-OFF torque = 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 d27, d28	Servo Lock (Gain, Completion Timer, Completion Width) Servo Lock (Gain Switching Time, Gain 2)

Servo-lock

Servo-lock function controls the motor position and keeps the position even when external power is applied.

Note While the inverter is servo-locked, the inverter output becomes low frequency. 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

Table 5.4-159

	Servo-lock activation condition (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 Set frequency < Stop frequency (F25)	
2	Servo-lock command ***LOCK*** is ON (Assignment of servo lock command ***LOCK*** (Function code data = 47))	
3	The detected speed is equal to or less than the stop frequency (F25).	The reference speed is equal to or less than the stop frequency (F25).

Operation examples

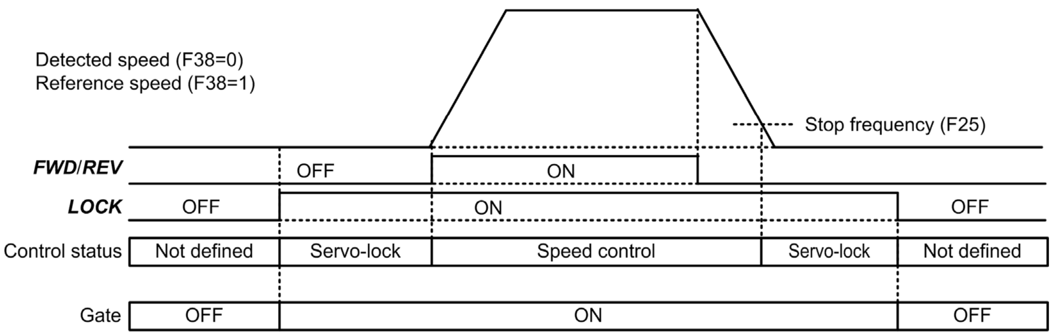


Fig. 5.4-117 Typical Control Sequence of Servo-lock

⚠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. **Electric shock may occur.**

Specifying servo-lock control

■ Assignment of 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.

■ Servo lock (gain) (J97) (Gain 2) (d28)

It sets the position controller gain of the servo lock. Adjusting the stop behavior shaft retaining power in the servo lock is possible. By the servo lock selection ***SLG2***, switching in two steps is possible. When the load inertia changes and controlling with one type of servo lock gain is difficult, use this function by switching.

Table 5.4-160

J97	Small ⟵⟶ Large
Stop behavior	Response slow, but smooth·····Response quick, but hunting large
Shaft holding torque	Holding Small·····Holding Large

■ Select Servo Lock Gain ***SLG2*** (Function code: E01 to E09 data = 110)

When OFF, the servo lock gain (J97) is selected, and when ON, the servo lock gain 2 (d28) is selected.

Switching during the servo lock is possible.

■ Servo lock gain switching time (d27)

When the servo lock gain is switched by the servo lock gain selection ***SLG2*** signal during servo locking, vibration may occur due to the step change. In that case, change the servo lock gain by the servo lock gain switching time (d27) lamp function in order to prevent vibration.

Monitor for servo-lock control

Table 5.4-161

Monitor Item	LED Monitor Indication	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	Indicated only when the position controller is working (when the position control is valid). When it is not in operation, the monitor is zero-cleared.
Positioning error	Operation monitor: 3_28 The upper and lower digits appear alternately.	Position deviation pulse Upper level 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-o

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.

(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-o (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, Set at F25 data < 2.4 Hz.

(3) Enabling 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 d06	Speed Control 1 (Speed Command Filter, Speed Detect Filter, P (Gain), I (Integral Time)) Speed Control 1 (Output Filter)

This function adjusts the speed control system under normal operations.

Block diagram of the speed control sequence

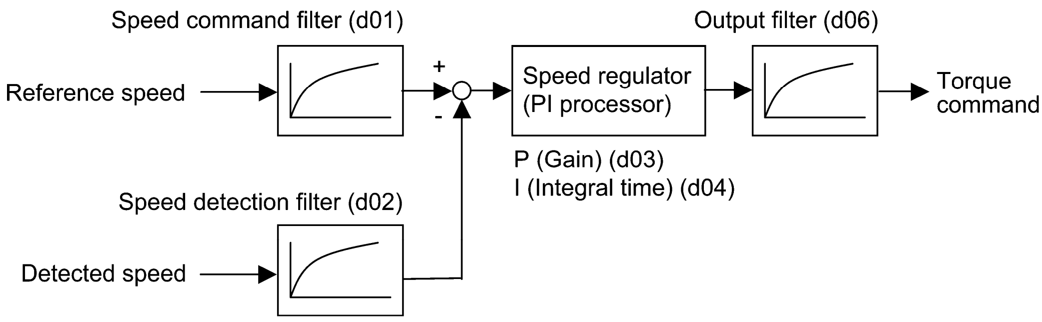


Fig. 5.4-118

■ Speed command filter (d01)

d01 sets a time constant of the primary delay filter to the speed set value.

- Data setting range: 0.000 to 5.000 (s)

Adjust this data when an excessive overshoot occurs against the change of the speed setting.

When the filter time constant is increased, the speed command value stabilizes, and the overshoot to the speed setting change decreases, and the speed response delays.

■ Speed detection filter (d02)

d02 specifies a time constant determining the primary delay of the speed detection filter.

- Data setting range: 0.000 to 0.100 (s)

Adjust 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 controller gain from increasing (resulting in a slow response speed of the inverter). In addition, set this value when the encoder pulse number is small, and when the speed makes the system oscillatory.

When the filter time constant is increased, the speed detect value stabilizes. Therefore, the PI controller gain can be increased even when the ripples superimpose on the detected speed. However, speed detection itself delays, resulting in a slower speed response, larger overshoot, or hunting.

■ P (gain) (d03), I (integral time) (d04)

This function sets the gain and the integral time for the speed controller (ASR).

By setting d04 = 999, the configuration of the speed controller (ASR) can be changed from the PI controller to the P controller for invalidating the integration operation.

- Data setting range: d03 = 0.1 to 200.0 (multiply)
  d04 = 0.001 to 9.999 (s)
  999 (Integral operation invalid)

◇ P gain

Definition of P gain = 1.0 is that the torque command is 100% (torque output of 100% of each inverter capacity) when the speed deviation (speed command - actual speed) is 100% (equivalent to the maximum speed set value).

Adjust the P gain according to inertia moment of the system connected to the motor shaft. Larger inertia moment 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. 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. Set 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 sets the time constant for the primary delay of the speed controller output filter.

- Data setting range: 0.000 to 0.100 (s)

Use d06 when even adjusting the P gain or integral time cannot suppress mechanical resonance such as hunting or vibration. Generally, setting a larger value to the time constant of the output filter decreases the amplitude of resonance; however, a too large time constant may make the system unstable.

d05	**Speed Control 1 (Feed Forward Gain)** Related Function Codes: A47, b47, r47 Speed Control 2 to 4 (Feed Forward Gain)

This function executes the feed forward control that directly adds the torque determined by the speed command change value to the torque command.

The speed controller PI control is the feedback control. It executes the corrective action (to follow the speed command) according to the result of objective for the control (actual speed). Therefore, this control can be used for correction of factors that cannot directly measure, such as the unmeasurable disturbance and uncertainness of the measurement. However, it leads the follow-up correction that corrects the change of known command order after the change appears to the deviation (speed command - actual speed value). The operation amount (torque command) for the known factor can be acquired in advance. Therefore, control with more readiness will be available when the acquired operation amount is added to the torque command. This is the function code that executes the following operation. This feed forward control directly adds the torque determined by the speed command change value to the torque command.

Setting range: 0.00 to 99.99 [s]

It is valid when the load inertia is known in advance. Conceptually, as shown in the following figures, the following speeds to the actual command value are completely different when the feed forward control is valid and invalid. However, in order to maximize the effect of the control, it is necessary to adjust the feedback control PI constant and this setting to a good balance.

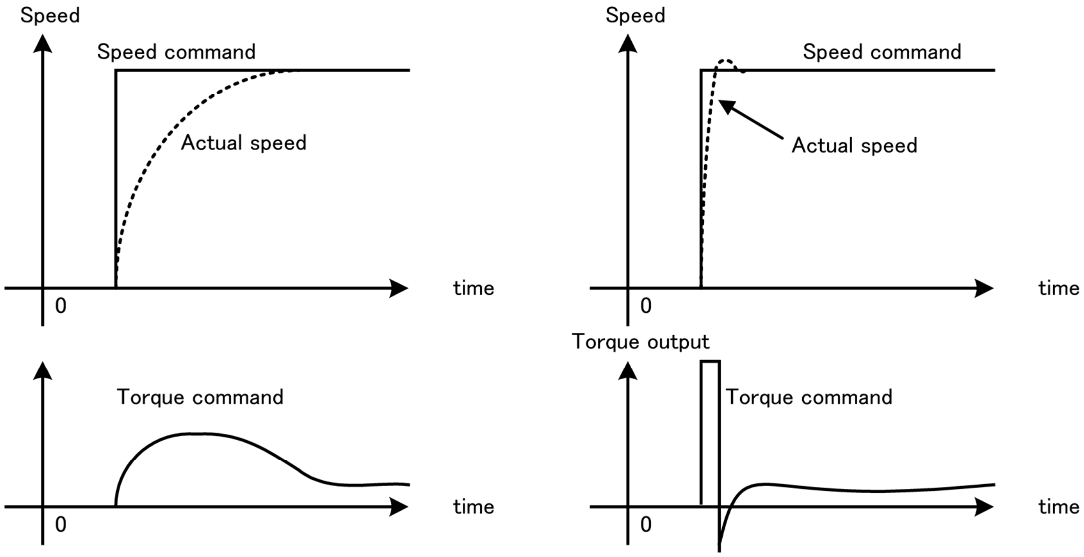


Fig. 5.4-119

Above effect can be acquired also by setting the P gain of the speed controller at a high value. However, when the gain is set high, the system response increases its speed. Therefore, the negative effects (mechanical resonance and vibration) also appear.

Chapter 5 Function Code
Details of Function Codes
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
U codes
d01 to d06
U codes
y codes

d07 d08	**Speed Control 1 (Notch Filter Resonance Frequency)** Related Function Codes: A49, b49, r49 Speed Control 2 to 4 (Notch Filter Resonance Frequency) **Speed Control 1 (Notch Filter Attenuation Level)** A50, b50, r50 Speed Control 2 to 4 (Notch Filter Attenuation Level)

The notch filters make it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points, suppressing the mechanical resonance.

The notch filters are available only under "vector control with speed sensor."

Setting the speed loop gain at a high level in order to obtain quicker speed response may cause mechanical resonance.

If it happens, decreasing the speed loop gain is required to slow the speed response as a whole. In such a case, using the notch filters makes it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points and set the speed loop gain at a high level in other resonance points, enabling a quicker speed response as a whole.

The following four types of notch filters can be set.

Table 5.4-162

	Function Code	Name	Data Setting Range	Unit	Default Setting
Notch filter 1	d07	Speed control 1 (Notch filter resonance frequency)	1 to 200	Hz	200
	d08	Speed control 1 (Notch filter attenuation level)	0 to 20	dB	0 (Disable)
Notch filter 2	A49	Speed control 2 (Notch filter resonance frequency)	1 to 200	Hz	200
	A50	Speed control 2 (Notch filter attenuation level)	0 to 20	dB	0 (Disable)
Notch filter 3	b49	Speed control 3 (Notch filter resonance frequency)	1 to 200	Hz	200
	b50	Speed control 3 (Notch filter attenuation level)	0 to 20	dB	0 (Disable)
Notch filter 4	r49	Speed control 4 (Notch filter resonance frequency)	1 to 200	Hz	200
	r50	Speed control 4 (Notch filter attenuation level)	0 to 20	dB	0 (Disable)

When "attenuation level" is set to "0" (dB), the corresponding notch filter becomes disabled.

It is possible to apply all of the four notch filters to the 1st motor or apply each notch filter to each of the 1st to 4th motors.

Table 5.4-163

Setting Condition	Notch Filter 1	Notch Filter 2	Notch Filter 3	Notch Filter 4
	d07 and d08	A49 and A50	b49 and b50	r49 and r50
Motor selection (***M2***, ***M3***, ***M4***) is not used. (E01 to E09, E98, E99 ≠ 12, 36, 37)	Four types of notch filters are set for the first motor.			
All of "Motor/parameter switching" is set to parameter switching. (A42, b42, r42 = 1)				
Other than the above	To the 1st motor	To the 2nd motor	To the 3rd motor	To the 4th motor

d09, d10 d11 to d13	**Speed Control (JOG) (Speed Command Filter, Speed Detect Filter)** **P (Gain), I (Integral Time), (Output Filter)** (See d01)

These functions adjust the speed control sequence for jogging operations.

The block diagrams and function codes related to the speed control sequence are same as for normal operations.

Since this speed control sequence is exclusive to jogging operations, set higher speed response than normal operation, so no trouble is led to the jogging operations.

For details of each function code, see the function codes d01 to d04 and d06 for adjustment of the speed control sequence of the corresponding normal operation.

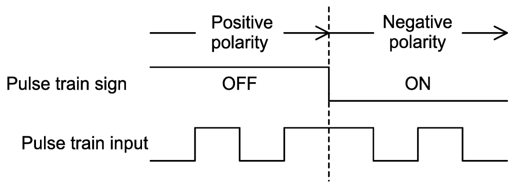
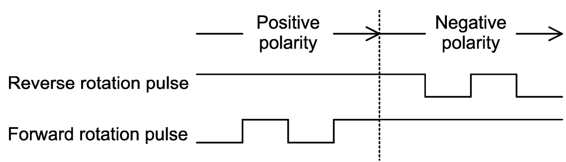
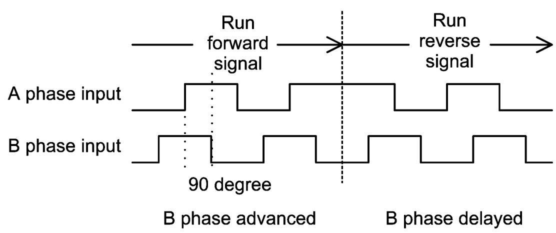
d14 to d17	**Return Home (Feedback Input)** **(Pulse Input Method), (Encoder Pulse Number), (Pulse Compensation Factor 1),** **(Pulse Compensation Factor 2)**

These functions set the speed feedback input under vector control with speed sensor.

■ Home Return (Pulse Input Method) (d14)

d14 selects the speed feedback input signal format.

Table 5.4-164

Data for d14	Pulse input method	Remarks
0	Pulse train sign/Pulse train input	 Fig. 5.4-120
1	Run forward pulse/run reverse pulse	 Fig. 5.4-121
2	A and B phases with 90 degree phase difference	Set "2" when the special motor for Fuji vector control is used.  Fig. 5.4-122

■ Return home (Encoder pulse number) (d15)

d15 sets the encoder pulse number of the speed feedback input.

- Data setting range: 0014 to EA60 (in hex.)

(Above range becomes 20 to 60000 (P/R) in decimal.)

Set "0400 (1024 P/R)" when an exclusive motor for Fuji vector control is used.

■ Return home (Pulse compensation factor 1) (d16), (Pulse compensation factor 2) (d17)

d16 and d17 set the factors to convert the speed feedback input pulse rate into the motor shaft speed.

- Data setting rage: 1 to 9999

Set the data according to the pulley and gear ratios as follows.

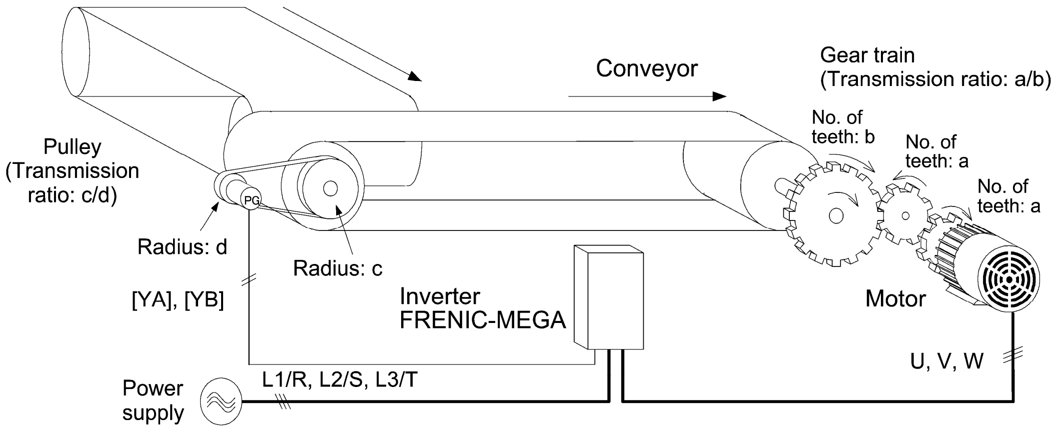


Fig. 5.4-123 Example of a Closed Loop Speed Control System (Conveyor)

Conversion expressions of the motor shaft speed of the speed feedback input.

$$\text{Motor shaft speed} = \frac{\text{Pulse compensation factor 2 (d17)}}{\text{Pulse compensation factor 1 (d16)}} \text{x Encoder shaft speed}$$

$$\frac{\text{Pulse compensation factor 2 (d17)}}{\text{Pulse compensation factor 1 (d16)}} = \frac{b}{a} \text{ X } \frac{d}{c}$$

$$\text{Pulse compensation factor 1 (d16)} = a \text{ X } c$$

$$\text{Pulse compensation factor 2 (d17)} = b \text{ X } d$$

Note When executing the vector control with speed sensor, mount the speed detector pulse encoder on the motor shaft directly, or on a shaft with the rigidity equivalent to the motor shaft. When a backlash or deflection exists, proper control may become not possible.

When the motor exclusively used for Fuji vector control is used, the pulse encoder is directly mounted on the motor shaft. Therefore, set "1" to both pulse compensation factor 1 (d16) and pulse compensation factor 2 (d17).

d21, d22 d23	Speed Agreement/PG Error (Detection Range, Detection Timer) PG Error Selection

These functions set the detection levels of the speed agreement signal ***DSAG*** and PG error detection ***PG-ERR***.

Speed Agreement Signal *DSAG* (Function Code E20 to E24, E27 Data = 71)

■ Speed Agreement/PG Error (Detection width) (d21), (Detection timer) (d22)

- Data setting range: d21 = 0.0 to 50.0 (%) --- Max. Speed/100%
  d22 = 0.00 to 10.00 (s)

If the speed controller's deviation (between the speed command and detected speed) is within the set range (d21), the ON signal turns on. If the deviation is out of the set range (d21) for the set time (d22), the signal turns off. With this signal, checking whether the speed controller is working properly or not.

PG Error Detected *PG-ERR* (Function Code E20 to E24, E27 Data = 76)

■ Speed Agreement/PG Error (Detection Range (d21) and Detection Timer (d22)), PG Error Selection (d23)

- Data setting range: d21 = 0.0 to 50.0 (%) ··· Max. Speed/100%
  d22 = 0.00 to 10.00 (s)
  d23 = 0 to 5

Table 5.4-165

Data for d23	Function
0	Continue to run 1
1	Alarm (Er-E) Stop 1
2	Alarm (Er-E) Stop 2
3	Continue to run 2
4	Alarm (Er-E) Stop 3
5	Alarm (Er-E) Stop 4

If the deviation of the speed controller (deviation between the speed command and estimated speed/detected speed) is out of the set range (d21) for the set period (d22), the inverter judges it as a PG error.

Data setting for d23, however, defines the detection conditions, the error processing after the error detection, and the range of error detection.

Table 5.4-166

d23 Data	Detection Condition	Processing After Detection	Speed Command > Error Detect Width at F04
0	When the inverter cannot follow the speed command (after soft-starting) due to a heavy overload or the like so that the detected speed is slow against the reference speed, the inverter does not interpret this situation as a PG error.	In this case, the PG error detect ***PG-ERR*** signal is output, and the inverter continues operating.	Constant at "Detect width = d21 x max. frequency" even at equal to or higher than the base frequency (F04).
1		Er-E alarm is inverter coast to a stop	
2	There is no excluding condition.		
3	When the inverter cannot follow the speed command (after soft-starting) due to a heavy overload or the like so that the detected speed is slow against the reference speed, the inverter does not interpret this situation as a PG error.	In this case, the PG error detect ***PG-ERR*** signal is output, and the inverter continues operating.	Constant at Detect width = "d21 x max. frequency" when equal to or lower than the base frequency (F04). "Detect width = d21 x speed command x max. frequency / base frequency" when equal to or higher than the base frequency (F04).
4		Er-E alarm is inverter coast to a stop	
5	There is no excluding condition.		

Note When limiting functions such as the torque limit and droop control are enabled, an actual speed becomes greatly different from the speed command, and the deviation becomes large. In this case, the situation may be judged PG error, and the inverter may get tripped. To avoid this incident, select the operation continuation (d23 = 0) to prevent the inverter from tripping.

d24	Zero Speed Control (See F23)

For the zero speed control, see the description of the function code F23.

d25	ASR Switching Time (See A42)

For the ASR switching time, see the description of the function code A42.

d32, d33 Torque Control (Speed Limit 1, Speed Limit 2)

There are cases that the motor unexpectedly starts rotating in high speed due to the regenerative load in droop control (which is not generated usually) or due to the incorrect setting of the function code. In order to protect the machinery, the overspeed level can be freely set.

- Forward overspeed level = Maximum output frequency (F03) x Speed limit 1 (d32) x 120 (%)
- Reverse overspeed level = Maximum output frequency (F03) x Speed limit 2 (d33) x 120 (%)

d35 Overspeed Detect Level

The overspeed detect level by the torque control can be set by using d35. The overspeed detect level is set in percentage to the maximum output frequency (F03, A01, b01, r01).

When the following conditions are established, the inverter judges the overspeed condition and outputs OS alarm.

Motor speed ≥ Max. output frequency (F03/A01/b01/r01) x d35

When "999" is set, the inverter outputs OS alarm under the following conventional conditions.

Motor speed ≥ Max. output frequency (F03/A01/b01/r01) x (d32 or d33) x 1.2

Or

Motor speed ≥ 200 Hz (vector control with speed sensor) or 120 Hz (vector control without speed sensor) x (d32 or d33) x 1.2

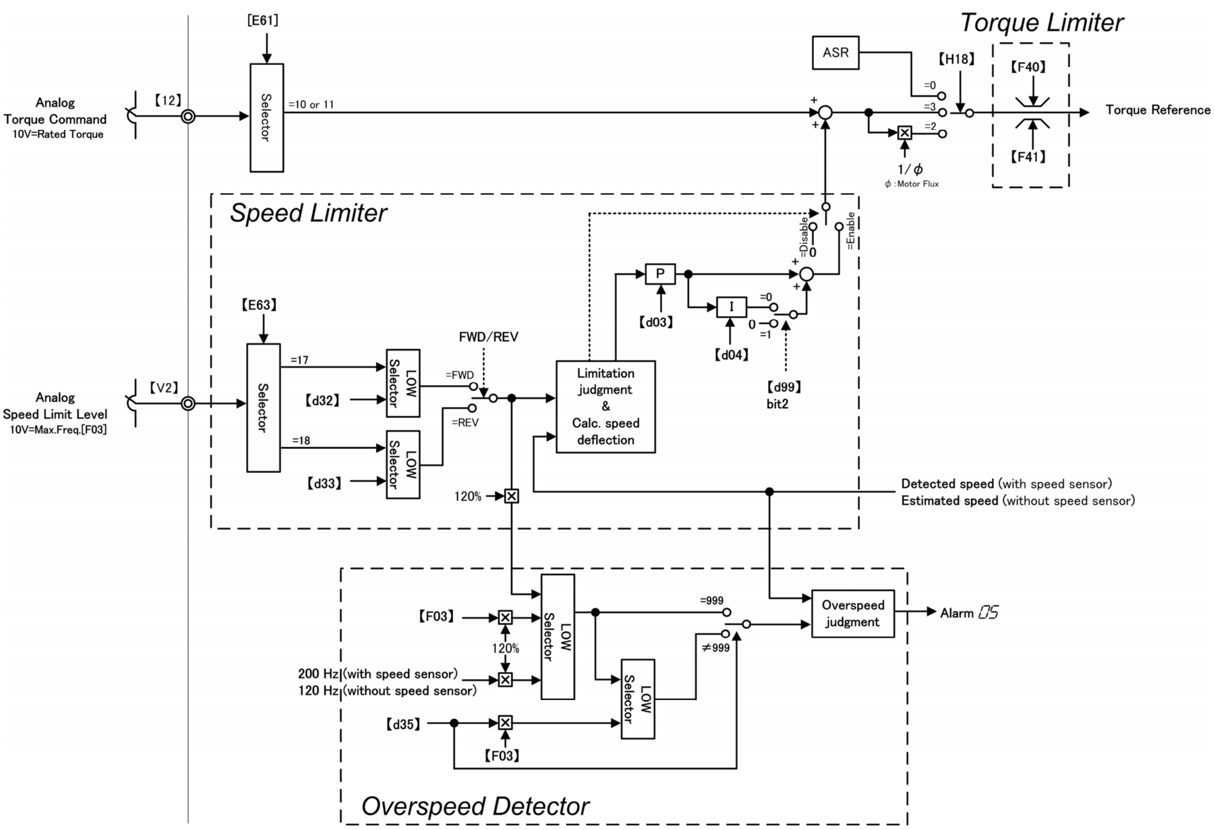


Fig.5.4-124 Torque control block drawing

Chapter 5 Function Code
Details of Function Codes
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d21 to d35
U codes
y codes

Note **Torque Command/Torque Current Command**

By the analog voltage input (terminal 12, V2), analog current input terminal (C1), or communication (function code S02, S03), the torque command/torque current can be applied.

(When analog voltage input/analog current input is used, set the function code E61 (terminal 12), E62 (terminal C1), and E63 (terminal V2) to 10 or 11 as shown in the following table.)

Table 5.4-167

Input	Command Form	Function Code	Definition of monitor amount 100% (factory default)
Terminal [12] (-10 V to 10 V)	Torque command	E61 = 10	Motor rated torque ±100% / ±10 V
	Torque current command	E61 = 11	Motor rated torque current ±100% / ±10V
Terminal [V2] (-10 V to 10 V)	Torque command	E63 = 10	Motor rated torque ±100% / ±10 V
	Torque current command	E63 = 11	Motor rated torque current ±100% / ±10V
Terminal [C1] (0, 4 to 20 mA)	Torque command	E62 = 10	Motor rated torque 100% / 20 mA
	Torque current command	E62 = 11	Motor rated torque current 100% / 20 mA
S02 (-327.68 to 327.67%)	Torque command	-	Motor rated torque / ±100.00%
S03 (-327.68 to 327.67%)	Torque current command	-	Motor rated torque current / ±100.00%

The function codes C31 to C45 (analog input adjustment) are applied to these analog inputs.

Speed control

The response of speed control can be adjusted by adjusting the following speed control P gain and integral time.

Table 5.4-168

Selected Motor	Function Code	
	P Gain	Integral Time
M1	d03	d04
M2	A45	A46
M3	b45	b46
M4	r45	r46

d41	Application Control Selection

Constant periphery control and synchronization operation (simultaneous start synchronization, wait synchronization) can be selected as an application.

The constant peripheral speed control suppresses an increase in peripheral speed (line speed) resulting from the increasing radius of the take-up roll in the winder system.

Synchronization operation takes positional synchronization of several shafts of the conveyor. For details of synchronization operation, see the instruction manual of the PG interface card.

■ Application control selection (d41)

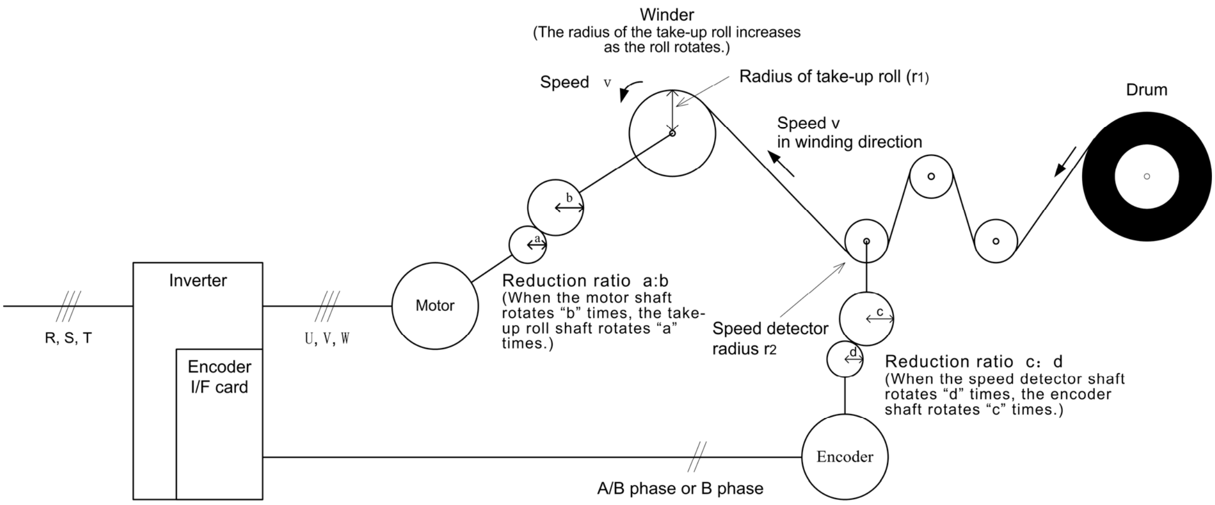
d41 sets whether to enable or disable constant peripheral speed control and synchronization operation (simultaneous start synchronization, wait synchronization).

Table 5.4-169

Data for d41	Function
0	Disable (Standard control)
1	Enable (Constant peripheral speed control) Note: It is valid only when "3: V/f control with speed sensor" or "4: Dynamic torque vector control with speed sensor" is selected for the control method selection 1 to 4 (F42, A14, b14, or r14).
2	Operation (simultaneous start synchronization (no Z phase))
3	Operation (wait synchronization)
4	Operation (simultaneous start synchronization (Z phase))

Machinery configuration and settings

When the machinery of the winder has the configuration as shown below, it is necessary to set the following function code.



- Speed reduction ratio between motor shaft and take-up roll shaft is a:b
- Speed reduction ratio between speed detector shaft and encoder shaft is c:d
- Radius r_1 of winder before winding [m]
- Radius r_2 of speed detection section [m]

Fig. 5.4-125

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Table 5.4-170 Setting method of the speed reduction ratio

Function Code	Name	Setting Contents
d15	Home return encoder pulse number	Encoder pulse number is set in hexadecimal [P/R]
d16	Pulse compensation factor 1	Speed reduction ratio of the whole machinery $\frac{K_2}{K_1} = \frac{r_2}{r_1} \times \frac{b}{a} \times \frac{d}{c} =$ d17/d16 d16 = Setting of denominator factor for speed reduction ratio (K1 = r1 x a x c) d17 = Setting of numerator factor for speed reduction ratio (K2 = r2 x b x d)
d17	Pulse compensation factor 2	

■ Peripheral speed (line speed) command

For the speed command under the constant peripheral speed, it is necessary to use the wind speed (line speed) command.

Setting with digital inputs

To digitally set a peripheral speed (line speed) in m/min, set as follows.

Table 5.4-171

Function Code	Name	Setting Contents
E48	LED monitor detail	5: Line speed
E50	Speed indication coefficient	$K_s = \frac{240\pi \times a \times r_1}{p \times b}$ Ks: Speed indication coefficient (E50) p: Number of motor poles a, b: Components of speed reduction ratio between motor shaft and take-up roll shaft (When the motor shaft rotates "b" times, the take-up roll shaft rotates "a" times.) r1: Radius of take-up roll of winder (initial value before winding) (m)

Setting with analog inputs

To specify a peripheral speed (line speed) using analog inputs, set an analog input (0 to 100%) based on the following relationship.

$$\text{Analog input (\%)} = \frac{p \times b \times 100}{240\pi \times r_1 \times a \times fmax} \times V$$

V: Peripheral speed (Line speed) (m/min), fmax: Maximum output frequency (F03)

■ Adjustment

Like usual speed controls, it is necessary to adjust the speed command filter, speed detection filter, P gain, and integral time in the speed control sequence that controls the peripheral speed at a constant level.

Table 5.4-172

Function Code	Name	Adjustment Point
d01	Speed control (Speed command filter)	If an excessive overshoot occurs for a speed command change, increase the filter constant.
d02	Speed control (Speed detection filter)	If ripples are superimposed on the speed detection signal so that the speed control gain cannot be increased, increase the filter constant to obtain a larger gain.
d03	Speed control P (Gain)	If hunting is caused in the speed control, decrease the gain. If the motor response is slow, increase the gain.
d04	Speed control I (Integral time)	If the motor response is slow, decrease the integral time.

■ Cancel constant peripheral speed control ***Hz/LSC*** (Function code E01 to E09, data = 70)

With ***Hz/LSC*** signal, the constant peripheral speed control can be canceled. When cancelled, the frequency compensation by PI calculation becomes zero; therefore, compensation of thickening of a take-up roll, resulting in increasing speed. Use this function to temporarily interrupt the control for repairing a thread break, for example.

Table 5.4-173

Hz/LSC	Function
OFF	Enables constant peripheral speed control (depending on d41 setting)
ON	Cancel constant peripheral speed control (V/f control, without compensation for a take-up roll getting bigger)

■ Constant peripheral speed control frequency in the memory ***LSC-HLD*** (Function code E01 to E09, data = 71)

While ***LSC-HLD*** signal is on under constant peripheral speed control, stopping the inverter (including an occurrence of an alarm and a coast-to-stop command) or turning off ***LSC-HLD*** saves the current frequency command compensating for a take-up roll getting bigger, in the memory. At the time of restarting, the saved frequency command applies and the inverter keeps the peripheral speed constant.

Table 5.4-174

LSC-HLD	Function
OFF	Disable (No saving operation)
ON	Enable (Saving the frequency command compensating for a take-up roll getting bigger)

Note Shutting down the inverter power during an operation stop loses the frequency compensation data saved in the memory. At the time of restart, therefore, the inverter runs at the frequency without compensation so that a large overshoot may occur.

d51 to d55 d68, d69, d99	**For manufacturers**

Function codes d51 to d55, d68, d69 and d99 appear on the monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

d59 to d63 d71 to d78	**Command (Pulse Train Input)** **(Pulse Input Method, Encoder Pulse Number, Filter Time Constant, Pulse Compensation Factor 1,** **Pulse Compensation Factor 2)** (See F01) **Simultaneous Operation Function Selection**

For the pulse train input, see the section describing the function code F01.

It is possible to execute the synchronization operation by using PG interface card (OPC-G1-PG/OPC-G1-PG22). For details, see the PG Interface Card Instruction Manual.

d70	Speed Control Limiter

Applying the limiter to the PI calculation output of the speed control system is possible by the V/f control with the speed sensor and the dynamic torque vector control with the speed sensor.

In general, the PI calculation output is within "slip frequency x maximum torque (%)" in a normally controlled state.

If an abnormal state such as a temporary overload arises, the PI calculation output greatly fluctuates and may take a long time to return to the normal state. Limiting the PI calculation output suppresses such abnormal operation.

Setting range: 0 to 100 (%) (assuming the maximum frequency as 100%)

d82	Magnetic State Weakening Control (Vector Without Speed Sensor)

When this function code is set to "1" (effective), the motor flux is controlled according to the command torque.

When the command torque is small, weak the motor flux, and improve the control stability.

d83	Magnetic State Weakening Lower Limit (Vector without Speed Sensor)

This function code is applied to the lower limit of the motor flux when the function code d82 data = 1 is set.

When the value of this function code is set too small, problems such as hunting and speed stagnation may occur.

Use with the default setting "40%" unless otherwise there are problems.

d86	Acceleration/deceleration Filter Time Constant (See F07)

For detailed descriptions of acceleration and deceleration filter time constant, see the section describing the function code F07.

d90	Magnetic State Level of Deceleration (Vector Control)

This function code is applied to the magnetic flux level in decelerating in the vector control.

The set unit is "%" of the motor rated magnetic flux determined by P06/A20/b20/r20.

This function code is effective only when H71 = 1 (deceleration characteristic effective) and F42/A14/b14/r14 = 5 or 6 (vector control with/without the speed sensor).

When this function code is set large, the deceleration time can be shortened. However, the output current and motor temperature increase get large. In case applications that repeatedly start and stop frequently, the inverter and motor may get overloaded.

Adjust this function code so that the equivalent RMS becomes smaller than the motor rated current.

Use with the default setting "150%" unless otherwise there are problems.

d99	Extension Function 1

When the jogging operation ***JOG*** is set effective from the communication, set this function code to bit 3 = 1.

Note: The function codes other than bit 3 are for manufacturers. Do not change the setting.

5.4.9 U codes (Application functions 3)

U00	**Customizable Logic (Operation Selection)**
U01 to U50	**Customizable Logic: Step 1 to 10 (Operation Setting)**
U71 to U75	**Customizable Logic Output Signal 1 to 5 (Output Selection)**
U81 to U85	**Customizable Logic Output Signal 1 to 5 (Function Selection)**
U91	**Customizable Logic Timer Monitor (Step Selection)**

The customizable logic function allows the user to form a logic circuit for digital input/output signals, customize those signals arbitrarily, and configure a simple relay sequence inside the inverter.

In a customizable logic, one step (component) is composed of 2 inputs and 1 output + logical operation (including timer) and a total of ten steps can be used to configure a sequence.

■ Specifications

Table 5.4-175

Item	Specifications
Input signal	2 inputs
Operation block	Logical operation, counter, etc.: 13 types Timer: 5 types
Output Signal	1 output
Number of steps	10 steps
Customizable logic output signal	5 outputs
Customizable logic processing time	2 ms (See page 5-256 "■ Notes for Usage (4).")

■ Block diagram

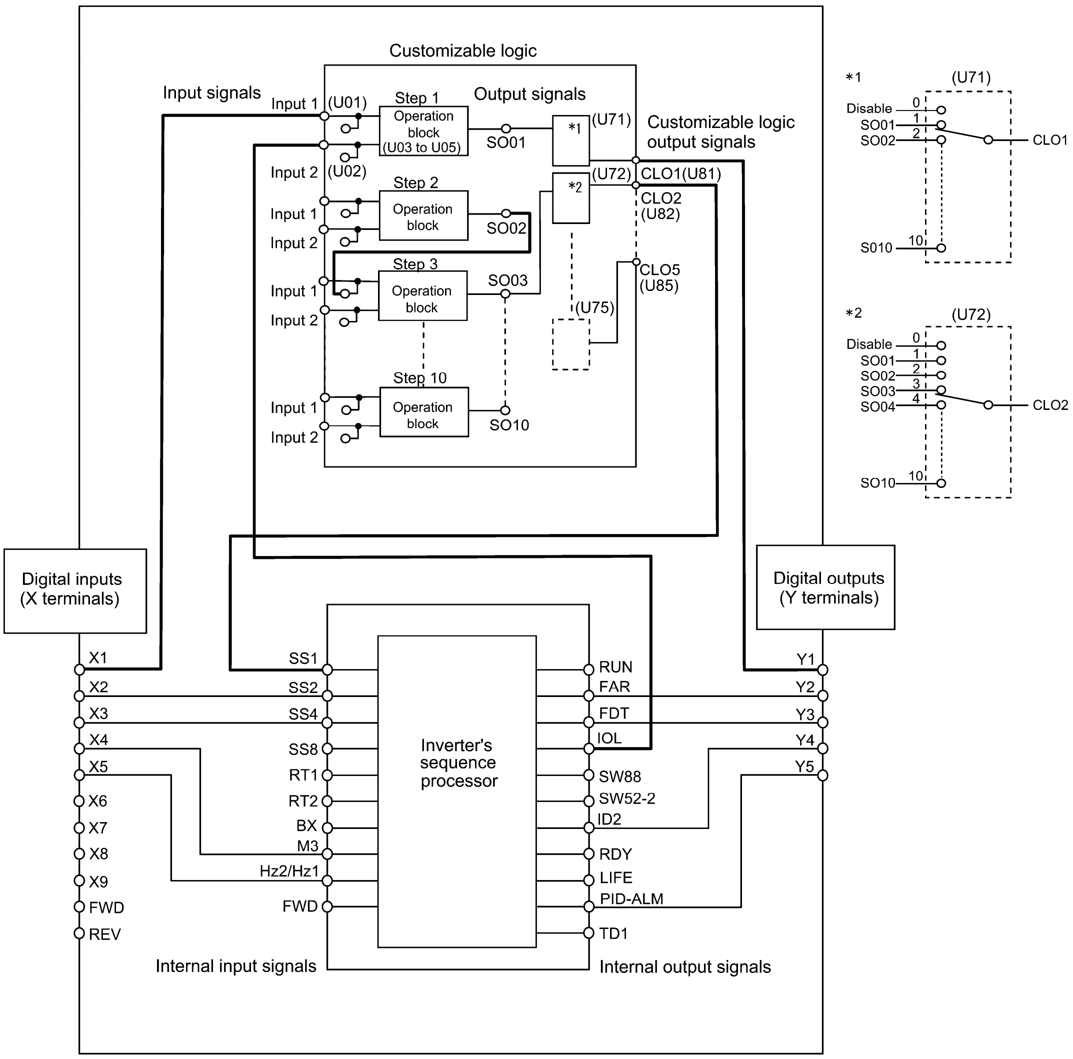


Fig. 5.4-126

■ Customizable Logic (Mode selection) (U00)

It specifies whether to enable the sequence configured with the customizable logic function or disable it to run the inverter only via its input terminals and others.

Table 5.4-176

Data for U00	Function
0	Disable
1	Enable (Customizable logic operation)

■ Customizable Logic (Operation Setting) (U01 to U50)

In a customizable logic, one step is composed of the components shown in the following block diagram.

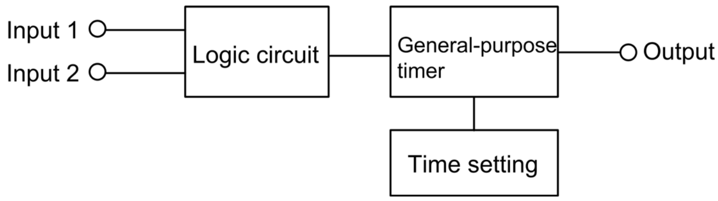


Fig. 5.4-127

Table 5.4-177 Setting of function codes for each step

Step No.	Input 1	Input 2	Logic circuit	General-purpose timer	Time setting	Output Note)
Step 1	U01	U02	U03	U04	U05	***SO01***
Step 2	U06	U07	U08	U09	U10	***SO02***
Step 3	U11	U12	U13	U14	U15	***SO03***
Step 4	U16	U17	U18	U19	U20	***SO04***
Step 5	U21	U22	U23	U24	U25	***SO05***
Step 6	U26	U27	U28	U29	U30	***SO06***
Step 7	U31	U32	U33	U34	U35	***SO07***
Step 8	U36	U37	U38	U39	U40	***SO08***
Step 9	U41	U42	U43	U44	U45	***SO09***
Step 10	U46	U47	U48	U49	U50	***SO10***

Note) Output is not the function code It indicates the output signal signs.

■ Inputs 1 and 2 (U01, U02, etc.)

The following signals are available as input signals.

Table 5.4-178

Data	Selectable Signal
0000 (1000) to 0105 (1105)	General-purpose output signals (Same as signals used in E20: ***RUN*** during running, ***FAR*** frequency (speed) arrival signal, ***FDT*** frequency (speed) detected, ***LU*** while stopping in undervoltage, ***B/D*** Torque polarity detected) Note) 27 (Universal DO) is not available.
2001 (3001)	Output of step 1 ***SO01***
2002 (3002)	Output of step 2 ***SO02***
2003 (3003)	Output of step 3 ***SO03***
2004 (3004)	Output of step 4 ***SO04***
2005 (3005)	Output of step 5 ***SO05***
2006 (3006)	Output of step 6 ***SO06***
2007 (3007)	Output of step 7 ***SO07***

Data	Selectable Signal
2008 (3008)	Output of step 8 ***SO08***
2009 (3009)	Output of step 9 ***SO09***
2010 (3010)	Output of step 10 ***SO10***
4001 (5001)	X1 terminal input signal, ***X1***
4002 (5002)	X2 terminal input signal ***X2***
4003 (5003)	X3 terminal input signal ***X3***
4004 (5004)	X4 terminal input signal ***X4***
4005 (5005)	X5 terminal input signal ***X5***
4006 (5006)	X6 terminal input signal ***X6***
4007 (5007)	X7 terminal input signal ***X7***
4008 (5008)	X8 terminal input signal ***X8***
4009 (5009)	X9 terminal input signal ***X9***
4010 (5010)	FWD terminal input signal ***FWD***
4011 (5011)	REV terminal input signal ***REV***
6000 (7000)	Final run command RUN ***FL_RUN***: ON when frequency command is not 0 and a run command is given.
6001 (7001)	Final run command FWD ***FL_FWD***: ON when frequency command is not 0, and a run forward command is given.
6002 (7002)	Final run command REV ***FL_REV***: ON when frequency command is not 0, and a run reverse command is given.
6003 (7003)	During acceleration ***DACC***: ON during acceleration
6004 (7004)	During deceleration ***DDEC***: ON during deceleration
6005 (7005)	Under anti-regenerative control ***REGA***: ON under anti-regenerative control
6006 (7006)	Within dancer basic position ***DR_REF***: ON when the dancer roll position is within the reference range
6007 (7007)	Alarm factor presence ***ALM_ACT***: ON when there is no alarm factor

■ Logic circuit (U03, etc.)

Any of the following functions is selectable as a logic circuit (with general-purpose timer).

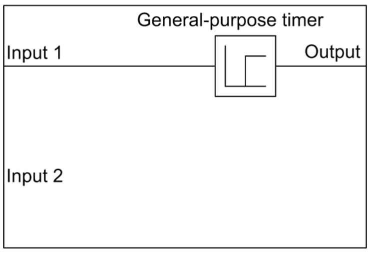
Table 5.4-179

Data	Function	Description
0	No function assigned	Output is always OFF.
1	Through output + General-purpose timer	Only a general-purpose timer. No logic circuit exists.
2	ANDing + General-purpose timer	AND circuit with 2 inputs and 1 output, plus general-purpose timer.
3	ORing + General-purpose timer	OR circuit with 2 inputs and 1 output, plus general-purpose timer.
4	XORing + General-purpose timer	XOR circuit with 2 inputs and 1 output, plus general-purpose timer.
5	Set priority flip-flop + General-purpose timer	Set priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
6	Reset priority flip-flop + General-purpose timer	Reset priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
7	Rising edge detector + General-purpose timer	Rising edge detector with 1 input and 1 output, plus general-purpose timer. This detects the rising edge of an input signal and outputs the ON signal for 2 ms.
8	Falling edge detector + General-purpose timer	Falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects the falling edge of an input signal and outputs the ON signal for 2 ms.

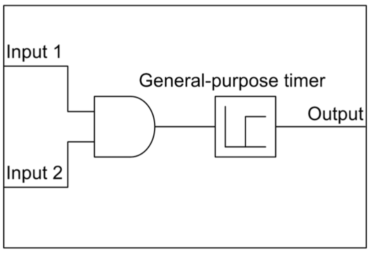
Data	Function	Description
9	Rising & falling edges detector + General-purpose timer	Rising and falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects both the falling and rising edges of an input signal and outputs the ON signal for 2 ms.
10	Hold + General-purpose timer	Hold function of previous values of 2 inputs and 1 output, plus general-purpose timer. When the hold control signal is off, the input signal is output. When the hold control signal is on, the value before the input signal is kept.
11	Increment counter	Increment counter with reset input. By the rising edge of an input signal, the logic circuit increments the counter value by one. When the counter value reaches the target one, the output signal turns on. Turning the reset signal on resets the counter value to zero.
12	Decrement counter	Decrement counter with reset input. By the rising edge of an input signal, the logic circuit decrements the counter value by one. When the counter value reaches zero, the output signal turns on. Turning the reset signal on resets the counter to the initial value.
13	Timer with reset input	Timer output with reset function. If an input signal turns on, the output signal turns on and the timer starts. When the period specified by the timer has elapsed, the output signal turns off, regardless of the input signal state. Turning the reset signal on resets the current timer value to zero and turns the output off.

The block diagrams for individual functions are given below.

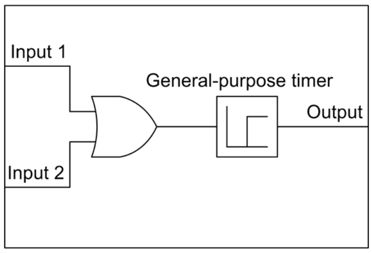
(1) Through output



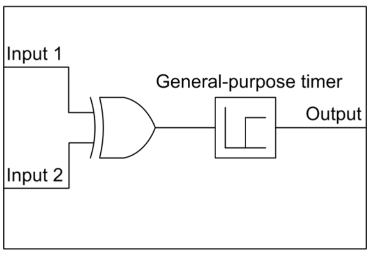
(2) Logical multiplication



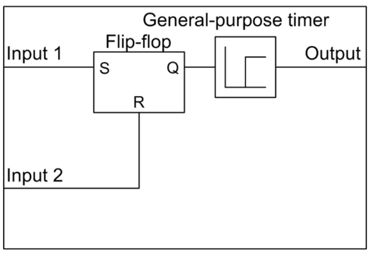
(3) Logical sum



(4) XORing

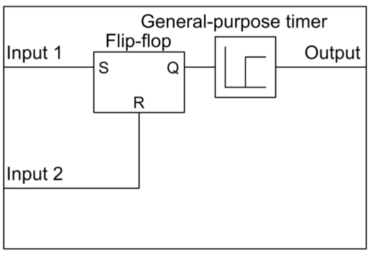


(5) Set priority flip-flop



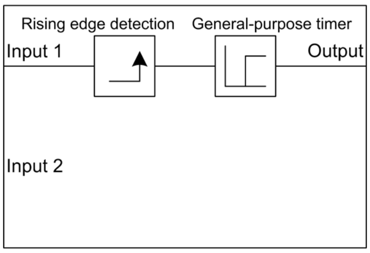
Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
	ON	-	OFF	
ON	-	-	ON	Set priority

(6) Reset priority flip-flop

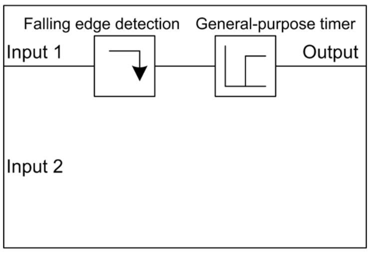


Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
-	ON	-	OFF	Reset priority
ON	OFF	-	ON	

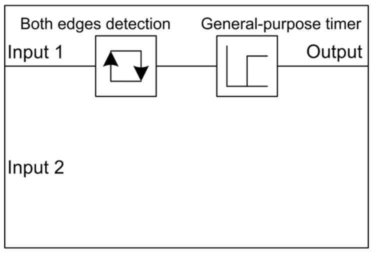
(7) Rise detect



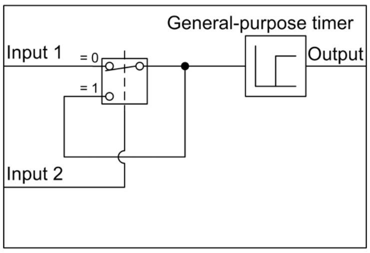
(8) Falling edge detect



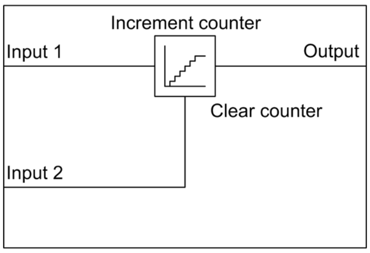
(9) Both edge detect



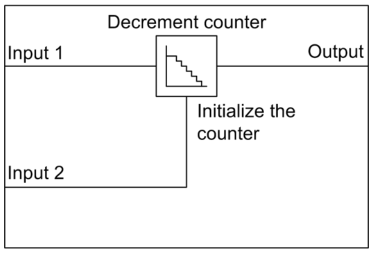
(10) Hold



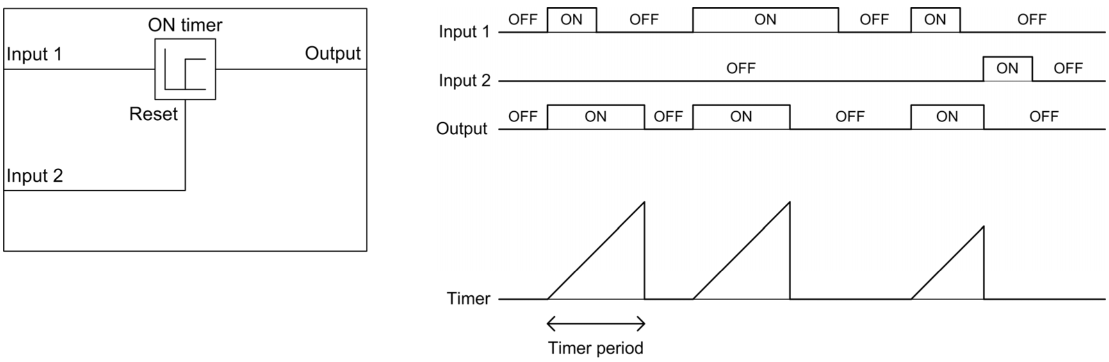
(11) Up counter



(12) Down counter



(13) Timer with reset input



■ General-purpose timer (U04, etc.)

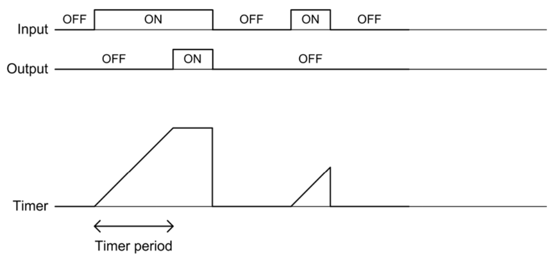
As a general-purpose timer, the following timers can be selected.

Table 5.4-180

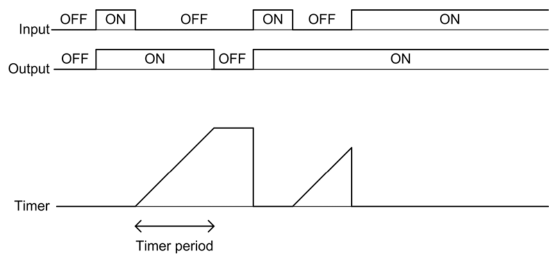
Data	Function	Description
0	No timer	
1	On-delay timer	Turning the input signal on starts the on-delay timer. When the period specified by the timer has elapsed, an output signal turns on. Turning the input signal off turns the output signal off.
2	Off-delay timer	Turning an input signal on turns an output signal on. Turning the input signal off starts the off-delay timer. When the period specified by the timer has elapsed, the output signal turns off.
3	Pulse (one-shot)	Turning an input signal on outputs a one-shot pulse of the set timer.
4	Retriggerable timer	Turning an input signal on outputs a one-shot pulse of the set timer. However, while outputting the one-shot pulse, if the input off -> on edge occurs again, output the one-shot pulse one more time.
5	Pulse train output	When the input turns on, the ON pulse and OFF pulse of the set timer is repeatedly output. This function is used to flash a luminescent device.

The operation charts for individual timers are shown below.

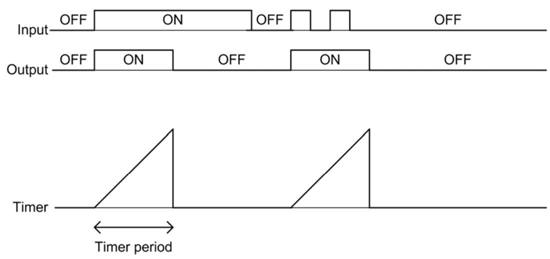
(1) On-delay timer



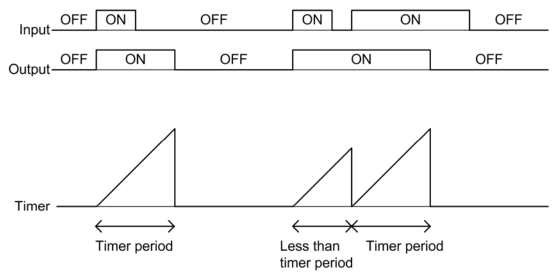
(2) Off-delay timer



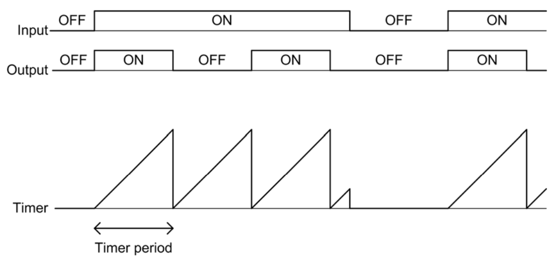
(3) Pulse (1 shot)



(4) Retriggerable timer



(5) Pulse train output



■ Time setting (U05, etc.)

Setting of the general-purpose timer and setting of count number of the up/down counter are possible.

Table 5.4-181

Data	Function	Description
0.00 to 600.00	Timer period	The period is specified by seconds.
	Counter value	The specified value is multiplied by 100 times. (If 0.01 is specified, it is converted to 1.)

■ Output Signal

Each step of the customizable logic is output to S001 to S010.

Settings of output s001 to S010 are different depending on the connecting target as shown in the following table. (When connecting to any function other than the customizable logic, connect via the customizable logic output (CL01 to CL05).

Table 5.4-182

Connecting destination of output of each step	Setting Method	Function Code
Customizable logic input	By using the customizable logic input setting, select an internal step output signal ***SO01*** to ***SO10***.	U01, U02, etc.
Input to the inverter's sequence process ("Select multi-frequency" ***SS1***, Run forward ***FWD***, etc.)	Select one of the internal step output signals ***SO01*** to ***SO10*** to be connected to customizable logic output signals 1 to 5 (***CLO1*** to ***CLO5***).	U71 to U75
	Selects an input function of the inverter sequence process connecting to the customizable logic output signals 1 or 5 (***CLO1*** to ***CLO5***). (Same as in E01)	U81 to U85
General-purpose digital output (terminal [Y])	Select the internal step output signals ***SO01*** to ***SO10*** to be connected to customizable logic output signals 1 to 5 (***CLO1*** to ***CLO5***).	U71 to U75
	To set the general-purpose output (terminal [Y]) to be connected to the customizable logic output signal 1 to 5 (***CL01*** to ***CL05***), select ***CL01*** to ***CL05*** at the general purpose digital output (terminal [Y]) function selection side.	E20 to E24, E27

Note The general-purpose digital output (terminal [Y]) updates the data in 5 ms interval. To surely output the customizable logic signal, turn on the on-delay and off-delay. Otherwise, short ON/OFF signal may not be reflected on terminal [Y].

Table 5.4-183

Function Code	Name	Data Setting Range	Default Setting
U71	Customizable logic output signal 1 (Output selection)	0: Disable 1: Output of step 1 ***SO01*** 2: Output of step 2 ***SO02*** 3: Output of step 3 ***SO03*** 4: Output of step 4 ***SO04*** 5: Output of step 5 ***SO05*** 6: Output of step 6 ***SO06*** 7: Output of step 7 ***SO07*** 8: Output of step 8 ***SO08*** 9: Output of step 9 ***SO09*** 10: Output of step 10 ***SO10***	0
U72	Customizable logic output signal 2 (Output selection)		0
U73	Customizable logic output signal 3 (Output selection)		0
U74	Customizable logic output signal 4 (Output selection)		0
U75	Customizable logic output signal 5 (Output selection)		0

Function Code	Name	Data Setting Range	Default Setting
U81	Customizable logic output signal 1 (Function selection)	0 to 100, 1000 to 1081 (Same as terminal function selection of E98 and E99) However, the following functions cannot be selected. 19 (1019): Edit accept command (Data change possible) 80 (1080): Cancel customizable logic	100
U82	Customizable logic output signal 2 (Function selection)		100
U83	Customizable logic output signal 3 (Function selection)		100
U84	Customizable logic output signal 4 (Function selection)		100
U85	Customizable logic output signal 5 (Function selection)		100

■ Notes for using a customizable logic

A customizable logic performs processing every 2 ms in the following sequence.

(1) At the beginning of the process, latch the external input signals to all customizable logics in step 1 to 10 to ensure simultaneity.

(2) Logical operations are performed in an order of steps 1 to 10.

(3) In case the output of one step becomes the input of the next step, the step output, of which output is highly prioritized, can be used in the same process.

(4) The customizable logic updates all of the five output signals simultaneously.

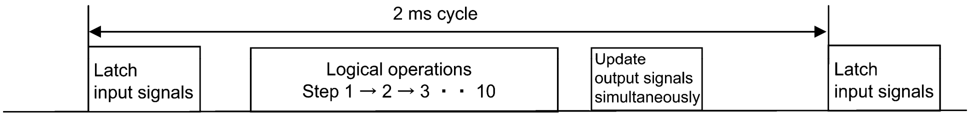


Fig. 5.4-128

When configuring the logic circuit, be sure to consider the processing order of the customizable logic. Otherwise, signal delay due to slow processing of the logic calculation occurs, causing failure of obtaining expected output, delayed operation, or output of hazard signals.

⚠CAUTION

When the function code (ex. U code) relating to the customizable logic is changed, or when the customizable logic cancel signal ***CLC*** is turned on, the operation sequence may change in some settings, and the operation unexpectedly and suddenly starts, causing danger. Secure sufficient safety before executing the process.

An accident or injuries could occur.

■ Customizable logic timer monitor (Step selection) (U91)

To monitor the timer operation status in the customizable logic, the monitor function codes and keypad can be used.

Selecting the monitor timer

Table 5.4-184

Function Code	Function	Remarks
U91	1 to 10: Sets the step number of the timer counter is to be monitored	

Monitoring Method

Table 5.4-185

Monitoring Method	Function Code and LED Monitor	Contents
Communication	X90 Customizable logic (Timer monitor)	Data of the timer counter value set in U91 (dedicated to monitoring)
Keypad	I/O check: 4_24	

■ Cancel customizable logic ***CLC*** (Function code: E01 to E09, data = 80)

During the maintenance or other required timing, the customizable logic operation can be temporarily invalidated, so that the separate operations becomes possible regardless of the logic circuit of customizable logic and timer operation.

Table 5.4-186

CLC	Function
OFF	Enable customizable logic (Depends on the U00 setting)
ON	Disable customizable logic

Note When the customizable logic cancel signal ***CLC*** is turned on, the sequence by the customizable logic disappears, and there are dangerous cases that the performance suddenly starts. Secure the safety, check the performance, and then switch the operation.

■ Clear all customizable logic timers ***CLTC*** (Function code: E01 to E09, data = 81)

When the CLTC terminal function is assigned to general-purpose input terminal and turned on, all general-purpose timers and counters in the customizable logic are reset. Use this terminal when the timings between the external sequence and the internal customizable logic do not match due to a momentary power failure or other reasons so that resetting and restarting the system is required.

Table 5.4-187

CLTC	Function
OFF	Ordinary operation
ON	Resets all of the general-purpose timers and counters in the customizable logic. (To operate the timers and counters again, revert ***CLTC*** to off.)

■ Customizable logic configuration samples

Configuration sample 1: Switching two or more signals by operating a single switch

When the motor 2/1 and the torque limit 2/torque limit 1 are simultaneously switched by using one switch, using general-purpose input terminal can be reduced to one by replacing the external circuit, which was conventionally needed, to the customizable logic.

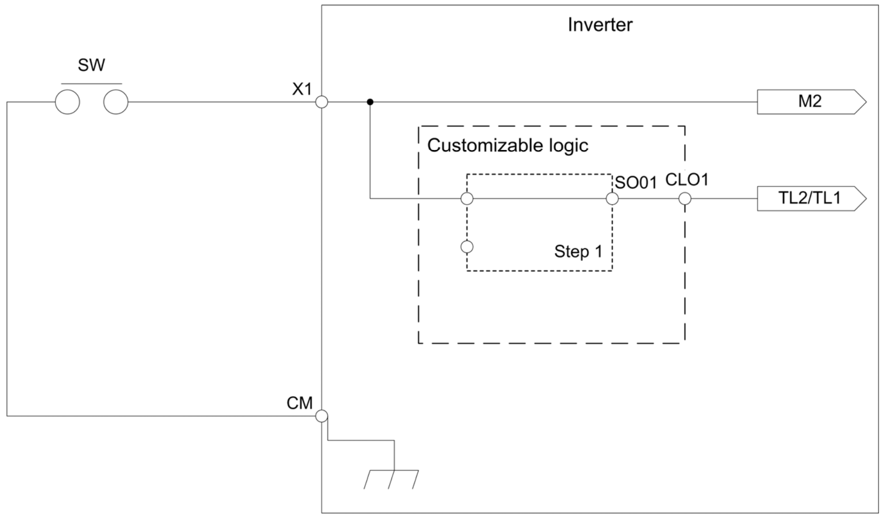


Fig. 5.4-129

To configure the above customizable logic, set function codes as follows. (Timer selection) and (Time setting) require no modification unless otherwise specified.

Table 5.4-188

Function Code			Setting Data	Setting Contents	Remarks
E01	Terminal X1 (Function selection)		12	Select motor 2 ***M2***	Parallel use is possible also as general-purpose input terminal.
U00	Customizable Logic (Operation selection)		1	Enable	
U01	Customizable Logic: Step 1	(Input 1)	4001	X1 terminal input signal ***X1***	
U03		(Logic circuit)	1	Through output + General-purpose timer	Operation selection
U71	Customizable Logic Output Signal 1	(Output selection)	1	Output of step 1 ***SO01***	
U81		(Function selection)	14	Torque limit 2/Torque limit 1 ***TL2/TL1***	

Configuration sample 2: Put two or more output signals into one

When the RUN signal of the general-purpose output is kept on during the restarting from momentary power failure, replace the external circuit, which was conventionally required, to the customizable logic. In this way, the using general-purpose output terminals and external relays can be reduced.

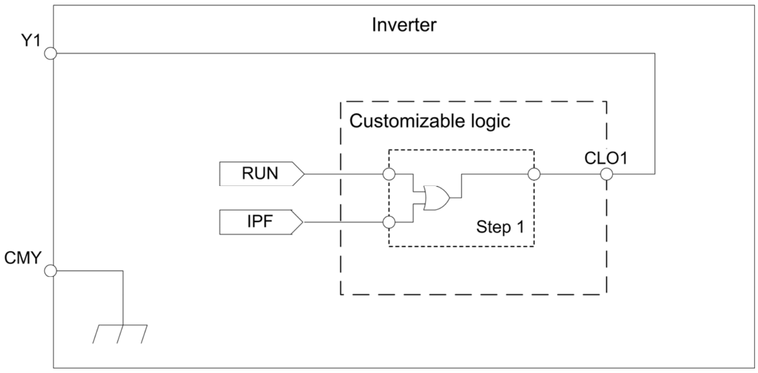


Fig. 5.4-130

To configure the above customizable logic, set function codes as listed below. (Timer selection) and (Time setting) require no modification unless otherwise required.

Table 5.4-189

Function Code			Setting Data	Setting Contents	Remarks
E20	Terminal Y1 (Function selection)		111	Customizable logic output signal 1 ***CLO1***	
U00	Customizable logic (Operation selection)		1	Operation	
U01	Customizable logic: Step 1	(Input 1)	0	Running ***RUN***	
U02		(Input 2)	6	Auto-restarting after momentary power failure *IPF*	
U03		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U71	Customizable logic Output signal 1	(Output selection)	1	Output of step 1 ***SO01***	
U81		(Function selection)	100	No function ***NONE***	

Configuration sample 3: One-shot operation

When starting the inverter by short-circuiting the SW-FWD or SW-REV switch and stopping it by short-circuiting the SW-STOP switch (which are functionally equivalent to depression of the RUN and STOP keys on the keypad, respectively), the external circuit, which was conventionally necessary, can be replaced to the customizable logic.

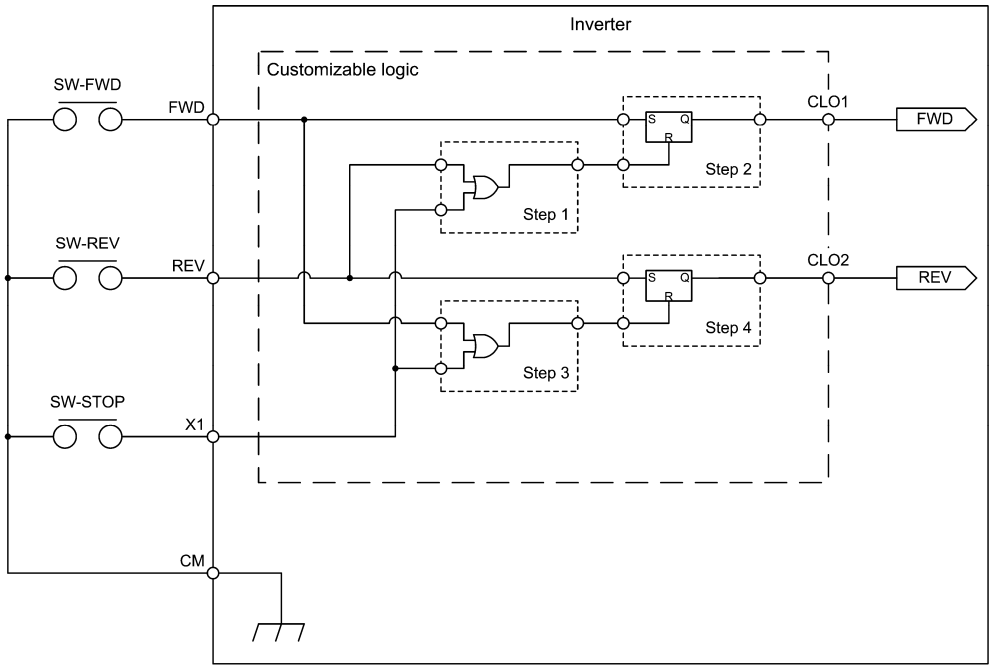


Fig. 5.4-131

To configure the above customizable logic, set function codes as follows. (Timer selection) and (Time setting) require no modification unless otherwise required.

Table 5.4-190

Function Code			Setting Data	Setting Contents	Remarks
E01	Terminal X1 (Function selection)		100	No function ***NONE***	
E98	Terminal FWD (Function selection)		100	No function ***NONE***	
E99	Terminal REV (Function selection)		100	No function ***NONE***	
U00	Customizable logic (Operation selection)		1	Enable	
U01	Customizable logic: Step 1	(Input 1)	4011	REV terminal input signal ***REV***	
U02		(Input 2)	4001	X1 terminal input signal ***X1***	
U03		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U06	Customizable logic: Step 2	(Input 1)	4010	FWD terminal input signal ***FWD***	
U07		(Input 2)	2001	Output of step 1 ***SO01***	
U08		(Logic circuit)	6	Reset priority flip-flop + General-purpose timer	Operation selection
U11	Customizable logic: Step 3	(Input 1)	4010	FWD terminal input signal ***FWD***	
U12		(Input 2)	4001	X1 terminal input signal ***X1***	
U13		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U16	Customizable logic: Step 4	(Input 1)	4011	REV terminal input signal ***REV***	
U17		(Input 2)	2003	Output of step 3 ***SO03***	
U18		(Logic circuit)	6	Reset priority flip-flop + General-purpose timer	Operation selection

Function Code			Setting Data	Setting Contents	Remarks
U71	Customizable logic output signal 1	(Output selection)	2	Output of step 2 ***SO02***	***FWD*** command
U72	Customizable logic output signal 2		4	Output of step 4 ***SO04***	***REV*** command
U81	Customizable logic output signal 1	(Function selection)	98	Run forward, stop command ***FWD***	
U82	Customizable logic output signal 2		99	Run reverse, stop command ***REV***	

Configuration sample 4: Pattern operation

Driving while switching the set frequency and acceleration/deceleration time at specified time intervals is called "Pattern operation." The configuration that enables pattern operation in the customizable logic is as follows.

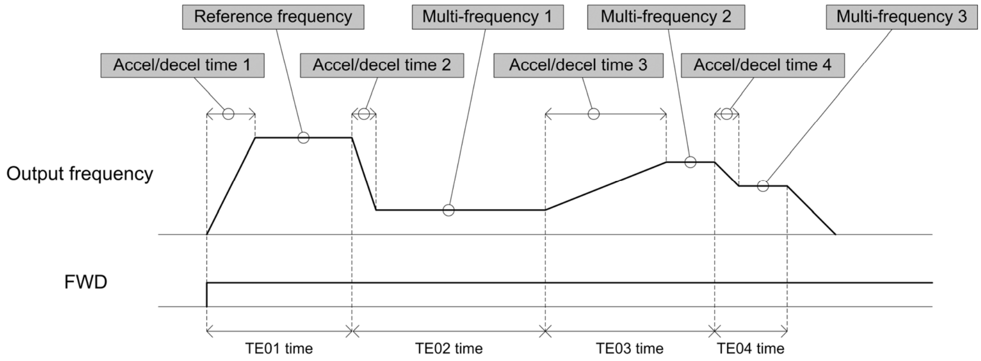


Fig. 5.4-132 Application setting of pattern operation for each stage

(1) A single cycle of pattern operation and stop

This sample carries out a cycle of the specified pattern operation and stops the inverter output.

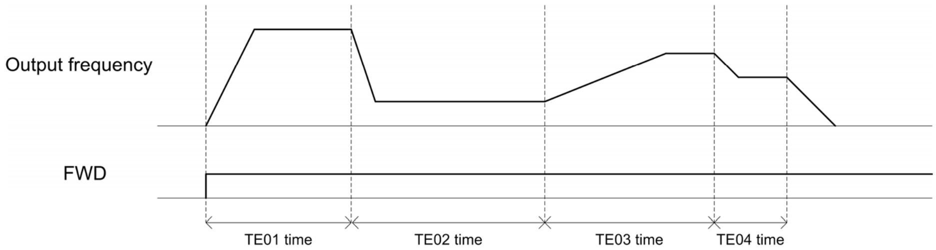


Fig. 5.4-133 Timing chart of pattern operation (stop after one cycle)

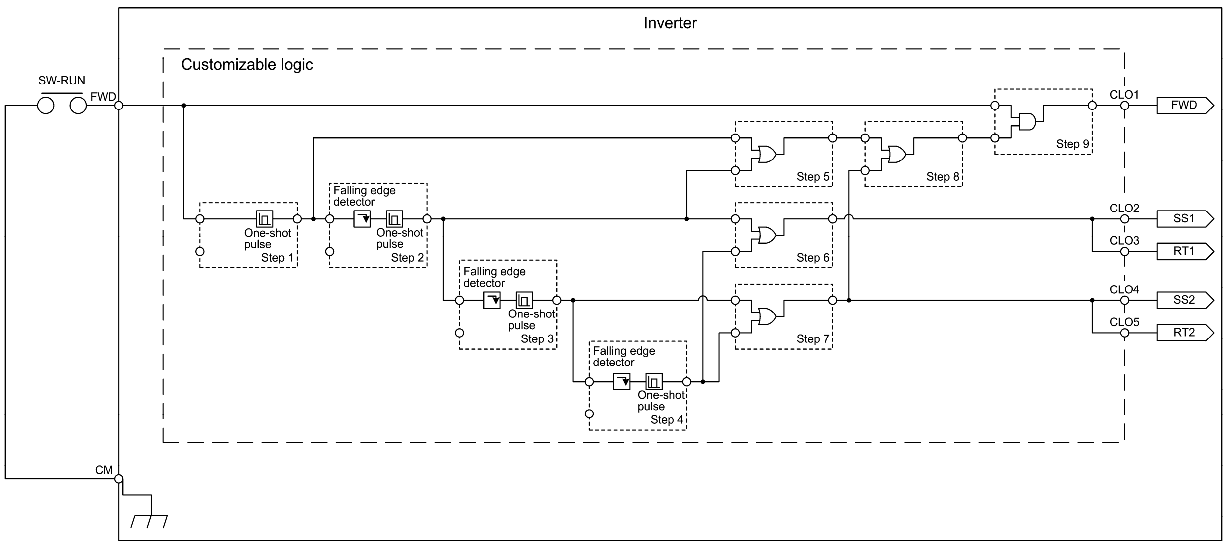


Fig. 5.4-134 Customizable logic configuration for pattern operation (stop after one cycle)

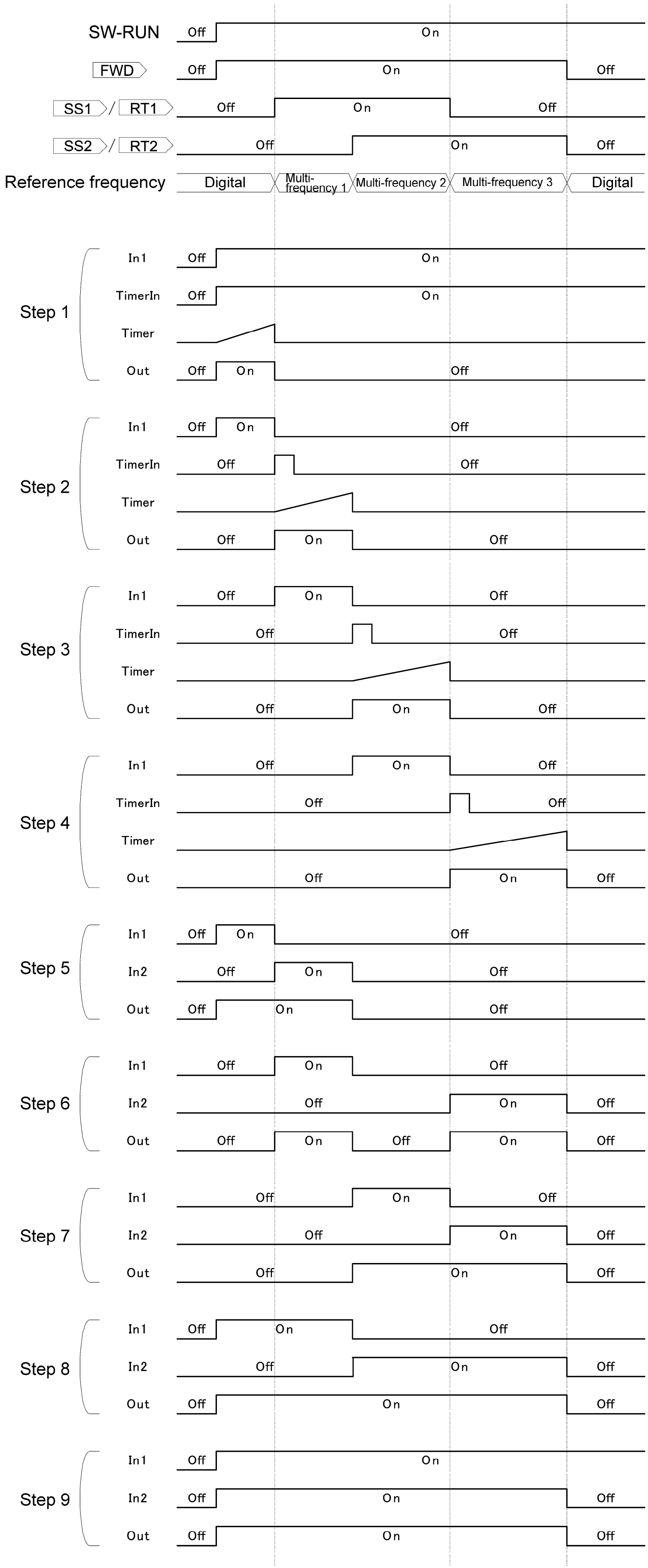


Fig. 5.4-135 Operation chart of customizable logic steps 1 to 9 for pattern operation (stop after one cycle)

Chapter 5 Function Code

Details of Function Codes
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
U00 to U91
y codes

To configure the above customizable logic, set function codes as follows. (Timer selection) and (Time setting) require no modification unless otherwise required.

Table 5.4-191

Function Code			Setting Data	Setting Contents	Remarks
E98	Terminal FWD (Function selection)		100	No function ***NONE***	
U00	Customizable logic (Operation selection)		1	Enable	
U01	Customizable logic: Step 1	(Input 1)	4010	FWD terminal input signal ***FWD***	
U03		(Logic circuit)	1	Through output + General-purpose timer	Operation selection
U04		(Timer selection)	3	Pulse (one-shot)	
U05		(Time setting)	Any value	Stage 1 run time	
U06	Customizable logic: Step 2	(Input 1)	2001	Output of step 1 ***SO01***	
U08		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U09		(Timer selection)	3	Pulse (one-shot)	
U10		(Timer setting)	Any value	Stage 2 run time	
U11	Customizable logic: Step 3	(Input 1)	2002	Output of step 2 ***SO02***	
U13		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U14		(Timer selection)	3	Pulse (one-shot)	
U15		(Time setting)	Any value	Stage 3 run time	
U16	Customizable logic: Step 4	(Input 1)	2003	Output of step 3 ***SO03***	
U18		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U19		(Timer selection)	3	Pulse (one-shot)	
U20		(Timer setting)	Any value	Stage 4 run time	
U21	Customizable logic: Step 5	(Input 1)	2001	Output of step 1 ***SO01***	
U22		(Input 2)	2002	Output of step 2 ***SO02***	
U23		(Logic circuit)	3	ORing + General-purpose timer	
U26	Customizable logic: Step 6	(Input 1)	2002	Output of step 2 ***SO02***	
U27		(Input 2)	2004	Output of step 4 ***SO04***	
U28		(Logic circuit)	3	ORing + General-purpose timer	
U31	Customizable logic: Step 7	(Input 1)	2003	Output of step 3 ***SO03***	
U32		(Input 2)	2004	Output of step 4 ***SO04***	
U33		(Logic circuit)	3	ORing + General-purpose timer	
U36	Customizable logic: Step 8	(Input 1)	2005	Output of step 5 ***SO05***	
U37		(Input 2)	2007	Output of step 7 ***SO07***	
U38		(Logic circuit)	3	ORing + General-purpose timer	
U41	Customizable logic: Step 9	(Input 1)	4010	FWD terminal input signal ***FWD***	
U42		(Input 2)	2008	Output of step 8 ***SO08***	
U43		(Logic circuit)	2	ANDing + General-purpose timer	

Function Code			Setting Data	Setting Contents	Remarks
U71	Customizable logic output signal 1	(Output selection)	9	Output of step 9 ***SO09***	***FWD*** command
U72	Customizable logic output signal 2		6	Output of step 6 ***SO06***	***SS1*** command
U73	Customizable logic output signal 3		6	Output of step 6 ***SO06***	***RT1*** command
U74	Customizable logic output signal 4		7	Output of step 7 ***SO07***	***SS2*** command
U75	Customizable logic output signal 5		7	Output of step 7 ***SO07***	***RT2*** command
U81	Customizable logic output signal 1	(Function selection)	98	Run forward, stop command ***FWD***	
U82	Customizable logic output signal 2		0	Select multi-frequency (0 to 1 step), ***SS1***	
U83	Customizable logic output signal 3		4	Select ACC/DEC time (2 steps) ***RT1***	
U84	Customizable logic output signal 4		1	Select multi-frequency (0 to 3 steps), ***SS2***	
U85	Customizable logic output signal 5		5	Select ACC/DEC time (4 steps) ***RT2***	

(2) Repeating of pattern operation

This sample carries out the specified pattern operation repeatedly and stops upon receipt of a stop command.

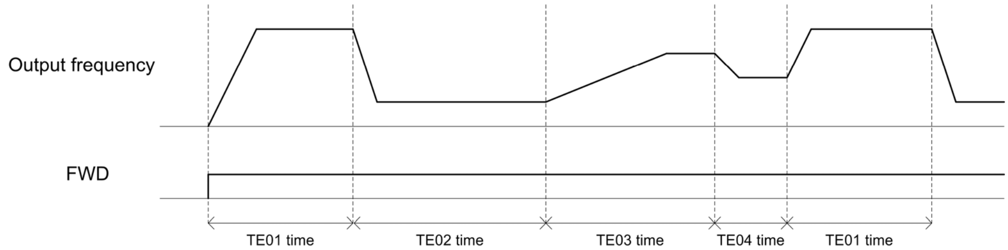


Fig. 5.4-136 Timing chart of pattern operation (repeating)

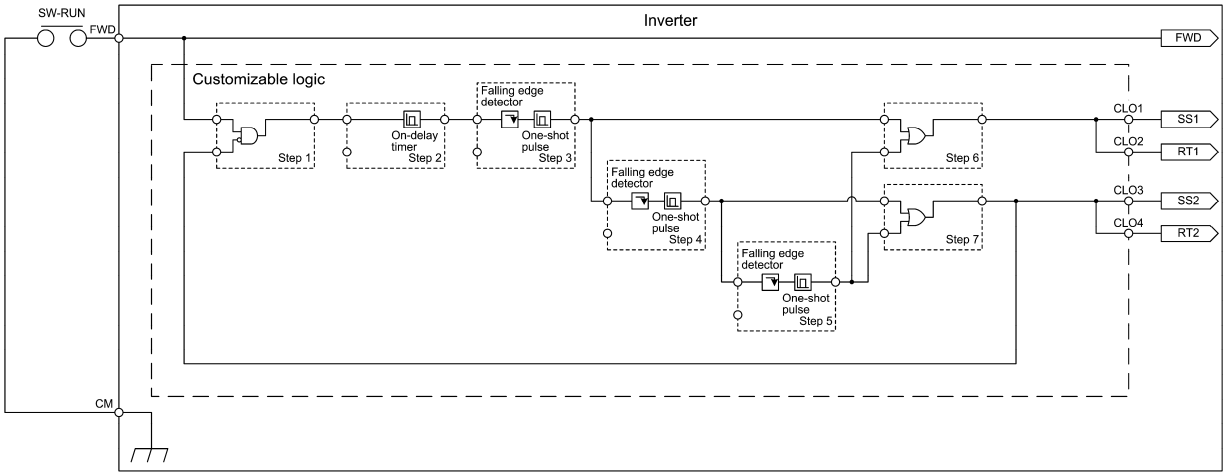


Fig. 5.4-137 Customizable logic configuration for pattern operation (repeating)

To configure the above customizable logic, set function codes as follows. (Timer selection) and (Time setting) require no modification unless otherwise required.

Table 5.4-192

Function Code			Setting Data	Setting Contents	Remarks
E98	Terminal FWD (Function selection)		98	Run forward, stop command ***FWD***	
U00	Customizable logic (Operation selection)		1	Enable	
U01	Customizable logic: Step 1	(Input 1)	4010	FWD terminal input signal ***FWD***	
U02		(Input 2)	3007	Output of step 7 (negative logic) ***SO07***	
U03		(Logic circuit)	2	ANDing + General-purpose timer	
U06	Customizable logic: Step 2	(Input 1)	2001	Output of step 1 ***SO01***	
U08		(Logic circuit)	1	Through output + General-purpose timer	Operation selection
U09		(Timer selection)	1	On-delay timer	
U10		(Timer setting)	Any value	Stage 1 run time	
U11	Customizable logic: Step 3	(Input 1)	3002	Output of step 2 (negative logic) ***SO02***	
U13		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U14		(Timer selection)	3	Pulse (one-shot)	
U15		(Timer setting)	Any value	Stage 2 run time	
U16	Customizable logic: Step 4	(Input 1)	2003	Output of step 3 ***SO03***	
U18		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U19		(Timer selection)	3	Pulse (one-shot)	
U20		(Timer setting)	Any value	Stage 3 run time	
U21	Customizable logic: Step 5	(Input 1)	2004	Output of step 4 ***SO04***	
U23		(Logic circuit)	8	Falling edge detector + General-purpose timer	
U24		(Timer selection)	3	Pulse (one-shot)	
U25		(Timer setting)	Any value	Stage 4 run time	
U26	Customizable logic: Step 6	(Input 1)	2003	Output of step 3 ***SO03***	
U27		(Input 2)	2005	Output of step 5 ***SO05***	
U28		(Logic circuit)	3	ORing + General-purpose timer	
U31	Customizable logic: Step 7	(Input 1)	2004	Output of step 4 ***SO04***	
U32		(Input 2)	2005	Output of step 5 ***SO05***	
U33		(Logic circuit)	3	ORing + General-purpose timer	
U71	Customizable logic output signal 1	(Output selection)	6	Output of step 6 ***SO06***	***SS1*** command
U72	Customizable logic output signal 2		6	Output of step 6 ***SO06***	***RT1*** command
U73	Customizable logic output signal 3		7	Output of step 7 ***SO07***	***SS2*** command
U74	Customizable logic output signal 4		7	Output of step 7 ***SO07***	***RT2*** command

Function Code			Setting Data	Setting Contents	Remarks
U81	Customizable logic output signal 1	(Function selection)	0	Select multi-frequency (0 to 1 step), ***SS1***	
U82	Customizable logic output signal 2		4	Select ACC/DEC time (2 steps) ***RT1***	
U83	Customizable logic output signal 3		1	Select multi-frequency (0 to 3 steps), ***SS2***	
U84	Customizable logic output signal 4		5	Select ACC/DEC time (4 steps) ***RT2***	

(3) Operation continuation after one cycle operation

This sample carries out one cycle of pattern operation and continues to run with the output frequency applied for the final operation.

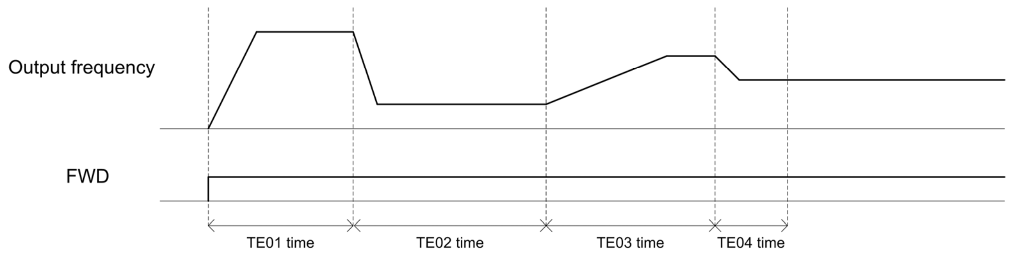


Fig. 5.4-138 Timing chart of pattern operation (operation continuation)

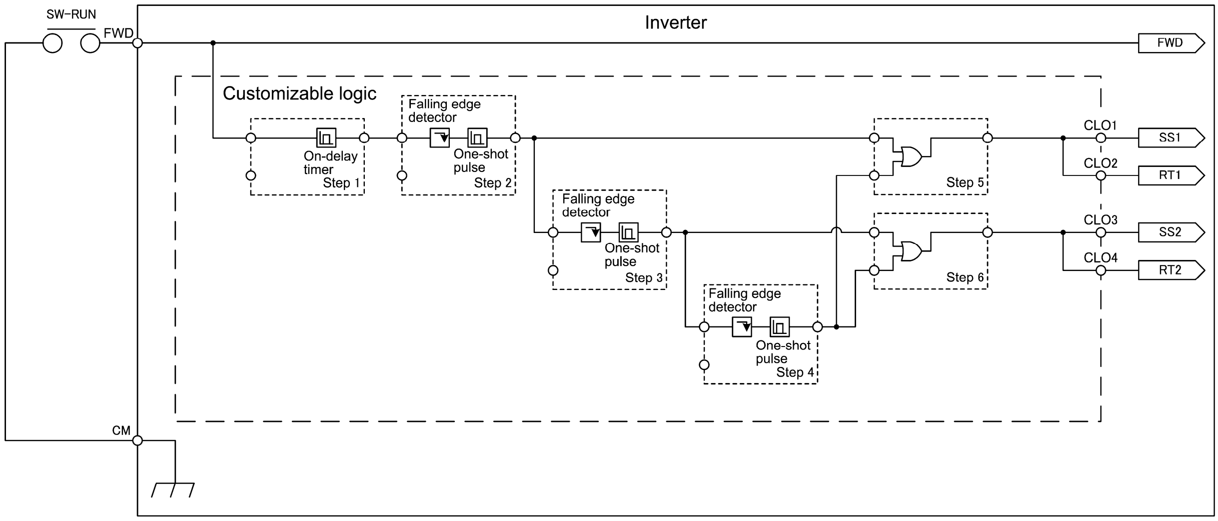


Fig. 5.4-139 Customizable logic configuration for pattern operation (operation continuation)

To configure the above customizable logic, set function codes as follows. (Timer selection) and (Time setting) require no modification unless otherwise required.

Table 5.4-193

Function Code			Setting Data	Setting Contents	Remarks
E98	Terminal FWD (Function selection)		98	Run forward, stop command ***FWD***	
U00	Customizable logic (Operation selection)		1	Enable	
U01	Customizable logic: Step 1	(Input 1)	4010	FWD terminal input signal ***FWD***	
U03		(Logic circuit)	1	Through output + General-purpose timer	Operation selection
U04		(Timer selection)	1	On-delay timer	
U05		(Timer setting)	Any value	Stage 1 run time	
U06	Customizable logic: Step 2	(Input 1)	3001	Output of step 1 (negative logic) ***SO01***	
U08		(Logic circuit)	8	Falling edge detector + General-purpose timer	Operation selection
U09		(Timer selection)	3	Pulse (one-shot)	
U10		(Timer setting)	Any value	Stage 2 run time	
U11	Customizable logic: Step 3	(Input 1)	2002	Output of step 2 ***SO02***	
U13		(Logic circuit)	8	Falling edge detector + General-purpose timer	Operation selection
U14		(Timer selection)	3	Pulse (one-shot)	
U15		(Timer setting)	Any value	Stage 3 run time	
U16	Customizable logic: Step 4	(Input 1)	2003	Output of step 3 ***SO03***	
U18		(Logic circuit)	8	Falling edge detector + General-purpose timer	Operation selection
U19		(Timer selection)	3	Pulse (one-shot)	
U20		(Timer setting)	Any value	Stage 4 run time	
U21	Customizable logic: Step 5	(Input 1)	2002	Output of step 2 ***SO02***	
U22		(Input 2)	2004	Output of step 4 ***SO04***	
U23		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U26	Customizable logic: Step 6	(Input 1)	2003	Output of step 3 ***SO03***	
U27		(Input 2)	2004	Output of step 4 ***SO04***	
U28		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U71	Customizable logic output signal 1	(Output selection)	5	Output of step 5 ***SO05***	***SS1*** command
U72	Customizable logic output signal 2		5	Output of step 5 ***SO05***	***RT1*** command
U73	Customizable logic output signal 3		6	Output of step 6 ***SO06***	***SS2*** command
U74	Customizable logic output signal 4		6	Output of step 6 ***SO06***	***RT2*** command

Function Code			Setting Data	Setting Contents	Remarks
U81	Customizable logic output signal 1	(Function selection)	0	Select multi-frequency (0 to 1 step), ***SS1***	
U82	Customizable logic output signal 2		4	Select ACC/DEC time (2 steps) ***RT1***	
U83	Customizable logic output signal 3		1	Select multi-frequency (0 to 3 steps), ***SS2***	
U84	Customizable logic output signal 4		5	Select ACC/DEC time (4 steps) ***RT2***	

5.4.10 y codes (Link functions)

y01 to y20	RS-485 Setting 1, RS-485 Setting 2

Up to two ports of RS-485 communications link are available.

Table 5.4-194

Ports	Connection Method	Function Code	Applicable Equipment
Port 1	RS-485 communications link (port 1) (via the RJ-45 connector prepared for keypad connection)	y01 through y10	Standard keypad Inverter support loader Host equipment (higher-level equipment)
Port 2	RS-485 communications link (port 2) via terminal block (DX+, DX-, and SD)	y11 through y20	Host equipment (higher-level equipment)

Outlines of each corresponding equipment are as follows.

(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) Inverter support loader (FRENIC loader)

When the computer, of which FRENIC loader is installed, is connected via the RS-485 communication (port 1), inverter support (monitoring, function code editing, test running) is possible.

For the settings of y codes, see the descriptions of function codes y01 to y10.

Note: FRENIC-MEGA series of inverters has a USB port on the keypad. When connecting to the inverter support loader via the USB port, simply set "1" (factory default) to the station address (y01).

(3) Host equipment (higher-level equipment)

The inverter can be controlled and monitored by connecting host equipment such as a host equipment (higher level equipment) such as the PLC and the controller. Modbus RTU* protocol and Fuji general-purpose inverter protocol are available for communications protocols.

* Modbus RTU is a protocol established by Modicon, Inc.

See the RS-485 Communication User's Manual for details.

■ Station address (y01, y11)

Station addresses of the RS-485 communications link can be set. The setting range is different for each protocol.

Table 5.4-195

Protocol	Range	Broadcast Address
Modbus RTU	1 to 247	0
Protocol for loader command	1 to 255	-
Fuji general-purpose inverter	1 to 31	99

- When the section outside of the range is specified, no response is returned.
- Match the setting, which is applied when the inverter support loader is used via RS-485 communication (port 1), to the computer side setting.

■ Operation selection when error generates (y02, y12)

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.

Table 5.4-196

y02, y12 Data	Function
0	Indicates the RS-485 communication error (Er-8 for y02 and Er-P for y12) and stops the operation immediately (alarm stop).
1	Operate for the time set to the error processing timer (y03, y13). Then, output the RS-485 communication error (Er-8 for Y02, Er-P for y12) to stop the operation (alarm stop).
2	The communication is retried during the time set to 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 (alarm stop).
3	Continues to run even when a communications error occurs.

See the RS-485 Communication User's Manual for details.

■ Timer operation time (y03, y13)

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)."

- Data setting range: 0.0 to 60.0 (s)

■ Baud rate (y04, y14)

This function sets the baud rate.

- In case of inverter support loader (via RS-485).
  Match to the computer setting.

Data for y04 and y14	Function
0	2400 bps
1	4800 bps
2	9600 bps
3	19200 bps
4	38400 bps

■ Data length selection (y05, y15)

y05 or y15 specifies the character length.

- In case of inverter support loader (via RS-485):
  It automatically becomes 8 bits; therefore, setting is unnecessary. (The same applies to the Modbus RTU.)

Data for y05 and y15	Function
0	8 bits
1	7 bits

■ Parity bit selection (y06, y16)

y06 or y16 specifies the parity bit.

- In case of inverter support loader (via RS-485). It automatically becomes even number parity; therefore, setting is unnecessary.

Data for y06 and y16	Function
0	No parity bit (In case of Modbus RTU, stop bit 2 bit)
1	Even parity (1 stop bit for Modbus RTU)
2	Odd parity (1 stop bit for Modbus RTU)
3	No parity bit (1 stop bit for Modbus RTU)

■ Stop bit selection (y07, y17)

y07 or y17 specifies the stop bits.

- In case of inverter support loader (via RS-485):
  No setting is required since the stop bits automatically become 1 bit.

  In case of Modbus RTU: The stop bit is automatically determined by interlocking with the parity bit; therefore, setting is unnecessary.

Data for y07 and y17	Function
0	2 bits
1	1 bit

■ No-response error detection time (y08, y18)

y08 or y18 detects the status, where no access is received for a certain amount of time from the equipment, which always accesses within a specified time to the station, due to open wire, etc. and sets the time to process the status as the communication error.

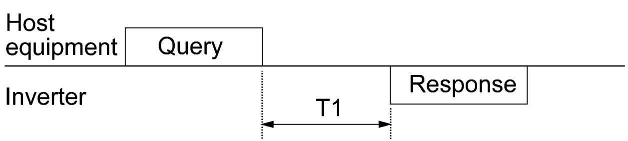
For the communication error handling, see y02 and y12.

Data for y08 and y18	Function
0	No-response is not detected.
1 to 60	Detection time of 1 to 60 (s)

■ Response interval time (y09, y19)

y09 or y19 specifies the latency time after the end of receiving a query sent from the host equipment (higher level equipment) such as a computer or PLC until the start of sending the response. This enables the inverter to control the response timing to match the host equipment that is slow in processing.

- Data setting range: 0.00 to 1.00 (s)



T1 = Response interval + α

α: Processing time inside of the inverter Varies depending on the timing and order.

See the RS-485 Communication User's Manual for details.

Note When configuring the inverter with FRENIC Loader via the RS-485 communications link, pay sufficient attention to the performance and configuration of the PC and protocol converter such as USB-RS-485 converter. (Some protocol converters monitor the communications status and switch between sending and receiving of transmission data with a timer.)

■ Protocol selection (y10, y20)

y10 or y20 specifies the communications protocol.

y10, y20 data	Function
0	Modbus RTU protocol
1	FRENIC Loader 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.

When the data are frequently re-written via the communications link, saving in the temporary memory is possible without writing to the nonvolatile storage. Using the temporary storage reduces the number of data writing times into the nonvolatile storage, preventing memory errors.

When y97 is set to "2," the data stored in the temporary memory are written in the nonvolatile memory.

Changing the y97 data requires simultaneous keying of "STOP key + ∧/∨ key."

Table 5.4-197

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 memory (After saving data, the y97 data automatically returns to "1.")

y98 Bus Function (Operation Selection) (See H30)

For the y98 bus function (operation selection) setting, see the description of function code H30.

y99 Loader Link Function (Operation Selection)

This is a link switching function for inverter support loader. By rewriting y99 by the inverter support loader (FRENIC loader), frequency command and operation command from the inverter support loader become effective. Since the data are rewritten by the inverter support loader, no keypad operation is required.

While the inverter support 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 the loader, disconnect the RS-485 communications cable (port 1) or the USB cable, connect a keypad instead, and reset the y99 data to "0." When the y99 data are set to 0, the command from the inverter support loader is detached, and the command is switched to the command by the own setting of the inverter (function code H30, etc.).

Note that the y99 data are not saved to the inverter. When the power is turned off, the data in y99 is lost and reset to "0."

Table 5.4-198

Data for y99	Function	
	Frequency Command	Run Command
0	Follow function codes H30 and y98	Follow function codes H30 and y98
1	Command from the FRENIC loader	Follow function codes H30 and y98
2	Follow function codes H30 and y98	Command from the FRENIC loader
3	Command from the FRENIC loader	Command from the FRENIC loader

Chapter 6

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

6.1 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 6.2 and onwards for troubleshooting.

Table 6.1-1

Protective Functions	Description	Related function code
"Heavy alarm" detection	This function detects an abnormal state, displays the corresponding alarm code on the keypad, and causes the inverter to trip. The "heavy alarm" codes are check-marked in the "Heavy alarm" object column in Table 6.1-2. 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 6.1-2. For how to check and release light alarms, see Section 6.5.	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 avoids trips by decreasing 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 (OU).	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*	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 6.1-2 Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)

Code	Name	Heavy alarm object	Light alarm object	Remarks	Ref. page
OC1 OC2 OC3	Instantaneous overcurrent	√	—		6-11
EF	Ground fault	√	—	30 kW or above	6-11
OU1 OU2 OU3	Overvoltage	√	—		6-12
LU	Undervoltage	√	—		6-12
Lin	Input phase loss	√	—		6-13
OPL	Output phase loss	√	—		6-13
OH1	Heat sink overheat	√	√		6-14
OH2	External alarm	√	√		6-14
OH3	Inverter internal overheat	√	√		6-14
OH4	Motor protection (PTC/NTC thermistor)	√	—		6-15
dbH	Braking resistor overheat	√	√	22 kW or below	6-15
FUS	Fuse blown	√	—	200 V class series with 75 kW or above 400 V class series with 90 kW or above	6-16
PbF	Charger circuit fault	√	—	200 V class series with 37 kW or above 400 V class series with 75 kW or above	6-16
OL1 to OL4	Overload of motors 1 through 4	√	√		6-16
OLU	Inverter overload	√	—		6-17
OS	Overspeed	√	—		6-18
PG	PG wire break	√	—		6-18
Er1	Memory error	√	—		6-18
Er2	Keypad communications error	√	—		6-19
Er3	CPU error	√	—		6-19
Er4	Option communications error	√	√		6-19
Er5	Option error	√	√		6-19
Er6	Operation protection	√	—		6-20
Er7	Tuning error	√	—		6-20
Er8 ErP	RS-485 communications error (COM port 1) RS-485 communications error (COM port 2)	√	√		6-21
ErF	Data saving error during undervoltage	√	—		6-21
ErH	Hardware error	√	—	200 V class series with 37 kW or above 400 V class series with 45 kW or above	6-22
ErE	Speed mismatch or excessive speed deviation	√	√		6-22
nrb	NTC wire break error	√	—		6-23
Err	Mock alarm	√	—		6-23
CoF	PID feedback wire break	√	√		6-23
dbA	Braking transistor error	√	—		6-23
Ero	Positioning control error	√	√		6-23
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	—	√		—
LiF	Lifetime alarm	—	√		—
rEF	Reference command loss detected	—	√		—
Pid	PID alarm	—	√		—
UTL	Low torque output	—	√		—
PTC	PTC thermistor activated	—	√		—
rTE	Inverter life (Cumulative motor run time)	—	√		—
CnT	Inverter life (Number of startups)	—	√		—

6.2 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, resulting in 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 2.2.1 "Connection diagrams."

(2) Check whether an alarm code or the "light alarm" indication (L-AL) is displayed on the LED monitor.

● If neither an alarm code nor "light alarm" indication (L-AL) appears on the LED monitor

Abnormal motor operation ——————► Go to Section 6.3.1.

[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 6.3.2.

[1] Nothing appears on the keypad.

[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 6.4.
- If the "light alarm" indication (L-AL) appears on the LED monitor ——► Go to Section 6.5.
- If an abnormal pattern appears on the LED monitor while neither an alarm code nor "light alarm" indication (L-AL) is displayed ——————► Go to Section 6.6.

If any problems persist after the above recovery procedure, contact your Fuji Electric representative.

6.3 If Neither an Alarm Code nor "Light Alarm" Indication (L-AL) Appears on the LED Monitor

Note: This section describes the troubleshooting procedure based on function codes dedicated to motor 1. For motors 2 to 4, replace those function codes with respective motor dedicated ones. Function codes that need to be replaced are asterisked.

📖 For the function codes dedicated to motors 2 to 4, see Chapter 5 "FUNCTION CODES."

6.3.1 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. ➔ Correct the run command source. (Set F02 data to "1.") ➔ Correct the assignment of commands ***FWD*** and ***REV***. (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 run command block (refer to Chapter 8), 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 of link function (operation selection) (in H30), bus function (operation selection) (in y98), 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 setting of the terminal [V2] function switch (SW5) and the setting of the thermistor mode selection (H26).

Possible Causes	What to Check and Suggested Measures
(7) The reference frequency was below the starting or stop frequency.	Check whether the analog frequency command (reference frequency) is correctly inputted, 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 8). ➔ 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*).
	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.

[2] The motor rotates, but the speed does not increase.

Possible Causes	What to Check and Suggested Measures
(1) The maximum output frequency currently specified was too low.	Check the data of function code F03* (Maximum output 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 the menus on the keypad by referring to the block diagram of the frequency command (refer to Chapter 8). ➔ Correct any incorrect function code data (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, if any.
(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 (forward)" or "3 (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 is 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 the motor to be used. ➔ Disable the automatic control systems by setting F37* to "1" (Constant torque load) and F42* to "0" (V/f control), 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 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," 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 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 "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. ➔ 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 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.

6.3.2 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, a residual-current- operated protective device (RCD)/earth leakage circuit breaker (with overcurrent protection) or a magnetic contactor. ➔ 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 recurs.

[2] The desired menu is not displayed.

Possible Causes	What to Check and Suggested 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 "Operation 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***.
(6) The function code(s) to be changed does not appear.	If Menu #0 "Quick Setup" (0.Fnc) is selected, only the particular function codes appear. ➔ With Menu #0 "Quick Setup" (0.Fnc) 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 3, Table 3.4-1 "Menus Available in Programming Mode."

6.4 If an Alarm Code Appears on the LED Monitor

6.4.1 OCn Instantaneous overcurrent

Problem The inverter momentary output current exceeded the overcurrent level.

OC1 Overcurrent occurred during acceleration.
OC2 Overcurrent occurred during deceleration.
OC3 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.

6.4.2 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).

6.4.3 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.

6.4.4 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.

Possible Causes	What to Check and Suggested Measures
(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.

6.4.5 Lin Input phase loss

Problem Input phase loss occurred, or interphase voltage unbalance rate was large.

Possible Causes	What to Check and Suggested Measures
(1) Wiring to the main power input terminal is broken.	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.
(3) Single-phase voltage was input to the three-phase input inverter.	Check the inverter type again. ➔ Select the inverter whose power supply is as specified.

Note The input phase loss protection can be disabled with the function code H98 (Protection/Maintenance Function).

6.4.6 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.

6.4.7 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 3, Section 3.4.6 "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).

6.4.8 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.
(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) ➔ Change 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.

6.4.9 OH3 Inverter internal overheat

Problem Temperature inside the inverter has exceeded the allowable limit.

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).

6.4.10 OH4 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 inverter. ➔ 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 overload early warning (E34) and reduce the load before the overload protection is activated.) (In winter, the load tends to increase.) ➔ Lower the temperature. ➔ 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.
(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. ➔ Adjust the value (F09*).
(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 thermistor mode selection (H26) to "0" (Disable).

6.4.11 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 was 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.

6.4.12 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.

6.4.13 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 (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.)

6.4.14 OLn Overload of motor 1 through 4

Problem Electronic thermal protection for motor 1, 2, 3, or 4 activated.

OL1 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*.

Possible Causes	What to Check and Suggested Measures
(3) The 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. ➔ Adjust the value (F09*).

6.4.15 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 around the inverter (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. ➔ Adjust the value (F09*).
(3) The 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 the overload prevention control (H70).
(5) 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.
(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 3, Section 3.4.6 "Reading maintenance information Menu #5 "Maintenance Information"." ➔ Replace the cooling fan.
	Visually check whether the cooling fan rotates normally. ➔ Replace the cooling fan.
(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).

6.4.16 OS 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.)

6.4.17 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. ➔ Isolate the control signal wires from the main circuit wires as far as possible.

6.4.18 Er1 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 has dropped.	Initialize the function code data with H03. 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 noise control measures are appropriate (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.

6.4.19 Er-2 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 communication 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) PG related circuit 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 (Er-2) occurs. ➔ Replace the keypad.

6.4.20 Er-3 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.

6.4.21 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) Inverter 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.

6.4.22 Er-5 Option error

An error detected by the option card.
Refer to the instruction manual of the option card for details.

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6.4.23 Er-6 Operation protection

Problem An error has occurred due to an operation incorrect to the operation method.

Possible Causes	What to Check and Suggested Measures
(1) The STOP key was pressed when the STOP key is enabled (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 Er-6 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].

6.4.24 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").
(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 "Basic settings/tuning of function codes < 2 >, ■ Tuning errors."

6.4.25 Er-8 RS-485 communications error (COM port 1)/ Er-P 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., programmable controllers 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 communication cable.
(6) 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. ➔ 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.)

6.4.26 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 noise control measures are appropriate (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.

6.4.27 Er-H Hardware error

Problem The LSI on the power printed circuit board malfunctions. Or, the fuse blew inside the inverter.

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.
(4) The fuse blew inside the inverter. (355 to 630 kW only)	Check whether there has been any excess surge or noise coming from outside. Take measures against surges and noise. The fuse needs to be replaced. ➔ Contact your Fuji Electric representative.

6.4.28 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 output current. ➔ Reduce the load.
	Check whether any mechanical brake is activated. ➔ Release the mechanical brake, if any.
(3) The motor speed does not increase due to the current limiter operation.	Check the data of function code F44 (Current limiter (Level)). ➔ Correct the F44 data. Or, if the current limiter operation is not needed, set F43 to "0" (disabled).
	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. ➔ 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.

6.4.29 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.

6.4.30 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 PRG/RESET key.

6.4.31 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 joint or connecting part bites the wire sheath.
(2) Inverter 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. ➔ Isolate the control signal wires from the main circuit wires as far as possible.

6.4.32 dbA Braking transistor error

Problem: A braking transistor error is detected.

Possible Causes	What to Check and Suggested Measures
The braking transistor is broken.	Check whether resistance of the braking resistor is correct or there is a misconnection of the resistor. ➔ Have the inverter repaired.

6.4.33 Ero 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.
(3) Excessive positioning deviation	Check whether the setting of d78 (excessive deviation detection width) is correct.

6.5 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 6.1-2.

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_35 (Light alarm factor (latest)) under Menu #5 "Maintenance Information" in Programming mode. In 5_35, the light alarm factor is displayed in alarm codes. For details about code factor, see Table 6.1-2.

For details about the menu transition in Menu #5 "Maintenance Information", see Chapter 3, Section 3.4.6 "Reading 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) temporarily from the light alarm indication (L-AL) 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 (showing the running status such as reference frequency) from the light alarm indication (L-AL). However, the KEYPAD CONTROL LED continues blinking.

■ Releasing the light alarm

1) First remove the light alarm factor that has been checked in 5_35 (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 6.1-2.
2) After checking the occurrence of the light alarm, press the FUNC/DATA key in Running mode to return the LED monitor from the L-AL display to the normal display state (showing the running status such as reference frequency).

   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 also goes 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.)

6.6 If an Abnormal Pattern Appears on the LED Monitor while Neither an Alarm Code nor "Light Alarm" Indication (L-AL) is Displayed

6.6.1 ---- (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.

6.6.2 ____ (under bar) appears

Problem Although you pressed the RUN key or entered a run forward/stop command ***FWD*** or a run reverse/stop 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_01 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.

6.6.3 [ ] 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.

Chapter 6 TROUBLESHOOTING

Chapter 7

MAINTENANCE AND INSPECTION

Contents

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time. When performing inspections, follow the instructions given in this chapter.

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, turn OFF the power **and wait at least five minutes for inverters of 22 kW or below, or at least ten minutes for inverters of 33 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.

- Maintenance, inspection, and parts replacement should be made only by authorized persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
- Never modify the inverter.

Electric shock or injuries could occur.

7.1 Daily Inspection

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

Check the following points.

- Check that the inverter provides the expected performance (as defined in the standard specifications).
- Check that the usage environment satisfies requirements listed in Chapter 1, Section 1.6.1.
- Check for abnormality in the keypad indication.
- Check for abnormal noise, excessive vibration, or odor.
- Check for traces of overheat, discoloration and other defects.

7.2 Periodic Inspection

Perform periodic inspections according to the items listed in Table 7.2-1. Before performing periodic inspection, shut down the power and then remove the front cover.

Table 7.2-1 Periodic Inspection List

Check part		Check item	How to inspect	Evaluation criteria
Environment		1) Check the surrounding temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.	1) Check visually or measure using apparatus. 2) Visual inspection	1) Standard specifications must be satisfied. 2) No foreign or dangerous objects are left.
Input voltage		Check that the input voltages of the main and control circuits are correct.	Measure the input voltages using a multimeter or the like.	Specifications for input voltages must be satisfied.
Keypad		1) Check that indication is clearly visible. 2) Check that no parts of letters, etc. are missing.	1), 2) Visual inspection	1), 2) Indication is visible and without abnormality,
Structure such as frame and cover		1) Check for abnormal noise or excessive vibration. 2) Check for loose bolts (at clamp sections). 3) Check for deformation and breakage. 4) Check for discoloration caused by overheat. 5) Check for contamination and accumulation of dust or dirt	1) Visual and audio inspection 2) Retighten. 3), 4), 5) Visual inspection	1), 2), 3), 4), 5) No abnormalities
Main circuit	Common	1) Check that bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities
	Conductors and wires	1) Check conductors for discoloration and distortion caused by overheat. 2) Check the sheath of the wires for cracks and discoloration.	1), 2) Visual inspection	1), 2) No abnormalities
	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities
	Braking resistor	1) Check for abnormal odor or cracks in insulators caused by overheat. 2) Check for wire breakage.	1) Olfactory and visual inspection 2) Check the wires visually, or disconnect either one of the wires and measure the conductivity with a multimeter.	1) No abnormalities 2) Within approx. ±10% of the resistance of the braking resistor

Check part		Check item	How to inspect	Evaluation criteria
Main circuit	Main circuit capacitor	1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing. 2) Check that the safety valve does not protrude or extend remarkably. 3) Measure the static capacitance as necessary.	1), 2) Visual inspection 3) Measure the discharging time using a static capacitance meter.	1), 2) No abnormalities 3) The discharging time should not be shorter than the value specified in the replacement procedures.
	Transformers and reactors	Check for abnormal roaring noise or odor when the inverter is running.	Audio, visual, and olfactory inspections	No abnormalities
	Magnetic contactors and relays	1) Check for chatters when the inverter is running. 2) Check that the contact point is not rough.	1) Audio inspection 2) Visual inspection	1), 2) No abnormalities
Control circuit	Printed circuit board	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Olfactory and visual inspection 3) Visual inspection 4) Visual inspection	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan	1) Check for abnormal noise or excessive vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheat.	1) Audio and visual inspection; Turn by hand. (Be sure to turn the power OFF beforehand.) 2) Retighten. 3) Visual inspection	1) Smooth rotation 2), 3) No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign materials.	Visual inspection	No abnormalities

If any section is stained, clean it with a chemically neutral dust cloth. Dust should be cleaned with a vacuum cleaner.

7.3 List of Periodic Replacement Parts

Each part of the inverter has its own service life that will vary according to the environmental and operating conditions. It is recommended that the following parts be replaced at the intervals specified in Table 7.3-1. When replacement is necessary, consult your Fuji Electric representative.

Table 7.3-1 Replacement Parts

Part name	Standard replacement intervals (See Note below.)
Main circuit capacitor	10 years
Electrolytic capacitor on PCB	10 years
Cooling fan	10 years
Fuse	10 years (90 kW or above)

Note) • These replacement intervals are based on the inverter's service life estimated at a surrounding temperature of 40°C at 100% (HD-mode inverters) or 80% (MD-/LD-mode inverters) of full load. In environments with an ambient temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

• The replacement intervals listed above are only provided as a guide. They do not guarantee the lifetimes of respective parts.

7.3.1 Judgment on service life

The inverter has the life prediction function for some parts which allows you to judge whether those parts are approaching the end of their service life. The predicted values should be used only as a guide since the actual service life is influenced by the ambient temperature and other usage environments.

Table 7.3-2 Life Prediction

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	LED monitor indication
Main circuit 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	At periodic inspection H98: bit3＝0	5_05 (Capacity)
		85% or lower of the reference capacitance under ordinary operating conditions at the user site (must be measured upon introduction of the unit)	During ordinary operation H98: bit3＝1	5_05 (Capacity)
	ON-time counting Counts the time elapsed when the voltage is applied to the DC link bus capacitor (ON-time counting), 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 PCBs	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 fan	Counts the run time of the cooling fans.	Exceeding 87,600 hours (10 years)	During ordinary operation	5_07 (Cumulative run time)

The service life of the DC link bus capacitor is automatically judged by the "measurement of discharging time" or by "ON-time counting."

<u>Measurement of discharging time</u>

- 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 drastically 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. Then automatic measurement is carried out (refer to the measuring procedure 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 at "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.

<u>ON-time counting</u>

- 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 time elapsed when the voltage is applied to the DC link bus capacitor is counted (ON-time counting) for judging the remaining lifetime. (The ON-time counting result can be represented as "elapsed time"(5_26) and as "time remaining before the end of life" (5_27), as shown in the "LED monitor indication" section in Table 7.3-2.)

(1) Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

The measuring procedure given below measures the capacitance of DC link bus capacitor, and judges and indicates the remaining lifetime. 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 the 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).
   - If the remote keypad was replaced with an optional multi-function keypad after purchase, return it to the remote 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 outputs [Y1] through [Y4] and relay output terminals [Y5A/C] 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.

- The surrounding temperature should be 25°C±10°C.

2) Turn ON the main circuit power.
3) Confirm that the DC cooling fan is rotating and the inverter is in stopped state.
4) Shut down the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor. Check 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 check the capacitance (%) of the DC link bus capacitor.

---

(2) Measuring the capacitance of the DC link bus capacitor under ordinary operating conditions

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.

-- Capacitance measuring procedure ------------------------------------

1) Set bit 3 of function code H98 at "1" (User mode) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor.
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set each of function codes H42 (Capacitance of DC Link Bus Capacitor) and H47 (Initial Capacitance of DC Link Bus Capacitor) at "0000."
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 measurement, " . . . . " appears 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) holds right values. Switch to Menu #5 "Maintenance Information" in Programming mode and confirm that the main capacitor capacity is 100%.

Note If the measurement has failed, "0001" is entered into each of the function codes H42 (Capacitance of DC Link Bus Capacitor) and H47 (Initial Capacitance of DC Link Bus Capacitor). 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 capacitance (%) of the DC link bus capacitor with Menu #5 "Maintenance Information" in Programming mode.

Note The condition given above may produce a rather large measurement error. If this mode gives you a lifetime alarm, revert the life judgment threshold of the DC link bus capacitor to the default setting, and conduct measurement again under the condition at the time of factory shipment.

(3) Early warning of lifetime alarm

For the components listed in Table 7.3-2, the inverter can issue an early warning of lifetime alarm LIFE at one of the transistor output terminals [Y1] through [Y4] and relay output terminals [Y5A/C] and [30A/B/C], as soon as any one of such components have passed the judgment criteria.

The early warning signal is also turned ON when a lock condition on the internal air circulation DC fan has been detected. (provided on 45 kW or above for 200 V class series, and on 75 kW or above for 400 V class series).

7.4 Measurement of Electrical Amounts in Main Circuit

Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) contain harmonic components, the readings may vary by the type of the meter. Use meters indicated in Table 7.4-1 when measuring with meters for commercial frequencies.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and use the following formula.

■ 3-phase input

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\sqrt{3} \times \text{Voltage (V)} \times \text{Current (A)}} \times 100\,\%$$

Table 7.4-1 Meters for Measurement of Main Circuit

Item	Input (primary) side			Output (secondary) side			DC link bus voltage (P(+)-N(-))
Waveform	Voltage	Current		Voltage	Current		
Name of meter	Ammeter AR, AS, AT	Voltmeter VR, VS, VT	Wattmeter WR, WT	Ammeter AU, AV, AW	Voltmeter VU, VV, VW	Wattmeter WU, WW	DC voltmeter V
Type of meter	Moving iron type	Rectifier or moving iron type	Digital AC power meter	Digital AC power meter	Digital AC power meter	Digital AC power meter	Moving coil type
Symbol of meter			—	—	—	—	

Note: It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged. For more precise measurement, a digital AC power meter is strongly recommended.

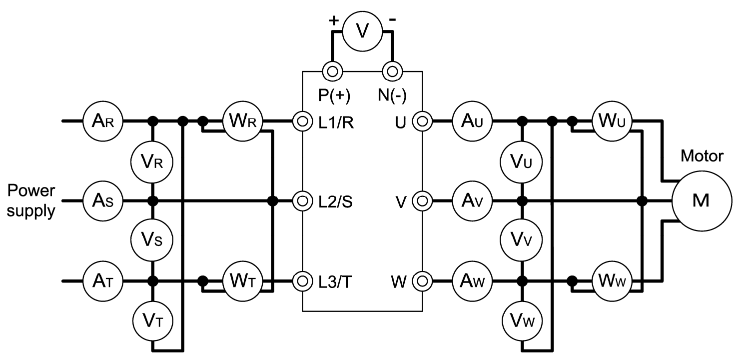


Figure 7.4-1 Connection of Meters

7.5 Insulation Test

Since the inverter has undergone an insulation test before shipment, avoid performing a Megger test at the customer's site.

If a Megger test is unavoidable for the main circuit, observe the following instructions; otherwise, the inverter may be damaged.

A withstand voltage test may also damage the inverter if the test procedure is wrong. When the withstand voltage test is necessary, consult your Fuji Electric representative.

(1) Megger test of main circuit

1) Use a 500 VDC Megger and shut off the main power supply without fail before measurement.
2) If the test voltage leaks to the control circuit due to wiring, disconnect all the wiring from the control circuit.
3) Connect the main circuit terminals with a common line as shown in Figure 7.5-1.
4) The Megger test must be limited to across the common line of the main circuit and the ground (⏚).
5) Value of 5 MΩ or more displayed on the Megger indicates a correct state. (The value is measured on an inverter alone.)

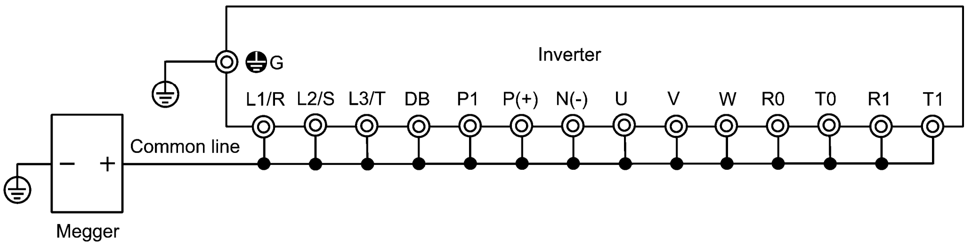


Figure 7.5-1 Main Circuit Terminal Connection for Megger Test

(2) Insulation test of control circuit

Do not perform a Megger test or withstand voltage test for the control circuit. Use a high resistance range tester for the control circuit.

1) Disconnect all the external wiring from the control circuit terminals.
2) Perform a continuity test to the ground. One MΩ or a larger measurement indicates a correct state.

(3) Insulation test of external main circuit and sequence control circuit

Disconnect all the wiring connected to the inverter so that the test voltage is not applied to the inverter.

7.6 Inquiries about Product and Guarantee

(1) When making an inquiry

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

1) Inverter type (Refer to Chapter 1, Section 1.1)
2) SER. No. (product number) (Refer to Chapter 1, Section 1.3)
3) Function codes and their data that you changed (Refer to Chapter 3, Section 3.4.3)
4) ROM version (Refer to Chapter 3, Section 3.4.6)
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)
7) Production year and week (Refer to Chapter 1, Section 1.3)

(2) Product warranty

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

<u>Please take the following items into consideration when placing your order.</u>

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

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

Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

1) Free of charge warranty period and warranty range

1)-1 Free of charge warranty period

(1) The product warranty period is "1 year from the date of purchase" or "18 months from the production year and week imprinted on the name plate", whichever comes earlier.

(2) However, in cases where the use environment, conditions of use, use frequency and times used, etc. have an effect on product life, this warranty period may not apply.

(3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date when repairs are completed."

1)-2 Warranty range

(1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.

i) The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, instruction manual, specifications or other relevant documents.

ii) The breakdown was caused by factors other than the purchased or delivered Fuji's product.

iii) The breakdown was caused by products other than Fuji's, such as the customer's equipment or software design, etc.

iv) Concerning Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or was resulted from using such a program.

v) The breakdown was caused by disassembly, modifications or repairs performed by a party other than Fuji Electric.

vi) The breakdown was caused by improper maintenance or replacement of consumables, etc. that are specified in the instruction manual or catalog, etc.

vii) The breakdown was caused by a scientific or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.

viii) The product was not used in the manner the product was originally intended to be used.

ix) The breakdown was caused by a reason which is not this company's responsibility, such as natural disaster or other accidents.

(2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.

(3) The upper limit for the warranty range shall be as specified in item (1) above, and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

1)-3 Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

2) Exclusion of liability for loss of opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not responsible for causing.

3) Repair period after production stop, spare parts supply period (holding period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

4) Transfer rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

5) Service contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or other service costs. Depending on the request, these can be discussed separately.

6) Applicable scope of service

Contents described above shall be assumed to apply to transactions and use of the product within Japan. Consult the local supplier or Fuji separately for transactions and use outside Japan.

Chapter 8

BLOCK DIAGRAMS FOR CONTROL LOGIC

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

Contents

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.

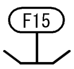
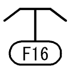
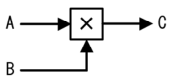
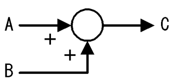
This chapter explains the main block diagrams for control logic in the inverter. You are requested to fully understand the inverter's control logic together with the function codes in order to set the function code data correctly.

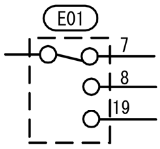
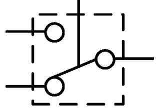
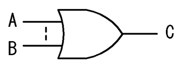
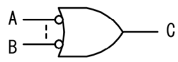
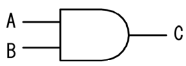
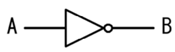
The block diagrams contained in this chapter show only function codes having mutual relationship. For the function codes that work independently and for detailed explanation of each function code, refer to Chapter 5 "FUNCTION CODES."

8.1 Symbols Used in Block Diagrams and their Meanings

Table 8.1-1 lists symbols commonly used in block diagrams and their meanings with some examples.

Table 8.1-1 Symbols and Meanings

Symbol	Meaning
[FWD], [Y1] etc.	General-purpose I/O terminals of the inverter 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.
Drive frequency command	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 × B
	Adder for 2 signals or values. C = A + B If B is negative then C = A – B (acting as a subtracter).

Symbol	Meaning
F01	Function code.
	Switch controlled by a function code. Numbers assigned to the terminals express the function code data.
Enable communications link ***LE*** 	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.

8.2 Drive Frequency Command Block

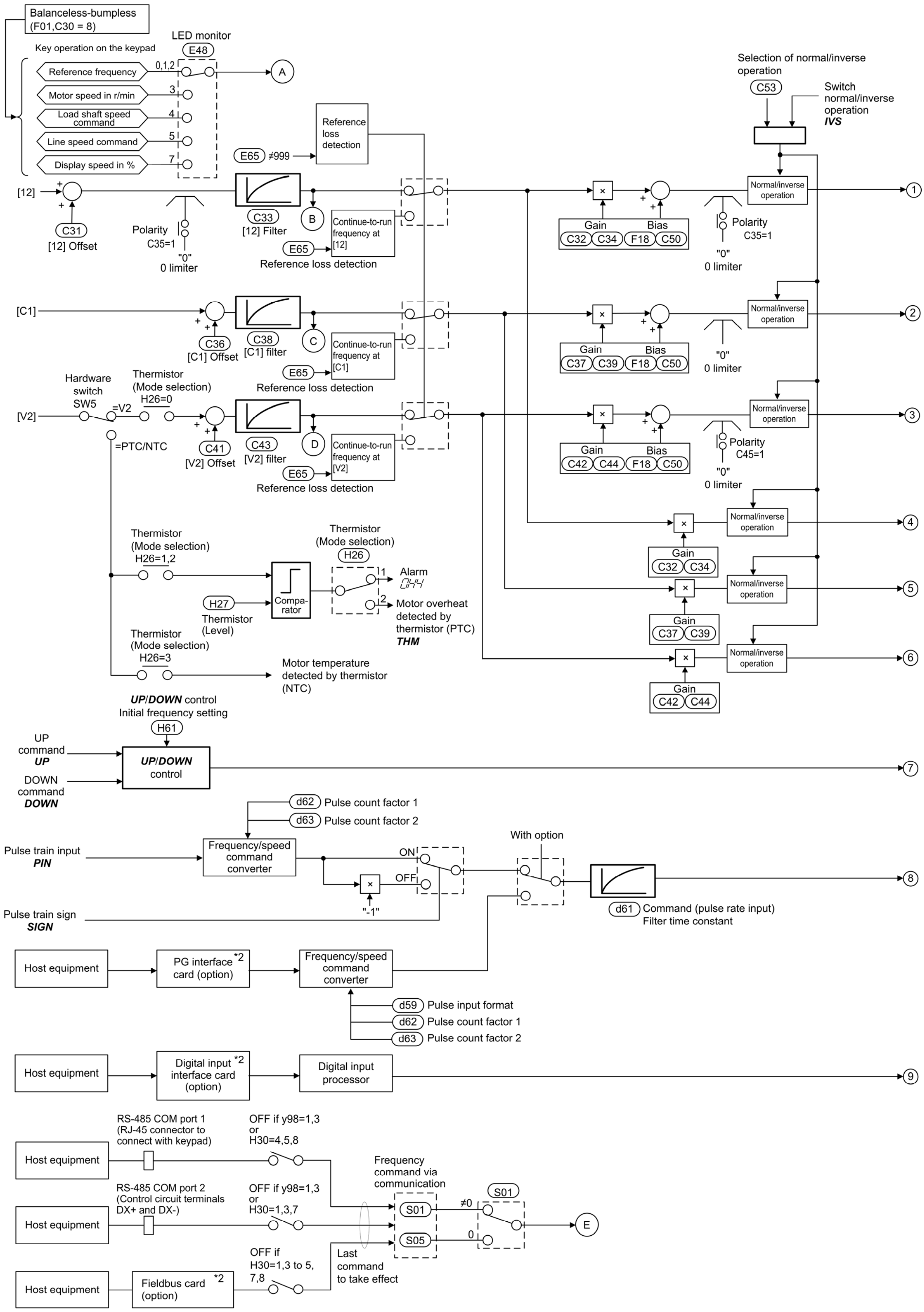
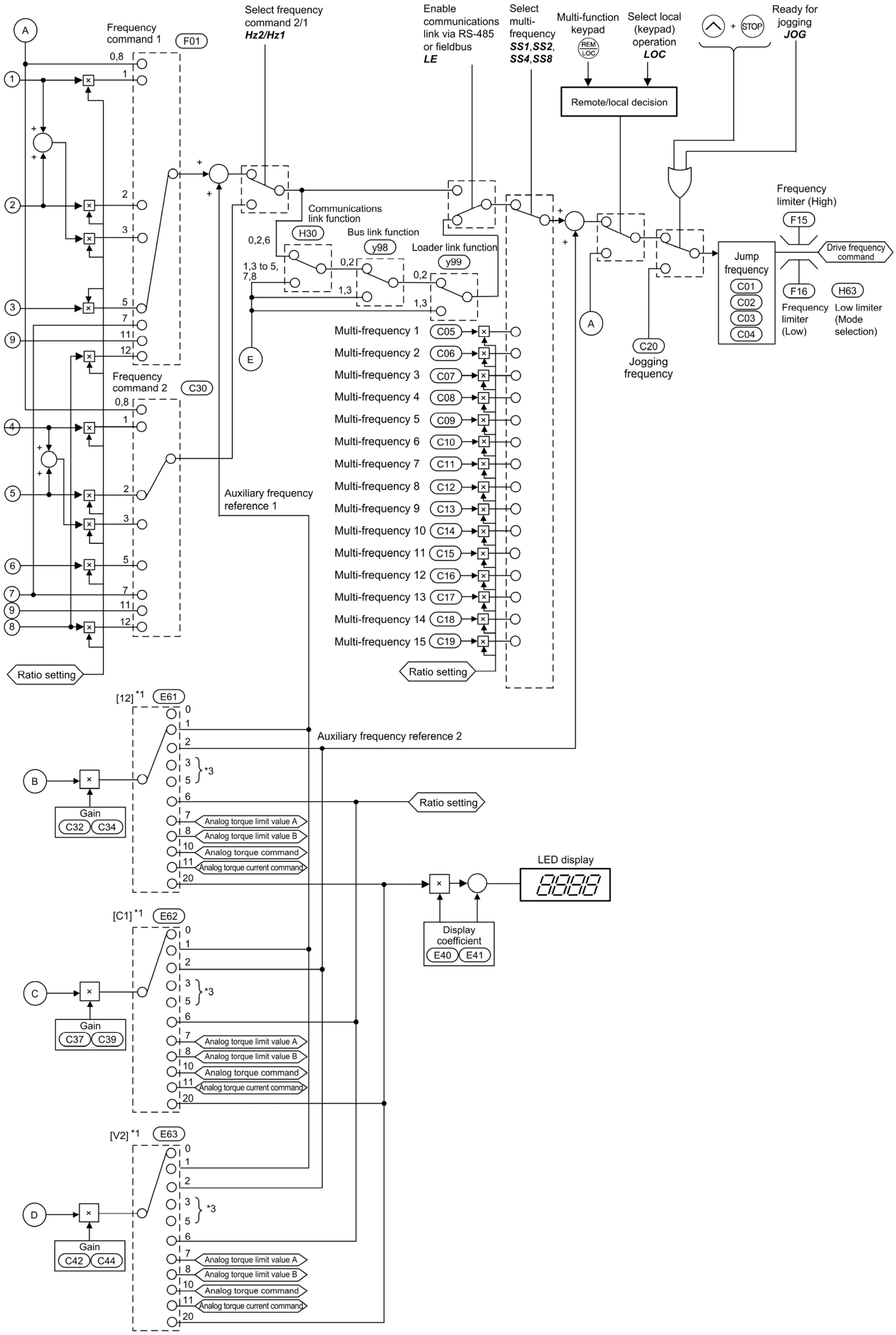


Figure 8.2-1 (1) Drive Frequency Command Block

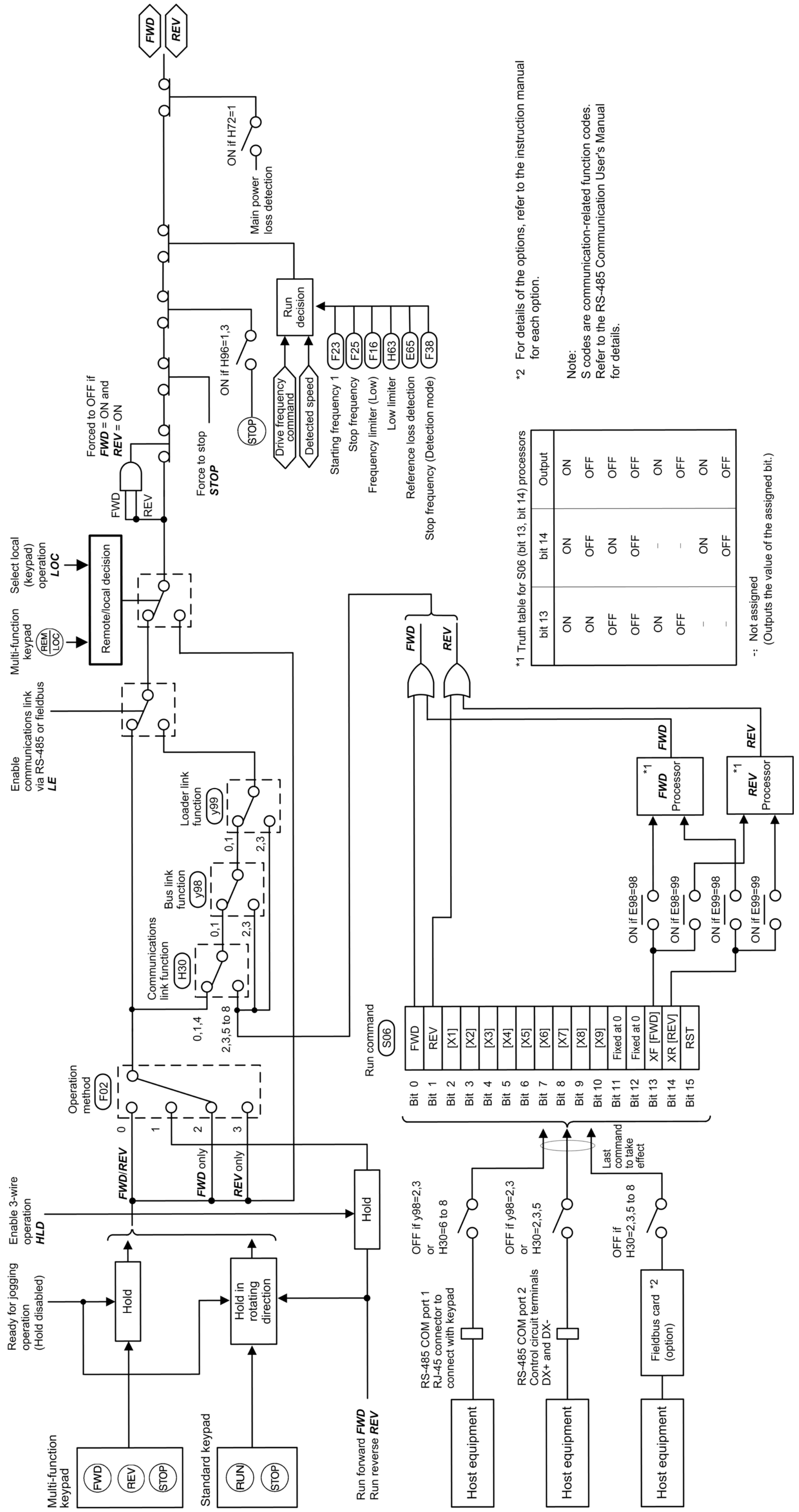


*1 Takes priority when the same function has been assigned by E61, E62 and E63:
Terminal [12] > Terminal [C1] > Terminal [V2]
*2 For details of the options, refer to the instruction manual for each option.
*3 Refer to block diagrams of PID control block for details.

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 8.2-1 (2) Drive Frequency Command Block

8.3 Drive Command Block



bit 13	bit 14	Output
ON	ON	ON
ON	OFF	OFF
OFF	ON	OFF
OFF	OFF	OFF
ON	–	ON
OFF	–	OFF
–	ON	ON
–	OFF	OFF

Figure 8.3-1 Drive Command Block

MEMO

8.4 Control Block

8.4.1 V/f control

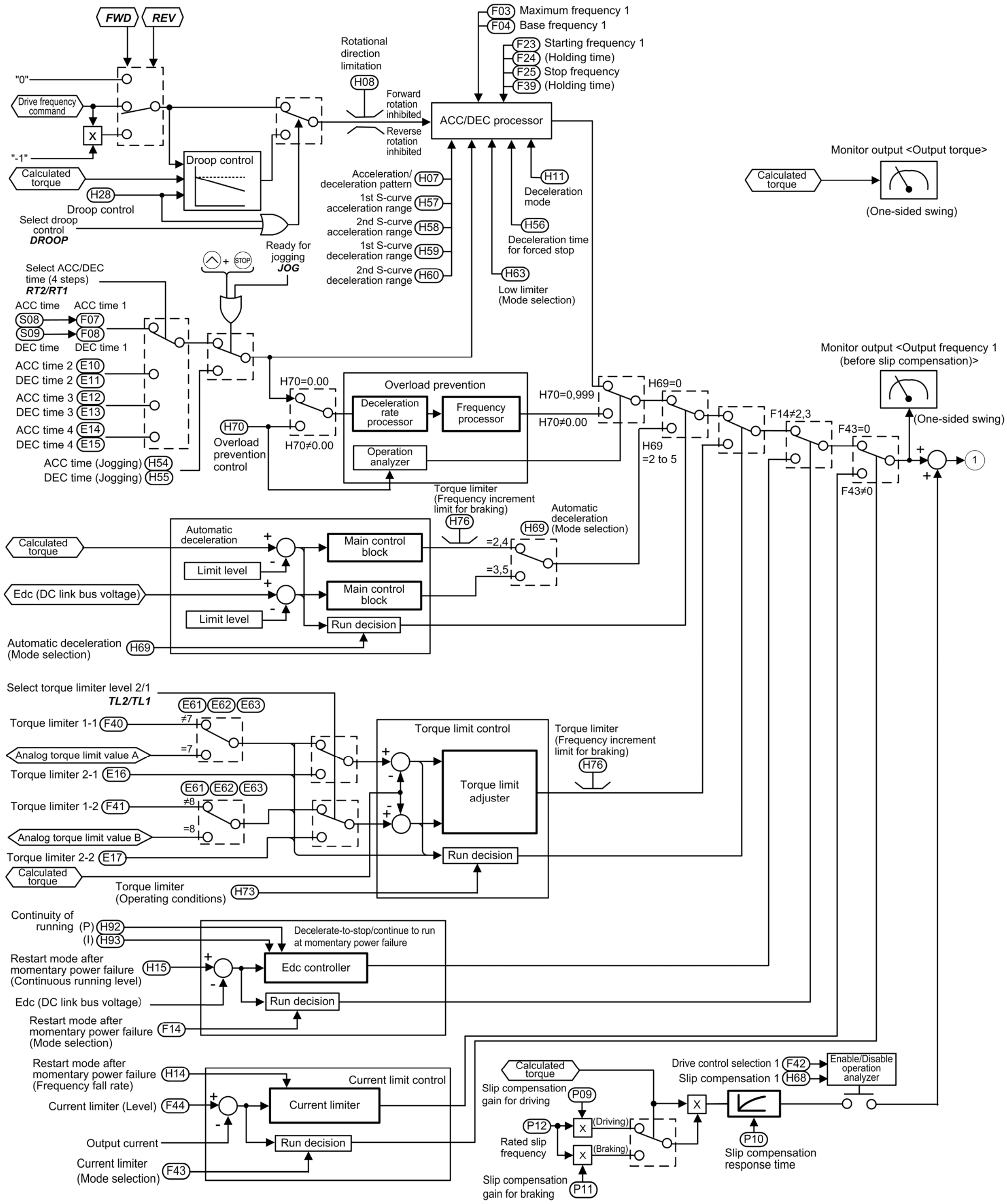


Figure 8.4-1 (1) V/f Control Block

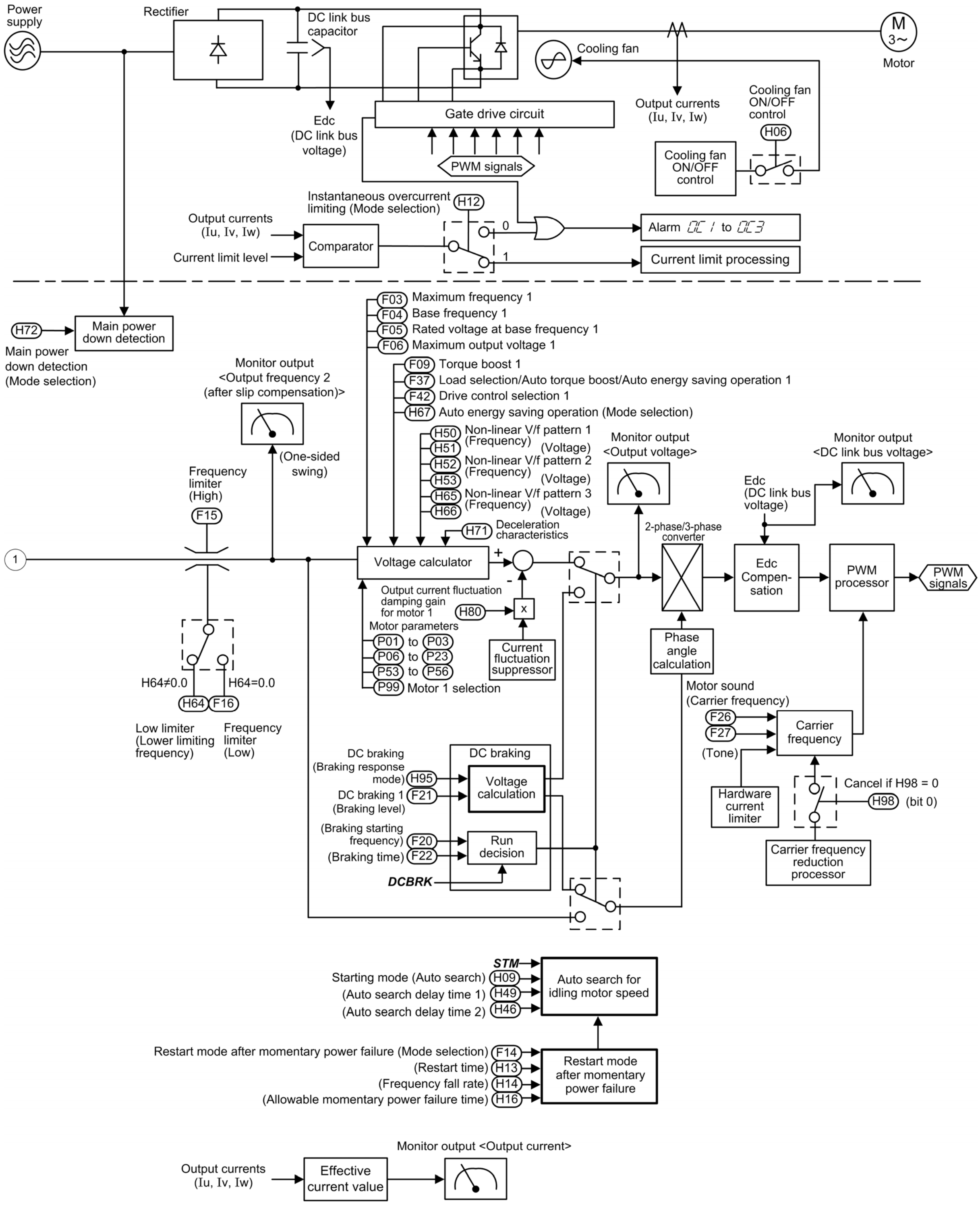


Figure 8.4-1 (2) V/f Control Block

8.4.2 V/f control with speed sensor

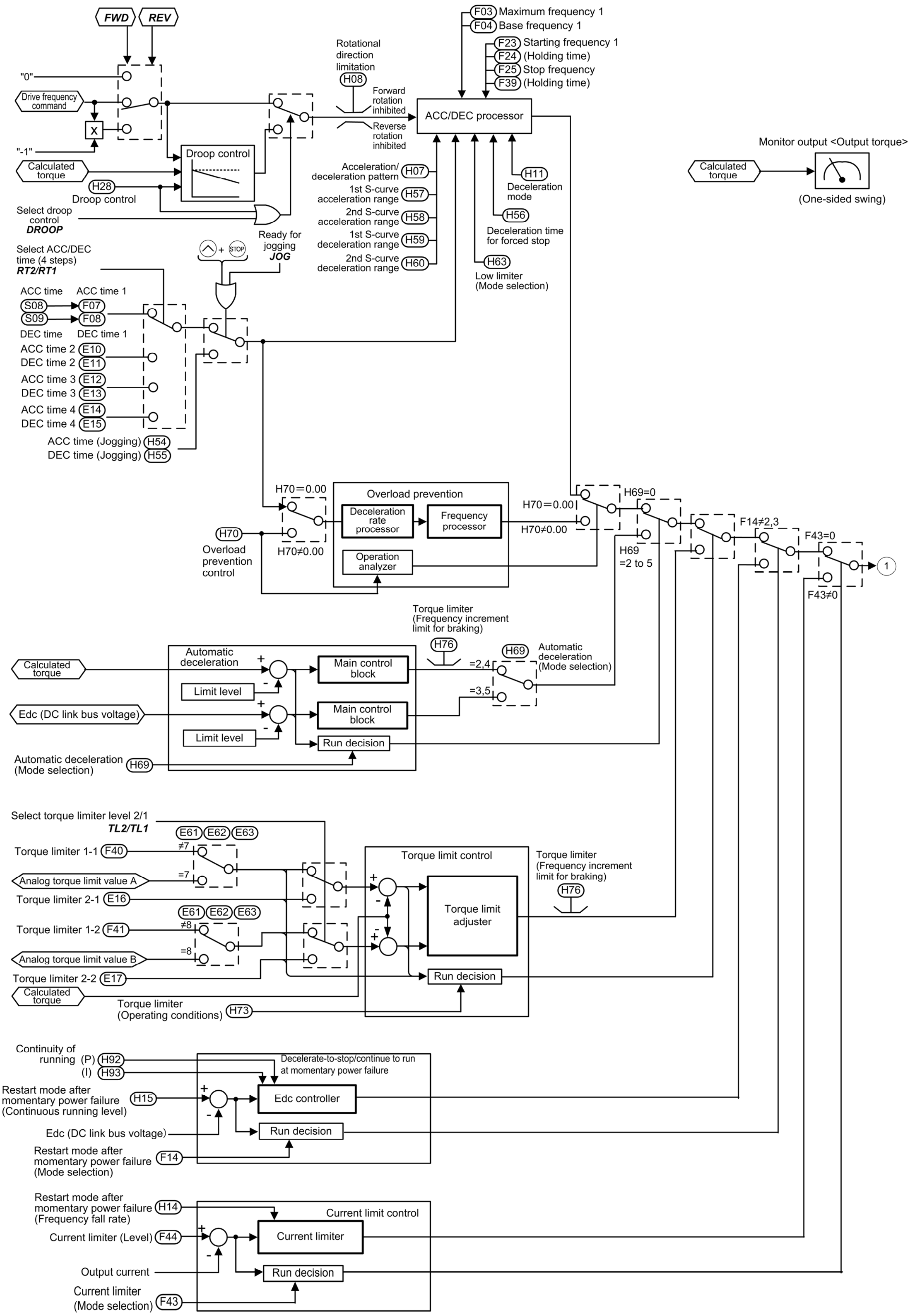


Figure 8.4-2 (1) Block of V/f Control with Speed Sensor

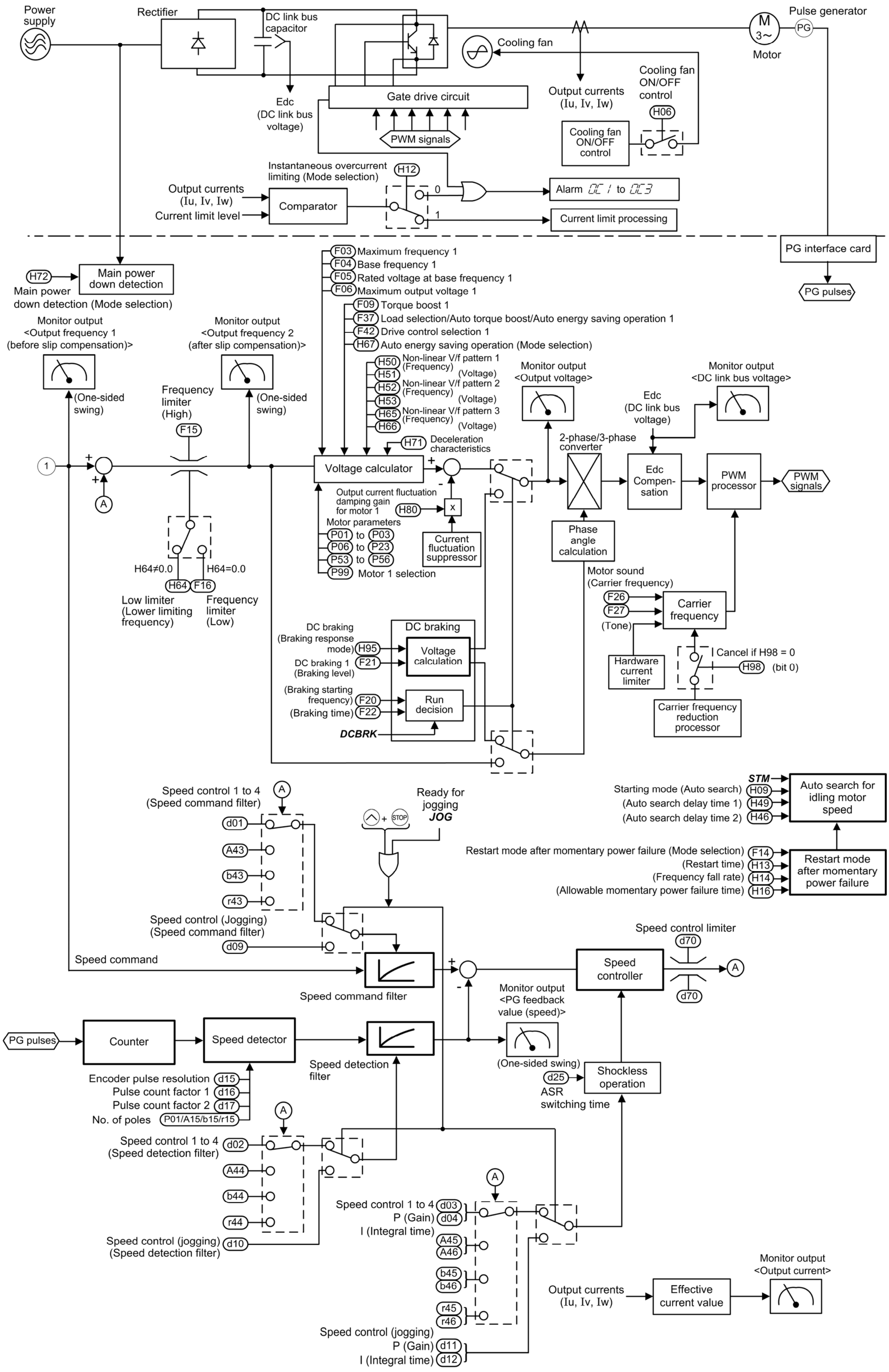
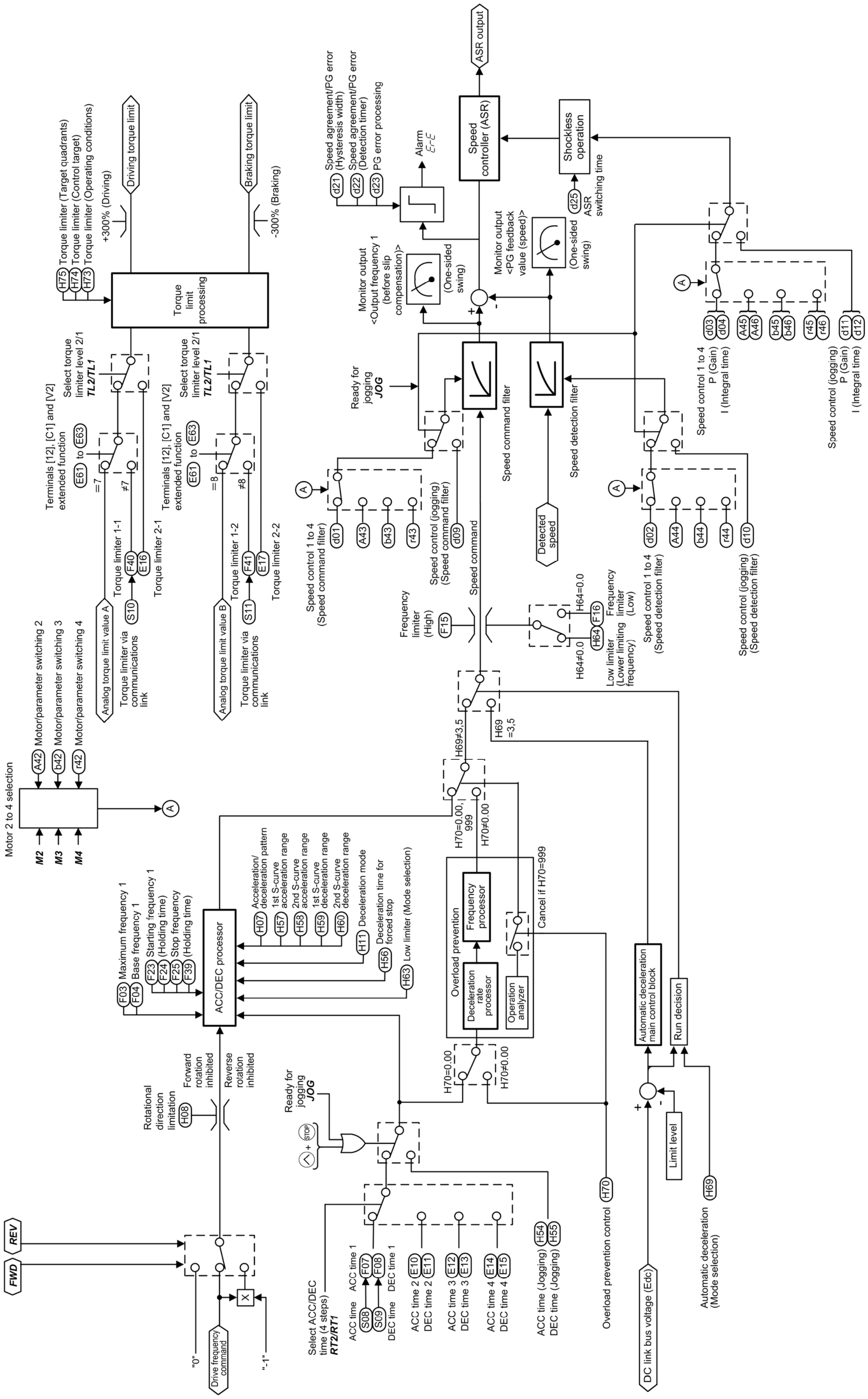


Figure 8.4-2 (2) Block of V/f Control with Speed Sensor

8.4.3 Vector control with/without speed sensor



8.4-3 (1) Block of Vector Control with/without Speed Sensor

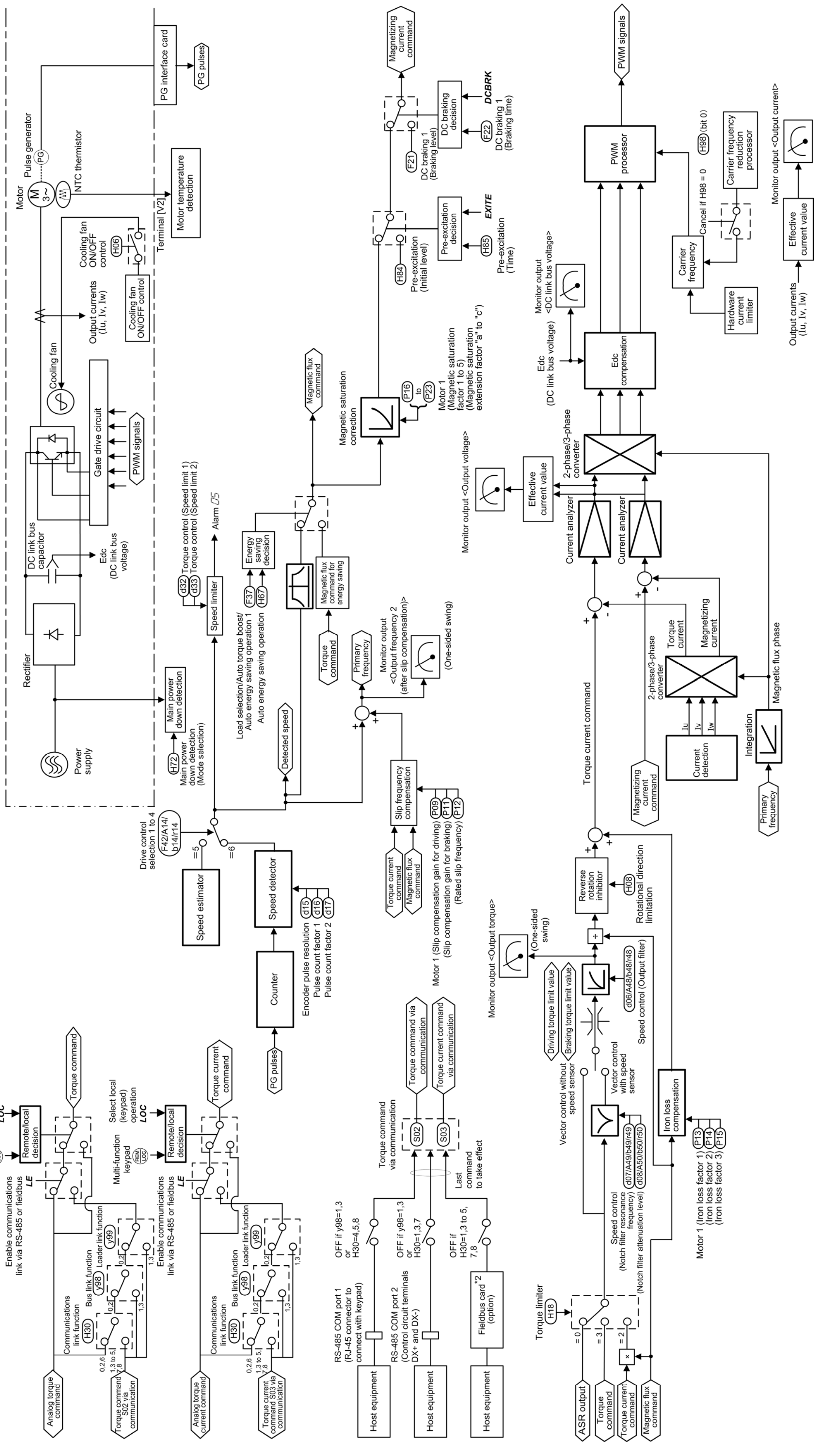


Figure 8.4-3 (2) Block of Vector Control with/without Speed Sensor

8.5 PID Process Control Block

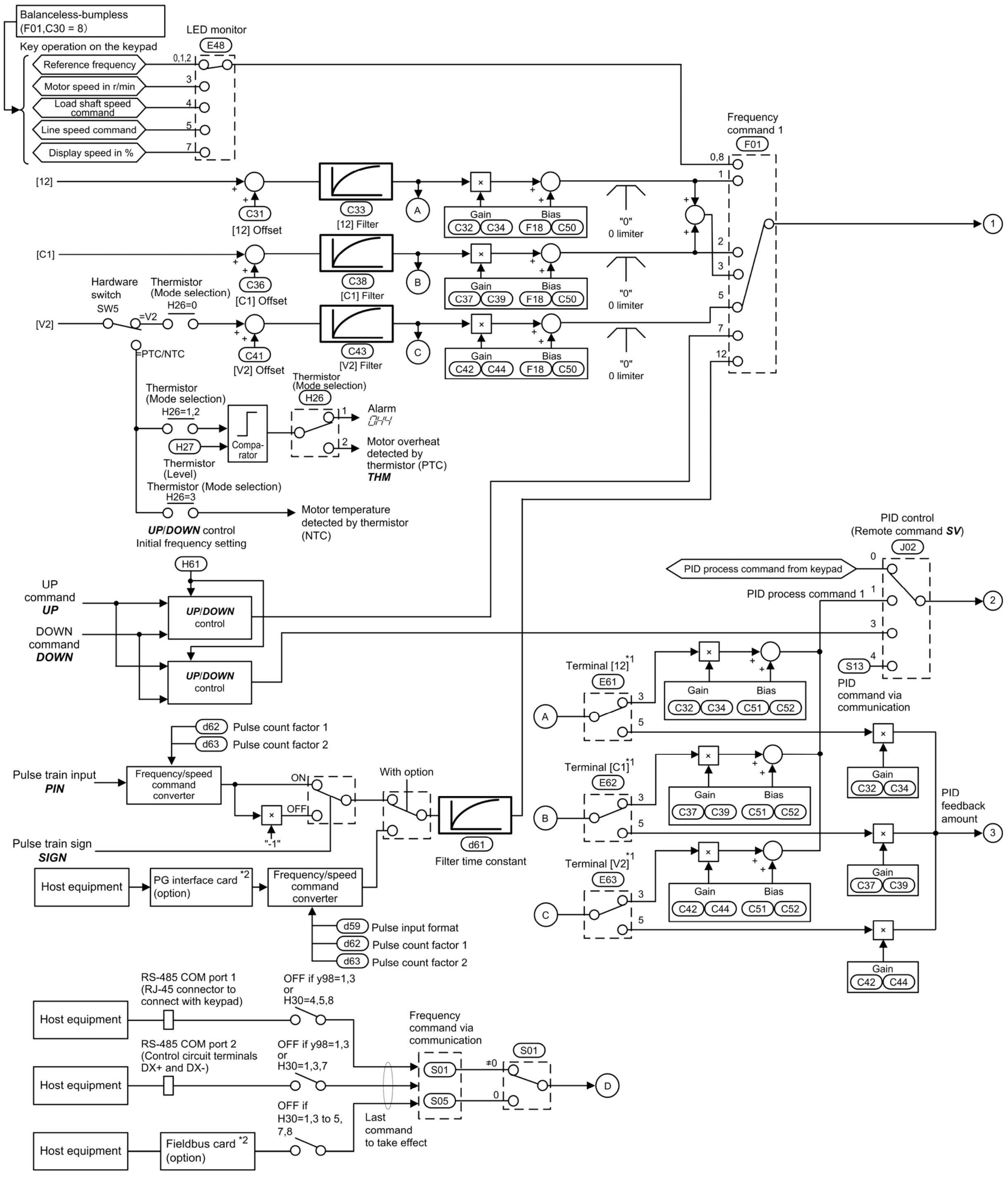
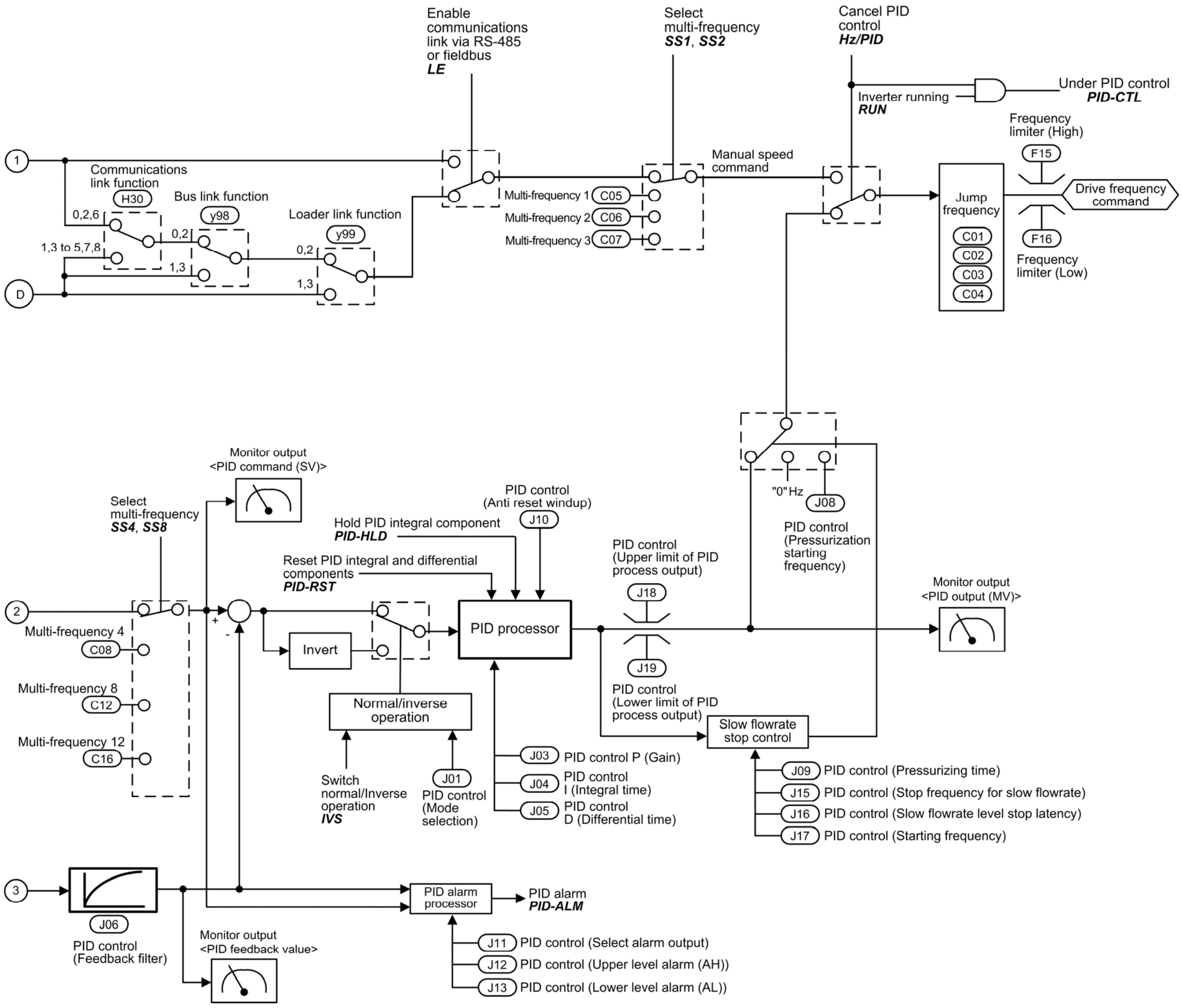


Figure 8.5-1 (1) PID Process Control Block



*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 8.5-1- (2) PID Process Control Block

8.6 PID Dancer Control Block

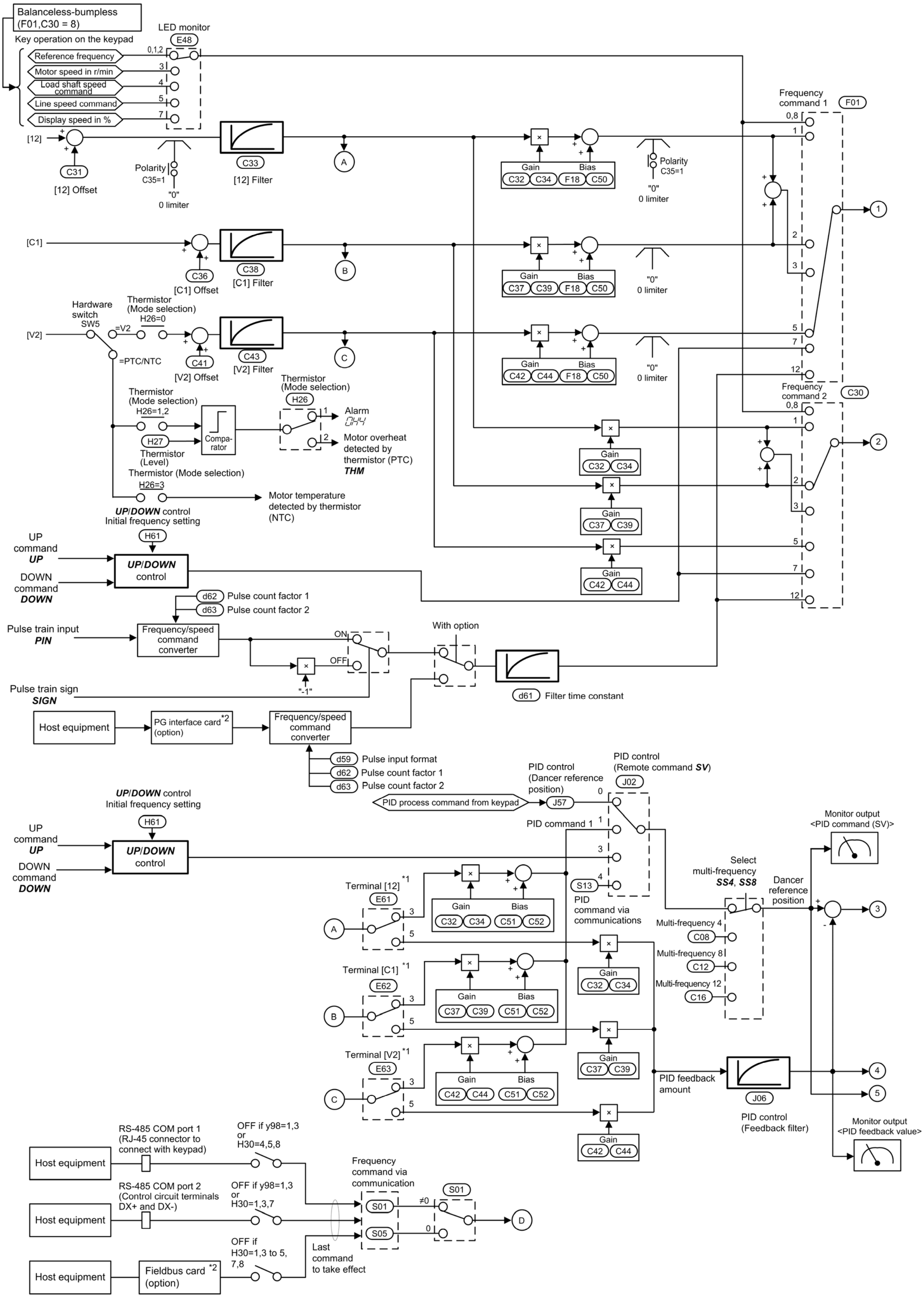


Figure 8.6-1 (1) PID Dancer Control Block

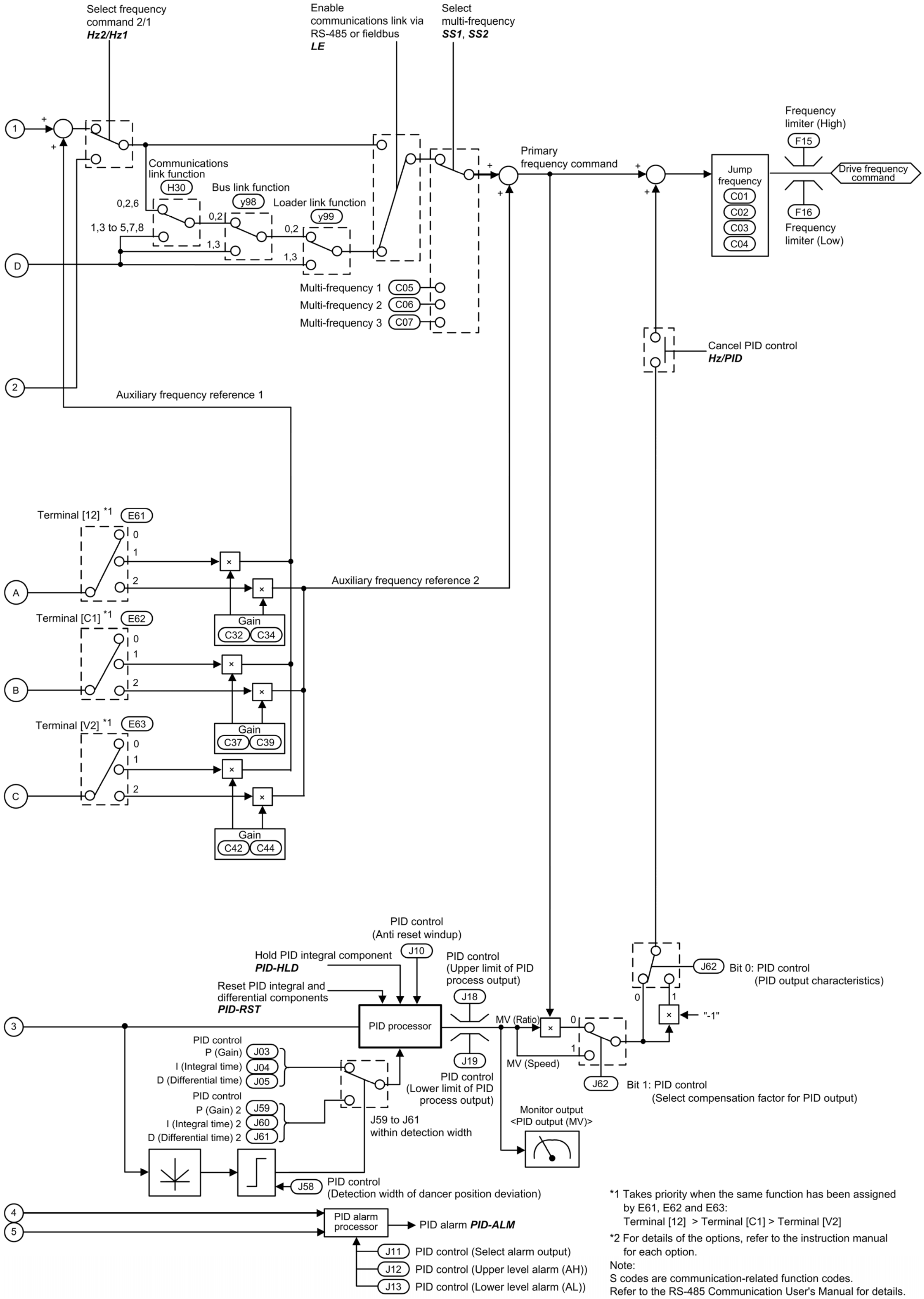


Figure 8.6-1- (2) PID Dancer Control Block

BLOCK DIAGRAMS FOR CONTROL LOGIC

Chapter 8

8.7 FMA/FMP Output Selector

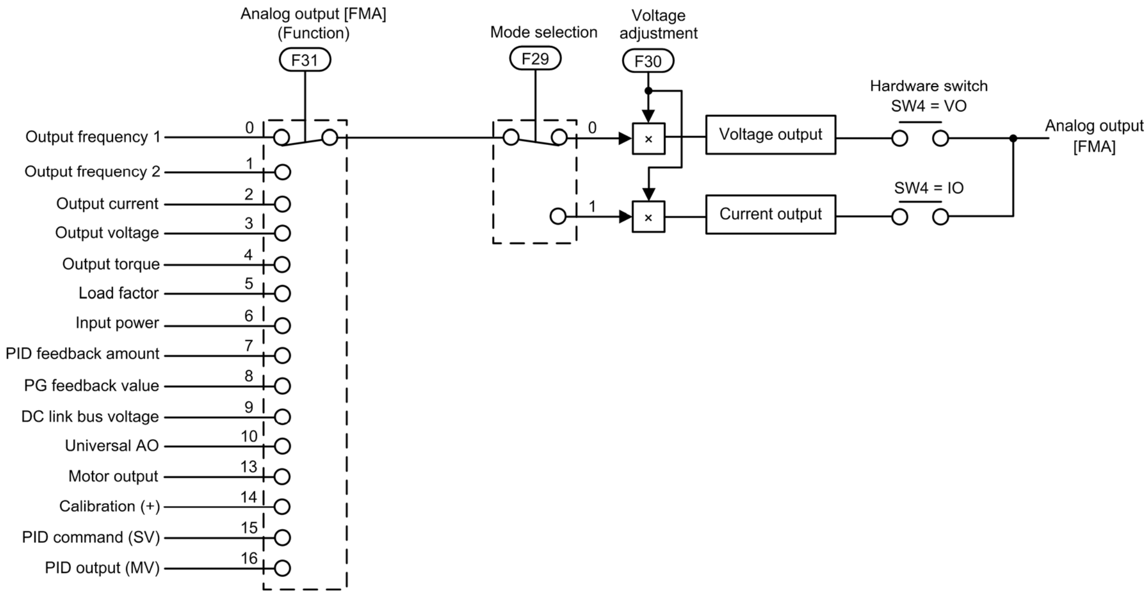


Figure 8.7-1 Terminal [FMA] Output Selector

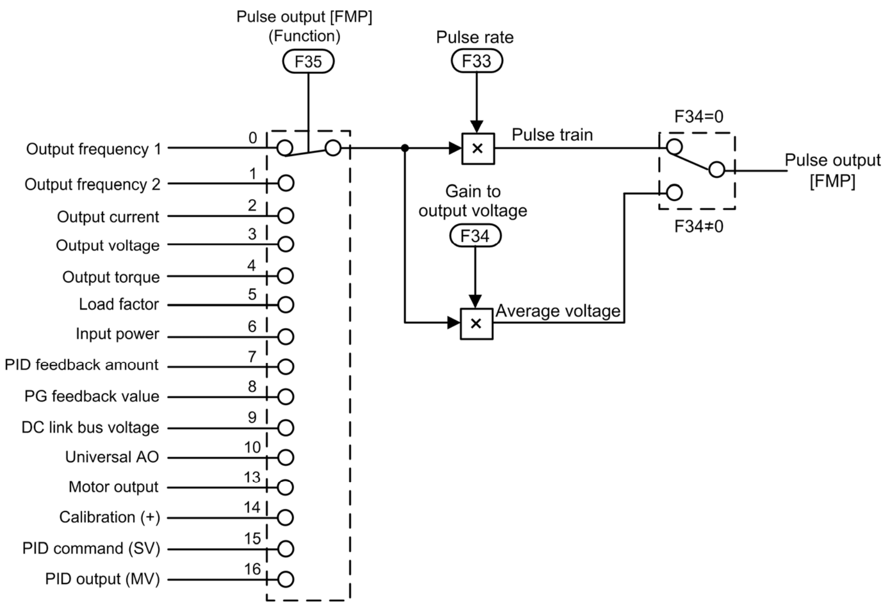


Figure 8.7-2 Terminal [FMP] Output Selector

Chapter 9

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 for details.

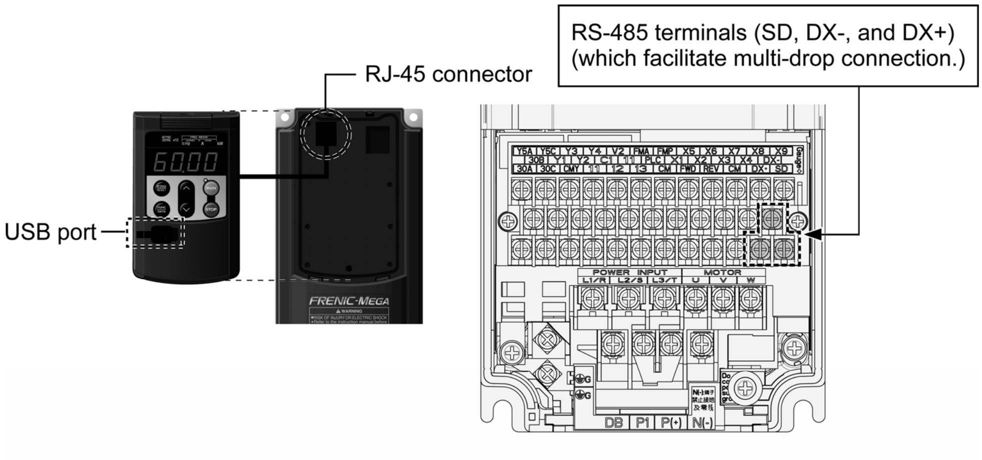
Contents

9.1 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 (Modular jack)

(2) Communications port 2: RS-485 terminals (Control circuit terminals SD, DX-, and DX+)



COM port 1 COM port 2

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 9.2 Overview of FRENIC Loader) 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.

9.1.1 RS-485 common specifications

Table 9.1-1

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)	Special command dedicated for the inverter support software (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	Loader commands
Frame synchronization	SOH (Start Of Header) character detection	Detection of no-data transmission time for 3-byte period	Start of header character detection (start code 96_H)
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: 100 words Read: 100 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

9.1.2 Terminal specifications for RS-485 communications

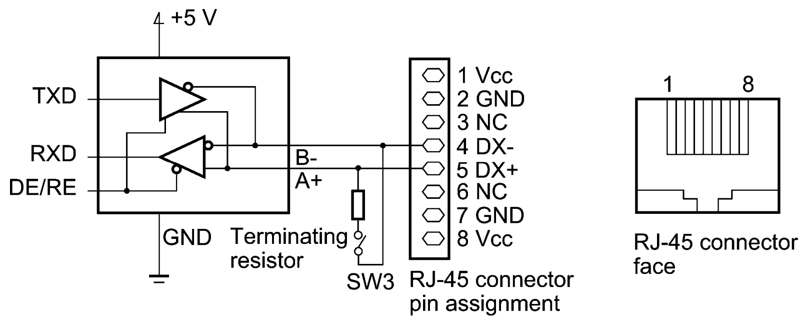
[1] RS-485 communications port 1 (for connecting the keypad)

The port designed for a standard keypad uses an RJ-45 connector having the following pin assignment:

Table 9.1-2

Pin	Signal name	Function	Remarks
1 and 8	Vcc	Power source for the keypad	5 V
2 and 7	GND	Reference potential	GND
3 and 6	NC	Not used.	-
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 2.2.7 "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. Use pins 4 and 5 only.

[2] RS-485 communications port 2 (control circuit terminal block)

The FRENIC-MEGA has terminals for RS-485 communications on the control circuit terminal block. The details of each terminal are shown below.

Table 9.1-3

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 2.2.7 "Setting up the slide switches."

RUNNING THROUGH RS-485 COMMUNICATION

Chapter 9

9.1.3 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.

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.

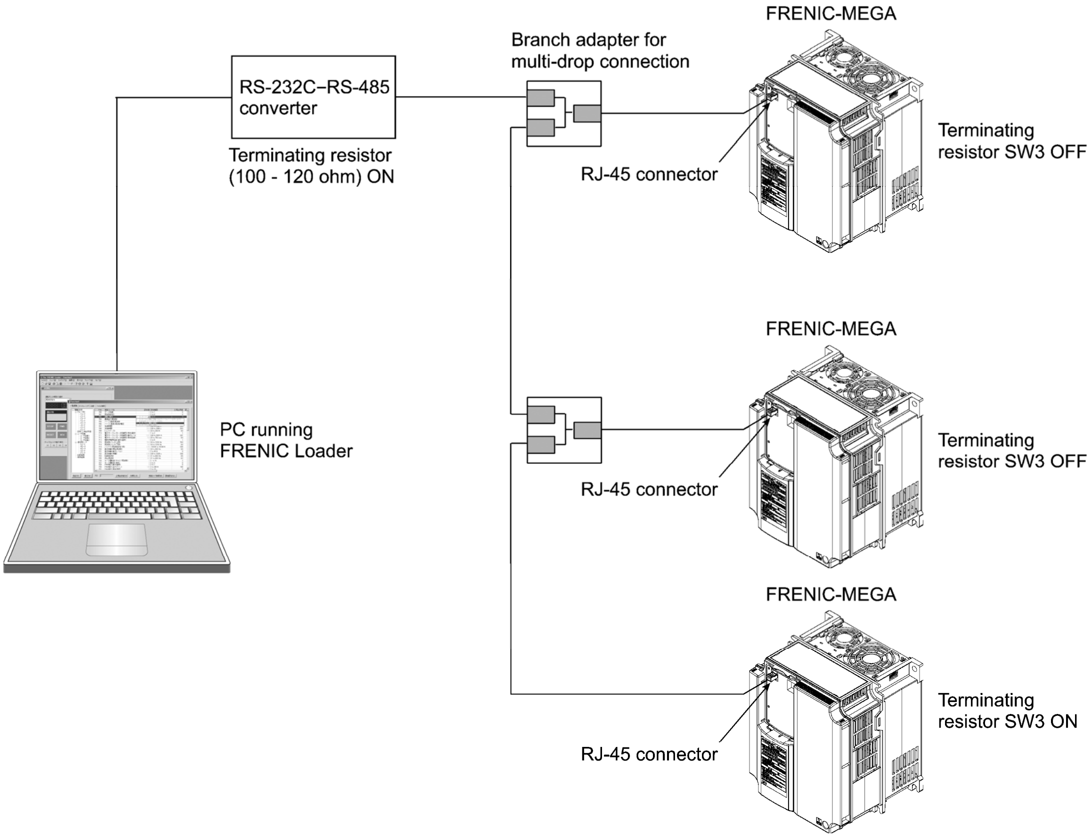


Figure 9.1-1 Multi-drop Connection (Using the RJ-45 Connector)

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. **Use pins 4 and 5 only.** (For details, refer to 9.1.2 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 9.1.4 "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 9.1.4 "Communications support devices."

Multi-drop connection using the RS-485 communications port 2 (on the terminal block)

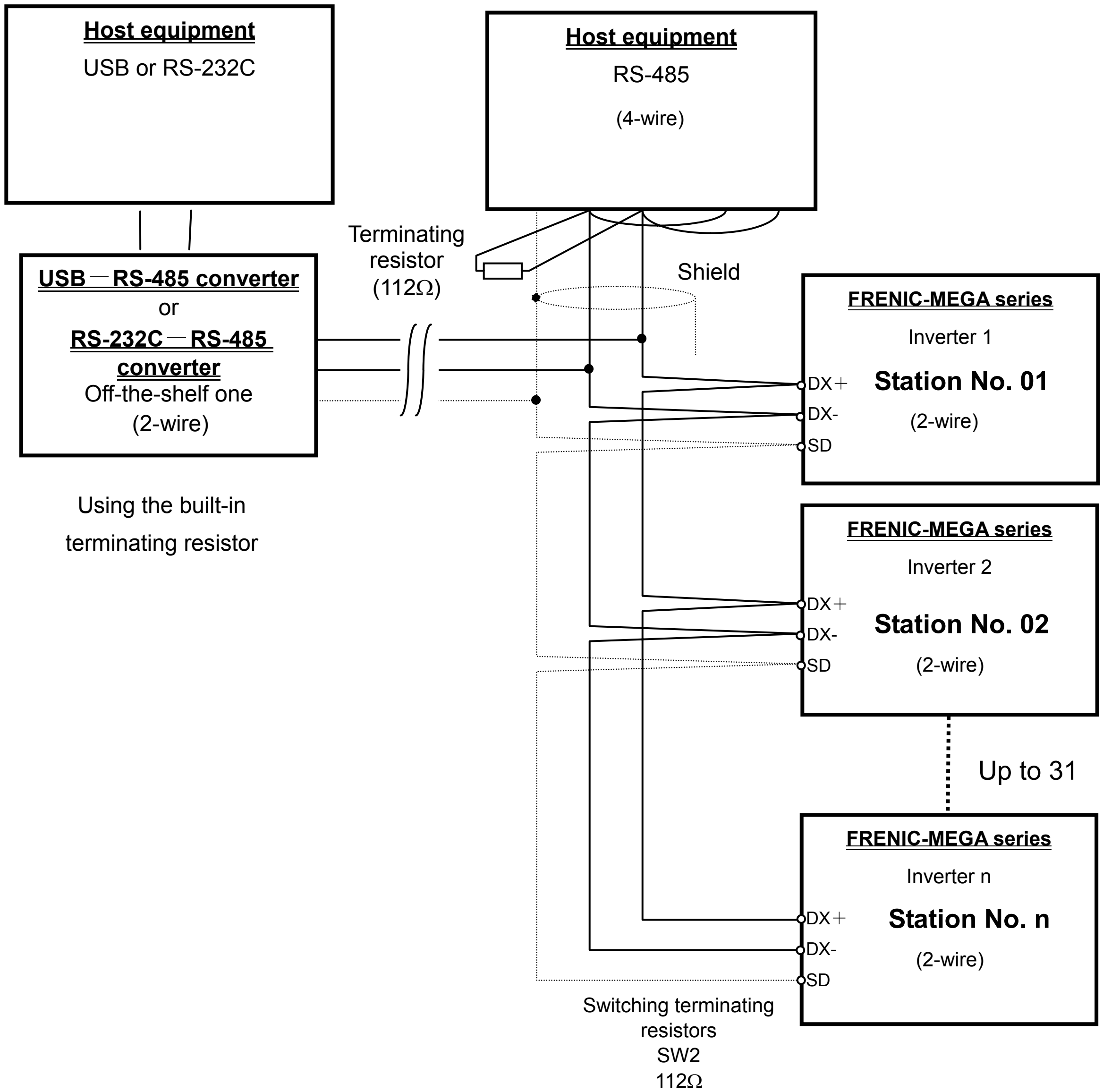


Figure 9.1-2 Multi-drop Connection Diagram (Connecting to the Terminal Block)

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 9.1.4 "Communications support devices."

9.1.4 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 9.1-3 "Communications Level Conversion."

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)

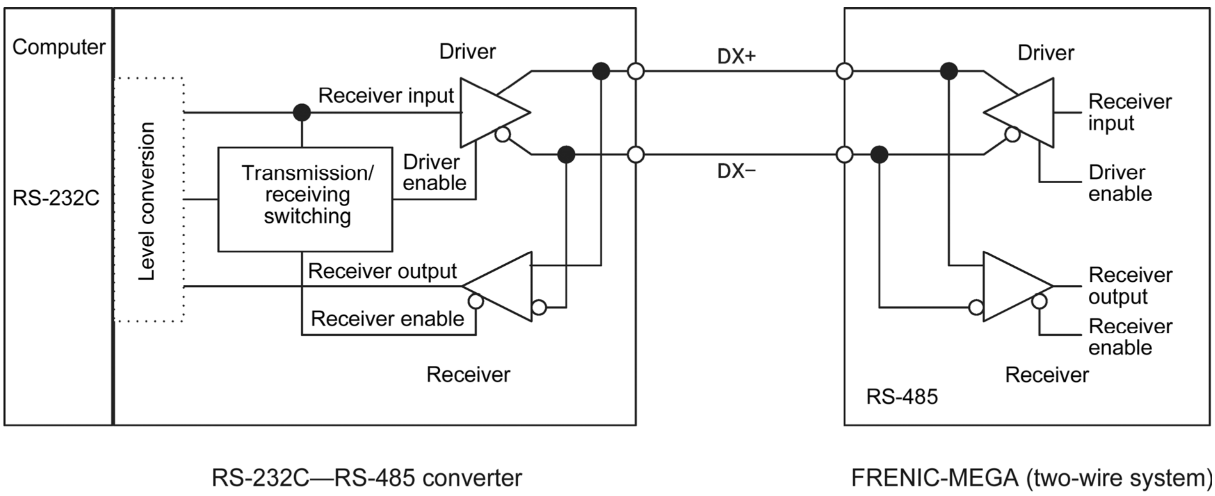


Figure 9.1-3 Communications Level Conversion

[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. 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

RJ-45 connectors are used for communications. When standard LAN cables are used for the multi-drop connection, branch adapters for RJ-45 connector are required.

Recommended branch adapter

SK Koki (Japan): MS8-BA-JJJ

9.1.5 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.

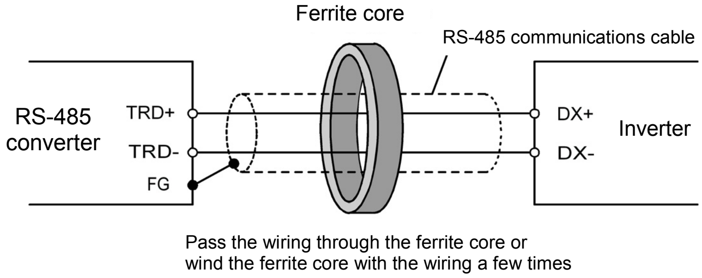


Figure 9.1-4 Adding an Inductance Component

9.2 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 history) 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.

9.2.1 Specifications

Table 9.2-1

Item		Specifications	Remarks
Name of software		FRENIC Loader	
Supported inverter		FRENIC-MEGA/Multi/Eco/Mini	(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 (Japanese Ver.) Microsoft Windows XP (Japanese Ver.) Microsoft Windows Vista (32 bits, 64 bits) Microsoft Windows 7 (32 bits, 64 bits)	
	Memory	512 MB or more RAM	1 GB or more is recommended.
	Hard disk	20 MB or more free space	
	Serial 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), 32-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.

(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.

9.2.2 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.

9.2.3 Function overview

[1] Setting of function code

You can edit, set, 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

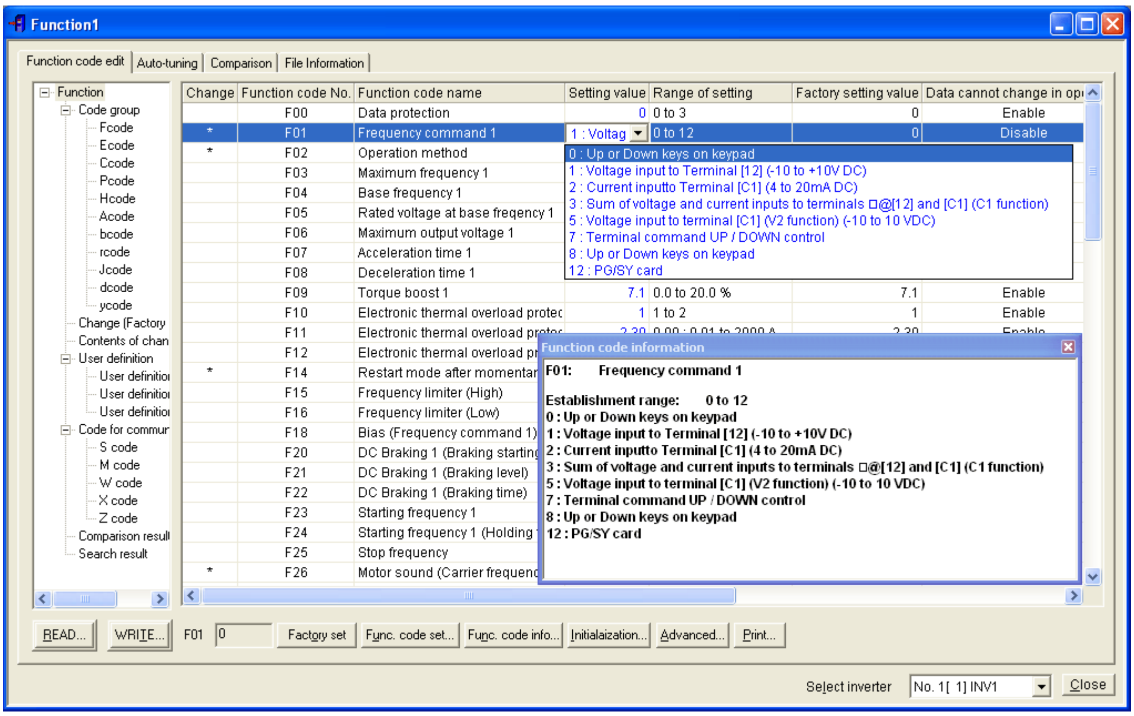


Figure 9.2-1

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.

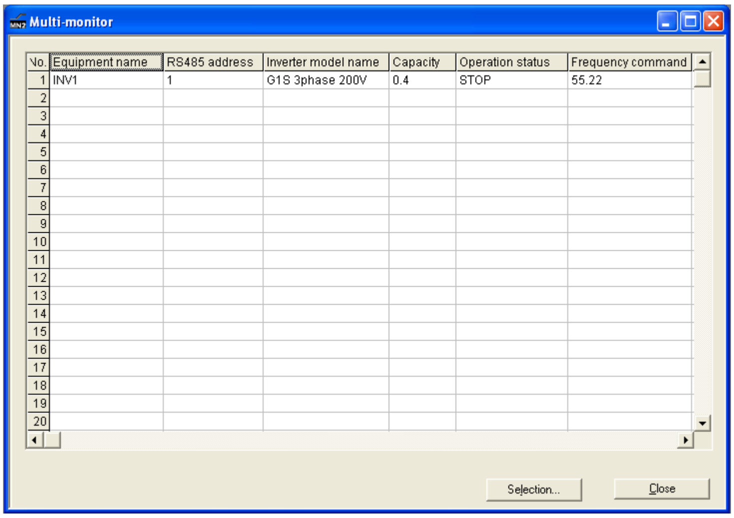
(1) Property
Shows file name, inverter model, inverter's capacity, date of readout, etc.

(2) Comments
Displays the comments you have entered. You can write any comments necessary for identifying the file.

[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.

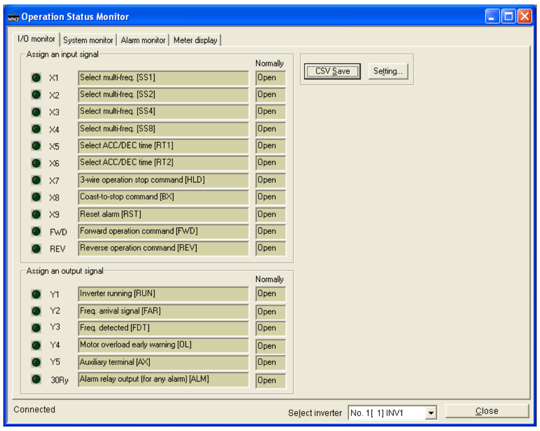


[3] Running status monitor

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.

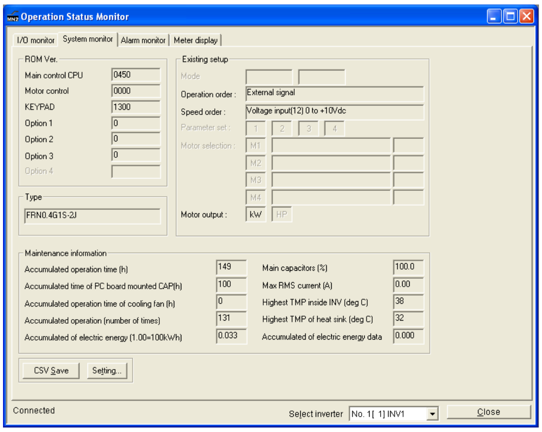
<u>I/O monitor</u>

Allows you to monitor the ON/OFF states of the digital input signals to the inverter and the transistor output signals.



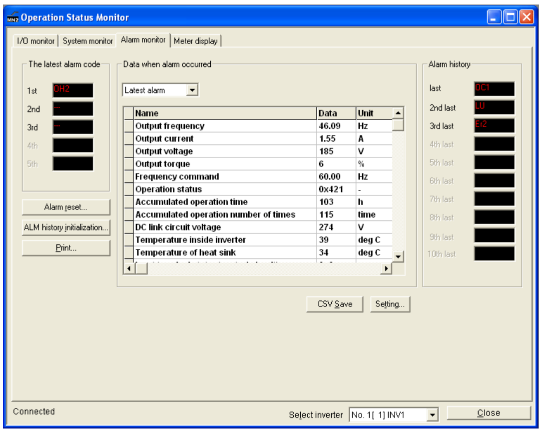
<u>System monitor</u>

Allows you to check the inverter's system information (version, model, maintenance information, etc.).



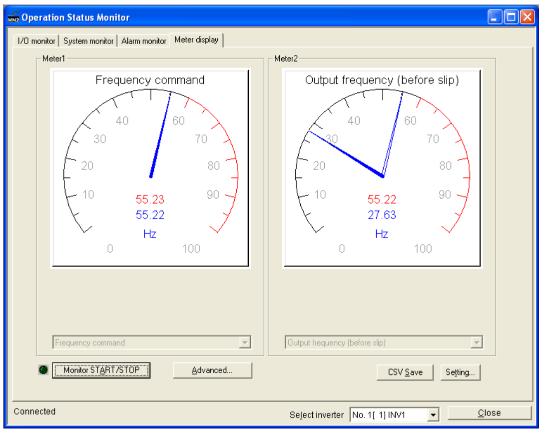
<u>Alarm monitor</u>

Displays the alarm status of the selected inverter. In this window you can check the details of the alarm currently occurs and related information.



<u>Meter display</u>

Displays analog readouts of the connected inverter (such as output frequency) on analog meters. The example on the right displays the reference frequency and the output frequency.



[4] Test-running

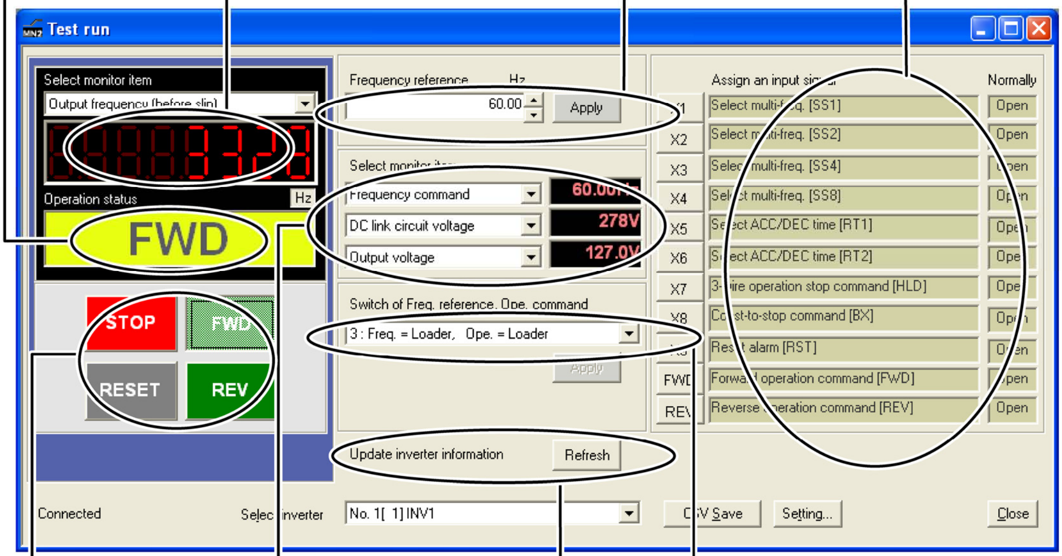
The Test-running feature allows you to test-run the motor in the forward or reverse direction while monitoring the running status of the selected inverter.

Operation status
Shows FWD, REV, STOP and alarm codes.

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.

I/O terminal status
Shows the status of the digital I/O terminals of the inverter.



Switching of frequency and run command sources
Select the frequency and run command sources and click Apply.

Operation buttons*

Select monitor item
Select the operation status information to be displayed in real-time.

Update inverter information
Click the Refresh button to refresh the contents of this window to show the latest inverter status.

Figure 9.2-2

* The details of the operation buttons are described in the table below.

Table 9.2-2

Button	Function
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.

[5] Real-time trace

The real-time trace can fix the sampling interval at 200 ms and monitor up to 4 analog readouts and up to 8 digital signals to display the running status of a selected inverter in real-time waveforms.
(Waveform capturing capability: Max. 15360 samples/channel)

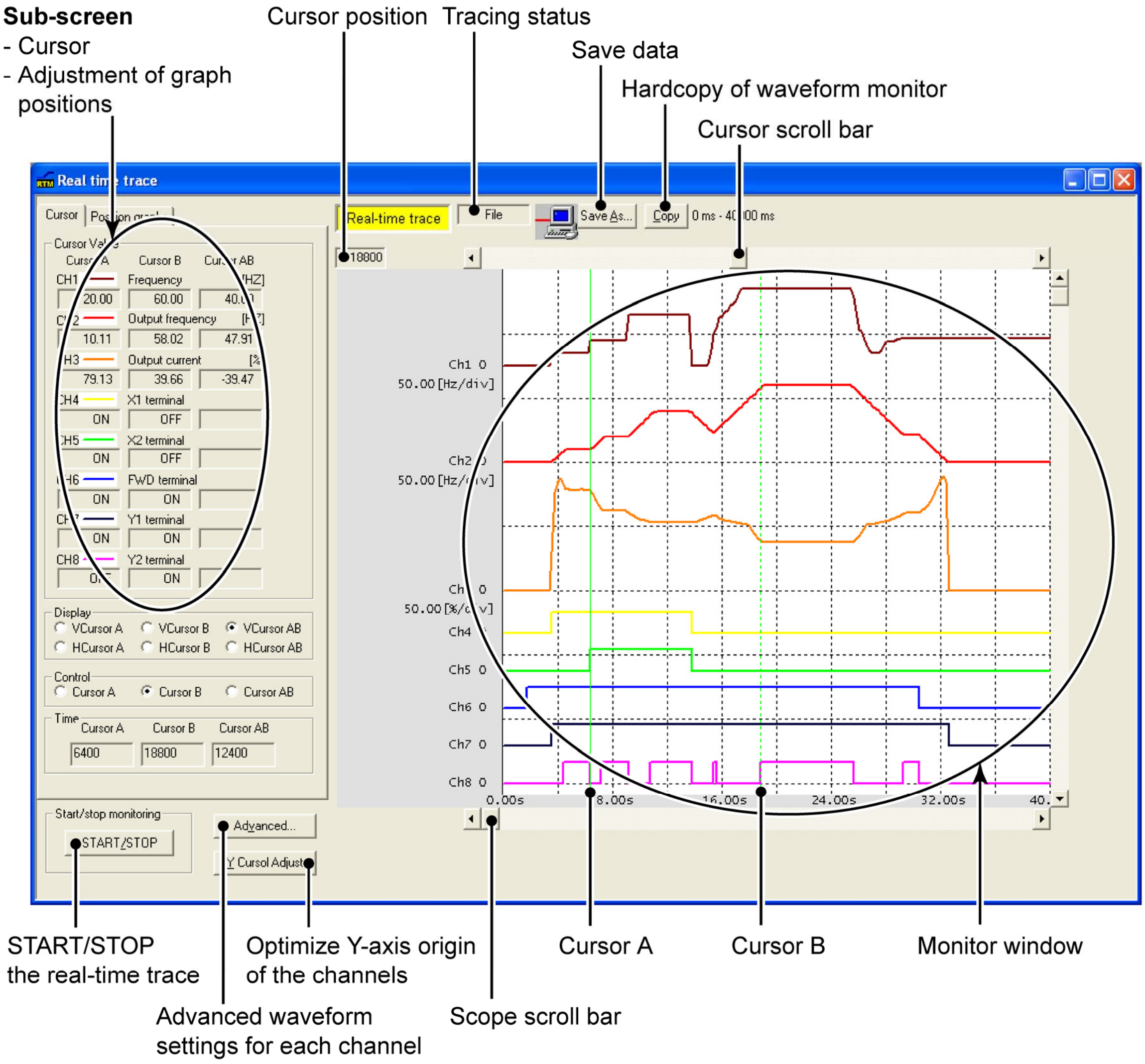


Figure 9.2-3

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 waveform monitor size.

[6] Historical trace

The historical trace can select the sampling interval between 1 to 200 ms and monitor up to 4 analog readouts and up to 8 digital signals to display the running status of a selected inverter in greater detail with more contiguous waveforms than in the real-time trace.

• Size of data saved: 2 kilobytes

(Waveform capturing capability: Max. 500 samples/channel)

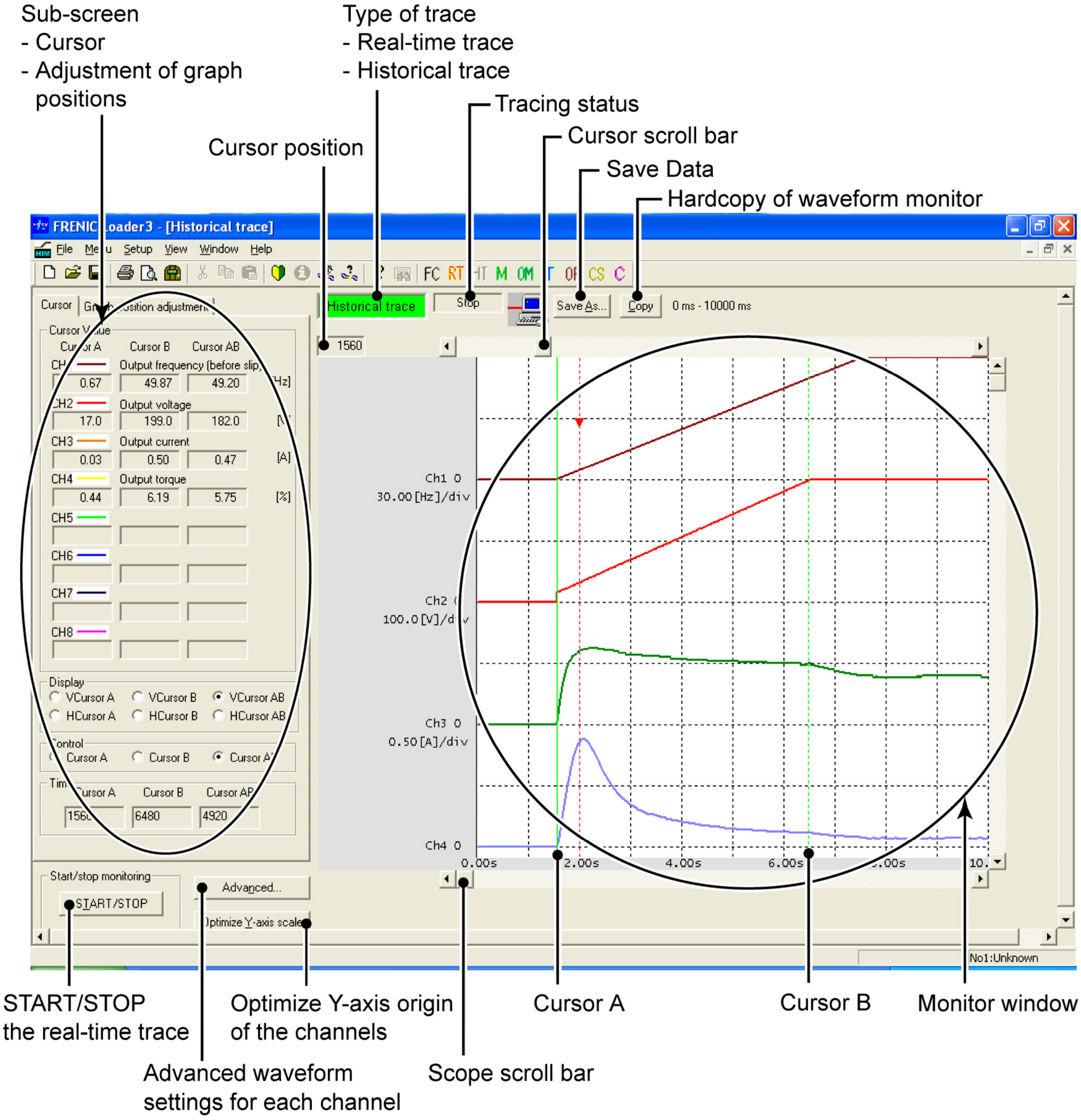


Figure 9.2-4

Note During the historical 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 waveform monitor size.

[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

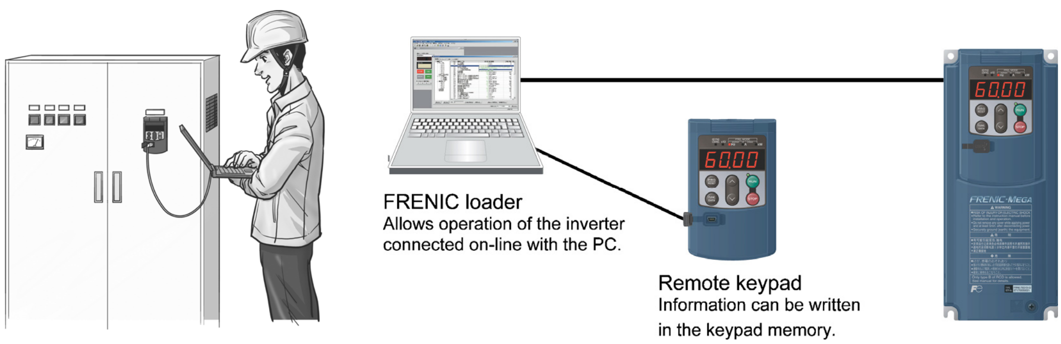
   (3) Trouble history (indicating the latest four trouble records)

   (4) Maintenance information

   (5) Historical trace

- Data can be transferred from the USB port of the keypad directly to the computer (FRENIC 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 10

SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES

This chapter describes the capacity selection of motor and inverter. 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.

Contents

10.1 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).

10.1.1 Output torque characteristics

Figures 10.1-1 and 10.1-2 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.

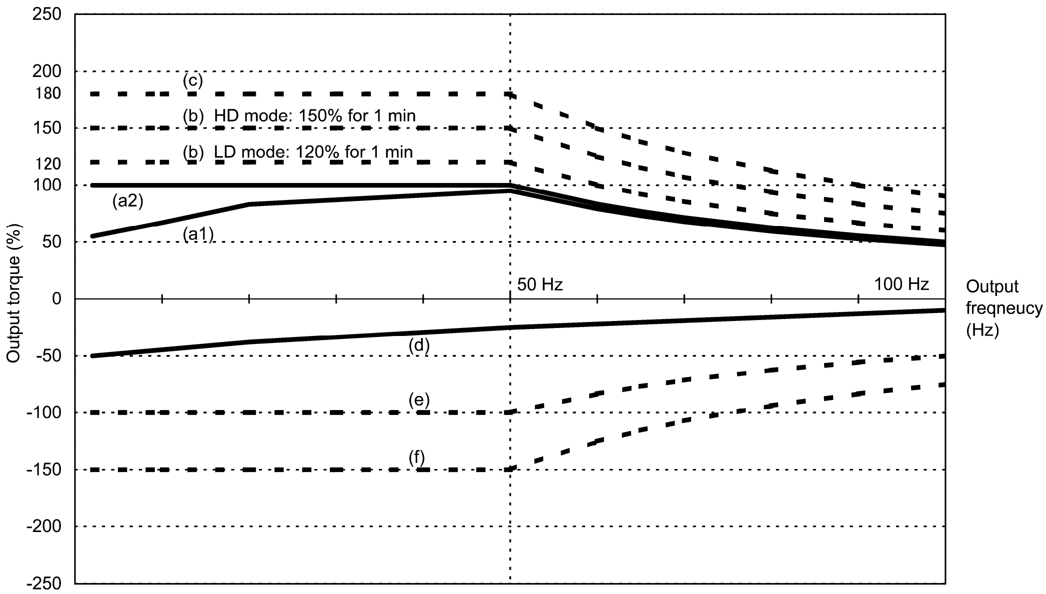


Figure 10.1-1 Output Torque Characteristics (Base frequency: 50Hz)

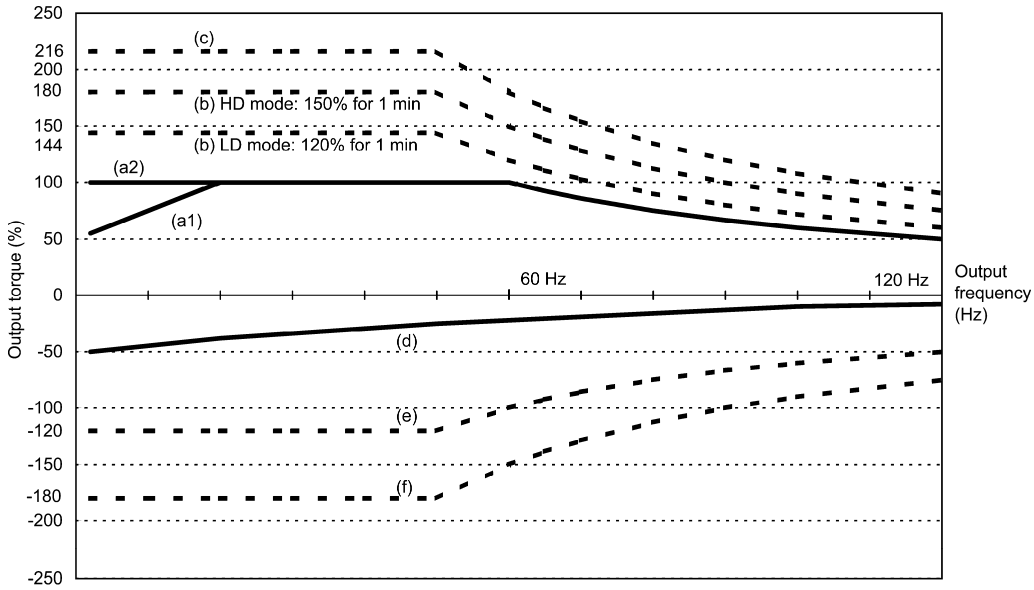


Figure 10.1-2 Output Torque Characteristics (Base frequency: 60Hz)

(1) Continuous allowable driving torque

1) Standard motor (Curve (a1) in Figure 10.1-1 and Figure 10.1-2)

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 Figure 10.1-1 and Figure 10.1-2)

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 Figure 10.1-1 and Figure 10.1-2)

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.

(3) Starting torque (around the output frequency 0 Hz in Figure 10.1-1 and Figure 10.1-2)

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

(4) Braking torque (Curves (d), (e), and (f) in Figure 10.1-1 and Figure 10.1-2)

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 11, Section 11.4.1 [1] "Braking resistors (DBRs) and braking units."

10.1.2 Selection procedure

Figure 10.1-3 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.

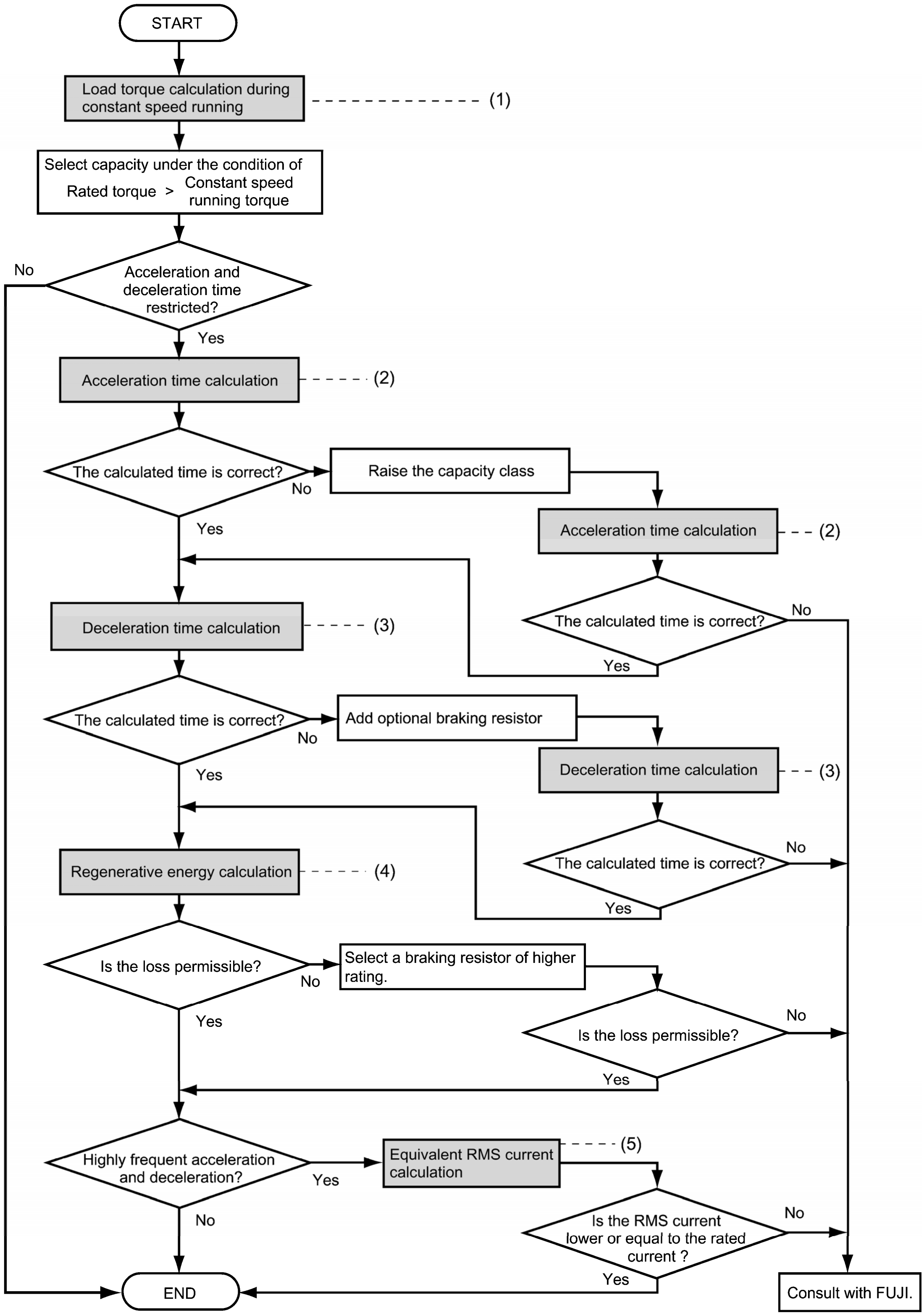


Figure 10.1-3 Selection Procedure

(1) Calculating the load torque during constant speed running (For detailed calculation, refer to Section 10.1.3 [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 10.1.3 [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 10.1.3 [2], "Acceleration and deceleration time calculation." For the motor, refer to the related motor catalogs.

2) Calculate the **minimum acceleration torque** (See Figure 10.1-4)
The acceleration torque is the difference between the motor short-time output torque (base frequency: 60 Hz) explained in Section 10.1.1 (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 (10.15) in Section 10.1.3 [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.

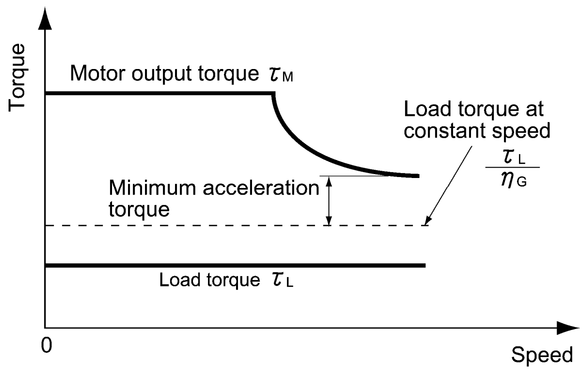


Figure 10.1-4 Example Study of Minimum Acceleration Torque

(3) Calculating the deceleration time (For detailed calculation, refer to Section 10.1.3 [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 Figure 10.1-5 and Figure 10.1-6)
Same as for the deceleration time.

3) Calculate the **deceleration time**
Assign the value calculated above to the equation (10.16) 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.

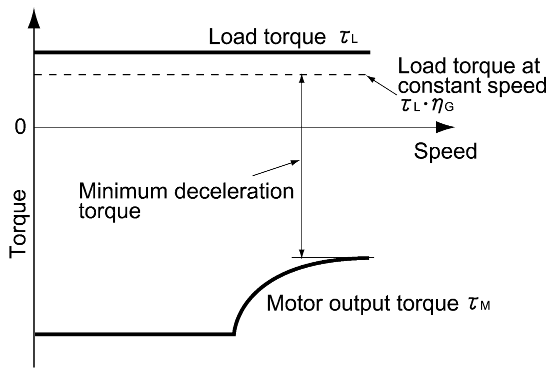


Figure 10.1-5 Example Study of Minimum Deceleration Torque (1)

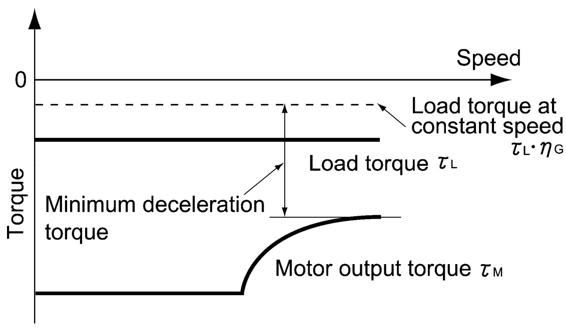


Figure 10.1-6 Example Study of Minimum Deceleration Torque (2)

(4) Braking resistor rating (For detailed calculation, refer to Section 10.1.3 [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 11, Section 11.4.1 [1] "Braking resistors (DBRs) and braking units."

(5) Motor RMS current (For detailed calculation, refer to Section 10.1.3 [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.

10.1.3 Equations for selections

[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:

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot \frac{F}{\eta_G} \quad (N \cdot m) \qquad (10.1)$$

where, η_G is Reduction-gear efficiency.

When the inverter brakes the motor, efficiency works inversely, so the required motor torque τ_M (N • m) should be calculated as follows:

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot F \cdot \eta_G \quad (N \cdot m) \qquad (10.2)$$

$(60 \cdot \upsilon) / (2\pi \cdot N_M)$ in the above equation is an equivalent turning radius corresponding to speedυ (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 10.1-7. 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:

$$F = (W_0 + W) \cdot g \cdot \mu \ (N) \qquad (10.3)$$

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

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

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot \frac{(W_O + W) \cdot g \cdot \mu}{\eta_G} \quad (N \cdot m) \qquad (10.4)$$

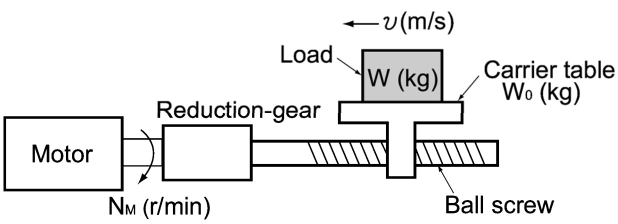


Figure 10.1-7 Moving a Load Horizontally

■ Vertical Lift Load

A simplified mechanical configuration is assumed as shown in Figure 10.1-8. 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:

(For lifting up)

$$F= (W_0+ W - W_B) \cdot g \text{ (N)} \tag{10.5}$$

(For lifting down)

$$F= (W_B- W - W_0) \cdot g \text{ (N)} \tag{10.6}$$

Assuming the maximum load is W_{max}, the mass of the balance weight W_B (kg) is generally obtained with the expression $W_B = W_O + Wmax /2$. 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 (10.1) or (10.2) depending on the driving or braking mode of the lift, that is, apply the expression (10.1) if the value of F (N) is positive, and the (10.2) if negative.

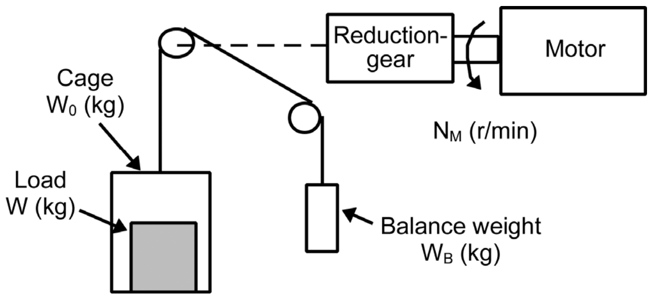


Figure 10.1-8 Vertical Lift Load

■ 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 10.1-9, the driving force F (N) is expressed as follows:

(For lifting up)

$$F =((W_O+ W)(\sin\theta + \mu \cdot \cos\theta) - W_B) \cdot g \text{ (N)} \tag{10.7}$$

(For lifting down)

$$F = (W_B- (W_O+ W) (\sin\theta + \mu \cdot \cos\theta)) \cdot g \text{ (N)} \tag{10.8}$$

The braking mode applies to both lifting up and down as in the vertical lift load. And the calculation of the required output torque around the motor shaft is the same as in the vertical lift load;

apply the expression (10.1) if the value of F (N) is positive, and the (10.2) if negative.

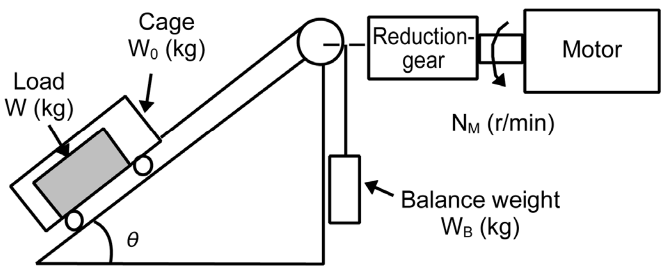


Figure 10.1-9 Inclined Lift Load

[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:

$$E = \frac{J}{2} \cdot \left(\frac{2\pi \cdot N}{60}\right)^2 \text{ (J)} \qquad (10.9)$$

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:

$$\tau = J \cdot \frac{2\pi}{60} \left(\frac{dN}{dt}\right) \text{ (N} \cdot \text{m)} \qquad (10.10)$$

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. The moment of inertia J can be calculated as follows:

$$J = \Sigma(Wi \cdot ri^2) \text{ (kg} \cdot \text{m}^2) \qquad (10.11)$$

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] respectively and total mass is W [kg] in Figure 10.1-10.

$$J = \frac{W \cdot (D_1^2 + D_2^2)}{8} \text{ (kg} \cdot \text{m}^2) \qquad (10.12)$$

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

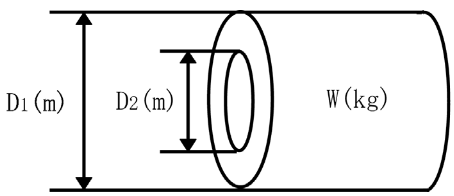
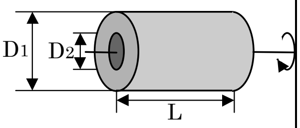
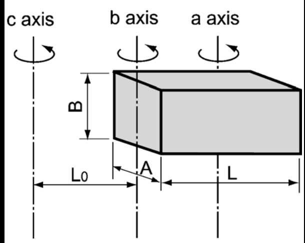
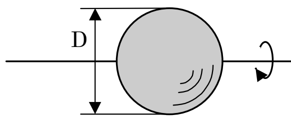
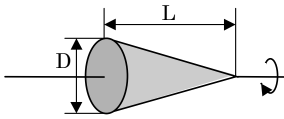
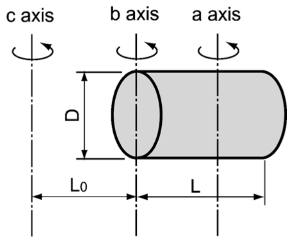
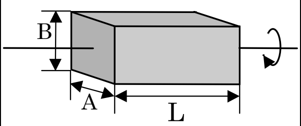
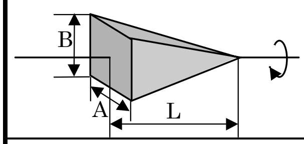
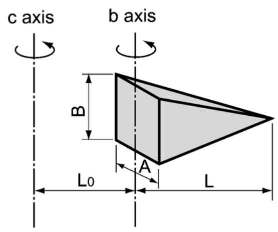
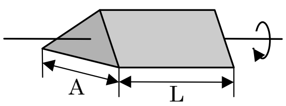
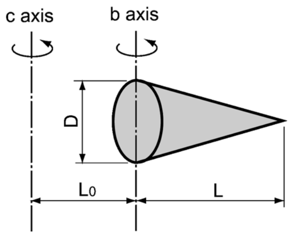
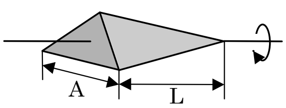


Figure 10.1-10 Hollow cylinder

(2) For a general rotating body

Table 10.1-1 lists the calculation equations of moment of inertia J of various rotating bodies (kg • m2) including the above cylindrical rotating body.

Table 10.1-1 Moment of Inertia of Various Rotating Bodies

Shape	Mass: W (kg) / Moment of inertia: J ($kg \cdot m^2$)	Shape	Mass: W (kg) / Moment of inertia: J ($kg \cdot m^2$)
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 	$W = \frac{\sqrt{3}}{4} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{3} \cdot W \cdot A^2$		$W = \frac{\pi}{12} \cdot D^2 \cdot L \cdot \rho$ $J_b = \frac{1}{10} \cdot W \cdot (L^2 + \frac{3}{8} \cdot D^2)$ $J_c \approx W \cdot (L_0^2 + \frac{3}{2} \cdot L_0 \cdot L + \frac{3}{5} \cdot L^2)$
Tetrahedron with an equilateral triangular base 	$W = \frac{\sqrt{3}}{12} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{5} \cdot W \cdot A^2$		

Main metal density (at 20ºC) 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 10.1-7. 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:

$$J = \left(\frac{60\upsilon}{2\pi \cdot N_M}\right)^2 \cdot (W_O + W) \quad (\mathrm{kg \cdot m^2}) \qquad (10.13)$$

(4) For a vertical or inclined lift load

The moment of inertia J ($\mathrm{kg \cdot m^2}$) of the loads connected with a rope as shown in Figure 10.1-8 and Figure 10.1-9 is calculated with the following equation using the mass of all moving objects, although the motion directions of those loads are different.

$$J = \left(\frac{60\upsilon}{2\pi \cdot N_M}\right)^2 \cdot (W_O + W + W_B) \quad (\mathrm{kg \cdot m^2}) \qquad (10.14)$$

[2] Calculation of the acceleration time

Figure 10.1-11 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:

$$t_{ACC} = \frac{J_1 + J_2/\eta_G}{\tau_M - \tau_L/\eta_G} \cdot \frac{2\pi \cdot (N_M - 0)}{60} \quad (\mathrm{s}) \qquad (10.15)$$

J_1: Motor shaft moment of inertia ($\mathrm{kg \cdot m^2}$)
J_2: Load shaft moment of inertia converted to motor shaft ($\mathrm{kg \cdot m^2}$)
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.

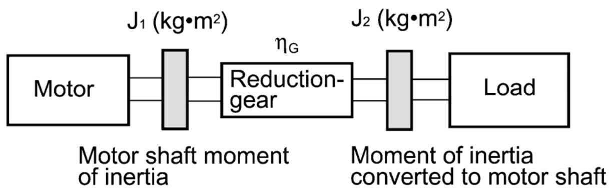


Figure 10.1-11 Load Model Including Reduction-gear

[3] Calculation of the deceleration time

In a load system shown in Figure 10.1-11, the time needed to stop the motor rotating at a speed of N_M (r/min) is calculated with the following equation:

$$t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot (0 - N_M)}{60} \quad \text{(s)} \qquad (10.16)$$

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) to select inverter capacity.

[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.

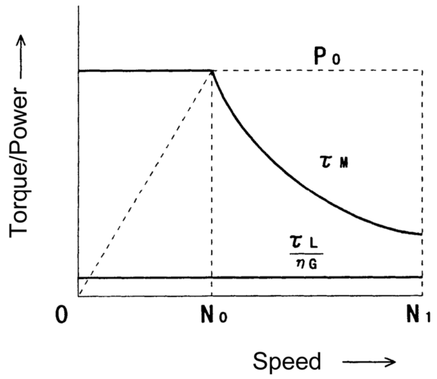


Figure 10.1-12 An Example of Driving Characteristics with a Constant Output Range

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 $\triangle$N 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 $\triangle$N 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 10.1-12 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.

The expression (10.17) gives an acceleration time Δt_{ACC}.

$$\triangle t_{ACC} = \frac{J_1 + J_2 / \eta_G}{\tau_M - \tau_L / \eta_G} \cdot \frac{2\pi \cdot \triangle N}{60} \quad \text{(s)} \qquad (10.17)$$

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 $N \leq N_O$]   Constant output torque range

$$\tau_M = \frac{60 \cdot P_O}{2\pi \cdot N_O} \quad (N \cdot m) \tag{10.18}$$

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

$$\tau_M = \frac{60 \cdot P_O}{2\pi \cdot N} \quad (N \cdot m) \tag{10.19}$$

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

[5] 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].

$$\triangle t_{DEC} = \frac{J_1 + J_2 / \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot \triangle N}{60} \quad (s) \tag{10.20}$$

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.

[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:

$$E = \frac{J}{2} \bullet \left(\frac{2\pi \bullet N_2}{60}\right)^2 \text{ (J = W}_S\text{)} \tag{10.21}$$

$$\approx \frac{1}{182.4} \bullet J \bullet N_2^2 \text{ (J)} \tag{10.21'}$$

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

$$E = \frac{J}{2} \bullet \left[\left(\frac{2\pi \bullet N_2}{60}\right)^2 - \left(\frac{2\pi \bullet N_1}{60}\right)^2\right] \text{ (J)} \tag{10.22}$$

$$\approx \frac{1}{182.4} \bullet J \bullet (N_2^2 - N_1^2) \quad \text{(J)} \tag{10.22'}$$

The energy regenerated to the inverter as shown in Figure 10.1-11 is calculated from the reduction-gear efficiency η_G and motor efficiency η_M as follows:

$$E \approx \frac{1}{182.4} \bullet (J_1 + J_2 \bullet \eta_G) \bullet \eta_M \bullet (N_2^2 - N_1^2) \quad \text{(J)} \tag{10.23}$$

(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:

$$E = W \bullet g \bullet (h_2 - h_1) \text{(J=W}_s\text{)} \tag{10.24}$$

$$g \approx 9.8065 \text{ (m/s}^2\text{)}$$

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

$$E = W \bullet g \bullet (h_2 - h_1) \bullet \eta_G \bullet \eta_M \text{(J)} \tag{10.25}$$

[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.

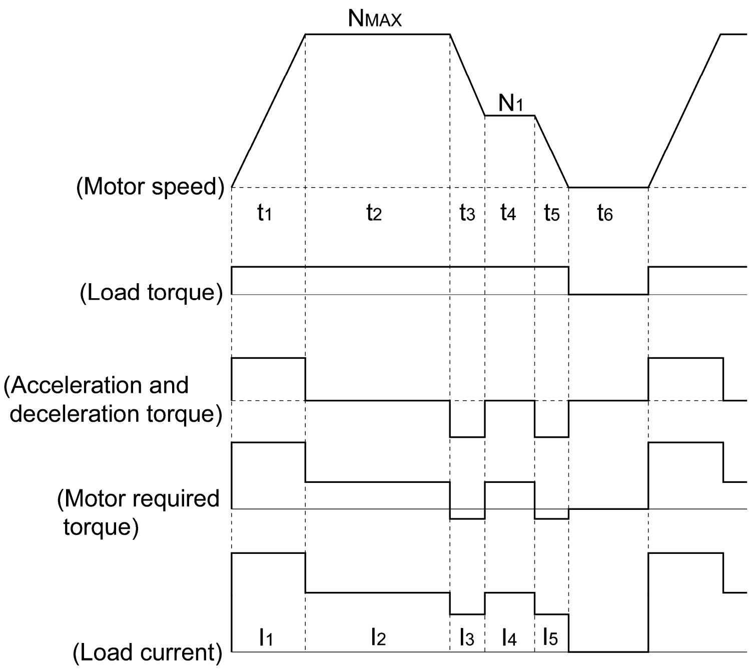


Figure 10.1-13 Sample of the Repetitive Operation

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, Ieq" can be finally calculated by the following equation:

$$I\,eq = \sqrt{\frac{I_1^2 \cdot t_1 + I_2^2 \cdot t_2 + I_3^2 \cdot t_3 + I_4^2 \cdot t_4 + I_5^2 \cdot t_5}{t_1+t_2+t_3+t_4+t_5+t_6}} \quad (A) \qquad (10.26)$$

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 (10.27). Then, calculate the equivalent current Ieq:

$$I = \sqrt{\left(\frac{\tau_1}{100} \times It_{100}\right)^2 + Im_{100}^2} \quad (A) \qquad (10.27)$$

Where, τ_1 is the load torque (%), It_{100} is the torque current, and Im_{100} is exciting current.

10.2 Selecting a Braking Resistor

10.2.1 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 [Requirements 3] below

2) If the cyclic period exceeds 100 s: [Requirements 1] and [Requirements 2] below

[Requirements 1] The maximum braking torque should not exceed values listed in the tables in Chapter 11, Section 11.4.1 [1] "Braking resistors (DBRs) and braking units." To use the maximum braking torque exceeding values in those tables, select the braking resistor having one class larger capacity.

[Requirements 2] The discharge energy for a single braking action should not exceed the discharging capability (kWs) listed in the tables in Chapter 11, Section 11.4.1 [1] "Braking resistors (DBRs) and braking units." For detailed calculation, refer to Section 10.1.3 [3] "Heat energy calculation of braking resistor."

[Requirements 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 the tables in Chapter 11, Section 11.4.1 [1] "Braking resistors (DBRs) and braking units."

10.2.2 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 Figure 10.2-1 shown below. However, you do not need to consider these values when selecting the braking resistor capacity.

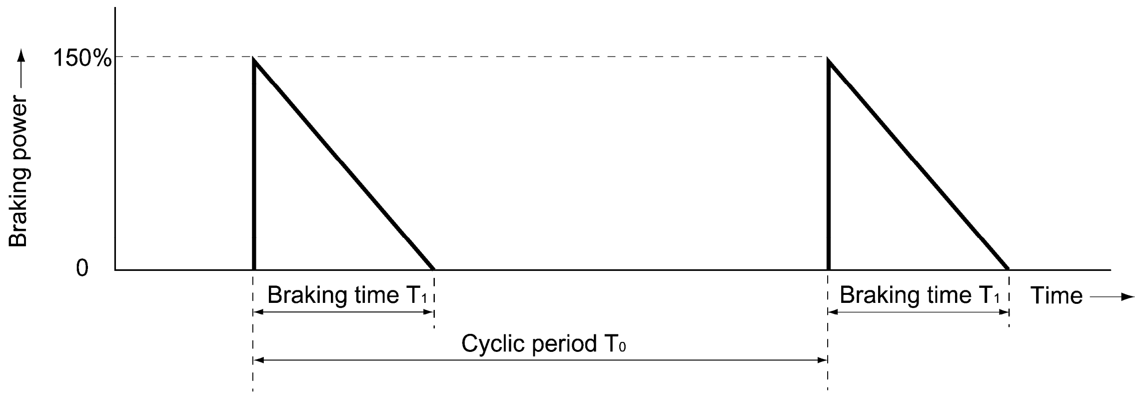


Figure 10.2-1 Duty Cycle

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

10.3 Selecting an Inverter Drive Mode (HD/MD/LD)

10.3.1 Precaution in making the selection

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 10.3.2 "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.

10.3.2 Guideline for selecting inverter drive mode and capacity

Table 10.3-1 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 10.3-1 Differences between HD, MD, and LD modes

Function	HD mode	MD mode	LD mode (Applies to 5.5 kW or above)	Remarks
Application	Heavy load	Medium load	Light 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.	Capable of driving a motor whose capacity is one rank higher than the inverter's.	Capable of driving a motor whose capacity is one or two ranks higher than the inverter's.	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 12 "SPECIFICATIONS."
Overload capability	150% for 1 min. 200% for 3 s	150% for 1 min	120% for 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 400 kW) 0.75 to 6 kHz (500, 630 kW)	Setting range: 0.75 to 2 kHz (90 to 400 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 500 kW) 0.75 to 4 kHz (630 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	—

10.4 Selecting a Motor Drive Control

10.4.1 Features of motor drive controls

The FRENIC-MEGA supports the following motor drive controls.

This section shows their basic configurations and describes their features.

Table 10.4-1

<table>
<tr><th>Drive control</th><th>Basic control</th><th>Speed feedback</th><th>Drive control class</th><th>Speed control</th><th>Other restrictions</th></tr>
<tr><td>V/f control with slip compensation inactive</td><td rowspan="5">V/f control</td><td rowspan="3">Disable</td><td rowspan="3">V/f</td><td>Frequency control</td><td>—</td></tr>
<tr><td>Dynamic torque vector control</td><td rowspan="2">Frequency control with slip compensation</td><td>—</td></tr>
<tr><td>V/f control with slip compensation active</td><td>—</td></tr>
<tr><td>V/f control with speed sensor*</td><td rowspan="2">Enable</td><td rowspan="2">PG V/f</td><td rowspan="2">Frequency control with automatic speed regulator (ASR)</td><td rowspan="2">Maximum frequency: 200 Hz</td></tr>
<tr><td>Dynamic torque vector control with speed sensor*</td></tr>
<tr><td>Vector control without speed sensor</td><td rowspan="2">Vector control</td><td>Estimated speed</td><td>w/o PG</td><td rowspan="2">Speed control with automatic speed regulator (ASR)</td><td>Maximum frequency: 120 Hz
Not available for MD-mode inverters.</td></tr>
<tr><td>Vector control with speed sensor*</td><td>Enable</td><td>w/ PG</td><td>Maximum frequency: 200 Hz</td></tr>
</table>

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

■ V/f control with slip compensation inactive

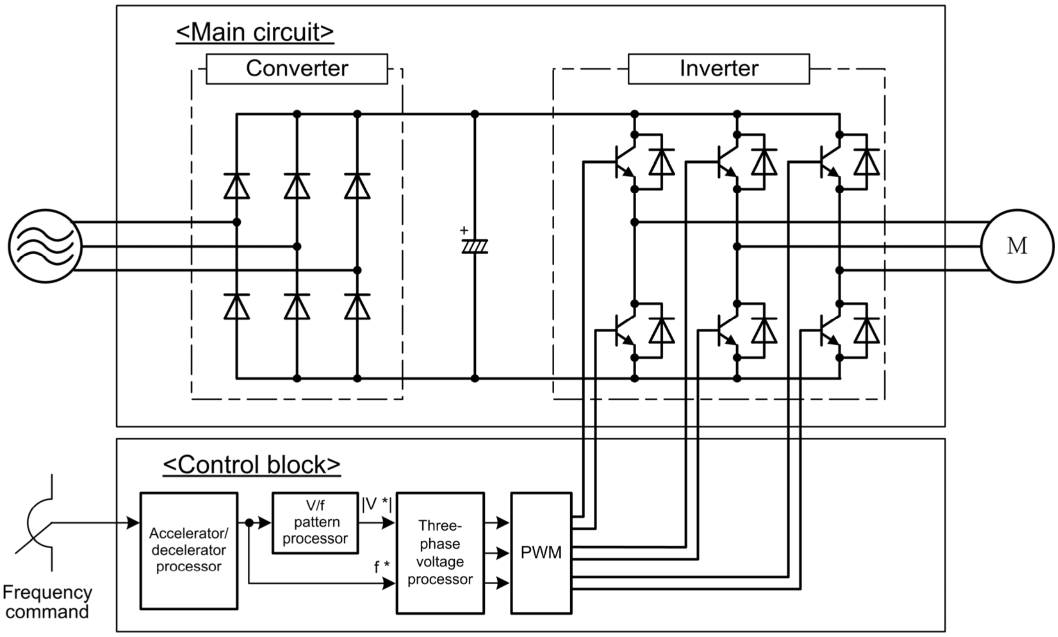


Figure 10.4-1 Schematic Block Diagram of V/f Control with Slip Compensation Inactive

As shown in the above configuration of Figure 10.4-1, 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. 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, so no unpredictable output fluctuation occurs, enabling stable operation with constant output frequency. This control is suitable for applications that makes the speed of existing motor variable or do not need quick speed change such as variable torque load equipment, fans, and pumps.

■ Dynamic torque vector control

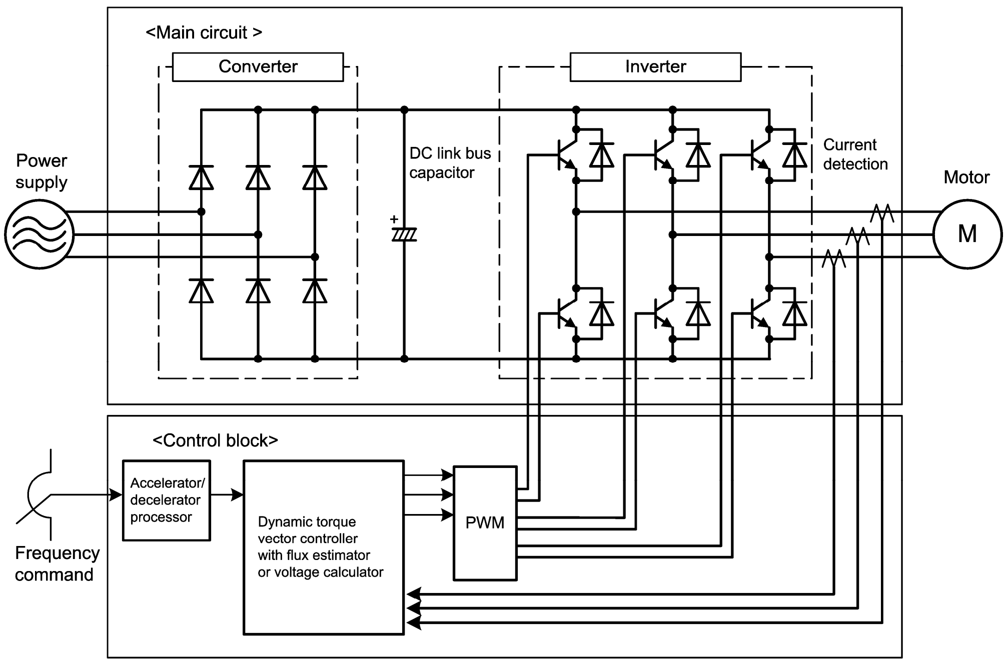


Figure 10.4-2 Schematic Block Diagram of Dynamic Torque Vector Control

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

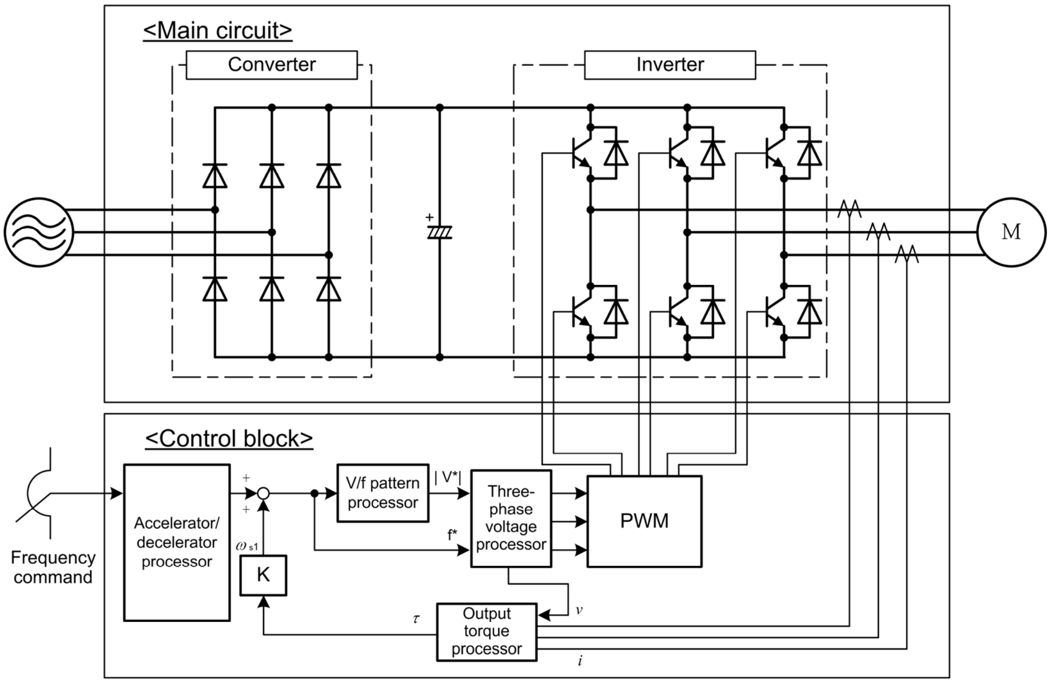


Figure 10.4-3 Schematic Block Diagram of V/f Control with Slip Compensation Active

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.

■ Vector control without speed sensor

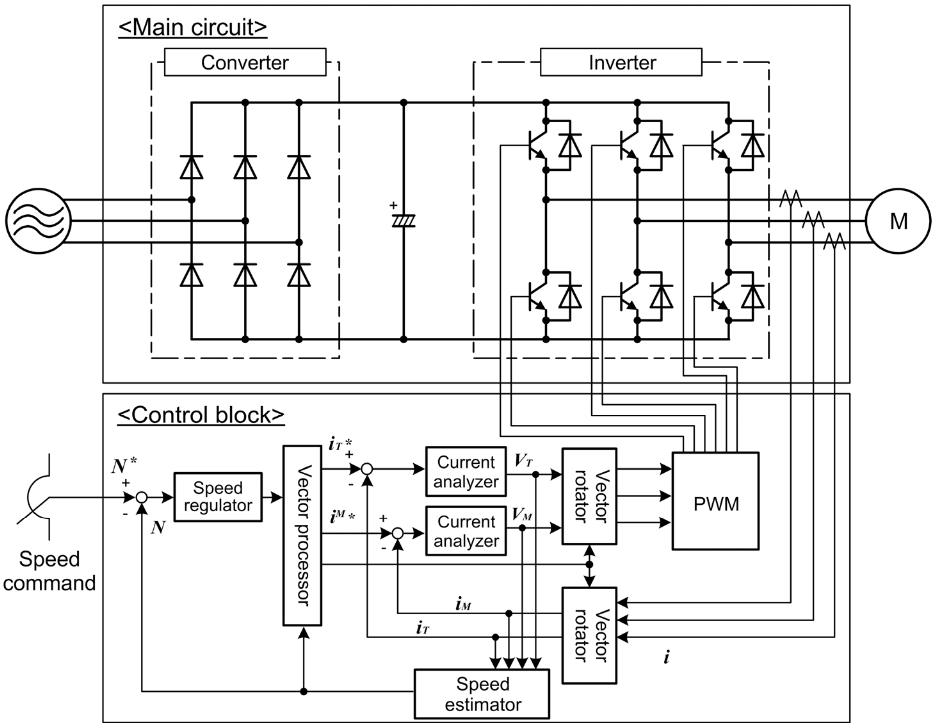


Figure 10.4-4 Schematic Block Diagram of Vector Control without Speed Sensor

This control estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. It also 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 a general-purpose motor is so designed that the voltage matches the commercial power. Under the control, therefore, it is necessary to suppress the motor terminal voltage to the lower level in order to secure the voltage margin required. However, driving the motor with the motor terminal voltage suppressed to the lower level cannot generate the rated torque even if the rated current originally specified for the motor is applied. To ensure the rated torque, it is necessary to increase the rated current. (This also applies to vector control with speed sensor.)

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

■ Vector control with speed sensor

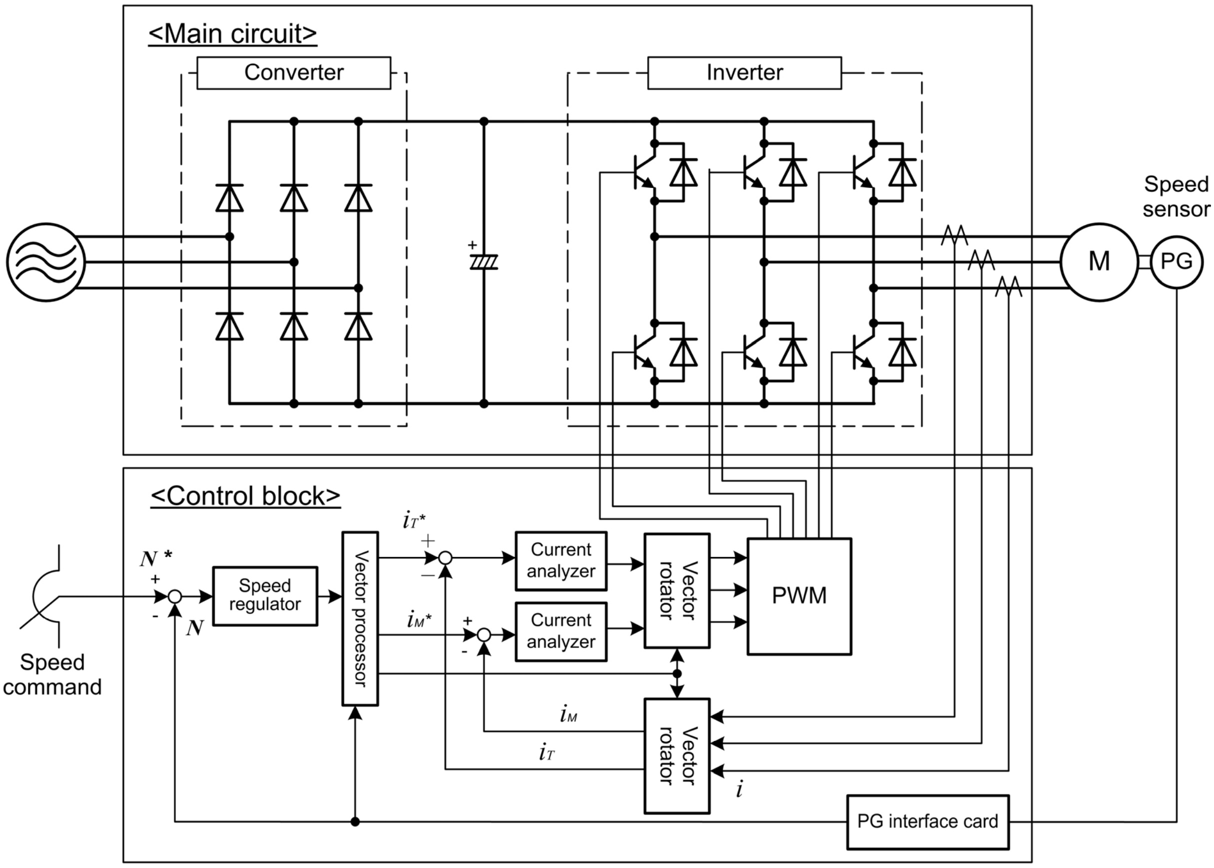


Figure 10.4-5 Schematic Block Diagram of Vector Control with Speed Sensor

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

10.4.2 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 10.4-2 Motor Drive Control by Purpose

Drive control abbreviation: Y: Applicable (Examination required), Y*: Examination required, N: Not applicable
"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
		50 m/min or above	Y*	Y*	Y*	Y
		50 m/min or above, zero speed required	N	N	N	Y*
	Parking tower (Circulation type)		Y*	Y	Y	Y
	Multistory warehouse	With position compensation	N	N	Y*	Y
	(Stacker crane)	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
	Draw bench		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*

Chapter 11

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.

Contents

11.1 Configuring the FRENIC-MEGA

This section lists the names, purposes of use, and connection examples of peripheral equipment and options.

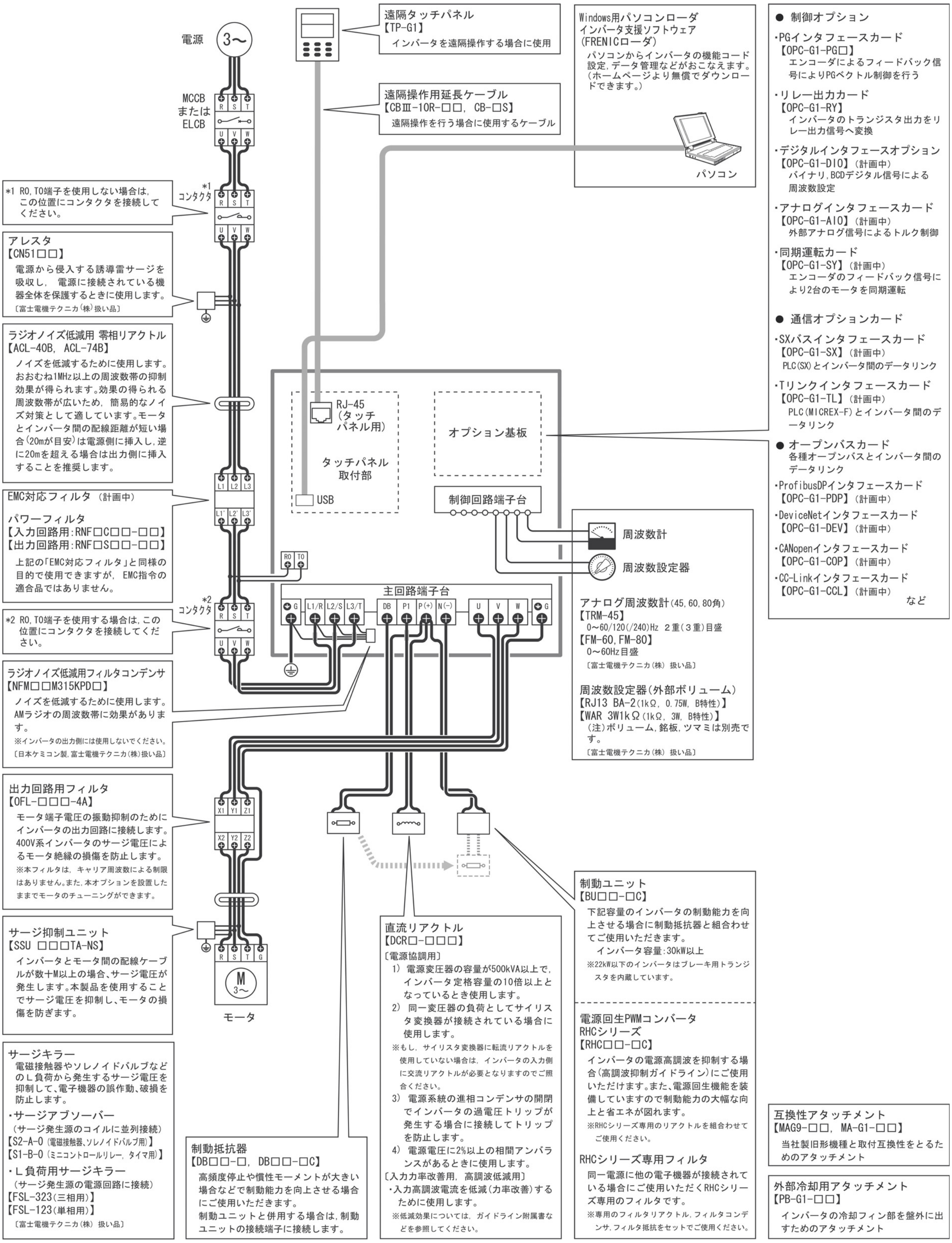


Figure 11.1-1 Quick Overview of Options

11.2 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 wiring and noise-related problems, refer to Appendix A "Advantageous Use of Inverters (Notes on Electrical Noise)" or "Technical Design Document of Inverter Panel."

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 wiring length is within the allowable range.
- Suitable for the form 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 except for the control circuit of the inverter. This class of wire is hard to twist, so using it for the control signal circuits is not recommended. Maximum allowable 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 of the inverter. However to use this class of wire for the control circuits of the inverter, 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 (FSLC 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 radiation noise and induction noise from external sources. 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.

Currents flowing across the inverter terminals

Table 11.2-1 summarizes electric currents flowing across the terminals of each inverter model for ease of reference when selecting peripheral equipment, options and electric wire size for each inverter; including supplied power voltage and applicable motor rating.

Table 11.2-1 Currents Flowing Across the Inverter Terminals

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 Input RMS current (A) DC reactor (DCR) w/ DCR	200 V, 50 Hz Input RMS current (A) DC reactor (DCR) w/o DCR	200 V, 50 Hz DC link bus current (A)	220 V, 60 Hz Input RMS current (A) DC reactor (DCR) w/ DCR	220 V, 60 Hz Input RMS current (A) DC reactor (DCR) w/o DCR	220 V, 60 Hz DC link bus current (A)	Braking resistor circuit current (A)
Three-phase 200 V	HD	0.4	FRN0.4G1□-2J	1.6	3.1	2.0	1.5	3.0	1.8	1.2
	HD	0.75	FRN0.75G1□-2J	3.2	5.3	4.0	3.0	4.9	3.7	1.6
	HD	1.5	FRN1.5G1□-2J	6.1	9.5	7.5	5.6	8.7	6.9	3.6
	HD	2.2	FRN2.2G1□-2J	8.9	13.2	11.0	8.1	12.0	10.0	3.5
	HD	3.7	FRN3.7G1S-2J	15.0	22.2	18.4	13.6	20.0	16.7	4.1
	HD	5.5	FRN5.5G1□-2J	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□-2J	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□-2J	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□-2J	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□-2J	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□-2J	84.4	112	103	76.0	101	93.1	15
	LD	30		114	151	140	103	136	126	15
	HD	30	FRN30G1□-2J	114	151	140	103	136	126	19
	LD	37		138	185	169	124	167	152	19
	HD	37	FRN37G1□-2J	138	185	169	124	167	152	25
	LD	45		167	225	205	150	203	184	25
	HD	45	FRN45G1□-2J	167	225	205	150	203	184	30
	LD	55		203	270	249	183	243	224	30
	HD	55	FRN55G1□-2J	203	270	249	183	243	224	37
	LD	75		282	–	345	254	–	311	37
	HD	75	FRN75G1□-2J	282		345	254		311	49
	LD	90		334		409	301		368	49
	HD	90	FRN90G1□-2J	334		409	301		368	62
	LD	110		410		502	369		452	62

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.
□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

- Inverter efficiency is calculated using values suitable for each inverter capacity. 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.

- 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 circuit current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

Table 11.2-1 Currents Flowing Across the Inverter Terminals (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	0.4	FRN0.4G1□-4J	0.85	1.7	1	0.74	1.7	0.99	0.8
	HD	0.75	FRN0.75G1□-4J	1.6	3.1	2.0	1.5	2.9	1.9	1.1
	HD	1.5	FRN1.5G1□-4J	3.0	5.9	3.7	2.8	5.4	3.5	1.8
	HD	2.2	FRN2.2G1□-4J	4.5	8.2	5.6	4.1	7.5	5.1	1.8
	HD	3.7	FRN3.7G1□-4J	7.5	13	9.2	6.9	11.8	8.5	2.1
	HD	5.5	FRN5.5G1□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	83.2	114	102	75.0	103	91.9	15
	LD	55		102	140	125	91.9	126	113	15
	HD	55	FRN55G1□-4J	102	140	125	91.9	126	113	19
	LD	75		138	–	169	124	–	152	19
	HD	75	FRN75G1□-4J	138		169	124		152	24
	LD	90		164		201	148		181	24
	HD	90	FRN90G1□-4J	164		201	148		181	31
	MD/LD	110		201		246	181		222	35/31
	HD	110	FRN110G1□-4J	201		246	181		222	35
	MD/LD	132		238		292	214		263	42/35
	HD	132	FRN132G1□-4J	238		292	214		263	42
	MD/LD	160		286		350	258		315	50/42
	HD	160	FRN160G1□-4J	286		350	258		315	50
	MD/LD	200		357		437	321		394	62/50
	HD	200	FRN200G1□-4J	357		437	321		394	62
	MD/LD	220		390		478	351		430	71/62

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

- Inverter efficiency is calculated using values suitable for each inverter capacity. 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.

- 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 circuit current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

Table 11.2-1 Currents Flowing Across the Inverter Terminals (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 Input RMS current (A) DC reactor (DCR) w/ DCR	400 V, 50 Hz Input RMS current (A) DC reactor (DCR) w/o DCR	400 V, 50 Hz DC link bus current (A)	440 V, 60 Hz Input RMS current (A) DC reactor (DCR) w/ DCR	440 V, 60 Hz Input RMS current (A) DC reactor (DCR) w/o DCR	440 V, 60 Hz DC link bus current (A)	Braking resistor circuit current (A)
Three-phase 400 V	HD	220	FRN220G1□-4J	390		478	351		430	71
	MD	250		443		543	399		489	100
	LD	280		500		613	450		552	71
	HD	280	FRN280G1□-4J	500		613	450		552	100
	MD	315		559		685	503		617	100
	LD	355		628		770	565		693	100
	HD	315	FRN315G1□-4J	559		685	503		617	100
	MD	355		628		770	565		693	124
	LD	400		705		864	635		778	124
	HD	355	FRN355G1□-4J	628	–	770	565	–	693	124
	MD	400		705		864	635		778	124
	LD	450		789		967	710		870	124
	HD	400	FRN400G1□-4J	705		864	635		778	124
	MD	450		789		967	710		870	150
	LD	500		881		1080	793		972	124
	HD	500	FRN500G1□-4J	881		1080	793		972	186
	LD	630		1115		1367	1004		1230	186
	HD	630	FRN630G1□-4J	1115		1367	1004		1230	212
	LD	710		1256		1539	1130		1385	212

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.
□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

- Inverter efficiency is calculated using values suitable for each inverter capacity. 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.
- 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 circuit current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

11.2.1 Recommended wires

This section lists the recommended wire size according to the wire type and the internal temperature of your power control panel.

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

Table 11.2-2 Wire Size (for main circuit power input and inverter output)

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/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 (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)
				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□-2J	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□-2J		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□-2J		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□-2J		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□-2J		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□-2J	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□-2J	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□-2J	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□-2J	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□-2J	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□-2J	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□-2J	HD	60	38			–	60	38		60	38	22	119					–	–	–	–
	37		LD	–	38	38	138	–	60	38	185	–	–	–	–	–	–	–	–	–	38	38	146
		FRN37G1□-2J	HD	100								100	38	38	146					–	–	–	–
	45		LD	100	60	38	167	–	100	60	225	–	–	–	–	–	–	–	–	–	60	38	180
		FRN45G1□-2J	HD									–	60	38	180					–	–	–	–
	55		LD	–	100	60	203	–	100	100	270	–	–	–	–	–	–	–	–	–	100	60	215
		FRN55G1□-2J	HD									–	100	60	215					–	–	–	–
	75		LD	–	150 *7)	100	282	–	–	–	–	–	–	–	–	–	–	–	–	–	150 *7)	100	283
		FRN75G1□-2J	HD									–	150	100	283					–	–	–	–
	90		LD	–	150	100	334	–	–	–	–	–	–	–	–	–	–	–	–	–	150	150	346
		FRN90G1□-2J	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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.

Table 11.2-2 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 (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)
				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□-4J	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□-4J		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□-4J		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□-4J		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□-4J		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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	HD									38	14	14	75					–	–	–	–
	45		LD	38	22	14	83.2	60	38	22	114	–	–	–	–	–	–	–	–	38	22	14	91
		FRN45G1□-4J	HD									38	22	14	91					–	–	–	–
	55		LD	60	22	22	102	–	38	38	140	–	–	–	–	–	–	–	–	60	38	22	112
		FRN55G1□-4J	HD									60	38	22	112					–	–	–	–
	75		LD	–	38	38	138	–	–	–	–	–	–	–	–	–	–	–	–	–	60	38	150
		FRN75G1□-4J	HD	100								100	60	38	150					–	–	–	–
	90		LD	100	60	38	164	–	–	–	–	–	–	–	–	–	–	–	–	–	60	38	176
		FRN90G1□-4J	HD									–	60	38	176					–	–	–	–
	110		MD/LD	–	100	60	201	–	–	–	–	–	–	–	–	–	100	60	210	–	100	60	210
		FRN110G1□-4J	HD									–	100	60	210	–	–	–	–	–	–	–	–
	132		MD/LD	–	100	60	238	–	–	–	–	–	–	–	–	–	100	100	253	–	100	100	253
		FRN132G1□-4J	HD									–	100	100	253	–	–	–	–	–	–	–	–
	160		MD/LD	–	150	100	286	–	–	–	–	–	–	–	–	–	150	100	304	–	150	100	304
		FRN160G1□-4J	HD									–	150	100	304	–	–	–	–	–	–	–	–
	200		MD/LD	–	150	150	357	–	–	–	–	–	–	–	–	–	200	150	377	–	200	150	377
		FRN200G1□-4J	HD									–	200	150	377	–	–	–	–	–	–	–	–
	220		MD/LD	–	200	150	390	–	–	–	–	–	–	–	–	–	200	150	415	–	200	150	415
			HD									–	200	150	415	–	–	–	–	–	–	–	–
	250	FRN220G1□-4J	MD	–	250	150	443	–	–	–	–	–	–	–	–	–	250	200	468	–	–	–	–
	280		LD	–	250	200	500	–	–	–	–	–	–	–	–	–	–	–	–	–	325	200	520
			HD									–	325	200	520					–	–	–	–
	315	FRN280G1□-4J	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□-4J	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□-4J	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□-4J	MD		2x250	2x200	789	–	–	–	–	–	–	–	–	–	2x250	2x200	840	–	–	–	–
	500		LD	–	2x325	2x200	881	–	–	–	–	–	–	–	–	–	–	–	–	–	2x325	2x250	960
		FRN500G1□-4J	HD									–	2x325	2x250	960					–	–	–	–
	630		LD	–	3x325	2x325	1115	–	–	–	–	–	–	–	–	–	–	–	–	–	3x325	2x325	1170
		FRN630G1□-4J	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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.

Table 11.2-2 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/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□-2J	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□-2J		2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	–	–	–	–	–	–	–	–												
	1.5	FRN1.5G1□-2J		2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	–	–	–	–	–	–	–	–												
	2.2	FRN2.2G1□-2J		2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	–	–	–	–	–	–	–	–												
	3.7	FRN3.7G1□-2J		3.5	2.0	2.0	18.4	2.0	2.0	2.0	4.1	–	–	–	–	–	–	–	–												
	5.5	FRN5.5G1□-2J	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										5.5		
		FRN7.5G1□-2J	HD					2.0	2.0	2.0	6.1					–	–	–	–												
	11		LD	22 *5)	8.0	5.5	51.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	6.1												
		FRN11G1□-2J	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										8.0		
		FRN15G1□-2J	HD					2.0	2.0	2.0	11					–	–	–	–												
	18.5		LD	38 *1)	22	14	87.0	–	–	–	–	–	–	–	–	2.0	2.0	2.0	11												
		FRN18.5G1□-2J	HD					2.0	2.0	2.0	14					–	–	–	–												
	22		LD	60 *2)	22	22	103	–	–	–	–	–	–	–	–	2.0	2.0	2.0	14										14		
		FRN22G1□-2J	HD					2.0	2.0	2.0	15					–	–	–	–												
	30		LD	100 *6)	38 *1)	38 *1)	140	–	–	–	–	–	–	–	–	2.0	2.0	2.0	15												
		FRN30G1□-2J	HD	–	38	38		3.5	2.0	2.0	19					–	–	–	–												
	37		LD	–	60	38	169	–	–	–	–	–	–	–	–	3.5	2.0	2.0	19										22		
		FRN37G1□-2J	HD	100				5.5	3.5	2.0	25					–	–	–	–							2.0 (37 kW or above)					
	45		LD	–	100	60	205	–	–	–	–	–	–	–	–	5.5	3.5	2.0	25												
		FRN45G1□-2J	HD					8.0	3.5	2.0	30					–	–	–	–												
	55		LD	–	100	60	249	–	–	–	–	–	–	–	–	8.0	3.5	2.0	30												
		FRN55G1□-2J	HD					14	5.5	3.5	37					–	–	–	–												
	75		LD	–	150 *7)	150 *7)	345	–	–	–	–	–	–	–	–	14	5.5	3.5	37												
		FRN75G1□-2J	HD		150	150		14	8.0	5.5	48					–	–	–	–												
	90		LD	–	200	150	409	–	–	–	–	–	–	–	–	14	8.0	5.5	48												
		FRN90G1□-2J	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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, referring to Table 11.2-1 and Appendix F "Allowable Current of Insulated Wires."

Table 11.2-2 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 (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) 60°C	75°C	90°C	Current (A)	Allowable temp. (Note 1) 60°C	75°C	90°C	Current (A)	Allowable temp. (Note 1) 60°C	75°C	90°C	Current (A)	Allowable temp. (Note 1) 60°C	75°C	90°C	Current (A)	Allowable temp. (Note 1) 60°C 75°C 90°C	Allowable temp. (Note 1) 60°C 75°C 90°C	Allowable temp. (Note 1) 60°C 75°C 90°C	Allowable temp. (Note 1) 60°C 75°C 90°C
Three-phase 400 V	0.4	FRN0.4G1□-4J	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□-4J		2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.1	–	–	–	–	–	–	–	–				
	1.5	FRN1.5G1□-4J		2.0	2.0	2.0	3.7	2.0	2.0	2.0	1.8	–	–	–	–	–	–	–	–				
	2.2	FRN2.2G1□-4J		2.0	2.0	2.0	5.6	2.0	2.0	2.0	1.8	–	–	–	–	–	–	–	–				
	3.7	FRN3.7G1□-4J		2.0	2.0	2.0	9.2	2.0	2.0	2.0	2.1	–	–	–	–	–	–	–	–				
	5.5	FRN5.5G1□-4J	HD	2.0	2.0	2.0	13.0	2.0	2.0	2.0	3.2	–	–	–	–	–	–	–	–				
	7.5		LD	3.5	2.0	2.0	17.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	3.2				3.5
		FRN7.5G1□-4J	HD					2.0	2.0	2.0	3.1					–	–	–	–				
	11		LD	5.5	3.5	2.0	25.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	3.1				
		FRN11G1□-4J	HD					2.0	2.0	2.0	4.5					–	–	–	–				
	15		LD	14	5.5	3.5	35.3	–	–	–	–	–	–	–	–	2.0	2.0	2.0	4.5				5.5
		FRN15G1□-4J	HD					2.0	2.0	2.0	5.7					–	–	–	–				
	18.5		LD	14	5.5	5.5	43.5	–	–	–	–	–	–	–	–	2.0	2.0	2.0	5.7				
		FRN18.5G1□-4J	HD					2.0	2.0	2.0	7.2					–	–	–	–				
	22		LD	22	8.0 *3)	5.5	51.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	7.2				
		FRN22G1□-4J	HD					2.0	2.0	2.0	7.7					–	–	–	–				
	30		LD	38 *1)	14	8.0 *3)	69.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	7.7				8.0
		FRN30G1□-4J	HD	38		8.0		2.0	2.0	2.0	10					–	–	–	–				
	37		LD	38	22	14	83.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	10				
		FRN37G1□-4J	HD					2.0	2.0	2.0	12					–	–	–	–				
	45		LD	60	22	22	102	–	–	–	–	–	–	–	–	2.0	2.0	2.0	12				
		FRN45G1□-4J	HD					2.0	2.0	2.0	15					–	–	–	–				
	55		LD	60	38	22	125	–	–	–	–	–	–	–	–	2.0	2.0	2.0	15				
		FRN55G1□-4J	HD					3.5	2.0	2.0	19					–	–	–	–				14
	75		LD	–	60	38	169	–	–	–	–	–	–	–	–	3.5	2.0	2.0	19				
		FRN75G1□-4J	HD	100				5.5	2.0	2.0	24					–	–	–	–			2.0 (75 kW or above)	
	90		LD	–	100	60	201	–	–	–	–	–	–	–	–	5.5	2.0	2.0	24				
		FRN90G1□-4J	HD					8.0	3.5	2.0	31					–	–	–	–				
	110		MD/LD	–	100	60	246	–	–	–	–	4.0	2.0	2.0	34	8.0	3.5	2.0	31				22
		FRN110G1□-4J	HD					8.0	5.5	3.5	34	–	–	–	–	–	–	–	–				
	132		MD/LD	–	150	100	292	–	–	–	–	8.0	5.5	3.5	41	8.0	5.5	3.5	34				
		FRN132G1□-4J	HD					14	5.5	3.5	41	–	–	–	–	–	–	–	–				
	160		MD/LD	–	150	150	350	–	–	–	–	14	5.5	3.5	50	14	5.5	3.5	41				
		FRN160G1□-4J	HD					14	8.0	5.5	50	–	–	–	–	–	–	–	–				
	200		MD/LD	–	250	150	437	–	–	–	–	14	8.0	5.5	62	14	8.0	5.5	50				38
		FRN200G1□-4J	HD					22	14	8.0	62	–	–	–	–	–	–	–	–				
	220		MD/LD	–	250	200	478	–	–	–	–	22	14	8.0	71	22	14	8.0	62				
		FRN220G1□-4J	HD					38	14	14	71	–	–	–	–	–	–	–	–				
	250		MD	–	325	250	543	–	–	–	–	22	14	8.0	71	–	–	–	–				
	280		LD	–	2x200	250	612	–	–	–	–	–	–	–	–	22	8.0	5.5	71				
		FRN280G1□-4J	HD					60	22	14	100					–	–	–	–				
	315		MD	–	2x200	325	685	–	–	–	–	60	22	14	100	–	–	–	–				60
	355		LD	–	2x250	2x200	769	–	–	–	–	–	–	–	–	38	22	14	100				
	315	FRN315G1□-4J	HD	–	2x200	325	685	60	22	14	100	–	–	–	–	–	–	–	–				
	355		MD	–	2x250	2x200	769	–	–	–	–	60	38	22	124	–	–	–	–				
	400		LD	–	2x325	2x200	864	–	–	–	–	–	–	–	–	38	22	14	124				
	355	FRN355G1□-4J	HD	–	2x250	2x200	769	60	38	22	124	–	–	–	–	–	–	–	–				
	400		MD	–	2x325	2x200	864	–	–	–	–	60	38	22	124	–	–	–	–				
	450		LD	–	2x325	2x250	966	–	–	–	–	–	–	–	–	60	38	22	124				
	400	FRN400G1□-4J	HD	–	2x325	2x200	864	60	38	22	124	–	–	–	–	–	–	–	–				
	450		MD	–	2x325	2x250	966	–	–	–	–	100	60	38	150	–	–	–	–				
	500		LD	–	3x325	2x325	1079	–	–	–	–	–	–	–	–	60	38	22	124				100
		FRN500G1□-4J	HD					150	100	38	186					–	–	–	–				
	630		LD	–	3x325	3x325	1366	–	–	–	–	–	–	–	–	150	100	38	186				
		FRN630G1□-4J	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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.

If environmental requirements such as power supply voltage and surrounding temperature differ from those listed above, select wires suitable for your system, referring to Table 11.2-1 and Appendix F "Allowable Current of Insulated Wires."

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

Table 11.2-3 Wire Size (for main circuit power input and inverter output)

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/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 (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)
				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□-2J	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□-2J	HD	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□-2J	HD	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□-2J	HD	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□-2J	HD	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□-2J	HD	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		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
		FRN7.5G1□-2J	HD									5.5	3.5	3.5	37					–	–	–	–
	11		LD	8.0	5.5	3.5	42.2	14	8.0	5.5	60.7	–	–	–	–	–	–	–	–	8.0	5.5	3.5	46.2
		FRN11G1□-2J	HD									8.0	5.5	5.5	49					–	–	–	–
	15		LD	14	8.0	5.5	57.6	22	14	14	80.1	–	–	–	–	–	–	–	–	14	8.0	5.5	59.4
		FRN15G1□-2J	HD									14	8.0	5.5	63					–	–	–	–
	18.5		LD	14	14	8.0	71.0	38 *1)	22	14	97.0	–	–	–	–	–	–	–	–	22	14	8.0	74.8
		FRN18.5G1□-2J	HD									22	14	8.0	76					–	–	–	–
	22		LD	22	14	14	84.4	38 *1)	22	14	112	–	–	–	–	–	–	–	–	22	14	14	88
		FRN22G1□-2J	HD									22	14	14	90					–	–	–	–
	30		LD	38 *1)	22	22	114	60 *2)	38 *1)	38 *1)	151	–	–	–	–	–	–	–	–	38 *1)	22	22	115
		FRN30G1□-2J	HD	38				60	38	38		38	22	22	119					–	–	–	–
	37		LD	60	38	22	138	–	60	38	185	–	–	–	–	–	–	–	–	60	38	22	146
		FRN37G1□-2J	HD					100				60	38	22	146					–	–	–	–
	45		LD	60	38	38	167	100	60	60	225	–	–	–	–	–	–	–	–	100	60	38	180
		FRN45G1□-2J	HD									100	60	38	180					–	–	–	–
	55		LD	100	60	38	203	–	100	60	270	–	–	–	–	–	–	–	–	100	60	60	215
		FRN55G1□-2J	HD									100	60	60	215					–	–	–	–
	75		LD	–	100	100	282	–	–	–	–	–	–	–	–	–	–	–	–	–	100	100	283
		FRN75G1□-2J	HD	150 *7)								150	100	100	283					–	–	–	–
	90		LD	–	150	100	334	–	–	–	–	–	–	–	–	–	–	–	–	200	150	100	346
		FRN90G1□-2J	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 an alphabetic letter depending on the enclosure.

□
└─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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 11.2-3 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 (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)
				60℃	75℃	90℃		60℃	75℃	90℃		60℃	75℃	90℃		60℃	75℃	90℃		60℃	75℃	90℃	
Three-phase 400 V	0.4	FRN0.4G1□-4J	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□-4J		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□-4J		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□-4J		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□-4J		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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	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□-4J	HD									22	14	8.0	75					–	–	–	–
	45		LD	22	14	14	83.2	38	22	22	114	–	–	–	–	–	–	–	–	22	14	14	91
		FRN45G1□-4J	HD									22	14	14	91					–	–	–	–
	55		LD	38	22	14	102	60	38	22	140	–	–	–	–	–	–	–	–	38	22	14	112
		FRN55G1□-4J	HD									38	22	14	112					–	–	–	–
	75		LD	60	38	22	138	–	–	–	–	–	–	–	–	–	–	–	–	60	38	38	150
		FRN75G1□-4J	HD									60	38	38	150					–	–	–	–
	90		LD	60	38	38	164	–	–	–	–	–	–	–	–	–	–	–	–	60	60	38	176
		FRN90G1□-4J	HD									60	60	38	176					–	–	–	–
	110		MD/LD	100	60	38	201	–	–	–	–	–	–	–	–	100	60	60	210	100	60	60	210
		FRN110G1□-4J	HD									100	60	60	210	–	–	–	–	–	–	–	–
	132		MD/LD	100	100	60	238	–	–	–	–	–	–	–	–	150	100	60	253	150	100	60	253
		FRN132G1□-4J	HD									150	100	60	253	–	–	–	–	–	–	–	–
	160		MD/LD	150	100	100	286	–	–	–	–	–	–	–	–	150	100	100	304	150	100	100	304
		FRN160G1□-4J	HD									150	100	100	304	–	–	–	–	–	–	–	–
	200		MD/LD	200	150	100	357	–	–	–	–	–	–	–	–	200	150	100	377	200	150	100	377
		FRN200G1□-4J	HD									200	150	100	377	–	–	–	–	–	–	–	–
	220		MD/LD	250	150	150	390	–	–	–	–	–	–	–	–	250	150	150	415	250	150	150	415
		FRN220G1□-4J	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□-4J	HD									325	250	200	520					–	–	–	–
	315		MD	–	250	200	559	–	–	–	–	–	–	–	–	–	250	200	585	–	–	–	–
	355		LD	–	325	250	628	–	–	–	–	–	–	–	–	–	–	–	–	–	325	250	650
	315	FRN315G1□-4J	HD	–	250	200	559	–	–	–	–	–	250	200	585	–	–	–	–	–	–	–	–
	355		MD	–	325	250	628	–	–	–	–	–	–	–	–	–	325	250	650	–	–	–	–
	400		LD	–	2x150	250	705	–	–	–	–	–	–	–	–	–	–	–	–	–	2x200	325	740
	355	FRN355G1□-4J	HD	–	325	250	628	–	–	–	–	–	325	250	650	–	–	–	–	–	–	–	–
	400		MD	–	2x150	250	705	–	–	–	–	–	–	–	–	–	2x200	325	740	–	–	–	–
	450		LD	–	2x200	325	789	–	–	–	–	–	–	–	–	–	–	–	–	–	2x200	2x150	840
	400	FRN400G1□-4J	HD	–	2x150	250	705	–	–	–	–	–	2x200	325	740	–	–	–	–	–	–	–	–
	450		MD	–	2x200	325	789	–	–	–	–	–	–	–	–	–	2x200	2x150	840	–	–	–	–
	500		LD	–	2x250	2x200	881	–	–	–	–	–	–	–	–	–	–	–	–	–	2x250	2x200	960
		FRN500G1□-4J	HD									–	2x250	2x200	960					–	–	–	–
	630		LD	–	2x325	2x250	1115	–	–	–	–	–	–	–	–	–	–	–	–	–	3x250	2x250	1170
		FRN630G1□-4J	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 an alphabetic letter depending on the enclosure.

□ └─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

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

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

Table 11.2-3 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/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 200 V	0.4	FRN0.4G1□-2J	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□-2J	HD	2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	–	–	–	–	–	–	–	–												
	1.5	FRN1.5G1□-2J	HD	2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	–	–	–	–	–	–	–	–												
	2.2	FRN2.2G1□-2J	HD	2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	–	–	–	–	–	–	–	–												
	3.7	FRN3.7G1□-2J	HD	2.0	2.0	2.0	18.4	2.0	2.0	2.0	4.1	–	–	–	–	–	–	–	–												
	5.5	FRN5.5G1□-2J	HD	3.5	2.0	2.0	25.9	2.0	2.0	2.0	6.4	–	–	–	–	–	–	–	–										3.5		
	7.5	FRN5.5G1□-2J	LD	5.5	3.5	3.5	35.3	–	–	–	–	–	–	–	–	2.0	2.0	2.0	6.4										5.5		
		FRN7.5G1□-2J	HD					2.0	2.0	2.0	6.1					–	–	–	–												
	11	FRN7.5G1□-2J	LD	14	5.5	5.5	51.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	6.1												
		FRN11G1□-2J	HD					2.0	2.0	2.0	9.1					–	–	–	–												
	15	FRN11G1□-2J	LD	14	14	8.0	70.6	–	–	–	–	–	–	–	–	2.0	2.0	2.0	9.1										8.0		
		FRN15G1□-2J	HD					2.0	2.0	2.0	11					–	–	–	–												
	18.5	FRN15G1□-2J	LD	22	14	14	87.0	–	–	–	–	–	–	–	–	2.0	2.0	2.0	11												
		FRN18.5G1□-2J	HD					2.0	2.0	2.0	14					–	–	–	–												
	22	FRN18.5G1□-2J	LD	38 *1)	22	14	103	–	–	–	–	–	–	–	–	2.0	2.0	2.0	14										14		
		FRN22G1□-2J	HD					2.0	2.0	2.0	15					–	–	–	–												
	30	FRN22G1□-2J	LD	60 *2)	38 *1)	22	140	–	–	–	–	–	–	–	–	2.0	2.0	2.0	15												
		FRN30G1□-2J	HD	60	38			2.0	2.0	2.0	19					–	–	–	–												
	37	FRN30G1□-2J	LD	60	38	38	169	–	–	–	–	–	–	–	–	2.0	2.0	2.0	19							2.0 (37 kW or above)			22		
		FRN37G1□-2J	HD					3.5	2.0	2.0	25					–	–	–	–												
	45	FRN37G1□-2J	LD	100	60	38	205	–	–	–	–	–	–	–	–	3.5	2.0	2.0	25												
		FRN45G1□-2J	HD					3.5	3.5	2.0	30					–	–	–	–												
	55	FRN45G1□-2J	LD	150 *7)	100	60	249	–	–	–	–	–	–	–	–	3.5	3.5	2.0	30												
		FRN55G1□-2J	HD					5.5	3.5	3.5	37					–	–	–	–												
	75	FRN55G1□-2J	LD	–	150 *7)	100	345	–	–	–	–	–	–	–	–	5.5	3.5	3.5	37												
		FRN75G1□-2J	HD		150			8.0	5.5	5.5	48					–	–	–	–												
	90	FRN75G1□-2J	LD	–	150	150	409	–	–	–	–	–	–	–	–	8.0	5.5	5.5	48												
		FRN90G1□-2J	HD					14.0	8.0	5.5	61					–	–	–	–												
	110	FRN90G1□-2J	LD	–	200	150	502	–	–	–	–	–	–	–	–	14	8.0	5.5	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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, referring to Table 11.2-1 and Appendix F "Allowable Current of Insulated Wires."

Table 11.2-3 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 [⏚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) 60°C / 75°C / 90°C	Allowable temp.(Note 1) 60°C / 75°C / 90°C	Allowable temp.(Note 1) 60°C / 75°C / 90°C	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					
Three-phase 400 V	0.4	FRN0.4G1□-4J	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□-4J	HD	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.1	–	–	–	–	–	–	–	–				
	1.5	FRN1.5G1□-4J	HD	2.0	2.0	2.0	3.7	2.0	2.0	2.0	1.8	–	–	–	–	–	–	–	–				
	2.2	FRN2.2G1□-4J	HD	2.0	2.0	2.0	5.6	2.0	2.0	2.0	1.8	–	–	–	–	–	–	–	–				
	3.7	FRN3.7G1□-4J	HD	2.0	2.0	2.0	9.2	2.0	2.0	2.0	2.1	–	–	–	–	–	–	–	–				
	5.5	FRN5.5G1□-4J	HD	2.0	2.0	2.0	13.0	2.0	2.0	2.0	3.2	–	–	–	–	–	–	–	–				
	7.5		LD	2.0	2.0	2.0	17.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	3.2				3.5
		FRN7.5G1□-4J	HD					2.0	2.0	2.0	3.1					–	–	–	–				
	11		LD	3.5	2.0	2.0	25.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	3.1				
		FRN11G1□-4J	HD					2.0	2.0	2.0	4.5					–	–	–	–				
	15		LD	5.5	3.5	3.5	35.3	–	–	–	–	–	–	–	–	2.0	2.0	2.0	4.5				5.5
		FRN15G1□-4J	HD					2.0	2.0	2.0	5.7					–	–	–	–				
	18.5		LD	8.0 *3)	5.5	3.5	43.5	–	–	–	–	–	–	–	–	2.0	2.0	2.0	5.7				
		FRN18.5G1□-4J	HD					2.0	2.0	2.0	7.2					–	–	–	–				
	22		LD	14	5.5	5.5	51.7	–	–	–	–	–	–	–	–	2.0	2.0	2.0	7.2				
		FRN22G1□-4J	HD					2.0	2.0	2.0	7.7					–	–	–	–				
	30		LD	14	14	8.0 *3)	69.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	7.7				8.0
		FRN30G1□-4J	HD			8.0		2.0	2.0	2.0	10					–	–	–	–				
	37		LD	22	14	14	83.9	–	–	–	–	–	–	–	–	2.0	2.0	2.0	10				
		FRN37G1□-4J	HD					2.0	2.0	2.0	12					–	–	–	–				
	45		LD	38	22	14	102	–	–	–	–	–	–	–	–	2.0	2.0	2.0	12				
		FRN45G1□-4J	HD					2.0	2.0	2.0	15					–	–	–	–				
	55		LD	38	38	22	125	–	–	–	–	–	–	–	–	2.0	2.0	2.0	15				14
		FRN55G1□-4J	HD					2.0	2.0	2.0	19					–	–	–	–				
	75		LD	60	38	38	169	–	–	–	–	–	–	–	–	2.0	2.0	2.0	19				
		FRN75G1□-4J	HD					3.5	2.0	2.0	24					–	–	–	–			2.0 (75 kW or above)	
	90		LD	100	60	38	201	–	–	–	–	–	–	–	–	3.5	2.0	2.0	24				
		FRN90G1□-4J	HD					5.5	3.5	2.0	31					–	–	–	–				
	110		MD/LD	150	100	60	246	–	–	–	–	5.5	3.5	2.0	34	5.5	3.5	2.0	31				22
		FRN110G1□-4J	HD					5.5	3.5	2.0	34	–	–	–	–	–	–	–	–				
	132		MD/LD	150	100	100	292	–	–	–	–	8.0	5.5	3.5	41	5.5	3.5	2.0	34				
		FRN132G1□-4J	HD					8.0	5.5	3.5	41	–	–	–	–	–	–	–	–				
	160		MD/LD	200	150	100	350	–	–	–	–	8.0	5.5	5.5	50	8.0	5.5	3.5	41				
		FRN160G1□-4J	HD					8.0	5.5	5.5	50	–	–	–	–	–	–	–	–				
	200		MD/LD	250	200	150	437	–	–	–	–	14	8.0	5.5	62	8.0	5.5	5.5	50				38
		FRN200G1□-4J	HD					14	8.0	5.5	62	–	–	–	–	–	–	–	–				
	220		MD/LD	325	200	150	478	–	–	–	–	14	14	8.0	71	14	8.0	5.5	62				
		FRN220G1□-4J	HD					14	14.0	8.0	71	–	–	–	–	–	–	–	–				
	250		MD	–	250	200	543	–	–	–	–	38	22	14	100	–	–	–	–				
	280		LD	–	325	250	612	–	–	–	–	–	–	–	–	14	14	8.0	71				
		FRN280G1□-4J	HD					38	22	14	100	–	–	–	–	–	–	–	–				
	315		MD	–	2x150	250	685	–	–	–	–	38	22	14	100	–	–	–	–				60
	355		LD	–	2x200	325	769	–	–	–	–	–	–	–	–	38	22	14.0	100				
	315	FRN315G1□-4J	HD	–	2x150	250	685	38	22	14	100	–	–	–	–	–	–	–	–				
	355		MD	–	2x200	325	769	–	–	–	–	38	22	22	124	–	–	–	–				
	400		LD	–	2x250	2x200	864	–	–	–	–	–	–	–	–	38	22	22	124				
	355	FRN355G1□-4J	HD	–	2x200	325	769	38	22	22	124	–	–	–	–	–	–	–	–				
	400		MD	–	2x250	2x200	864	–	–	–	–	38	22	22	124	–	–	–	–				
	450		LD	–	2x250	2x200	966	–	–	–	–	–	–	–	–	38	22	22	124				
	400	FRN400G1□-4J	HD	–	2x250	2x200	864	38	22	22	124	–	–	–	–	–	–	–	–				
	450		MD	–	2x250	2x200	966	–	–	–	–	60	38	38	150	–	–	–	–				
	500		LD	–	2x325	2x250	1079	–	–	–	–	–	–	–	–	38	22	22	124				100
		FRN500G1□-4J	HD					60	38	38	186					–	–	–	–				
	630		LD	–	3x325	2x325	1366	–	–	–	–	–	–	–	–	60	38	38	186				
		FRN630G1□-4J	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 an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

*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, referring to Table 11.2-1 and Appendix F "Allowable Current of Insulated Wires."

Chapter 11 SELECTING PERIPHERAL EQUIPMENT

11.3 Peripheral Equipment

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

[1] Function 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.

The Earth Leakage Circuit Breakers (ELCBs) is also connected for main circuit wire protection and power ON/OFF in the same way as MCCBs.

Built-in overcurrent/overload protective functions protect the inverter itself from failures.

■ Magnetic contactor

A Magnetic contactor (MC) can be used at both the power input and output sides of the inverter. At each side, the MC works as described below. Use this terminal if needed. The MC on the output side can also be used for swithcing the commercial power lines.

At the input (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 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 this purpose only, it is recommended that you use an MC capable of turning the inverter OFF manually.

Note Avoid frequent ON/OFF operation of the magnetic contactor (MC) in the input (primary) side; 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 the FWD/REV signals of the control circuit terminals or the RUN/STOP keys on the inverter's keypad.

At the output (motor) 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) side 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 (secondary) side 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, when driving multiple motors.

Driving the motor using commercial power lines

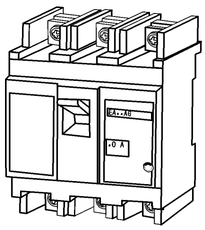
MCs can also be used to switch the power supply of the motor driven by the inverter to a commercial power supply.

Select the MC so as to satisfy the input RMS currents listed in Table 11.2-1, which are the most critical RMS currents for using the inverter (Refer to Table 11.3-1). 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.

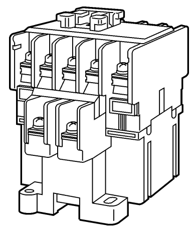
[2] Connection example and criteria for selection of circuit breakers

Figure 11.3-1 shows a connection example for MCCB or RCD/ELCB (with overcurrent protection) and MC in the inverter input circuit. Table 11.3-1 lists the rated current and magnetic contactor format necessary to select a circuit breaker. Table 11.3-2 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. Do not use an MCCB or RCD/ELCB of a higher than that recommended. **Otherwise, a fire could occur.**



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



Magnetic contactor

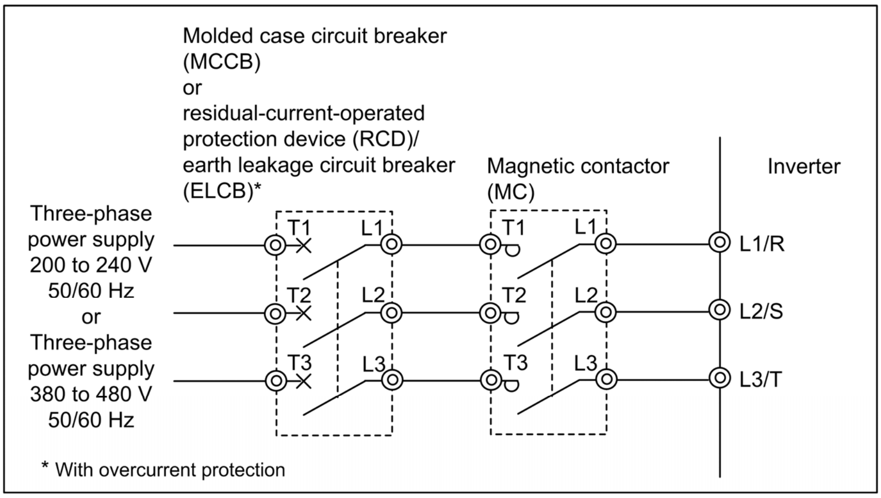


Figure 11.3-1 External Views of MCCB or RCD/ELCB and MC and Connection Example

Table 11.3-1 Molded Case Circuit Breaker (MCCB), Residual-Current-Operated Protective Device (RCD)/Earth Leakage Circuit Breaker (ELCB), 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□-2J	HD	5	5	SC-05	SC-05	SC-05	–
	0.75	FRN0.75G1□-2J			10				
	1.5	FRN1.5G1□-2J		10	15				
	2.2	FRN2.2G1□-2J			20				
	3.7	FRN3.7G1□-2J		20	30		SC-5-1		
	5.5	FRN5.5G1□-2J	HD	30	50		SC-N1	SC-4-0	
	7.5		LD	40	75	SC-5-1	SC-N2	–	SC-5-1
		FRN7.5G1□-2J	HD					SC-N1	–
	11		LD	50	100	SC-N1	SC-N2S	–	SC-N1
		FRN11G1□-2J	HD					SC-N1	–
	15		LD	75	125	SC-N2	SC-N3	–	SC-N2
		FRN15G1□-2J	HD					SC-N2	–
	18.5		LD	100	150	SC-N2S	SC-N4	–	SC-N2S
		FRN18.5G1□-2J	HD					SC-N2S	–
	22		LD		175		SC-N5	–	SC-N2S
		FRN22G1□-2J	HD					SC-N3	–
	30		LD	150	200	SC-N4	SC-N7	–	SC-N4
		FRN30G1□-2J	HD					SC-N4	–
	37		LD	175	250	SC-N5	SC-N8	–	SC-N5
		FRN37G1□-2J	HD					SC-N5	–
	45		LD	200	300	SC-N7		–	SC-N7
		FRN45G1□-2J	HD					SC-N7	–
	55		LD	250	350	SC-N8	SC-N11	–	SC-N8
		FRN55G1□-2J	HD					SC-N8	–
	75		LD	350	–	SC-N11	–	–	SC-N10
		FRN75G1□-2J	HD					SC-N11	–
	90		LD	400				–	SC-N11
		FRN90G1□-2J	HD					SC-N11	–
	110		LD	500		SC-N12		–	SC-N12

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

- 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 50°C or lower. The rated current is factored by a correction coefficient of 0.85 as the MCCB's and RCD's/ELCB's original rated current is specified when using them in a surrounding temperature. Select an MCCB and/or RCD/ELCB suitable for the actual short-circuit breaking capacity needed for your power systems.
- When selecting an MC, the HIV wire (capable of 75°C) is assumed. 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 11.3-1 Molded Case Circuit Breaker (MCCB), Residual-Current-Operated Protective Device (RCD)/Earth Leakage Circuit Breaker (ELCB), 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				
				DC reactor (DCR)		For input circuit DC reactor (DCR)		For output circuit		
				w/ DCR	w/o DCR	w/ DCR	w/o DCR	HD	MD	LD
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	5	5	SC-05	SC-05	SC-05	–	–
	0.75	FRN0.75G1□-4J								
	1.5	FRN1.5G1□-4J			10					
	2.2	FRN2.2G1□-4J			15					
	3.7	FRN3.7G1□-4J		10	20					
	5.5	FRN5.5G1□-4J	HD	15	30		SC-4-0			
	7.5		LD	20	40		SC-5-1	–		SC-05
		FRN7.5G1□-4J	HD					SC-05		–
	11		LD	30	50		SC-N1	–		SC-4-0
		FRN11G1□-4J	HD					SC-4-0		–
	15		LD	40	60	SC-5-1		–		SC-5-1
		FRN15G1□-4J	HD					SC-5-1		–
	18.5		LD		75	SC-N1	SC-N2	–		SC-N1
		FRN18.5G1□-4J	HD					SC-N1		–
	22		LD	50	100		SC-N2S	–		SC-N1
		FRN22G1□-4J	HD					SC-N1		–
	30		LD	75	125	SC-N2	SC-N3	–		SC-N2
		FRN30G1□-4J	HD					SC-N2		–
	37		LD	100		SC-N2S	SC-N4	–		SC-N2S
		FRN37G1□-4J	HD					SC-N2S		–
	45		LD		150	SC-N3		–		SC-N3
		FRN45G1□-4J	HD					SC-N3		–
	55		LD	125	200		SC-N5	–		SC-N4
		FRN55G1□-4J	HD					SC-N4		–
	75		LD	175	–	SC-N4	–	–		SC-N5
		FRN75G1□-4J	HD					SC-N5		–
	90		LD	200		SC-N7		–		SC-N7
		FRN90G1□-4J	HD					SC-N7		–
	110		MD/LD	250		SC-N8		–	SC-N8	SC-N8
		FRN110G1□-4J	HD					SC-N8	–	–
	132		MD/LD	300				–	SC-N8	SC-N8
		FRN132G1□-4J	HD					SC-N8	–	–
	160		MD/LD	350		SC-N11		–	SC-N11	SC-N11
		FRN160G1□-4J	HD					SC-N11	–	–
	200		MD/LD	500		SC-N12		–	SC-N12	SC-N12
		FRN200G1□-4J	HD					SC-N12	–	–
	220		MD/LD					–	SC-N12	SC-N12
		FRN220G1□-4J	HD					SC-N12	–	–
	250		MD	600				–	SC-N14	
	280		LD			SC-N14			–	SC-N14
		FRN280G1□-4J	HD					SC-N14		–
	315		MD	800				–	SC-N14	
	355		LD						–	SC-N14
	315	FRN315G1□-4J	HD					SC-N14		–
	355		MD					–	SC-N14	
	400		LD	1200		SC-N16			–	SC-N16
	355	FRN355G1□-4J	HD	800		SC-N14		SC-N14		–
	400		MD	1200		SC-N16		–	SC-N16	
	450		LD						–	610CM*
	400	FRN400G1□-4J	HD					SC-N16		–
	450		MD					–	610CM*	
	500		LD			610CM*			–	610CM*
		FRN500G1□-4J	HD					610CM*		–
	630		LD	1400		612CM*		–		612CM*
		FRN630G1□-4J	HD					612CM*		–
	710		LD	1600		616CM*		–		616CM*

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

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

- 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. Select an MCCB and/or RCD/ELCB suitable for the actual short-circuit breaking capacity needed for your power systems.
- When selecting an MC, the HIV wire (capable of 75°C) is assumed. 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 11.3-2 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 11.3-2 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					
		10m	30m	50m	100m	200m	300m
	0.4						
	0.75						
	1.5						
	2.2		30mA				
	3.7						
	5.5						
	7.5				100mA		
Three-phase 200 V	11						
	15						
	18.5					200mA	
	22						
	30						
	37						
	45						
	55						
	75						500mA
	90						
	110						
	0.4						
	0.75						
	1.5						
	2.2						
	3.7	30mA					
	5.5						
	7.5						
	11			100mA			
	15						
	18.5						
	22				200mA		
	30						
	37						
	45					500mA	
	55						
Three-phase 400 V	75						
	90						
	110						
	132						1000mA
	160						(Special)
	200						
	220						
	250						
	280						
	315						
	355						3000mA
	400						(Special)
	450						
	500						
	630						
	710						

- 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).
- 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 sum of the length of the wires to the motors.

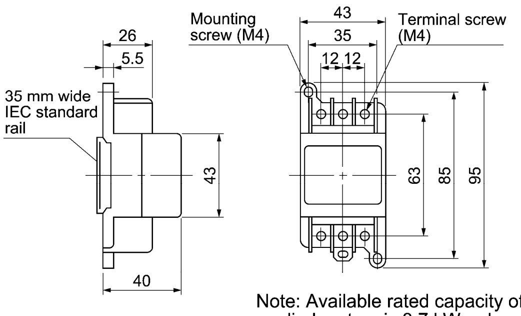
11.3.2 Surge killer for L-load

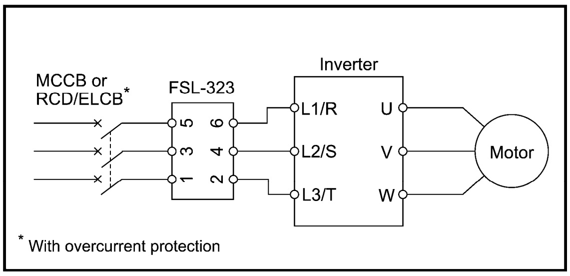
A surge killer absorbs the surge voltage generated from L-load of a magnetic contactor (MC) or solenoid valve in the power system to effectively protect electronic equipment in the panel from malfunctions or breakdown.

Install a surge killer near the power coil of the surge source. As shown in Figure 11.3-2 by connecting a surge killer to the inverter's power source side, it absorbs the surge voltage from the power supply, preventing the electronic equipment, from damage or malfunctioning. (Available capacity is 3.7 kW or less.)

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.





Note: Available rated capacity of nominal applied motors is 3.7 kW or less.

Available from Fuji Electric Technica Co., Ltd.

Figure 11.3-2 Dimensions of Surge Killer and Connection Example

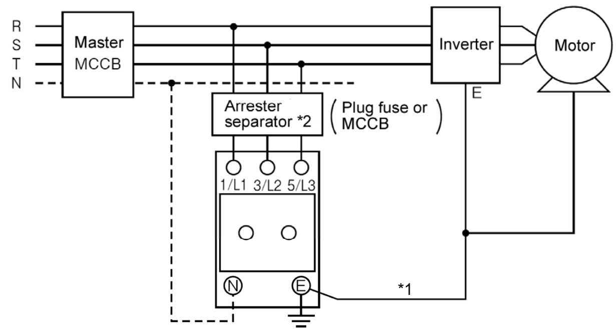
11.3.3 Arrester

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

Applicable arrester models are CN5132 for three-phase AC 200 V class series, and CN5134 for three-phase 400 V class series. (CN523 series with 20 kA of discharging capability is also available.)

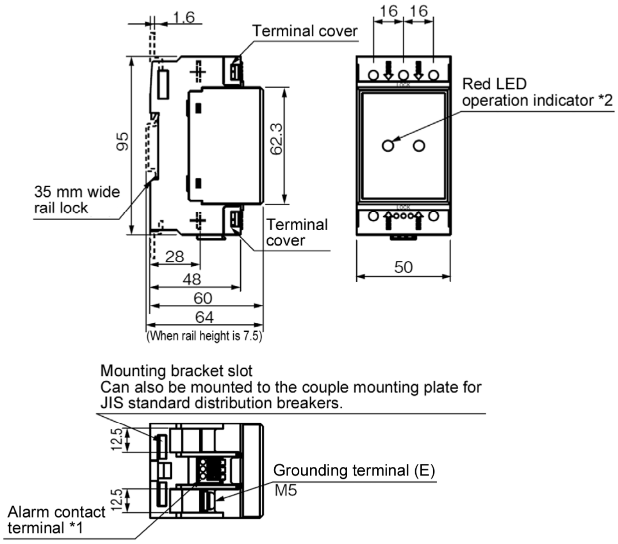
Figure 11.3-3 shows their external dimensions and connection examples. Refer to the catalog "Fuji Surge Killers/Absorbers (HS165a: Japanese edition only)" for details. These products are available from Fuji Electric Technica Co., Ltd.

● Tree-phase (AC240/440V)



*1 Keep the wiring length as short as possible.
*2 The models with a built-in arrestor separator (CN5212-FK and CN5232-FK) are not required when the short-circuit current of the circuit is 250 VAC, 10kA or less.

(N-phase terminal is only for CN5234 and CN5234-K.)



*1 Available only on the CN5□-K series.
*2 Two-pole models have only the left indicator.

Available from Fuji Electric Technica Co., Ltd.

Figure 11.3-3 Dimensions of Arrester and Connection Example

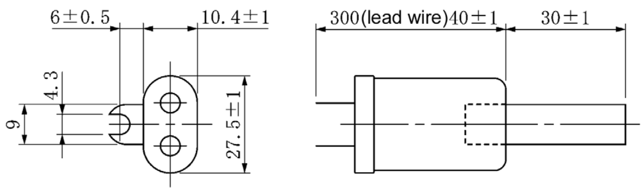
11.3.4 Surge absorber

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.

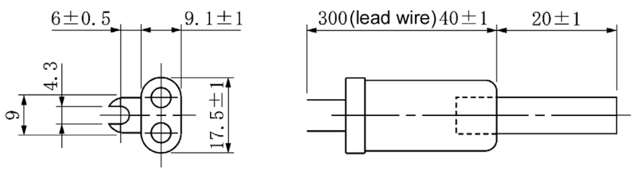
Applicable surge absorber models are the S2-A-O and S1-B-O. Figure 11.3-4 shows their external dimensions.

These products are available from Fuji Electric Technica Co., Ltd.

Type: S2-A-O (for magnetic contactor)



Type: S1-B-O (for mini-control relay or timer)



Available from Fuji Electric Technica Co., Ltd.

Figure 11.3-4 Dimensions of Surge Absorber

Chapter 11 SELECTING PERIPHERAL EQUIPMENT

11.3.5 Filter capacitor for radio noise reduction

These capacitors are effective to suppress AM radio band (1 MHz or less) 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 11.3-5 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.

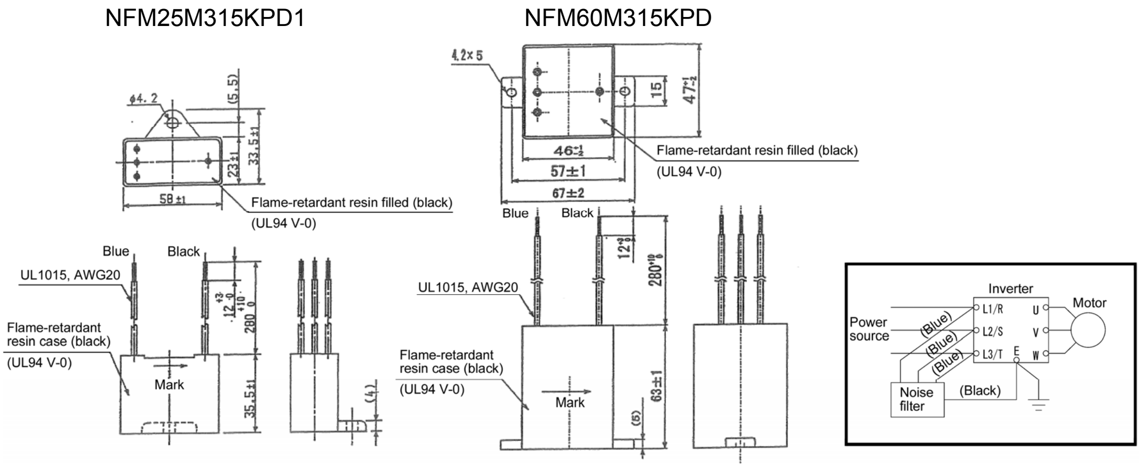


Figure 11.3-5 Dimensions of Filtering Capacitors for Radio Noise Reduction

11.4 Option

11.4.1 Peripheral equipment options

[1] Braking resistors (DBRs) and braking units

(1) Braking resistors (DBRs)

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 10, Section 10.2 "Selecting a Braking Resistor."

(1.1) Standard model

The standard model of a braking resistor integrates a facility that outputs temperature detection signals. 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 displays alarm OH2 on the LED monitor and shuts down its power output.

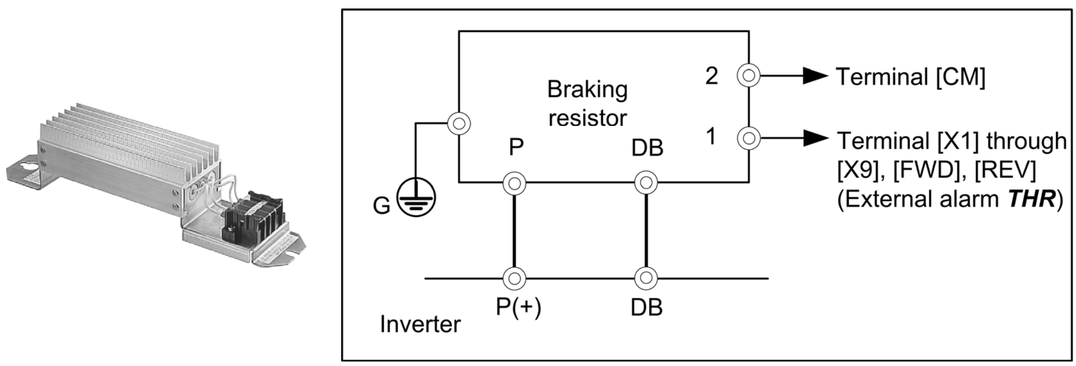


Figure 11.4-1 Braking Resistor (Standard Model) and Connection Example

(1.2) 10% ED model

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

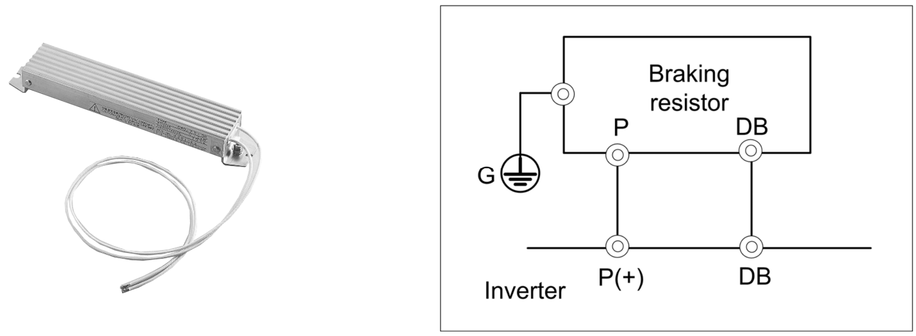


Figure 11.4-2 Braking Resistor (10% ED Model) and Connection Example

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

(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 transistor for the braking resistor.

Figure 11.4-3 Braking Unit

📖 For the specifications and external dimensions of the braking resistors, refer to (3) and (4) in this section.

(3) Specifications

Table 11.4-1 Generated Loss in Braking Unit

Model name	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 11.4-2 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)		50Hz (N·m)	60Hz (N·m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	0.4	FRN0.4G1□-2J	–		DB0.75-2	1	100	150	4.02	3.32	9	45	0.044	22
	0.75	FRN0.75G1□-2J							7.57	6.25	17	45	0.068	18
	1.5	FRN1.5G1□-2J			DB2.2-2	1	40		15	12.4	34	45	0.075	10
	2.2	FRN2.2G1□-2J							22	18.2	33	30	0.077	7
	3.7	FRN3.7G1□-2J			DB3.7-2	1	33		37.1	30.5	37	20	0.093	5
	5.5	FRN5.5G1□-2J			DB5.5-2	1	20		54.3	45	55	20	0.138	5
	7.5	FRN7.5G1□-2J			DB7.5-2	1	15		73.6	61.6	37	10	0.188	5
	11	FRN11G1□-2J			DB11-2	1	10		108	89.5	55	10	0.275	5
	15	FRN15G1□-2J			DB15-2	1	8.6		147	122	75	10	0.375	5
	18.5	FRN18.5G1□-2J			DB18.5-2	1	6.8		182	151	92	10	0.463	5
	22	FRN22G1□-2J			DB22-2	1	5.8		216	179	88	8	0.55	5
	30	FRN30G1□-2J	BU37-2C	1	DB30-2C	1	4	100	195	162	150	10	1.50	10
	37	FRN37G1□-2J			DB37-2C	1	3		240	200	185	10	1.85	10
	45	FRN45G1□-2J	BU55-2C	1	DB45-2C	1	2.5		292	243	225	10	2.25	10
	55	FRN55G1□-2J			DB55-2C	1	2		359	298	275	10	2.75	10
	75	FRN75G1□-2J	BU90-2C	1	DB75-2C	1	1.6		487	405	375	10	3.75	10
	90	FRN90G1□-2J			DB110-2C	1	1.2		585	486	450	10	4.50	10
Three-phase 400 V	0.4	FRN0.4G1□-4J	–		DB0.75-4	1	200	150	4.02	3.32	9	45	0.044	22
	0.75	FRN0.75G1□-4J							7.57	6.25	17	45	0.068	18
	1.5	FRN1.5G1□-4J			DB2.2-4	1	160		15	12.4	34	45	0.075	10
	2.2	FRN2.2G1□-4J							22	18.2	33	30	0.077	7
	3.7	FRN3.7G1□-4J			DB3.7-4	1	130		37.1	30.5	37	20	0.093	5
	5.5	FRN5.5G1□-4J			DB5.5-4	1	80		54.3	45	55	20	0.138	5
	7.5	FRN7.5G1□-4J			DB7.5-4	1	60		73.6	61.6	38	10	0.188	5
	11	FRN11G1□-4J			DB11-4	1	40		108	89.5	55	10	0.275	5
	15	FRN15G1□-4J			DB15-4	1	34.4		147	122	75	10	0.375	5
	18.5	FRN18.5G1□-4J			DB18.5-4	1	27		182	151	93	10	0.463	5
	22	FRN22G1□-4J			DB22-4	1	22		216	179	88	8	0.55	5
	30	FRN30G1□-4J	BU37-4C	1	DB30-4C	1	15	100	195	162	150	10	1.50	10
	37	FRN37G1□-4J			DB37-4C	1	12		240	200	185	10	1.85	10
	45	FRN45G1□-4J	BU55-4C	1	DB45-4C	1	10		292	243	225	10	2.25	10
	55	FRN55G1□-4J			DB55-4C	1	7.5		359	298	275	10	2.75	10
	75	FRN75G1□-4J	BU90-4C	1	DB75-4C	1	6.5		487	405	375	10	3.75	10
	90	FRN90G1□-4J			DB110-4C	1	4.7		585	486	450	10	4.50	10
	110	FRN110G1□-4J	BU132-4C	1					712	592	550	10	5.50	10
	132	FRN132G1□-4J			DB132-4C	1	3.9		855	710	660	10	6.60	10
	160	FRN160G1□-4J	BU220-4C	1	DB160-4C	1	3.2		1036	861	800	10	8.00	10
	200	FRN200G1□-4J			DB200-4C	1	2.6		1295	1076	1000	10	10.0	10
	220	FRN220G1□-4J			DB220-4C	1	2.2		1424	1184	1100	10	11.0	10
	280	FRN280G1□-4J		2	DB160-4C	2	1.6		1813	1506	1400	10	14.0	10
	315	FRN315G1□-4J							2039	1695	1575	10	15.8	10
	355	FRN355G1□-4J			DB200-4C		1.3		2298	1910	1775	10	17.8	10
	400	FRN400G1□-4J							2590	2152	2000	10	20.0	10
	500	FRN500G1□-4J		3		3	0.867		3237	2691	2500	10	25.0	10
	630	FRN630G1□-4J			DB220-4C		0.733		4090	3408	3150	10	31.5	10

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-3 Braking Unit and Braking Resistor (Standard Model) for LD-Mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type LD mode	Option: Braking unit Type	Braking unit Q'ty	Braking resistor Type	Braking resistor Q'ty	Resistance (Ω)	Maximum braking torque (%)	50Hz (N·m)	60Hz (N·m)	Continuous braking (100% braking torque) Discharging capability (kWs)	Braking time (s)	Repetitive braking (each cycle is less than 100 (s)) Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	7.5	FRN5.5G1□-2J	–		DB5.5-2	1	20	100	49.1	41	55	15	0.138	3.5
	11	FRN7.5G1□-2J			DB7.5-2	1	15		72	59.7	37	7	0.188	3.5
	15	FRN11G1□-2J			DB11-2	1	10		98.1	81.4	55	7	0.275	3.5
	18.5	FRN15G1□-2J			DB15-2	1	8.6		121	100	75	8	0.375	4
	22	FRN18.5G1□-2J			DB18.5-2	1	6.8		144	119	92	8	0.463	4
	30	FRN22G1□-2J			DB22-2	1	5.8		216	179	88	6	0.55	3.5
	37	FRN30G1□-2J	BU37-2C	1	DB30-2C	1	4	75	180	150	150	10	1.50	10
	45	FRN37G1□-2J			DB37-2C	1	3		219	182	185	10	1.85	10
	55	FRN45G1□-2J	BU55-2C	1	DB45-2C	1	2.5		269	223	225	10	2.25	10
	75	FRN55G1□-2J			DB55-2C	1	2		365	303	275	10	2.75	10
	90	FRN75G1□-2J	BU90-2C	1	DB75-2C	1	1.6		439	364	375	10	3.75	10
	110	FRN90G1□-2J			DB110-2C	1	1.2		534	444	450	10	4.50	10
Three-phase 400 V	7.5	FRN5.5G1□-4J	–		DB5.5-4	1	80	100	49.6	41	55	15	0.138	3.5
	11	FRN7.5G1□-4J			DB7.5-4	1	60		72	59.7	38	7	0.188	3.5
	15	FRN11G1□-4J			DB11-4	1	40		98.1	81.4	55	7	0.275	3.5
	18.5	FRN15G1□-4J			DB15-4	1	34.4		121	100	75	8	0.375	4
	22	FRN18.5G1□-4J			DB18.5-4	1	27		144	119	93	8	0.463	4
	30	FRN22G1□-4J			DB22-4	1	22		195	162	88	6	0.55	3.5
	37	FRN30G1□-4J	BU37-4C	1	DB30-4C	1	15	75	180	150	150	10	1.50	10
	45	FRN37G1□-4J			DB37-4C	1	12		219	182	185	10	1.85	10
	55	FRN45G1□-4J	BU55-4C	1	DB45-4C	1	10		269	223	225	10	2.25	10
	75	FRN55G1□-4J			DB55-4C	1	7.5		365	303	275	10	2.75	10
	90	FRN75G1□-4J	BU90-4C	1	DB75-4C	1	6.5		439	364	375	10	3.75	10
	110	FRN90G1□-4J			DB110-4C	1	4.7		534	444	450	10	4.50	10
	132	FRN110G1□-4J	BU132-4C	1					641	533	550	10	5.50	10
	160	FRN132G1□-4J			DB132-4C	1	3.9		777	646	660	10	6.60	10
	200	FRN160G1□-4J	BU220-4C	1	DB160-4C	1	3.2		971	807	800	10	8.00	10
	220	FRN200G1□-4J			DB200-4C	1	2.6		1068	888	1000	10	10.0	10
	280	FRN220G1□-4J			DB220-4C	1	2.2		1360	1130	1100	10	11.0	10
	355	FRN280G1□-4J		2	DB160-4C	2	1.6		1724	1433	1400	10	14.0	10
	400	FRN315G1□-4J							1942	1614	1775	10	1.75	10
	450	FRN355G1□-4J			DB200-4C		1.3		2185	1816	2000	10	20.0	10
	500	FRN400G1□-4J							2428	2018	2000	10	20.0	10
	630	FRN500G1□-4J		3		3	0.867		3067	2556	2500	10	25.0	10
	710	FRN630G1□-4J			DB220-4C		0.733		3457	2881	3150	10	31.5	10

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-4 Braking Unit and Braking Resistor (Standard Model) for MD-Mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type MD mode	Option: Braking unit Type	Braking unit Q'ty	Braking resistor Type	Braking resistor Q'ty	Resistance (Ω)	Maximum braking torque (%)	50Hz (N·m)	60Hz (N·m)	Continuous braking (100% braking torque) Discharging capability (kWs)	Braking time (s)	Repetitive braking (each cycle is less than 100 (s)) Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	110	FRN90G1□-4J	BU132-4C	1	DB110-4C	1	4.7	100	712	592	550	10	5.50	10
	132	FRN110G1□-4J			DB132-4C		3.9		855	710	660	10	6.60	10
	160	FRN132G1□-4J	BU220-4C		DB160-4C		3.2		1036	861	800	10	8.00	10
	200	FRN160G1□-4J			DB200-4C		2.6		1295	1078	1000	10	10.0	10
	220	FRN200G1□-4J			DB220-4C		2.2		1424	1184	1100	10	11.0	10
	250	FRN220G1□-4J	BU132-4C	2	DB132-4C	2	1.95		1623	1352	1250	10	12.5	10
	315	FRN280G1□-4J	BU220-4C		DB160-4C		1.6		2039	1695	1575	10	15.8	10
	355	FRN315G1□-4J			DB200-4C		1.3		2298	1910	1775	10	17.8	10
	400	FRN355G1□-4J							2590	2152	2000	10	20.0	10
	450	FRN400G1□-4J		3	DB160-4C	3	1.067		2913	2421	2250	10	22.5	10

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-5 Braking Resistor (10%ED Model) for HD-Mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type: HD mode	Option: Braking resistor: Type	Q'ty	Resistance (Ω)	Maximum braking torque (%)	50Hz (N·m)	60Hz (N·m)	Continuous braking (100% braking torque): Discharging capability (kWs)	Braking time (s)	Repetitive braking (each cycle is less than 100 (s)): Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	0.4	FRN0.4G1□-2J	DB0.75-2C	1	100	150	4.02	3.32	50	250	0.075	37
	0.75	FRN0.75G1□-2J					7.57	6.25	50	133	0.075	20
	1.5	FRN1.5G1□-2J	DB2.2-2C	1	40		15	12.4	55	73	0.110	14
	2.2	FRN2.2G1□-2J					22	18.2	55	50	0.110	10
	3.7	FRN3.7G1□-2J	DB3.7-2C	1	33		37.1	30.5	140	75	0.185	
	5.5	FRN5.5G1□-2J	DB5.5-2C	1	20		54.3	45	55	20	0.275	
	7.5	FRN7.5G1□-2J	DB7.5-2C	1	15		73.6	61.6	37	10	0.375	
	11	FRN11G1□-2J	DB11-2C	1	10		108	89.5	55	10	0.55	
	15	FRN15G1□-2J	DB15-2C	1	8.6		147	122	75	10	0.75	
	18.5	FRN18.5G1□-2J	DB22-2C	1	5.8		182	151	92	10	0.925	
	22	FRN22G1□-2J					216	179	110	10	1.1	
Three-phase 400 V	0.4	FRN0.4G1□-4J	DB0.75-4C	1	200	150	4.02	3.32	50	250	0.075	37
	0.75	FRN0.75G1□-4J					7.57	6.25	50	133	0.075	20
	1.5	FRN1.5G1□-4J	DB2.2-4C	1	160		15	12.4	55	73	0.110	14
	2.2	FRN2.2G1□-4J					22	18.2	55	50	0.110	10
	3.7	FRN3.7G1□-4J	DB3.7-4C	1	130		37.1	30.5	140	75	0.185	
	5.5	FRN5.5G1□-4J	DB5.5-4C	1	80		54.3	45	55	20	0.275	
	7.5	FRN7.5G1□-4J	DB7.5-4C	1	60		73.6	61.6	37	10	0.375	
	11	FRN11G1□-4J	DB11-4C	1	40		108	89.5	55	10	0.55	
	15	FRN15G1□-4J	DB15-4C	1	34.4		147	122	75	10	0.75	
	18.5	FRN18.5G1□-4J	DB22-4C	1	22		182	151	92	10	0.925	
	22	FRN22G1□-4J					216	179	110	10	1.1	

* The 10% ED braking resistor does not support overheating detection or warning output, so an electronic thermal function (function codes F50 and F51) to protect the braking resistor needs to be set.

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-6 Braking Resistor (10%ED Model) for LD-Mode Inverters

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

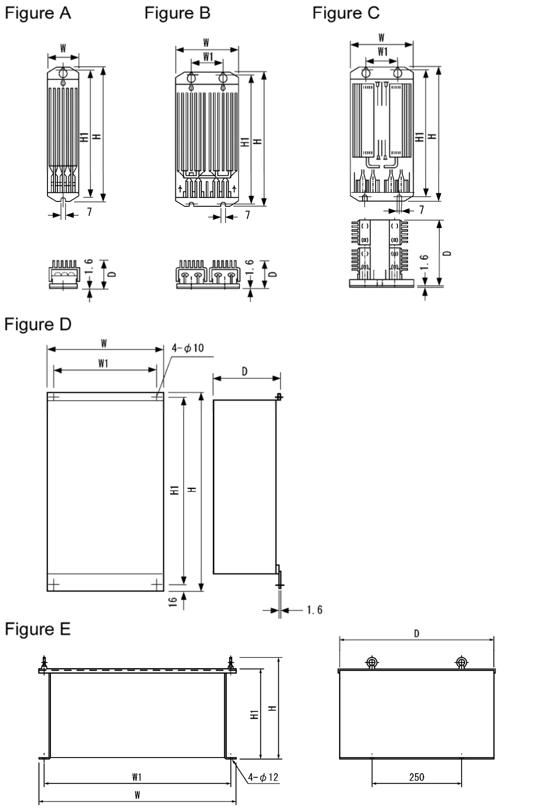
* The 10% ED braking resistor does not support overheating detection or warning output, so an electronic thermal function (function codes F50 and F51) to protect the braking resistor needs to be set.

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

(4) External Dimensions

Braking register (standard model)

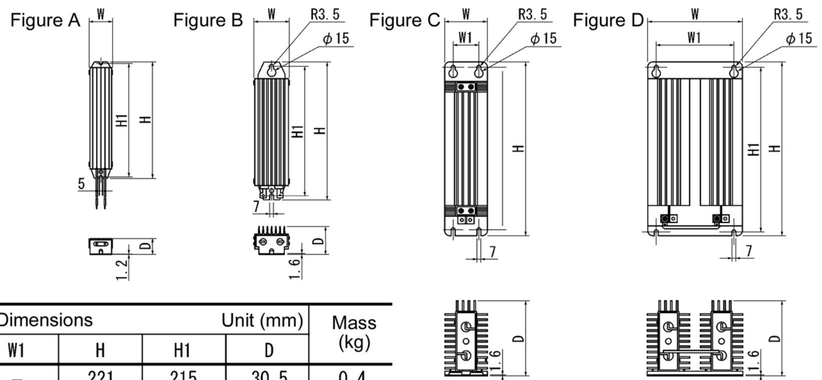


Power supply voltage	Type	Figure	Dimensions (mm)					Mass (kg)
			W	W1	H	H1	D	
200 V Class series	DB0.75-2	A	68		310	295	67	1.3
	DB2.2-2	A	80	—	345	332	94	2.0
	DB3.7-2	A	80		345	332	94	2.0
	DB5.5-2	B	146	90	450	430	67.5	4.5
	DB7.5-2	B	160	90	390	370	90	5.0
	DB11-2	C	142	74	430	415	160	6.9
	DB15-2	C	142	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					140	10
	DB37-2C	D	400	368	660	628		13
	DB45-2C	D					240	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		68		310	295	67	1.3
	DB2.2-4	A	68	—	470	455	67	2.0
	DB3.7-4		68		470	455	67	1.7
	DB5.5-4	B	146	74	470	455	67	4.5
	DB7.5-4		146	74	510	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					140	11
	DB37-4C	D	420	388	660	628		14
	DB45-4C	D					240	19
	DB55-4C		425		750	718		21
	DB75-4C		550	520				26
	DB110-4C							30
	DB132-4C	E	650	620	283	240	440	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.

Figure 11.4-4

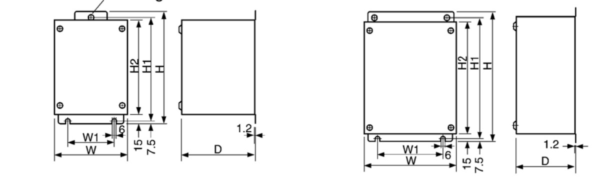
Braking resistor (10%ED model)



Type	Figure	Dimensions			Unit (mm)		Mass (kg)
		W	W1	H	H1	D	
DB0.75-2C/4C	A	43	–	221	215	30.5	0.4
DB2.2-2C/4C	B	67	–	188	172	55	0.8
DB3.7-2C/4C	B	67	–	328	312	55	1.4
DB5.5-2C/4C	B	80	–	378	362	78	2.6
DB7.5-2C/4C	B	80	–	418	402	78	2.8
DB11-2C/4C	C	80	50	460	440	140	4.3
DB15-2C/4C	C	80	50	580	560	140	5.6
DB22-2C/4C	D	180	144	400	383	145	8.4

Figure 11.4-5

Braking unit



Power supply voltage	Type	Figure	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

(Dimensions (mm): W, W1, H, H1, H2, D)

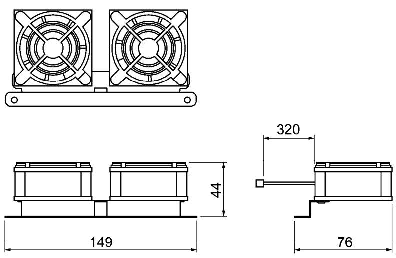
Figure 11.4-6

Fan units for braking units

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

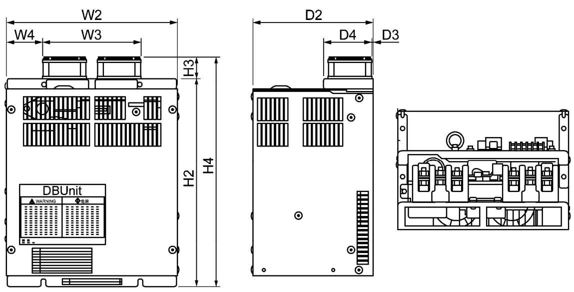
■ Fan unit

● BU-F



■ Braking unit + Fan unit

●BU37 to 220 - 2C/4C + BU-F



[Braking unit + Fan unit]

Power supply voltage	Type	W2	W3	W4	H2	H3	H4	D2	D3	D4
		Dimensions				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			

Figure 11.4-7

[2] Power regenerative PWM converters, 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.

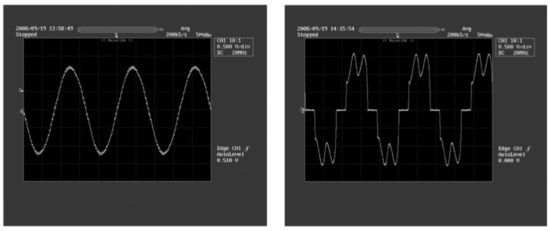
Thus, energy saving during regenerative operation is possible.

As the current waveform is sinusoidal during regenerative operation, no troubles are caused to the power supply system.

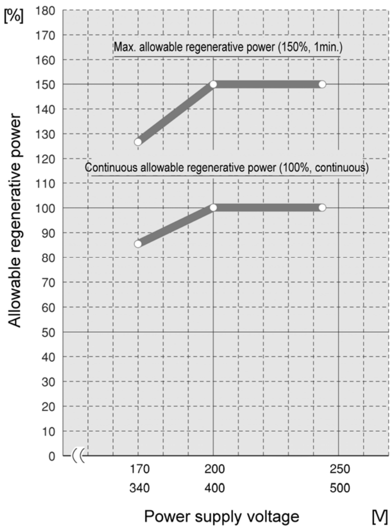
Rated continuous regeneration :	100%
Rated regeneration for 1 min	150% (CT use)
	120% (VT use)

Comparison of Input Current Waveforms

(Without PWM converter) (With PWM converter)



Allowable characteristics of the RHC unit



■ 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.

Note: When replacing an inverter from an old model (FRENIC5000VG7S or FRENIC5000G11S) to FRENIC-MEGA, changes to cabling may be required. For details, refer to Appendix H.

(2) Specifications

(2.1) Standard specifications

Table 11.4-7

■ 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
CT mode	Output: Continuous capacity (kW)	8.8	13	18	22	26	36	44	53	65	88	103
CT mode	Output: Overload rating	150% of continuous rating for 1 minute										
CT mode	Output: Voltage 200 V	320 to 355 VDC (Variable with input power voltage) (*3)										
CT mode	Required power supply (kVA)	9.5	14	19	24	29	38	47	57	70	93	111
CT mode	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
VT mode	Output: Continuous capacity (kW)	13	18	22	26	36	44	53	65	88	103	126
VT mode	Output: Overload rating	120% of continuous rating for 1 minute										
VT mode	Output: Voltage 200 V	320 to 355 VDC (Variable with input power voltage) (*3)										
VT mode	Required power supply (kVA)	14	19	24	29	38	47	57	70	93	111	136
VT mode	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 (*1), 200 to 230 V 60 Hz										
Input power	Voltage/frequency fluctuation	Voltage: –15 to +10%, Frequency: ±5%, Voltage unbalance: 2% or less (*4)										

■ 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
CT mode	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
CT mode	Output: Overload rating	150% of continuous rating for 1 min																					
CT mode	Output: Voltage 200 V	640 to 710 V (Variable with input power voltage) (*3)																					
CT mode	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
CT mode	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		
VT mode	Output: Continuous capacity (kW)	13	18	22	26	36	44	53	65	88	103	126	150	182	227	247	314	353	400	448	560		
VT mode	Output: Overload rating	120% of continuous rating for 1 min																					
VT mode	Output: Voltage 200 V	640 to 710 V (Variable with input power voltage) (*3)																					
VT mode	Required power supply (kVA)	14	19	24	29	38	47	57	70	93	111	136	161	196	244	267	341	383	433	488	610		
VT mode	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 (*2)																					
Input power	Voltage/frequency fluctuation	Voltage: –15 to +10%, Frequency: ±5%, Voltage unbalance: 2% or less (*4)																					

(*1) The 220 to 230 V/50 Hz models are available on request.
(*2) 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.
(*3) 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.
(*4) Voltage unbalance (%) = (Max. voltage (V) - Min. voltage (V)) / Three-phase average voltage (V) x 67

(2.2) Common specifications

Table 11.4-8

Item		Specifications
Control	Control method	AVR constant control with DC ACR minor
Control	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.
Control	Running status signal	Running, power running, regenerative operation, ready-to-run, alarm output (for any alarm), etc.
Control	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
Control	Carrier frequency	Fixed to high carrier frequency
Control	Input power factor	0.99 or above
Control	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.
Control	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
Indication	Alarm history	Saves and displays the most recent 10 alarms. Saves and displays the detailed information of the trip cause for the previous alarm.
Indication	Monitor	Displays input power, input current in RMS, input voltage in RMS, DC link bus voltage and power supply frequency.
Indication	Load factor	Allows the user to measure the load factor with the keypad.
Indication	Language	Allows the user to specify or refer to function codes in any of the three languages--Japanese, English or Chinese.
Indication	Charging lamp	Lights when the DC link bus capacitor is charged.

(3) Function specifications

Table 11.4-9

■ 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.
	ok	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).

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

■ 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	FrE	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
Memory error	Er1	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	Er6	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	

(4) Converter configuration

Table 11.4-10

List of configurators

CT mode

Power supply	Nominal applied motor (kW)	PWM converter type	MC for charging circuit (73)	Q'ty	MC for power supply (52)	Q'ty	Charging circuit box (*1) (CU)	Q'ty	Charging resistor (R0)	Q'ty	Fuse (F)	Q'ty	Boosting reactor (Lr)	Q'ty	Filtering resistor (Rf)	Q'ty	Filtering reactor (Lf)	Q'ty	Filtering capacitor (Cf)	Q'ty	MC for filtering circuit (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	(HF5C5504)		(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)	SC-N4 (*3)	
	630	RHC630-4C			SC-N12	3					A70P2000-4	2	LR4-630C	1	RF4-630C	1	LFC4-630C	1	CF4-630C	1 (*2)	SC-N7 (*4)	1

VT mode

Power supply	Nominal applied motor (kW)	PWM converter type	MC for charging circuit (73)	Q'ty	MC for power supply (52)	Q'ty	Charging circuit box (*1) (CU)	Q'ty	Charging resistor (R0)	Q'ty	Fuse (F)	Q'ty	Boosting reactor (Lr)	Q'ty	Filtering resistor (Rf)	Q'ty	Filtering reactor (Lf)	Q'ty	Filtering capacitor (Cf)	Q'ty	MC for filtering circuit (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)	SC-N4/SF	

(*1) The charging box (CU) contains the charging resistor (R0) and fuse (F). If the charging box (CU) is not used, the charging resistor (R0) and fuse (F) must be prepared separately.

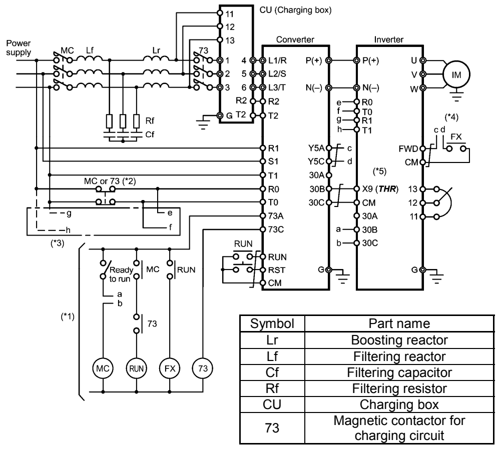
(*2) This filtering capacitor consists of two capacitors. When a single unit of filtering capacitor is ordered, a set of two capacitors will be delivered.

(*3) (*4) When the carrier frequency is decreased or the OPC-VG7-SIR is used, the generated loss will be increased. Therefore, use SC-N4/SF for (*3) and SC-N8 for (*4), respectively.

■ 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.

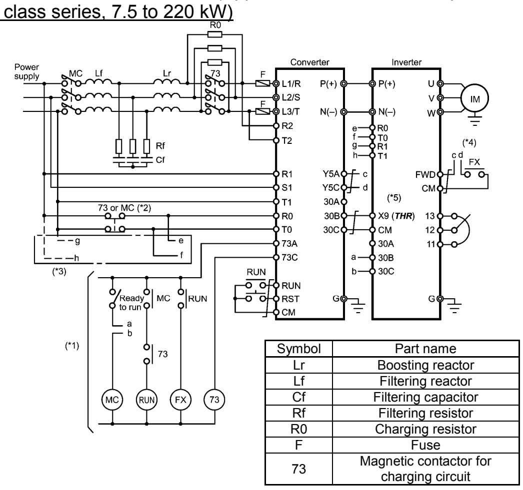
(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC).
If 73 uses SC-05, SC-4-0, or SC-5-1, connect an auxiliary contact unit to the MC's B contact or 73.

(*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.

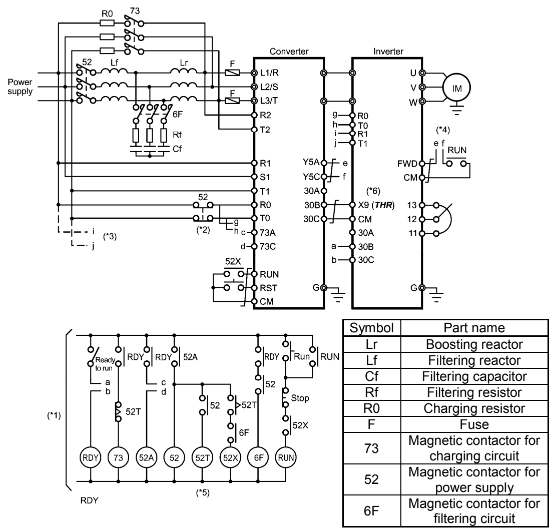
(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC).
If 73 uses SC-05, SC-4-0, or SC-5-1, connect an auxiliary contact unit to the MC's B contact or 73.

(*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.

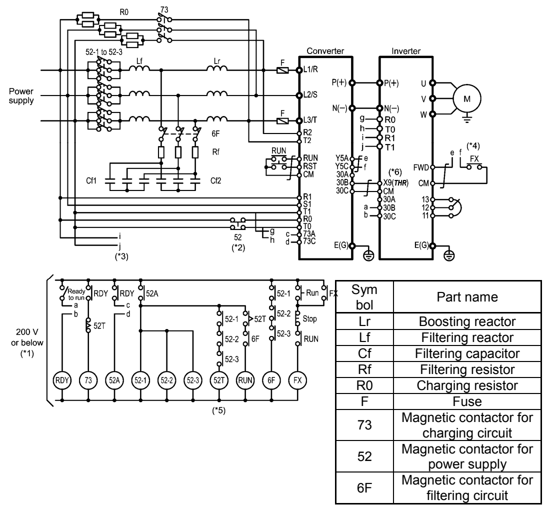
- RHC280-4C to RHC400-4C (Applicable inverters: Three-phase 400 V, 280 to 400 kW)



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)



Sym bol	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.

Figure 11.4-8

(5) External Dimensions

PWM converter

Figure A

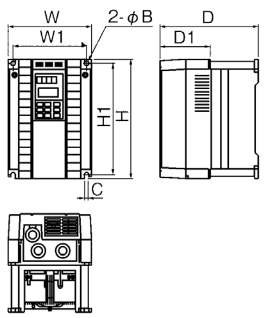


Figure B

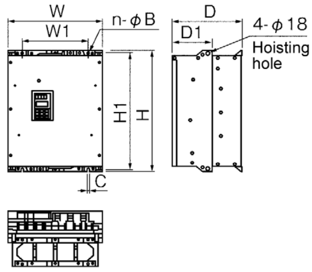


Figure C

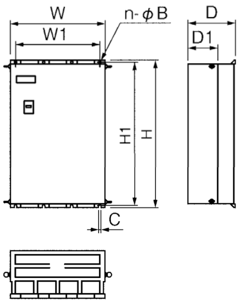


Figure D

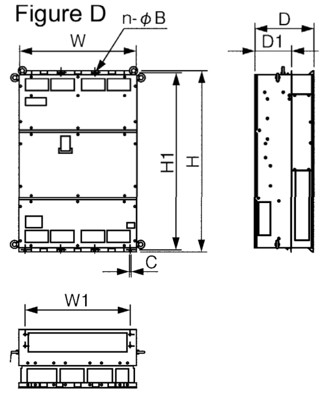


Figure 11.4-9

Table 11.4-11

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
400 V class series	RHC7.5-4C	A	250	226	380	358	245	125	2	10	10	12.5
	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	B	375	275	675	655	270	145	2	10	10	39
	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 >

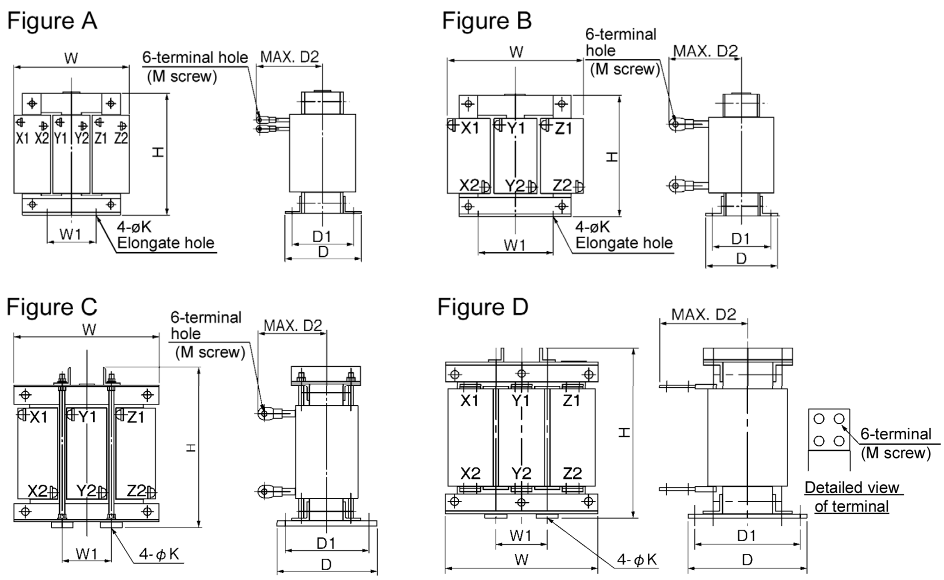


Figure 11.4-10

Table 11.4-12

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
	LR4-630C	D	600	200	64	440	390	290	19	4×M12	450

< Filtering reactor >

Figure A

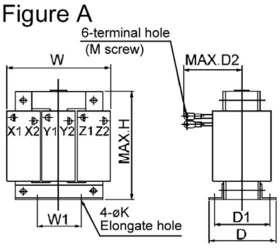


Figure B

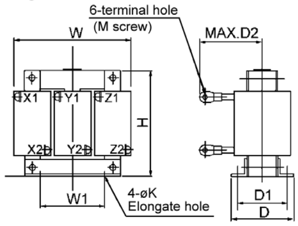


Figure C

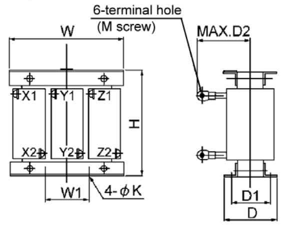


Figure D

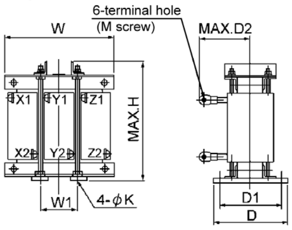


Figure E

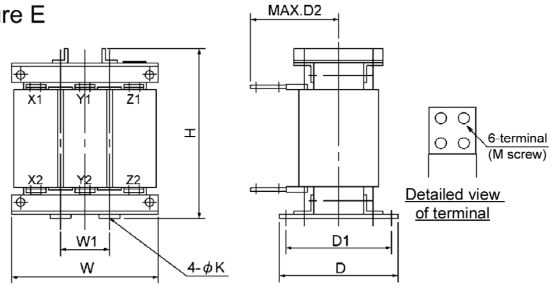


Figure 11.4-11

Table 11.4-13

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	7	M12	22
	LFC4-220C	D	300	100	320	210	180	170	10	M12	35
	LFC4-280C	D	330	110	320	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	205	15	4×M12	175

< Filtering capacitor >

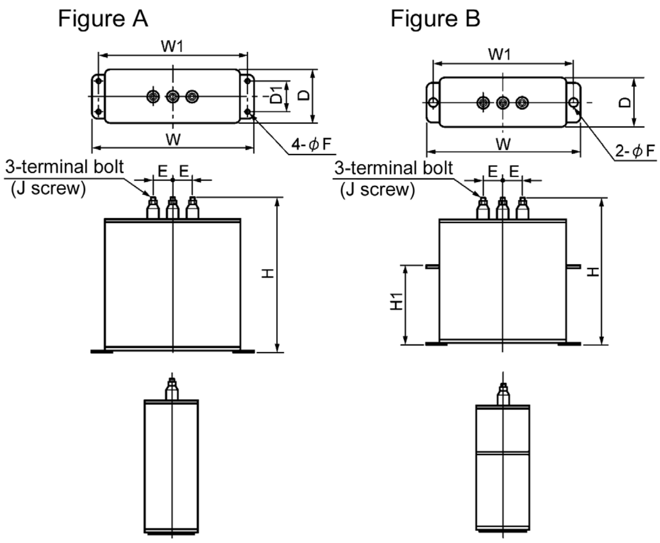


Figure 11.4-12

Table 11.4-14

Filtering capacitor type		Figure	Dimensions (mm)									Mass (kg)
			W	W1	H	H1	D	D1	E	F	J	
200 V class series	CF2-7.5C	A	165	150	185	-	70	40	30	7	M5	1.9
	CF2-15C	A	205	190	245	-	70	40	30	7	M5	3.5
	CF2-22C	A	280	265	215	-	90	55	30	7	M5	5.5
	CF2-37C	A	280	265	235	-	90	55	30	7	M5	6.0
	CF2-55C	A	280	265	340	-	90	55	80	7	M6	8.5
	CF2-75C	A	280	265	235	-	90	55	30	7	M5	6.0
	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 long hole	M12	13.0
	CF4-280C	B	435	400	350	165	100	-	80	15x20 long hole	M12	15.0
	CF4-315C	B	435	400	460	275	100	-	80	15x20 long hole	M12	20.0
	CF4-355C	B	435	400	520	335	100	-	80	15x20 long hole	M12	23.0
	CF4-400C	B	435	400	610	425	100	-	80	15x20 long hole	M12	27.0
	CF4-500C	B	435	400	310	125	100	-	80	15x20 long hole	M12	13.0
	CF4-630C	B	435	400	460	275	100	-	80	15x20 long hole	M12	20.0

<Filtering resistor>

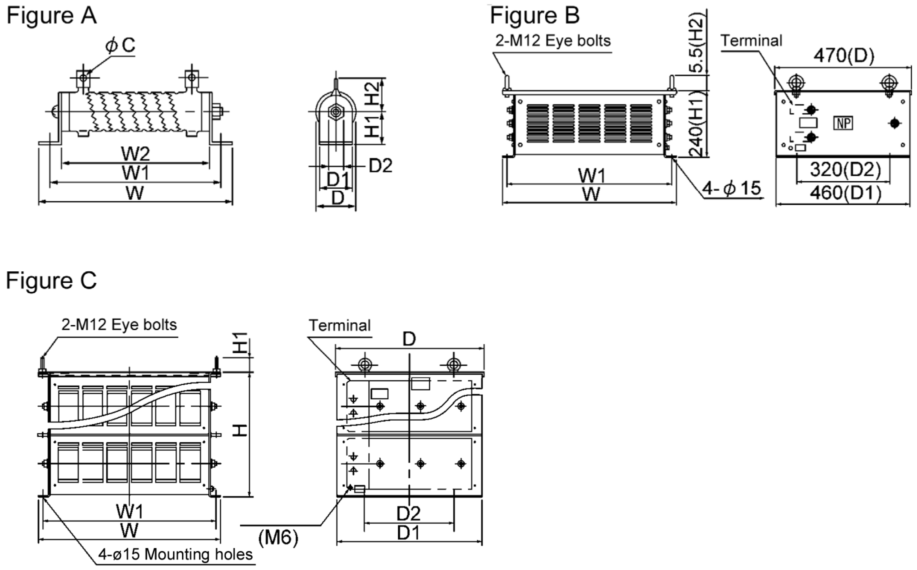


Figure 11.4-13

Table 11.4-15

Filtering resistor type		Figure	Dimensions (mm)									Mass (kg)
			W	W1	W2	H1	H2	D	D1	D2	C	
200 V class series	GRZG80 0.42 Ω	A	167	148	115	22	32	33	26	6	5.5	0.19
	GRZG150 0.2 Ω	A	247	228	195	22	40	33	26	6	8.2	0.19
	GRZG200 0.13 Ω	A	306	287	254	22	40	33	26	6	8.2	0.35
	GRZG400 0.1 Ω	A	411	385	330	40	46	47	40	9.5	8.2	0.85
	GRZG400 0.12 Ω	A	411	385	330	40	46	47	40	9.5	8.2	0.85
400 V class series	GRZG80 1.74 Ω	A	167	148	115	22	32	33	26	6	5.5	0.19
	GRZG150 0.79 Ω	A	247	228	195	22	32	33	26	6	5.5	0.3
	GRZG200 0.53 Ω	A	306	287	254	22	32	33	26	6	5.5	0.35
	GRZG400 0.38 Ω	A	411	385	330	40	46	47	40	9.5	8.2	0.85
	GRZG400 0.26 Ω	A	411	385	330	40	46	47	40	9.5	8.2	0.85
	GRZG400 0.53 Ω	A	411	385	330	40	46	47	40	9.5	8.2	0.85
	RF4-160C	B	400	370	-	240	55	470	460	320	-	22
	RF4-220C											25
	RF4-280C	C	655	625	-	240	55	470	460	320	-	31
	RF4-315C											35
	RF4-355C											36
	RF4-400C											38
	RF4-500C											41
	RF4-630C	C	655	625	-	440	55	530	520	320	-	70

<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. 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

400 V class series: The charging resistor and the fuse are separately provided with a capacity of 280 to 400 kW.

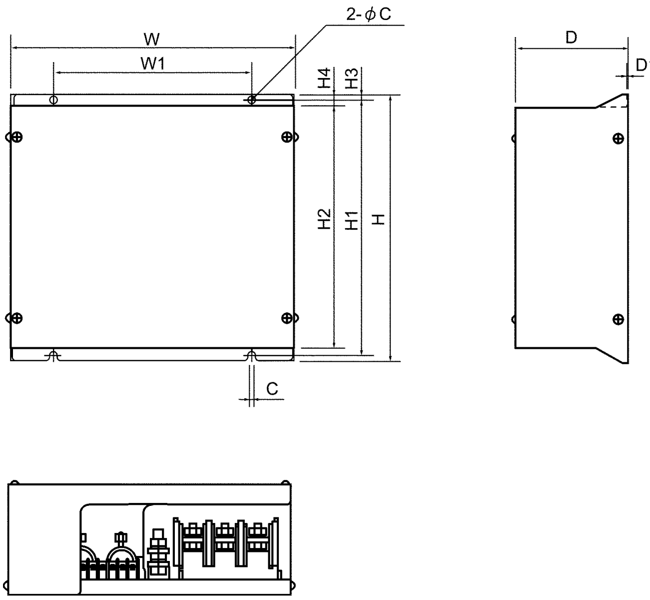


Figure 11.4-14

Table 11.4-16

Charging box type		Dimensions (mm)										Mounting bolt	Mass (kg)
		W	W1	H	H1	H2	H3	4	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	7.5	15	110	2.4	6	M5	7
	CU45-2C	330	230	310	295	280	7.5	15	130	2.4	6	M5	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	7.5	15	110	2.4	6	M5	7
	CU45-4C												
	CU55-4C												
	CU75-4C	330	230	310	295	280	7.5	15	130	2.4	6	M5	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

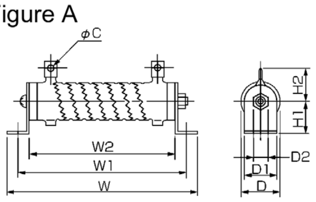


Figure B

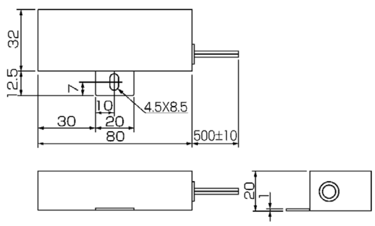


Figure C

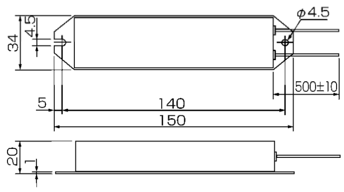


Figure 11.4-15

Table 11.4-17

Charging resistor type	Figure	Dimensions (mm)									Mass (kg)
		W	W1	W2	H1	H2	D	D1	D2	C	
GRZG120 2 Ω	A	217	198	165	22	32	33	22	6	5.5	0.25
GRZG400 1 Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85
TK50B 30 ΩJ (HF5B0416)	B	-	-	-	-	-	-	-	-	-	0.15
80W 7.5 Ω (HF5C5504)	C	-	-	-	-	-	-	-	-	-	0.19

<Fuse>

Figure A

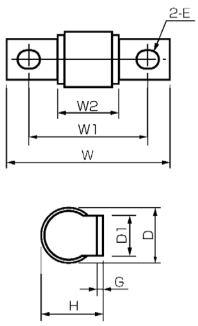


Figure B

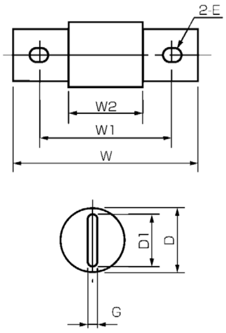
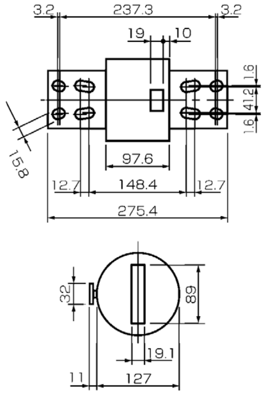
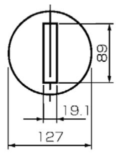


Figure C



Side view of the A70P1600-4TA



Side view of the A70P2000-4

Figure 11.4-16

Table 11.4-18

Fuse type		Figure	Dimensions (mm)								Mass (kg)
			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	0.03
	CR2LS-75/UL										
	CR2LS-100/UL										
	CR2L-150/UL	A	80	58	29.5	30.5	27	20	3	9x11	0.10
	CR2L-200/UL	A	85	60	30	33.5	30	25	3.2	11x13	0.13
	CR2L-260/UL										
	CR2L-400/UL	A	95	70	31	42	37	30	4	11x13	0.22
	A50P600-4	B	113.5	81.75	56.4	-	50.8	38.1	6.4	10.3x18.2	0.60
400 V class series	CR6L-30/UL	A	76	62	47	18.5	17.5	12	2	6.5x8.5	0.04
	CR6L-50/UL										
	CR6L-75/UL	A	95	70	40	34	30	25	3.2	11x13	0.15
	CR6L-100/UL										
	CR6L-150/UL										
	CR6L-200/UL	A	107	82	43	42	37	30	4	11x13	0.25
	CR6L-300/UL										
	A50P400-4	B	110	78.6	53.1	-	38.1	25.4	6.4	10.3x18.4	0.30
	A50P600-4	B	113.5	81.75	56.4	-	50.8	38.1	6.4	10.3x18.2	0.60
	A70QS800-4	B	180.2	129.4	72.2	-	63.5	50.8	9.5	13.5x18.3	1.1
	A70P1600-4T	C	-	-	-	-	-	-	-	-	8.0
	A70P2000-4	C	-	-	-	-	-	-	-	-	8.0

■ Generated loss

Generated loss in CT mode

Table 11.4-19

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

Generated loss in VT mode

Table 11.4-20

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 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 value 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%).

[3] DC reactor (DCR)

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

■ For power supply matching

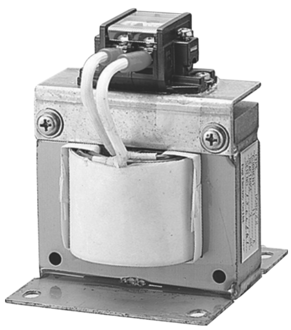
- Use a DCR when the capacity of a power supply transformer exceeds 500 kVA and is 10 times or more the rated inverter capacity. In this case, the percent reactance of the power supply decreases, and harmonic components and their peak value increase. These factors may break rectifiers or main circuit 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 at the same power supply.
- Use a DCR when the interphase voltage unbalance ratio of the inverter power supply exceeds 2%.

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

■ Input power factor correction (for reducing harmonic components)

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 (+). Remove the jumper bar when connecting a DCR.
- If a DCR is not going to be used, do not remove the jumper bar.



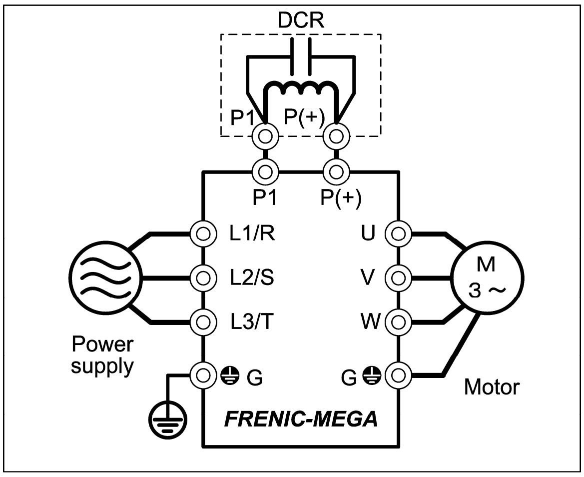


Figure 11.4-17 External View of a DC Reactor (DCR) and Connection Example

Table 11.4-21 DC Reactor (DCR)

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	DC reactor type	Rated current (A)	Inductance (mH)	Generated loss (W)
Three-phase 200 V	0.4	FRN0.4G1□-2J	HD	DCR2-0.4	3	12	1.9
	0.75	FRN0.75G1□-2J		DCR2-0.75	5	7	2.8
	1.5	FRN1.5G1□-2J		DCR2-1.5	8	4	4.6
	2.2	FRN2.2G1□-2J		DCR2-2.2	11	3	6.7
	3.7	FRN3.7G1□-2J		DCR2-3.7	18	1.7	8.8
	5.5	FRN5.5G1□-2J	HD	DCR2-5.5	25	1.2	14
	7.5		LD	DCR2-7.5	34	0.8	16
		FRN7.5G1□-2J	HD				
	11		LD	DCR2-11	50	0.6	27
		FRN11G1□-2J	HD				
	15		LD	DCR2-15	67	0.4	27
		FRN15G1□-2J	HD				
	18.5		LD	DCR2-18.5	81	0.35	29
		FRN18.5G1□-2J	HD				
	22		LD	DCR2-22A	98	0.3	38
		FRN22G1□-2J	HD				
	30		LD	DCR2-30B	136	0.23	37
		FRN30G1□-2J	HD				
	37		LD	DCR2-37B/ DCR2-37C	167/ 175	0.19/ 0.119	47/ 63
		FRN37G1□-2J	HD				
	45		LD	DCR2-45B/ DCR2-45C	203/ 213	0.16/ 0.1	52/ 68
		FRN45G1□-2J	HD				
	55		LD	DCR2-55B/ DCR2-55C	244/ 256	0.13/ 0.08	55/ 75
		FRN55G1□-2J	HD				
	75		LD	DCR2-75C	358	0.05	96
		FRN75G1□-2J	HD				
	90		LD	DCR2-90C	431	0.042	100
		FRN90G1□-2J	HD				
	110		LD	DCR2-110C	552	0.034	126

(Note 1) 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 value 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.

(Note 2) A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
S (Basic type), E (EMC filter built-in type)

Table 11.4-21 DC Reactor (DCR) (Continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	DC reactor type	Rated current (A)	Inductance (mH)	Generated loss (W)
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	DCR4-0.4	1.5	50	2
	0.75	FRN0.75G1□-4J		DCR4-0.75	2.5	30	2.5
	1.5	FRN1.5G1□-4J		DCR4-1.5	4	16	4.8
	2.2	FRN2.2G1□-4J		DCR4-2.2	5.5	12	6.8
	3.7	FRN3.7G1□-4J		DCR4-3.7	9	7	8.1
	5.5	FRN5.5G1□-4J	HD	DCR4-5.5	13	4	10
	7.5		LD	DCR4-7.5	18	3.5	15
		FRN7.5G1□-4J	HD				
	11		LD	DCR4-11	25	2.2	21
		FRN11G1□-4J	HD				
	15		LD	DCR4-15	34	1.8	28
		FRN15G1□-4J	HD				
	18.5		LD	DCR4-18.5	41	1.4	29
		FRN18.5G1□-4J	HD				
	22		LD	DCR4-22A	49	1.2	35
		FRN22G1□-4J	HD				
	30		LD	DCR4-30B	71	0.86	35
		FRN30G1□-4J	HD				
	37		LD	DCR4-37B/	88/	0.70/	40/
		FRN37G1□-4J	HD	DCR4-37C	88	0.483	63
	45		LD	DCR4-45B/	107/	0.58/	44/
		FRN45G1□-4J	HD	DCR4-45C	107	0.4	69
	55		LD	DCR4-55B/	131/	0.47/	55/
		FRN55G1□-4J	HD	DCR4-55C	131	0.324	78
	75		LD	DCR4-75C	178	0.23	97
		FRN75G1□-4J	HD				
	90		LD	DCR4-90C	214	0.2	111
		FRN90G1□-4J	HD				
	110		MD/LD	DCR4-110C	261	0.166	122
		FRN110G1□-4J	HD				
	132		MD/LD	DCR4-132C	313	0.148	159
		FRN132G1□-4J	HD				
	160		MD/LD	DCR4-160C	380	0.122	185
		FRN160G1□-4J	HD				
	200		MD/LD	DCR4-200C	475	0.098	218
		FRN200G1□-4J	HD				
	220		MD/LD	DCR4-220C	524	0.087	231
		FRN220G1□-4J	HD				
	250		MD	DCR4-250C	589	0.077	249
	280		LD	DCR4-280C	649	0.069	270
		FRN280G1□-4J	HD				
	315		MD	DCR4-315C	739	0.061	285
	355		LD	DCR4-355C	833	0.054	308
	315	FRN315G1□-4J	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□-4J	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□-4J	HD	DCR4-400C	938	0.048	323
	450		MD	DCR4-450C	1056	0.043	338
	500		LD	DCR4-500C	1173	0.039	384
		FRN500G1□-4J	HD				
	630		LD	DCR-630C	1477	0.031	620
		FRN630G1□-4J	HD				
	710		LD	DCR-710C	1666	0.028	600

(Note 1) A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└ S (Basic type), E (EMC filter built-in type)

(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 value 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.

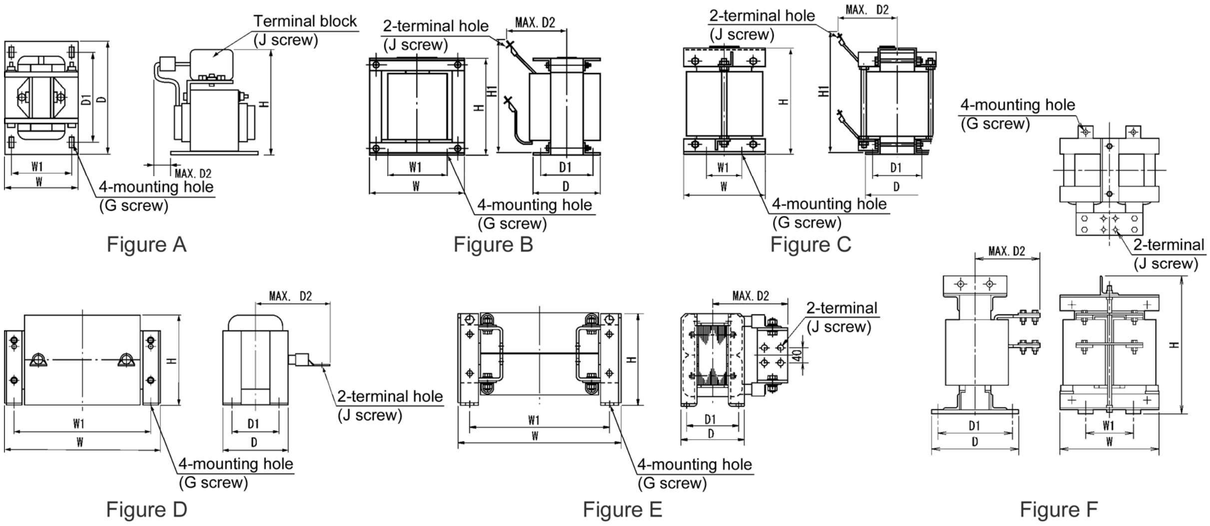


Figure 11.4-18

Table 11.4-22 DC Reactor (DCR) External Dimensions

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	DC reactor type	Figure	Dimensions (mm) W	W1	D	D1	D2	H	H1	Mounting hole G	Terminal hole J	Approximate mass (kg)
Three-phase 200 V	0.4	FRN0.4G1□-2J	HD	DCR2-0.4	A	66	56	90	72	15	94	-	M4 (5.2×8)	M4	1.0
	0.75	FRN0.75G1□-2J	HD	DCR2-0.75	A	66	56	90	72	20	94	-	M4 (5.2×8)	M4	1.4
	1.5	FRN1.5G1□-2J	HD	DCR2-1.5	A	66	56	90	72	20	94	-	M4 (5.2×8)	M4	1.6
	2.2	FRN2.2G1□-2J	HD	DCR2-2.2	A	86	71	100	80	10	110	-	M5 (6×9)	M4	1.8
	3.7	FRN3.7G1□-2J	HD	DCR2-3.7	A	86	71	100	80	20	110	-	M5 (6×9)	M4	2.6
	5.5	FRN5.5G1□-2J	HD	DCR2-5.5	A	111	95	100	80	20	130	-	M6 (7×11)	M5	3.6
	7.5	FRN5.5G1□-2J / FRN7.5G1□-2J	LD / HD	DCR2-7.5	A	111	95	100	80	23	130	-	M6 (7×11)	M5	3.8
	11	FRN7.5G1□-2J / FRN11G1□-2J	LD / HD	DCR2-11	A	111	95	100	80	24	137	-	M6 (7×11)	M6	4.3
	15	FRN11G1□-2J / FRN15G1□-2J	LD / HD	DCR2-15	A	146	124	120	96	15	180	-	M6 (7×11)	M8	5.9
	18.5	FRN15G1□-2J / FRN18.5G1□-2J	LD / HD	DCR2-18.5	A	146	124	120	96	25	180	-	M6 (7×11)	M8	7.4
	22	FRN18.5G1□-2J / FRN22G1□-2J	LD / HD	DCR2-22A	A	146	124	120	96	25	180	-	M6 (7×11)	M8	7.5
	30	FRN22G1□-2J / FRN30G1□-2J	LD / HD	DCR2-30B	B	152	90	156	116	115	130	190	M6 (φ8)	M10	12
	37	FRN30G1□-2J / FRN37G1□-2J	LD / HD	DCR2-37B / DCR2-37C	B/ D	171/ 210	110/ 185	151/ 101	110/ 81	115/ 125	150/ 125	200/ -	M6 (φ8)/ M6 (7×13)	M10/ M10	14/ 7.4
	45	FRN37G1□-2J / FRN45G1□-2J	LD / HD	DCR2-45B / DCR2-45C	B/ D	171/ 210	110/ 185	166/ 106	125/ 86	120/ 135	150/ 125	200/ -	M6 (φ8)/ M6 (7×13)	M10/ M12	16/ 8.4
	55	FRN45G1□-2J / FRN50G1□-2J	LD / HD	DCR2-55B / DCR2-55C	C/ D	190/ 255	160/ 225	131/ 96	90/ 76	100/ 140	210/ 145	250/ -	M6 (φ8)/ M6 (7×13)	M12/ M12	16/ 11
	75	FRN50G1□-2J / FRN75G1□-2J	LD / HD	DCR2-75C	D	255	225	106	86	145	145	-	M6 (7×13)	M12	12
	90	FRN75G1□-2J / FRN90G1□-2J	LD / HD	DCR2-90C	D	255	225	116	96	155	145	-	M6 (7×13)	M12	14
	110	FRN90G1□-2J	LD	DCR2-110 C	D	300	265	116	90	185	160	-	M8 (10×18)	M12	17

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type)

Chapter 11 SELECTING PERIPHERAL EQUIPMENT

Table 11.4-22 DC Reactor (DCR) External Dimensions (Continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	DC reactor type	Figure	Dimensions (mm)									Approximate Mass (kg)
						W	W1	D	D1	D2	H	H1	Mounting hole G	Terminal hole J	
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	DCR4-0.4	A	66	56	90	72	15	94	-	M4 (5.2×8)	M4	1.0
	0.75	FRN0.75G1□-4J	HD	DCR4-0.75	A	66	56	90	72	20	94	-	M4 (5.2×8)	M4	1.4
	1.5	FRN1.5G1□-4J	HD	DCR4-1.5	A	66	56	90	72	20	94	-	M4 (5.2×8)	M4	1.6
	2.2	FRN2.2G1□-4J	HD	DCR4-2.2	A	86	71	100	80	15	110	-	M5 (6×9)	M4	2.0
	3.7	FRN3.7G1□-4J	HD	DCR4-3.7	A	86	71	100	80	20	110	-	M5 (6×9)	M4	2.6
	5.5	FRN5.5G1□-4J	HD	DCR4-5.5	A	86	71	100	80	20	110	-	M5 (6×9)	M4	2.6
	7.5	FRN5.5G1□-4J	LD	DCR4-7.5	A	111	95	100	80	24	130	-	M6 (7×11)	M5	4.2
		FRN7.5G1□-4J	HD												
	11	FRN7.5G1□-4J	LD	DCR4-11	A	111	95	100	80	24	130	-	M6 (7×11)	M5	4.3
		FRN11G1□-4J	HD												
	15	FRN11G1□-4J	LD	DCR4-15	A	146	124	120	96	15	168	-	M6 (7×11)	M5	5.9
		FRN15G1□-4J	HD												
	18.5	FRN15G1□-4J	LD	DCR4-18.5	A	146	124	120	96	25	171	-	M6 (7×11)	M6	7.2
		FRN18.5G1□-4J	HD												
	22	FRN18.5G1□-4J	LD	DCR4-22A	A	146	124	120	96	25	171	-	M6 (7×11)	M6	7.2
		FRN22G1□-4J	HD												
	30	FRN22G1□-4J	LD	DCR4-30B	B	152	90	157	115	100	130	190	M6 (φ8)	M8	13
		FRN30G1□-4J	HD												
	37	FRN30G1□-4J	LD	DCR4-37B/	B/	171/	110/	150/	110/	100/	150/	200/	M6 (φ8)/	M8/	15/
		FRN37G1□-4J	HD	DCR4-37C	D	210	185	101	81	105	125	-	M6 (7×13)	M8	7.4
	45	FRN37G1□-4J	LD	DCR4-45B/	B/	171/	110/	165/	125/	110/	150/	210/	M6 (φ8)/	M8/	18/
		FRN45G1□-4J	HD	DCR4-45C	D	210	185	106	86	120	125	-	M6 (7×13)	M8	8.4
	55	FRN45G1□-4J	LD	DCR4-55B/	B/	171/	110/	170/	130/	110/	150/	210/	M6 (φ8)/	M8/	20/
		FRN55G1□-4J	HD	DCR4-55C	D	255	225	96	76	120	145	-	M6 (7×13)	M10	11
	75	FRN55G1□-4J	LD	DCR4-75C	D	255	225	106	86	125	145	-	M6 (7×13)	M10	13
		FRN75G1□-4J	HD												
	90	FRN75G1□-4J	LD	DCR4-90C	D	255	225	116	96	140	145	-	M6 (7×13)	M12	15
		FRN90G1□-4J	HD												
	110	FRN90G1□-4J	MD/LD	DCR4-110C	D	300	265	116	90	175	155	-	M8 (10×18)	M12	19
		FRN110G1□-4J	HD												
	132	FRN110G1□-4J	MD/LD	DCR4-132C	D	300	265	126	100	180	160	-	M8 (10×18)	M12	22
		FRN132G1□-4J	HD												
	160	FRN132G1□-4J	MD/LD	DCR4-160C	D	350	310	131	103	180	190	-	M10 (12×22)	M12	26
		FRN160G1□-4J	HD												
	200	FRN160G1□-4J	MD/LD	DCR4-200C	D	350	310	141	113	185	190	-	M10 (12×22)	M12	30
		FRN200G1□-4J	HD												
	220	FRN200G1□-4J	MD/LD	DCR4-220C	D	350	310	146	118	200	190	-	M10 (12×22)	M12	33
		FRN220G1□-4J	HD												
	250	FRN220G1□-4J	MD	DCR4-250C	D	350	310	161	133	210	190	-	M10 (12×22)	M12	35
	280	FRN220G1□-4J	LD	DCR4-280C	D	350	310	161	133	210	190	-	M10 (12×22)	M16	37
		FRN280G1□-4J	HD												
	315	FRN280G1□-4J	MD	DCR4-315C	D	400	345	146	118	200	225	-	M10 (12×22)	M16	40
	355	FRN280G1□-4J	LD	DCR4-355C	E	400	345	156	128	200	225	-	M10 (12×22)	4×M12	49
	315	FRN315G1□-4J	HD	DCR4-315C	D	400	345	146	118	200	225	-	M10 (12×22)	M16	40
	355	FRN315G1□-4J	MD	DCR4-355C	E	400	345	156	128	200	225	-	M10 (12×22)	4×M12	49
	400	FRN315G1□-4J	LD	DCR4-400C	E	455	385	145	117	213	245	-	M10 (12×22)	4×M12	52
	355	FRN355G1□-4J	HD	DCR4-355C	E	400	345	156	128	200	225	-	M10 (12×22)	4×M12	49
	400	FRN355G1□-4J	MD	DCR4-400C	E	455	385	145	117	213	245	-	M10 (12×22)	4×M12	52
	450	FRN355G1□-4J	LD	DCR4-450C	E	440	385	150	122	215	245	-	M10 (12×22)	4×M12	62
	400	FRN400G1□-4J	HD	DCR4-400C	E	455	385	145	117	213	245	-	M10 (12×22)	4×M12	52
	450	FRN400G1□-4J	MD	DCR4-450C	E	440	385	150	122	215	245	-	M10 (12×22)	4×M12	62
	500	FRN400G1□-4J	LD	DCR4-500C	E	445	390	165	137	220	245	-	M10 (12×22)	4×M12	72
		FRN500G1□-4J	HD												
	630	FRN500G1□-4J	LD	DCR4-630C	F	285	145	203	170	195	480	-	M12 (14×20)	2×M12	75
		FRN630G1□-4J	HD												
	710	FRN630G1□-4J	HD	DCR4-710C	F	340	160	295	255	225	480	-	M12 (φ15)	4×M12	95

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type)

[4] AC reactor (ACR)

Use an ACR when the converter part of the inverter should supply very stable DC power, for example, when the power supply voltage is unstable (e.g., inter-phase voltages are exteremly imbalanced) 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.

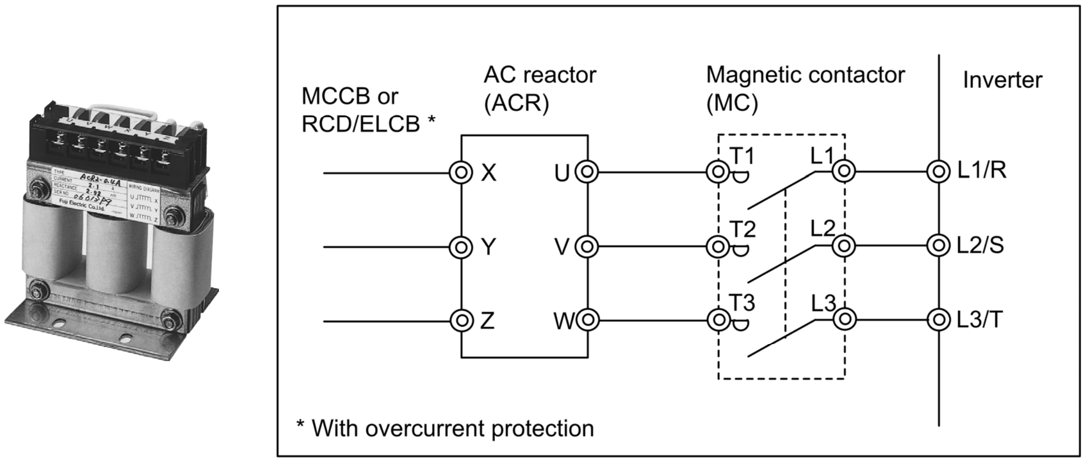


Figure 11.4-19 External View of AC Reactor (ACR) and Connection Example

Table 11.4-23 AC Reactor (ACR) Specifications

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	AC Reactor type	Rated current (A)	Reactance (mΩ/phase) 50 Hz	Reactance (mΩ/phase) 60 Hz	Wirewound resistor (mΩ)	Generated loss (W)
Three-phase 200 V	0.4	FRN0.4G1□-2J	HD	ACR2-0.4A	3	917	1100	-	10
	0.75	FRN0.75G1□-2J	HD	ACR2-0.75A	5	493	592	-	12
	1.5	FRN1.5G1□-2J	HD	ACR2-1.5A	8	295	354	-	14
	2.2	FRN2.2G1□-2J	HD	ACR2-2.2A	11	213	256	-	16
	3.7	FRN3.7G1□-2J	HD	ACR2-3.7A	17	128	153	-	23
	5.5	FRN5.5G1□-2J	HD	ACR2-5.5A	25	87.7	105	-	27
	7.5	FRN5.5G1□-2J	LD	ACR2-7.5A	33	65	78	-	30
	7.5	FRN7.5G1□-2J	HD	ACR2-7.5A	33	65	78	-	30
	11	FRN7.5G1□-2J	LD	ACR2-11A	46	45.5	54.7	-	37
	11	FRN11G1□-2J	HD	ACR2-11A	46	45.5	54.7	-	37
	15	FRN11G1□-2J	LD	ACR2-15A	59	34.8	41.8	-	43
	15	FRN15G1□-2J	HD	ACR2-15A	59	34.8	41.8	-	43
	18.5	FRN15G1□-2J	LD	ACR2-18.5A	74	28.6	34.3	-	51
	18.5	FRN18.5G1□-2J	HD	ACR2-18.5A	74	28.6	34.3	-	51
	22	FRN18.5G1□-2J	LD	ACR2-22A	87	24	28.8	-	57
	22	FRN22G1□-2J	HD	ACR2-22A	87	24	28.8	-	57
	30	FRN22G1□-2J	LD	ACR2-37	200	10.8	13	0.5	28.6
	30	FRN30G1□-2J	HD	ACR2-37	200	10.8	13	0.5	28.6
	37	FRN30G1□-2J	LD	ACR2-37	200	10.8	13	0.5	40.8
	37	FRN37G1□-2J	HD	ACR2-37	200	10.8	13	0.5	40.8
	45	FRN37G1□-2J	LD	ACR2-55	270	7.5	9	0.375	47.1
	45	FRN45G1□-2J	HD	ACR2-55	270	7.5	9	0.375	47.1
	55	FRN45G1□-2J	LD	ACR2-55	270	7.5	9	0.375	66.1
	55	FRN55G1□-2J	HD	ACR2-55	270	7.5	9	0.375	66.1
	75	FRN55G1□-2J	LD	ACR2-75	390	5.45	6.54	0.25	55.1
	75	FRN75G1□-2J	HD	ACR2-75	390	5.45	6.54	0.25	55.1
	90	FRN75G1□-2J	LD	ACR2-90	450	4.73	5.67	0.198	61.5
	90	FRN90G1□-2J	HD	ACR2-90	450	4.73	5.67	0.198	61.5
	110	FRN90G1□-2J	LD	ACR2-110	500	4.25	5.1	0.18	83.4

(Note 1) A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□
└── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

(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 value 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%).

Table 11.4-23 AC Reactor (ACR) Specifications (Continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	AC reactor type	Rated current (A)	Reactance (mΩ/phase)		Wirewound resistor (mΩ)	Generated loss (W)
						50 Hz	60 Hz		
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	ACR4-0.75A	2.5	1920	2300	-	5
	0.75	FRN0.75G1□-4J	HD						10
	1.5	FRN1.5G1□-4J	HD	ACR4-1.5A	3.7	1160	1390	-	11
	2.2	FRN2.2G1□-4J	HD	ACR4-2.2A	5.5	851	1020	-	14
	3.7	FRN3.7G1□-4J	HD	ACR4-3.7A	9	512	615	-	17
	5.5	FRN5.5G1□-4J	HD	ACR4-5.5A	13	349	418	-	22
	7.5	FRN5.5G1□-4J / FRN7.5G1□-4J	LD / HD	ACR4-7.5A	18	256	307	-	27
	11	FRN7.5G1□-4J / FRN11G1□-4J	LD / HD	ACR4-11A	24	183	219	-	40
	15	FRN11G1□-4J / FRN15G1□-4J	LD / HD	ACR4-15A	30	139	167	-	46
	18.5	FRN15G1□-4J / FRN18.5G1□-4J	LD / HD	ACR4-18.5A	39	114	137	-	57
	22	FRN18.5G1□-4J / FRN22G1□-4J	LD / HD	ACR4-22A	45	95.8	115	-	62
	30	FRN22G1□-4J / FRN30G1□-4J	LD / HD	ACR4-37	100	41.7	50	2.73	38.9
	37	FRN30G1□-4J / FRN37G1□-4J	LD / HD	ACR4-37	100	41.7	50	2.73	55.7
	45	FRN37G1□-4J / FRN45G1□-4J	LD / HD	ACR4-55	135	30.8	37	1.61	50.2
	55	FRN45G1□-4J / FRN55G1□-4J	LD / HD	ACR4-55	135	30.8	37	1.61	70.7
	75	FRN55G1□-4J / FRN75G1□-4J	LD / HD	ACR4-75 *	160	25.8	31	1.16	65.3
	90	FRN75G1□-4J / FRN90G1□-4J	LD / HD	ACR4-110	250	16.7	20	0.523	42.2
	110	FRN90G1□-4J / FRN110G1□-4J	MD/LD / HD	ACR4-110	250	16.7	20	0.523	60.3
	132	FRN110G1□-4J / FRN132G1□-4J	MD/LD / HD	ACR4-132 *	270	20.8	25	0.741	119
	160	FRN132G1□-4J / FRN160G1□-4J	MD/LD / HD	ACR4-220	561	10	12	0.236	56.4
	200	FRN160G1□-4J / FRN200G1□-4J	MD/LD / HD	ACR4-220	561	10	12	0.236	90.4
	220	FRN200G1□-4J / FRN220G1□-4J	MD/LD / HD	ACR4-220	561	10	12	0.236	107
	250	FRN220G1□-4J	MD	ACR4-280	825	6.67	8	0.144	96.4
	280	FRN220G1□-4J / FRN280G1□-4J	LD / HD						108
	315	FRN280G1□-4J	MD	ACR4-355	825	6.67	8	0.144	194
	355	FRN280G1□-4J	LD	ACR4-355 *					245
	315	FRN315G1□-4J	HD	ACR4-355	825	6.67	8	0.144	194
	355	FRN315G1□-4J	MD	ACR4-355 *					245
	400	FRN315G1□-4J	LD	ACR4-450	950	6.67	8	0.136	380
	355	FRN355G1□-4J	HD	ACR4-355 *	825	6.67	8	0.144	245
	400	FRN355G1□-4J	MD	ACR4-450	950	6.67	8	0.136	380
	450	FRN355G1□-4J	LD						473
	400	FRN400G1□-4J	HD	ACR4-450	950	6.67	8	0.136	380
	450	FRN400G1□-4J	MD						473
	500	FRN400G1□-4J / FRN500G1□-4J	LD / HD	ACR4-530	1100	5.75	6.9	0.0824	340
	630	FRN500G1□-4J / FRN630G1□-4J	LD / HD	ACR4-630	1300	4.87	5.84	0.0713	422
	710	FRN630G1□-4J	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 an alphabetic letter depending on the enclosure.

□ └─ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

(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 value 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%).

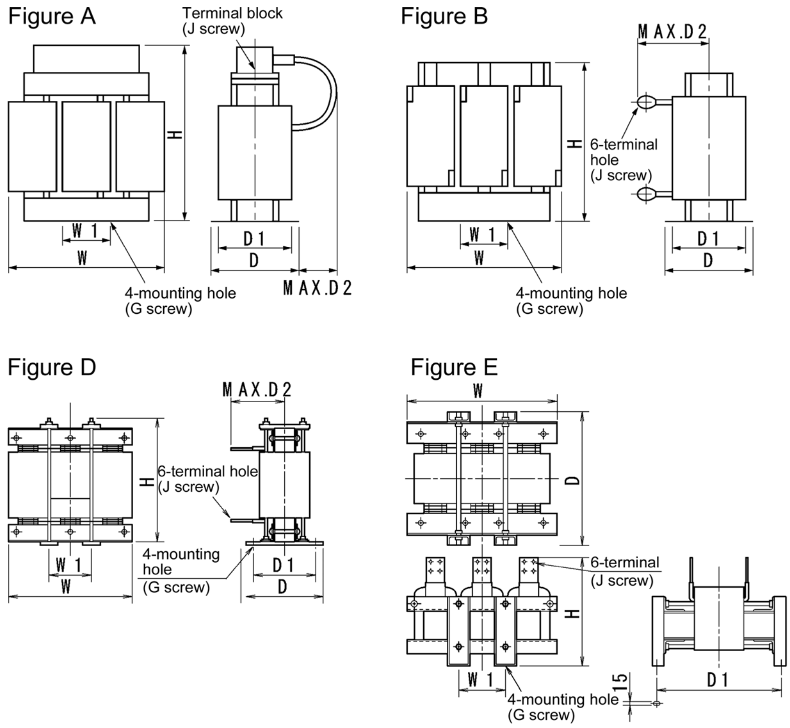


Figure 11.4-20

Table 11.4-24 AC Reactor (ACR) External Dimensions

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	AC Reactor type	Figure	Dimensions (mm) W	W1	D	D1	D2	G	H	Terminal hole J	Approximate mass (kg)
Three-phase 200 V	0.4	FRN0.4G1□-2J	HD	ACR2-0.4A	A	120	40	90	65	20	M5 (6×10)	115	M4	1.4
	0.75	FRN0.75G1□-2J	HD	ACR2-0.75A	A	120	40	100	75	20	M5 (6×10)	115	M4	1.9
	1.5	FRN1.5G1□-2J	HD	ACR2-1.5A	A	120	40	100	75	20	M5 (6×10)	115	M4	2.0
	2.2	FRN2.2G1□-2J	HD	ACR2-2.2A	A	120	40	100	75	20	M5 (6×10)	115	M4	2.0
	3.7	FRN3.7G1□-2J	HD	ACR2-3.7A	A	125	40	100	75	25	M5 (6×10)	125	M4	2.4
	5.5	FRN5.5G1□-2J	HD	ACR2-5.5A	A	125	40	115	90	25	M5 (6×10)	125	M4	3.1
	7.5	FRN5.5G1□-2J	LD	ACR2-7.5A	B	125	40	115	90	106	M5 (6×10)	95	M5	3.1
	7.5	FRN7.5G1□-2J	HD	ACR2-7.5A	B	125	40	115	90	106	M5 (6×10)	95	M5	3.1
	11	FRN7.5G1□-2J	LD	ACR2-11A	B	125	40	125	100	106	M5 (6×10)	95	M6	3.7
	11	FRN11G1□-2J	HD	ACR2-11A	B	125	40	125	100	106	M5 (6×10)	95	M6	3.7
	15	FRN11G1□-2J	LD	ACR2-15A	B	180	60	110	85	106	M6 (7×11)	115	M6	4.8
	15	FRN15G1□-2J	HD	ACR2-15A	B	180	60	110	85	106	M6 (7×11)	115	M6	4.8
	18.5	FRN15G1□-2J	LD	ACR2-18.5A	B	180	60	110	85	109	M6 (7×11)	115	M6	5.1
	18.5	FRN18.5G1□-2J	HD	ACR2-18.5A	B	180	60	110	85	109	M6 (7×11)	115	M6	5.1
	22	FRN18.5G1□-2J	LD	ACR2-22A	B	180	60	110	85	109	M6 (7×11)	115	M6	5.1
	22	FRN22G1□-2J	HD	ACR2-22A	B	180	60	110	85	109	M6 (7×11)	115	M6	5.1
	30	FRN22G1□-2J	LD	ACR2-37	B	190	60	120	90	172	M6 (7×11)	190	M8	11
	30	FRN30G1□-2J	HD	ACR2-37	B	190	60	120	90	172	M6 (7×11)	190	M8	11
	37	FRN30G1□-2J	LD	ACR2-37	B	190	60	120	90	172	M6 (7×11)	190	M8	11
	37	FRN37G1□-2J	HD	ACR2-37	B	190	60	120	90	172	M6 (7×11)	190	M8	11
	45	FRN37G1□-2J	LD	ACR2-55	C	190	60	120	90	200	M6 (7×11)	190	M12	13
	45	FRN45G1□-2J	HD	ACR2-55	C	190	60	120	90	200	M6 (7×11)	190	M12	13
	55	FRN45G1□-2J	LD	ACR2-55	C	190	60	120	90	200	M6 (7×11)	190	M12	13
	55	FRN55G1□-2J	HD	ACR2-55	C	190	60	120	90	200	M6 (7×11)	190	M12	13
	75	FRN55G1□-2J	LD	ACR2-75	C	250	100	120	90	200	M8 (9×14)	250	M12	25
	75	FRN75G1□-2J	HD	ACR2-75	C	250	100	120	90	200	M8 (9×14)	250	M12	25
	90	FRN75G1□-2J	LD	ACR2-90	C	285	190	158	120	190	M10 (12×20)	210	M12	26
	90	FRN90G1□-2J	HD	ACR2-90	C	285	190	158	120	190	M10 (12×20)	210	M12	26
	110	FRN90G1□-2J	LD	ACR2-110	C	280	150	138	110	200	M8 (10×20)	270	M12	30

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └── S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-24 AC Reactor (ACR) External Dimensions (Continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	Mode	AC reactor type	Figure	Dimensions (mm) W	W1	D	D1	D2	G	H	Terminal hole J	Approximate mass (kg)
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	ACR4-0.75A	B	120	40	90	65	106	M5 (6×10)	85	M4	1.1
	0.75	FRN0.75G1□-4J												
	1.5	FRN1.5G1□-4J		ACR4-1.5A		125	40	100	75	106	M5 (6×10)	85	M4	1.9
	2.2	FRN2.2G1□-4J		ACR4-2.2A		125	40	100	75	106	M5 (6×10)	95	M4	2.2
	3.7	FRN3.7G1□-4J		ACR4-3.7A		125	40	100	75	106	M5 (6×10)	95	M4	2.4
	5.5	FRN5.5G1□-4J	HD	ACR4-5.5A		125	40	115	90	106	M5 (6×10)	95	M5	3.1
	7.5		LD	ACR4-7.5A		125	40	115	90	106	M5 (6×10)	95	M5	3.7
		FRN7.5G1□-4J	HD											
	11		LD	ACR4-11A		180	60	110	85	106	M6 (7×11)	115	M6	4.3
		FRN11G1□-4J	HD											
	15		LD	ACR4-15A		180	60	110	85	106	M6 (7×11)	137	M6	5.4
		FRN15G1□-4J	HD											
	18.5		LD	ACR4-18.5A		180	60	110	85	106	M6 (7×11)	137	M6	5.7
		FRN18.5G1□-4J	HD											
	22		LD	ACR4-22A		180	60	110	85	106	M6 (7×11)	137	M6	5.9
		FRN22G1□-4J	HD											
	30		LD	ACR4-37		190	60	120	90	172	M6 (7×11)	190	M8	12
		FRN30G1□-4J	HD											
	37		LD											
		FRN37G1□-4J	HD											
	45		LD	ACR4-55	C	190	60	120	90	200	M6 (7×11)	190	M10	14
		FRN45G1□-4J	HD											
	55		LD											
		FRN55G1□-4J	HD											
	75		LD	ACR4-75		190	60	126	90	157	M6 (7×10)	190	M10	16
		FRN75G1□-4J	HD											
	90		LD	ACR4-110		250	100	136	105	202	M8 (9.5×18)	245	M12	24
		FRN90G1□-4J	HD											
	110		MD/LD											
		FRN110G1□-4J	HD											
	132		MD/LD	ACR4-132		250	100	146	115	207	M8 (10×16)	250	M12	32
		FRN132G1□-4J	HD											
	160		MD/LD	ACR4-220		320	120	150	110	240	M10 (12×20)	300	M12	40
		FRN160G1□-4J	HD											
	200		MD/LD											
		FRN200G1□-4J	HD											
	220		MD/LD											
		FRN220G1□-4J	HD											
	250		MD	ACR4-280		380	130	150	110	260	M10 (12×20)	300	M12	52
	280		LD											
		FRN280G1□-4J	HD											
	315		MD	ACR4-355		380	130	150	110	260	M10 (12×20)	300	M12	52
	355		LD											
	315	FRN315G1□-4J	HD											
	355		MD											
	400		LD											
	355	FRN355G1□-4J	HD											
	400		MD	ACR4-450	D	460	155	290	230	200	M12 (φ15)	490	4× M12	95
	450		LD											
	400	FRN400G1□-4J	HD											
	450		MD											
	500		LD	ACR4-530	E	480	155	420	370	-	M12 (15×25)	380	4× M12	100
		FRN500G1□-4J	HD											
	630		LD	ACR4-630		510	170	420	370	-	M12 (15×25)	390	4× M12	110
		FRN630G1□-4J	HD											

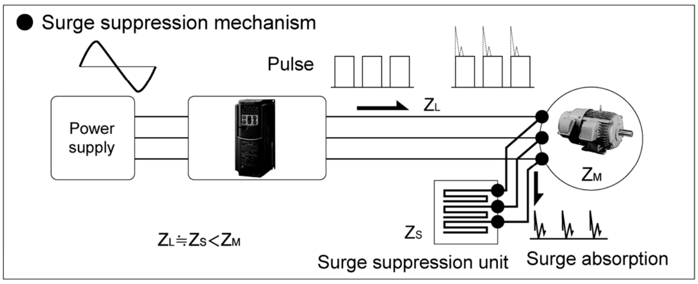
Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Chapter 11 SELECTING PERIPHERAL EQUIPMENT

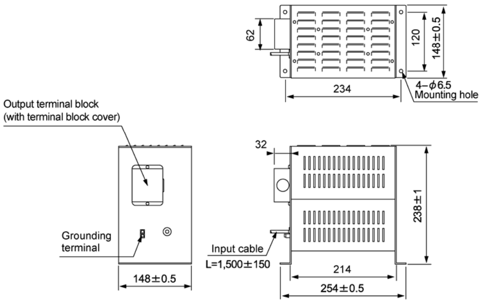
[5] Surge suppression unit (SSU)

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

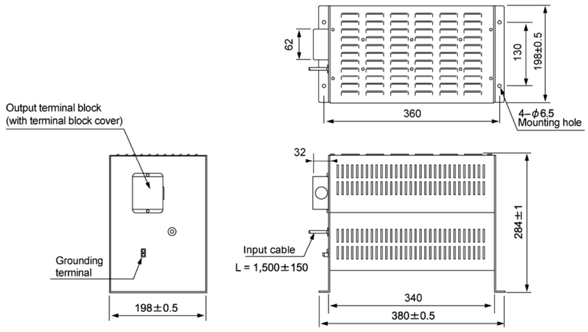


■ Dimensions

・ 50 m spec.: SSU 50TA-NS

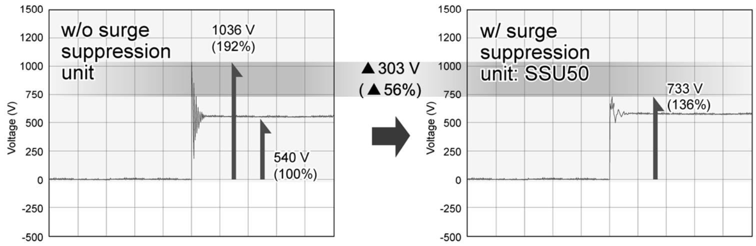


・ 100 m spec.: SSU 100TA-NS

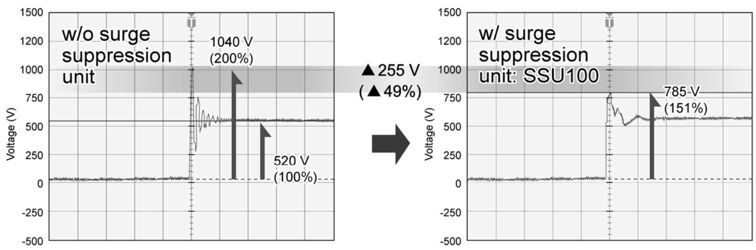


■ Effects of installing the surge suppression units (shown by voltage waveform between motors)

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



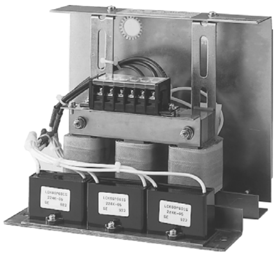
■ Basic specifications

Item	Specifications	
Type	SSU 50TA-NS	SSU100TA-NS
Applicable wiring length	50 m or shorter	100 m or shorter
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	

[6] Output circuit filter (OFL)

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 surge voltage from the 400 V class series of inverters.
- Suppress leakage current 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 of 400 m or less.)
- 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.



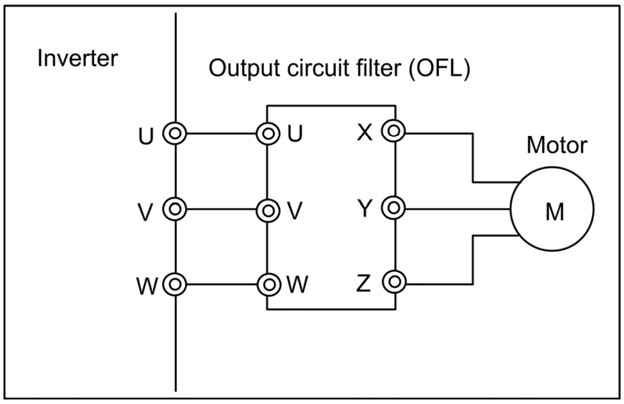


Figure 11.4-21 External View of Output Circuit Filter (OFL) and Connection Example

Table 11.4-25 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□-4J	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 480V 50/60Hz	0.75 to16kHz	400Hz	80
	0.75	FRN0.75G1□-4J		OFL-1.5-4A	3.7					105
	1.5	FRN1.5G1□-4J								
	2.2	FRN2.2G1□-4J		OFL-3.7-4A	9					210
	3.7	FRN3.7G1□-4J								
	5.5	FRN5.5G1□-4J	HD	OFL-7.5-4A	18					190
	7.5		LD							
		FRN7.5G1□-4J	HD							
	11		LD	OFL-15-4A	30					320
		FRN11G1□-4J	HD							
	15		LD							
		FRN15G1□-4J	HD							
	18.5		LD	OFL-22-4A	45					350
		FRN18.5G1□-4J	HD							
	22		LD							
		FRN22G1□-4J	HD							
	30		LD	OFL-30-4A	60				120Hz	570
		FRN30G1□-4J	HD							
	37		LD	OFL-37-4A	75					610
		FRN37G1□-4J	HD							
	45		LD	OFL-45-4A	91					810
		FRN45G1□-4J	HD							
	55		LD	OFL-55-4A	112					910
		FRN55G1□-4J	HD							
	75		LD	OFL-75-4A	150			0.75 to10kHz		1200
		FRN75G1□-4J	HD							
	90		LD	OFL-90-4A	176					1360
		FRN90G1□-4J	HD							
	110		MD/LD	OFL-110-4A	210					1410
		FRN110G1□-4J	HD							
	132		MD/LD	OFL-132-4A	253					1800
		FRN132G1□-4J	HD							
	160		MD/LD	OFL-160-4A	304					2210
		FRN160G1□-4J	HD							
	200		MD/LD	OFL-200-4A	377					2520
		FRN200G1□-4J	HD							
	220		MD/LD	OFL-220-4A	415					2590
		FRN220G1□-4J	HD							
	250		MD	OFL-280-4A	520					3570
	280		LD							
		FRN280G1□-4J	HD							
	315		MD	OFL-315-4A	585					3290
	355		LD	OFL-355-4A	650					3320
	315	FRN315G1□-4J	HD	OFL-315-4A	585					3290
	355		MD	OFL-355-4A	650					3320
	400		LD	OFL-400-4A	740					3390
	355	FRN355G1□-4J	HD	OFL-355-4A	650					3320
	400		MD	OFL-400-4A	740					3390
	450		LD	OFL-450-4A	840					3390
	400	FRN400G1□-4J	HD	OFL-400-4A	740					3390
	450		MD	OFL-450-4A	840					3390
	500		LD	OFL-500-4A	960			0.75 to 6kHz		4250
		FRN500G1□-4J	HD							
	630		LD	OFL-630-4A	1170					4700
		FRN630G1□-4J	HD							

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

□ └ S (Basic type), E (EMC filter built-in type), H (DC reactor built-in type)

Table 11.4-26 Output Circuit Filter (OFL) External Dimensions

OFL-☐☐☐-4A

■ Filter (for 22 kW or below)

Figure A

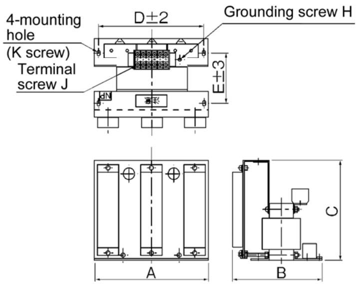
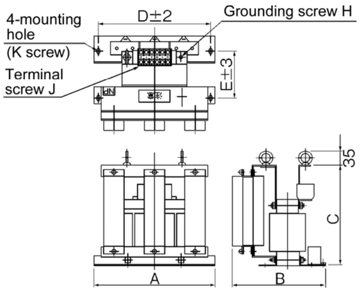


Figure B



■ Reactor (for 30 kW or above)

Figure C

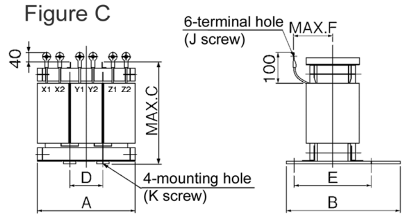


Figure D

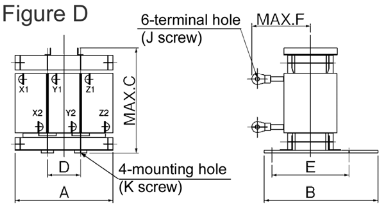
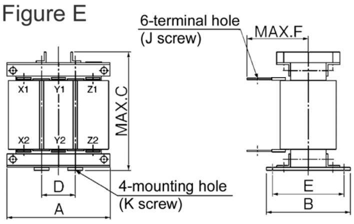
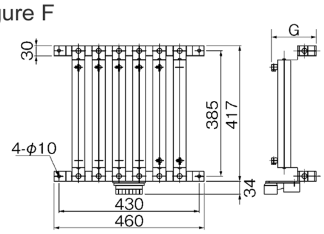


Figure E



■ Resistor and Capacitor
(for 30 kW or above)

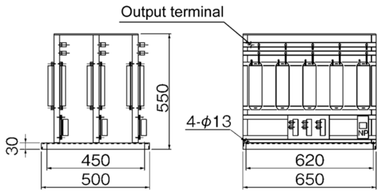
Figure F



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



Series	Filter type	Dimensions (mm)											Approximate mass (kg)
		Figure	A	B	C	D	E	F	G	Grounding screw H	Terminal screw J	Mounting screw K	
Three-phase 400 V	OFL-0.4-4A	A	220	175	195	200	95	-	-	M4	M4	M5	7
	OFL-1.5-4A		220	175	195	200	95	-	-	M4	M4	M5	7
	OFL-3.7-4A		220	225	220	200	115	-	-	M4	M4	M5	14
	OFL-7.5-4A		290	290	230	260	160	-	-	M5	M5	M6	22
	OFL-15-4A	B	330	275	310	300	145	-	-	M6	M6	M8	35
	OFL-22-4A		330	300	330	300	170	-	-	M6	M6	M8	45
	OFL-30-4A	C/F	210	175	210	70	140	90	160	-	M5	M6	12
	OFL-37-4A		220	190	220	75	150	95	160	-	M5	M6	15
	OFL-45-4A	D/F	220	195	265	70	155	140	160	-	M6	M8	17
	OFL-55-4A		260	200	275	85	160	150	160	-	M6	M8	22
	OFL-75-4A		260	210	290	85	170	150	233	-	M8	M10	25
	OFL-90-4A		260	210	290	85	170	155	233	-	M8	M10	28
	OFL-110-4A		300	230	330	100	190	170	233	-	M8	M10	38
	OFL-132-4A		300	240	340	100	200	170	233	-	M10	M10	42
	OFL-160-4A		300	240	340	100	200	180	233	-	M10	M10	48
	OFL-200-4A		320	270	350	105	220	190	333	-	M10	M12	60
	OFL-220-4A		340	300	390	115	250	190	333	-	M10	M12	70
	OFL-280-4A		350	300	430	115	250	200	333	-	M10	M12	78
	OFL-315-4A	E/G	440	275	450	150	230	170	-	-	M12	M12	90
	OFL-355-4A		440	290	480	150	245	175	-	-	M12	M12	100
	OFL-400-4A		440	295	510	150	240	175	-	-	M12	M12	110
	OFL-450-4A		440	325	470	150	270	195	-	-	M12	M12	125
	OFL-500-4A		440	335	500	150	280	210	-	-	M12	M12	145
	OFL-630-4A		480	355	560	150	280	245	-	-	M12	M12	170

Note: The OFL-***-4A models have no restrictions on carrier frequency.

[7] Zero-phase reactors 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, it is recommended to insert an ACL to the power supply lines; if it is 20 m or more, insert it to the power output lines of the inverter.

Wire size is determined depending upon the ACL size (I.D.) and installation requirements.

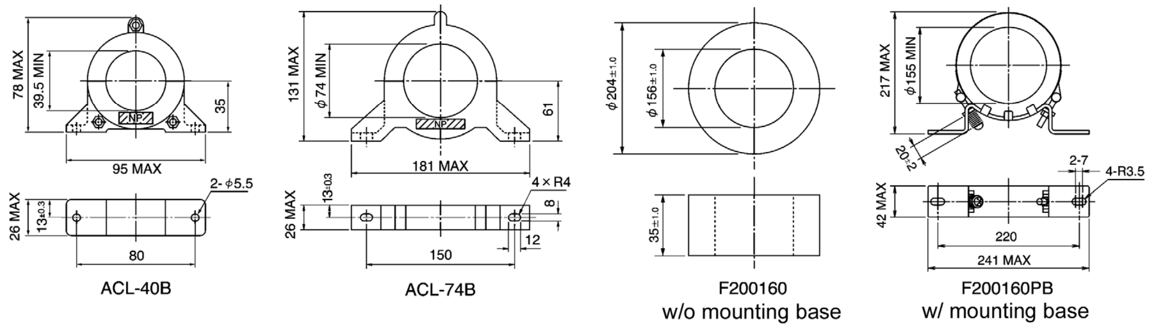


Figure 11.4-22

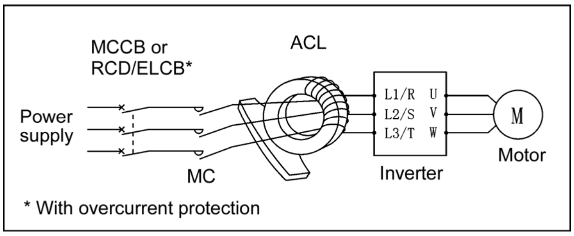


Figure 11.4-23 Dimensions of Zero-phase Reactor for Reducing Radio Noise (ACL) and Connection Example

Table 11.4-27 Zero-phase Reactors for Reducing Radio Noise (ACL)

Zero-phase reactors for reducing radio noise	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, F200160PB	4	1	200×2, 250×2, 325×2, 325×3

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.

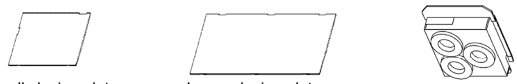
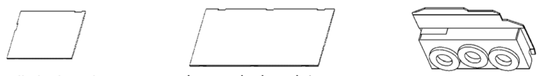
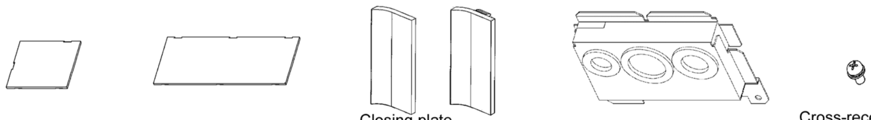
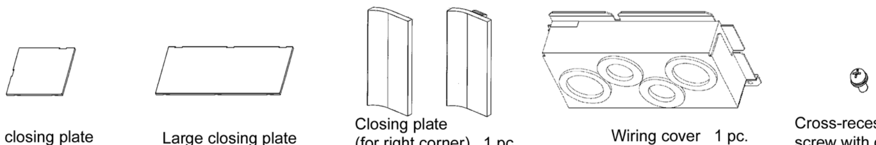
[8] IP40 kits (P40G1-☐☐)

(1) Overview

Mounting the IP40 kit on the FRENIC-MEGA standard model 1 (basic type) enables the inverter's enclosure to be totally encolosed (IP40).

(2) Configuration

Table 11.4-28

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) 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)

(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

Table 11.4-29

Inverter series	Inverter capacity
FRENIC-MEGA	0.4 kW to 22 kW

Type and mass

Table 11.4-30

Item	Specifications										
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
Weight / 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.

Table 11.4-31

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

Surrounding temperature

-10 to +40°C

Number of option cards (printed circuit boards) mountable on the inverter

The inverter equipped with the IP40 kit can accept only one more option card except the relay output interface card (while OPC-G1-RY, the relay output interface card, allows for installing two 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

Select IP40 by setting Bit 7 (Switch IP20/IP40) of function code H98 (Protection/Maintenance Function (Mode selection)).

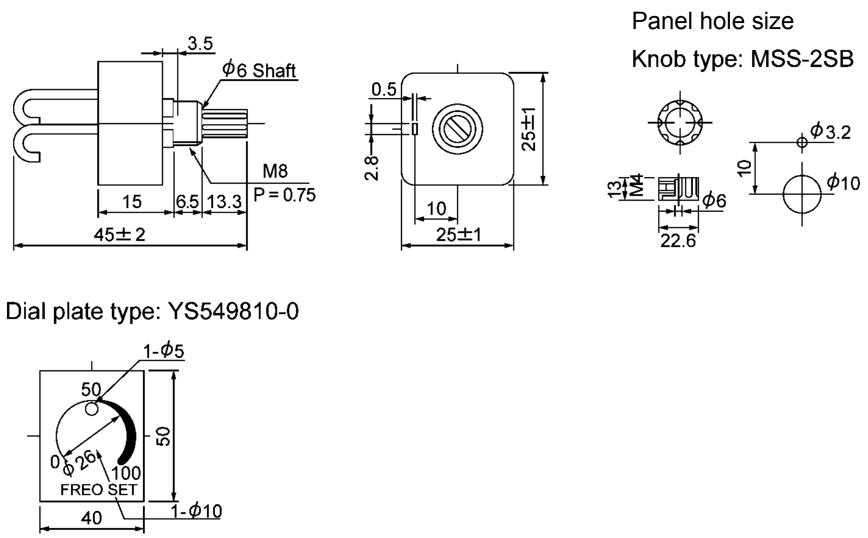
For protection coordination, it is necessary to switch to the protection level suitable for the protection rating.

11.4.2 Options for operation and communication

[1] External frequency command potentiometer (external volume)

An external frequency command potentiometer may be used to set the reference frequency. Connect the potentiometer to control circuit terminals [11] through [13] of the inverter.

Model: RJ-13 (BA-2 B-characteristics, 1 kΩ)

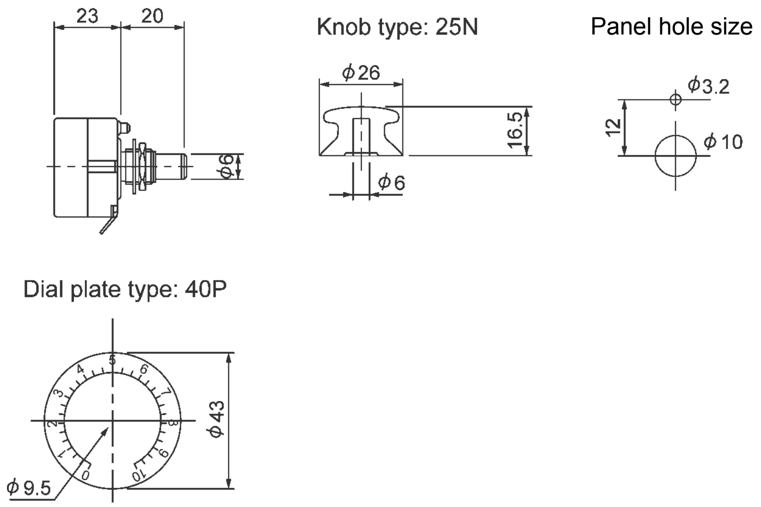


Note: The dial plate and knob must be ordered as separated items.

Available from Fuji Electric Technica Co., Ltd.

Figure 11.4-24

Model: WAR3W-1kΩ (3W B-characteristics)



Note: The dial plate and knob must be ordered as separated items.

Available from Fuji Electric Technica Co., Ltd.

Figure 11.4-25

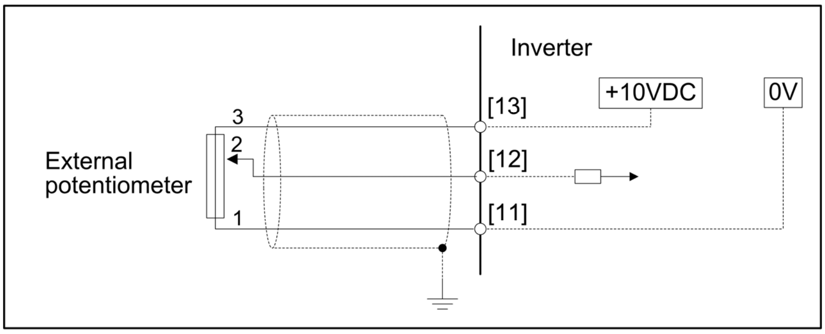


Figure 11.4-26 External Frequency Command Potentiometer Dimensions and Connection Example

[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

Table 11.4-32

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

Figure 11.4-27

[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.

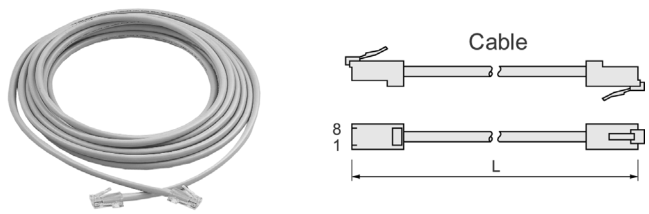


Figure 11.4-28

Table 11.4-33 Extension Cable Length for Remote Operation

Model name	Length (m)
CB-5S	5
CB-3S	3
CB-1S	1

[4] Inverter support loader

FRENIC Loader (inverter support loader) is a support software which enables the inverter to be operated. 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 9 "RUNNING THROUGH RS-485 COMMUNICATION" for details.

[5] PG interface card (OPC-G1-PG)

The PG interface card has a two-shifted pulse train (A, B, Z 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, V/f control with speed sensor, dynamic torque vector control with speed sensor) using PG feedback signals, and servo-lock function

(2) Pulse train input as frequency commands

Note: Using this interface card disables the pulse train frequency command via the digital input terminal [X7] on the inverter.

Ports available for the communications 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 11.4-34 lists PG interface specifications of this interface card.

Table 11.4-34 PG Interface Specifications

Item	Specifications
Encoder pulse resolution	20 to 3000 P/R, A-, B- and Z-phase pulse trains in incremental format
Pulse input mode	Open collector (Maximum cable length: 20 m) Complementary (Maximum cable length: 100 m)
Pulse input voltage	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 input current	8 mA or lower
PG power supply *1	+12 VDC±10% / 120 mA or below, or +15 VDC±10% / 120 mA or below

*1 If the PG power current exceeds 120 mA, use an external power supply.

Pulse train input interface specifications

Table 11.4-35 lists pulse train input interface specifications of this interface card.

Table 11.4-35 Pulse Train Input Interface Specifications

Item	Specifications
Input pulse frequency	30 kHz max. (Open collector) 100 kHz max. (Complementary)
Pulse input mode	Open collector (Maximum cable length: 20 m) Complementary (Maximum cable length: 100 m)
Pulse input voltage	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 input current	8 mA or lower

Terminal functions

Table 11.4-36

Terminal Signal	Name	Specifications
[PI]	External power input terminal *1	Power input terminal from the external device for PG +12 VDC±10% input, or +15 VDC±10% input (Use the power source 150 mA or above which is larger than the PG current consumption.)
[PO]	Power output terminal *2	Power output terminal for PG +12 VDC±10%/120 mA output, or +15 VDC±10%/120 mA output
[CM]	Common output	Common terminal for power supply to PG (Equipotent with the inverter's terminal [CM])
[XA]	Command input terminal for A-phase pulse train	Input terminal for A-phase signal of command pulse train
[XB]	Command input terminal for B-phase pulse train	Input terminal for B-phase signal of command pulse train
[XZ]	—	(Not used.)
[YA]	Feedback input terminal for A-phase pulse train	Input terminal for A-phase signal of pulse train fed back from PG
[YB]	Feedback input terminal for B-phase pulse train	Input terminal for B-phase signal of pulse train fed back from PG
[YZ]	Feedback input terminal for Z-phase pulse train	Input terminal for Z-phase signal of 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 voltage specification of PG power.

Internal circuit configuration

Figure 11.4-29 shows the internal circuit configuration of the optional PG interface card. This figure is an example of supplying the PG power from the internal +12 VDC source.

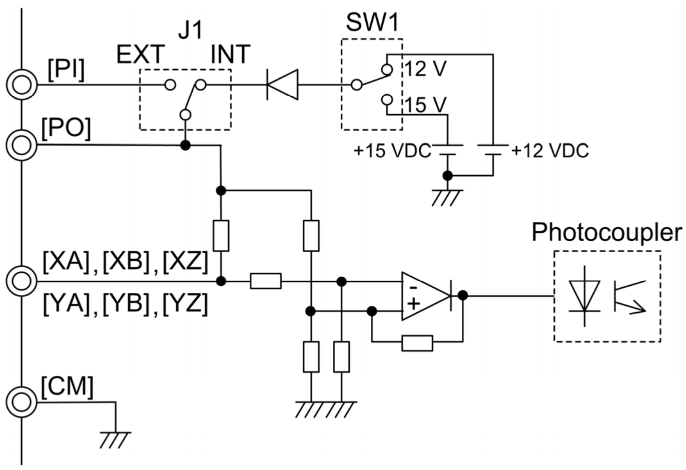


Figure 11.4-29 Internal Circuit Configuration

Control mode

Speed control (Vector control with speed sensor, V/f control with speed sensor, and Dynamic torque vector control with speed sensor)

To control the motor speed, the inverter equipped with this interface card detects feedback signals sent from the PG (pulse generator) mounted on the motor output shaft, enabling high-accuracy and high-response speed control.
(A recommended motor for this control is a FUJI VG motor exclusively designed for vector control.)

Table 11.4-37

Item		Specifications	Remarks
Control specifications *1	Maximum output frequency	25 to 200 Hz	When a VG motor (1024 P/R) is connected.
	Speed control range	Under vector control with speed sensor Minimum speed : Base speed = 1 : 1500 (For 4-pole motors, 1 to 1500 r/min) Under V/f control with speed sensor or dynamic torque vector control with speed sensor Minimum speed : Base speed = 1 : 100 (For 4-pole motors, 15 to 1500 r/min)	
	Speed control accuracy	Within ±0.2% of the rated speed (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 11.4-38

Pulse train format	Operation overview
Pulse train sign/ pulse train input	Gives the speed command to the inverter, following the pulse train input frequency on the terminal [XB]. Switching the terminal [XA] ON/OFF determines polarity of the speed command.*1
Run forward/ run reverse pulse	Gives the run forward speed command to the inverter, following the pulse train input frequency on the terminal [XB], if any. Gives the run reverse speed command to the inverter, following the pulse train input frequency on the terminal [XA], if any.*1
90 degree phase shifted A/B pulse trains	Gives the speed command with polarity 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 train input command polarity and FWD/REV command in the inverter.

For details, refer to the PG Interface Card Instruction Manual (SI47-1215).

[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 (A, B, Z phase) input circuit for 5 V line driver output type PG (pulse generator), 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.

Mounting this interface card on the FRENIC-MEGA enables the following:

(1) Speed control (vector control with speed sensor, V/f control with speed sensor, dynamic torque vector control with speed sensor) using PG feedback signals, and servo-lock function

(2) Pulse train input as frequency commands

Applicable ports

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 11.4-39

Item		Specification
Applicable PG	Output 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 11.4-40 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 11.4-40 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)

Terminal functions

Table 11.4-41

Terminal Signal	Name	Functions
[PI]	External power input terminal *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]	Internal power output terminal	Power output terminal for PG +5 VDC -0% to +10%, 200 mA output
[CM]	Common terminal	Common terminal for power supply to PG (Equipotent with the inverter's terminal [CM])
[YA]	Feedback input terminal for A(+) phase pulse train	Input terminal for A(+) phase signal of pulse train fed back from PG
[*YA]	Feedback input terminal for A(-) phase pulse train	Input terminal for A(-) phase signal of pulse train fed back from PG
[YB]	Feedback input terminal for B(+) phase pulse train	Input terminal for B(+) phase signal of pulse train fed back from PG
[*YB]	Feedback input terminal for B(-) phase pulse train	Input terminal for B(-) phase signal of pulse train fed back from PG
[YZ]	Feedback input terminal for Z(+) phase pulse train	Input terminal for Z(+) phase signal of pulse train fed back from PG
[*YZ]	Feedback input terminal for Z(-) phase pulse train	Input terminal for Z(-) phase signal of 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.

Circuit Configuration

Circuit configuration shown below is an 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 11.4-31) to ON and OFF, respectively. The factory default of SW1 is OFF.

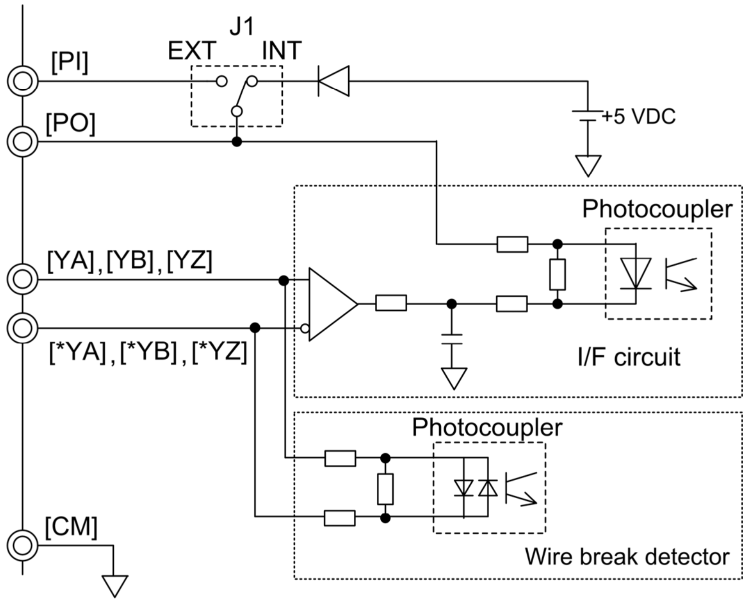


Figure 11.4-30 Circuit Configuration

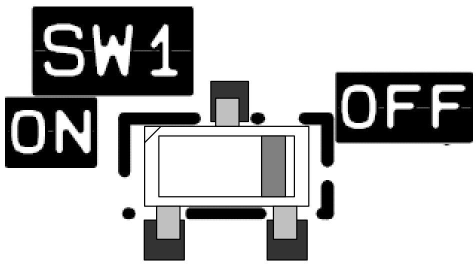


Figure 11.4-31 Z-phase Wire Break Detector ON/OFF Switch

Control mode

Speed control (Vector control with speed sensor, V/f control with speed sensor, and Dynamic torque vector control with speed sensor)

To control the motor speed, the inverter equipped with this interface card detects 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, enabling high-accuracy and high-response speed control. For configuration and adjustment of the vector control, refer to Chapter 5, "FUNCTION CODES."

(A recommended motor for this control is a FUJI VG motor exclusively designed for vector control.)

Table 11.4-42

Item		Specifications	Remarks
Control specifications *1	Maximum output frequency	25 to 200 Hz	When a VG motor (1024 P/R) is connected.
	Speed control range	<u>Under vector control with speed sensor</u> Minimum speed : Base speed = 1 : 1500 (For 4-pole motors, 1 to 1500 r/min) <u>Under V/f control with speed sensor or dynamic torque vector control with speed sensor</u> Minimum speed : Base speed = 1 : 100 (For 4-pole motors, 15 to 1500 r/min)	
	Speed control accuracy	Analog setting: ±0.2% or less of maximum output frequency (at 25°C ±10°C) Digital setting: ±0.01% or less of maximum output 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 (SI47-1250-JE).

[7] PG interface (5 V line driver x 2) card (OPC-G1-PG22)

The PG interface card has the following circuits: two-shifted phase pulse train (YA, YB, YZ and XA, XB, and XZ) input circuit (5 V line driver output type), wire break detection circuit (detection of wire breaks on the YZ, XA, XB, and XZ phase can be cancelled.), power output circuit for feeding power to the connected PG (pulse generator). Using this card, synchronous operation of two PG motors by PG feedback signals, positioning control (TBD), vibration control, and frequency command by pulse train input are possible.

Applicable ports

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. Note that installing this card also occupies the B-port space, the B-port cannot be used for other option cards.

PG interface specifications

Table 11.4-43

Item		Specification
Applicable PG	Output pulse resolution	20 to 3000 P/R *1
	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 *3	100 m
PG power supply		DC +5 V±10% / 300 mA or less *2

Note 1) The setting range is 20 to 60000 P/R.

Note 2) If the total PG current consumption exceeds 300 mA, use an external power supply.

Note 3) If the PG power supply voltage specifications are not met due to a voltage drop caused by increased wire length, use a wire with a larger diameter. Table 11.4-44 shows estimated wire length and wire diameter. Or use external power supply.

Note 4) Use a PG motors with the same pulse resolution for the main and sub PGs during synchronous operation.

Table 11.4-44 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%, 300 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)

Pulse train input interface specifications

Table 11.4-45

Item		Specification
Pulse train generator	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	100 m

Terminal functions

Table 11.4-46

Terminal Signal	Name	Functions
PI	External power input terminal *1	Power input terminal from the external device for PG +5 VDC±10% input *2 (Use the power source equal to or above the PG current consumption.)
PO	Internal power output terminal	Power output terminal for PG +5 VDC -0% to +10% / 300 mA output mm^2
CM	Common terminal	Common terminal for power supply to PG (Equipotent with the inverter's terminal [CM])
YA	Input terminal for YA(+) phase pulse train	Input terminal for YA(+)-phase signal of pulse train of sub PG
*YA	Input terminal for YA(-) phase pulse train	Input terminal for YA(-)-phase signal of pulse train of sub PG
YB	Input terminal for YB(+) phase pulse train	Input terminal for YB(+)-phase signal of pulse train of sub PG
*YB	Input terminal for YB(-) phase pulse train	Input terminal for YB(-)-phase signal of pulse train of sub PG
YZ	Input terminal for YZ(+) phase pulse train	Input terminal for YZ(+)-phase signal of pulse train of sub PG
*YZ	Input terminal for YZ(-) phase pulse train	Input terminal for YZ(-)-phase signal of pulse train of sub PG
XA	Input terminal for XA(+) phase pulse train	Input terminal for XA(+)-phase signal of pulse train of main PG
*XA	Input terminal for XA(-) phase pulse train	Input terminal for XA(-)-phase signal of pulse train of main PG
XB	Input terminal for XB(+) phase pulse train	Input terminal for XB(+)-phase signal of pulse train of main PG
*XB	Input terminal for XB(-) phase pulse train	Input terminal for XB(-)-phase signal of pulse train of main PG
XZ	Input terminal for XZ(+) phase pulse train	Input terminal for XZ(+)-phase signal of pulse train of main PG
*XZ	Input terminal for XZ(-) phase pulse train	Input terminal for XZ(-)-phase signal of pulse train of main PG

Note 1) If the total PG current consumption exceeds 300 mA, use an external power supply.

Note 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.

Circuit configuration

Shown below is a circuit configuration 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. It can be disabled when YZ, XA, XB, XZ-phase wire break does not need to be detected. The YA- and YB-phase wire break detectors are always ON.

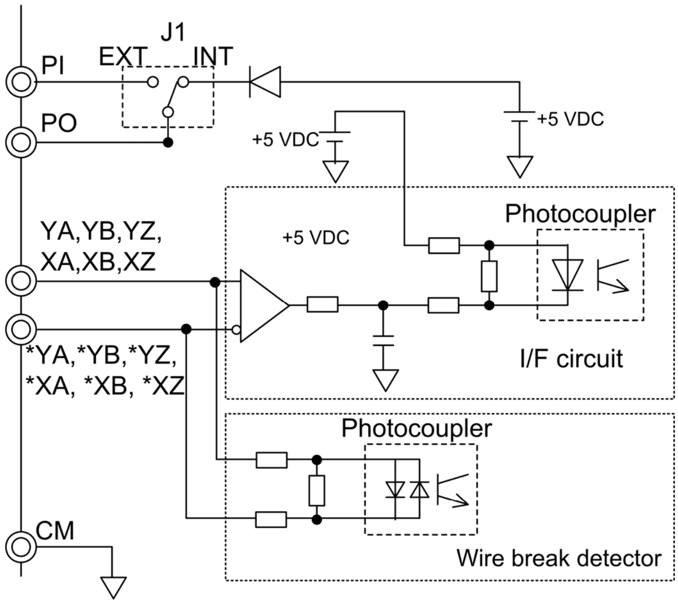


Figure 11.4-32 Circuit Configuration

Corresponding control type

Using this interface card allows for the following control types:

1) Vector control with speed sensor
2) V/f control with speed sensor or torque vector control with speed sensor
3) Pulse train input
4) Synchronous operation
5) Positioning control (BTO)/vibration control

[8] Relay output interface card (OPC-G1-RY)

The relay output interface card is a relay output (1C contact) card for general output signal. It has two independent relay outputs so that using two cards allows the user to activate up to four relay outputs.

A signal to be output to each relay output can be defined with function codes E20 to E23. Selecting "Active OFF" with the function code enables the relay to be turned ON without relay coil excitation. This is useful for a fail-safe application for the power system.

Applicable ports

A FRENIC-MEGA inverter has three option connection ports. Note that each port has some limitations as shown below.

Table 11.4-47

Port	Output signals	Assignment	Notes
A-port	Relay output 1 Relay output 2	Function code E20 (Y1 output) Function code E21 (Y2 output)	Do not connect this card to the inverter's terminal [Y1] or [Y2].
B-port	Relay output 1 Relay output 2	Function code E22 (Y3 output) Function code E23 (Y4 output)	Do not connect this card to the inverter's terminal [Y3] or [Y4].
C-port	Not available for the relay output interface card		

Terminal functions

Table 11.4-48

Terminal Signal	Name	Function
[1A] [1B] [1C]	Relay 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 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 specifications

Table 11.4-49

Item	Specifications
Contact capacity	250 VAC 0.3 A COSΦ = 0.3 or 48 VDC 0.5 A (resistor load)
Contact life	250 VAC 0.3 A :200,000 times (ON/OFF every 1 second) 48 VDC 0.5 A :200,000 times (ON/OFF every 1 second) 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.
Applicable safety standards	EN61800-5-1:2007, Overvoltage Category II (Reinforced Insulation) 250 VAC class

Internal circuits

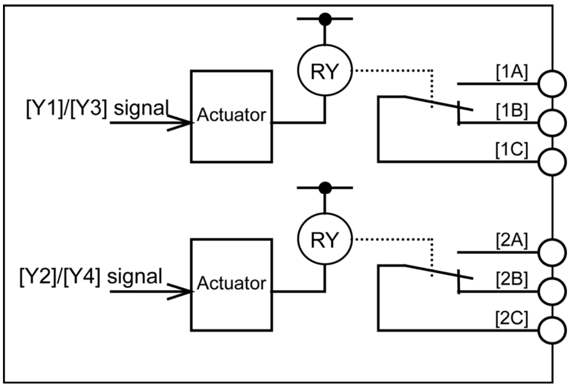


Figure 11.4-33 Internal Circuits

The relationship between function codes and relay output functions is as follows.

Table 11.4-50

Function Code	Name	Data setting range
E20	Terminal [Y1] (Function selection)	0 to 105 1000 to 1105 (negative logic signals)
E21	Terminal [Y2] (Function selection)	
E22	Terminal [Y3] (Function selection)	
E23	Terminal [Y4] (Function selection)	

Y1, Y2, Y3 and Y4 signals are programmable general-purpose output signals. Their functions can be assigned by function codes E20 through E23. 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 externally masks them during the transient period.

[9] 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.

Applicable ports

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

Table 11.4-51

Terminal Signal	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

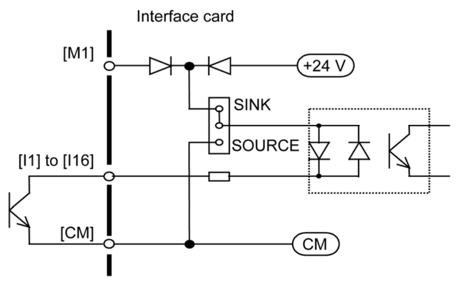
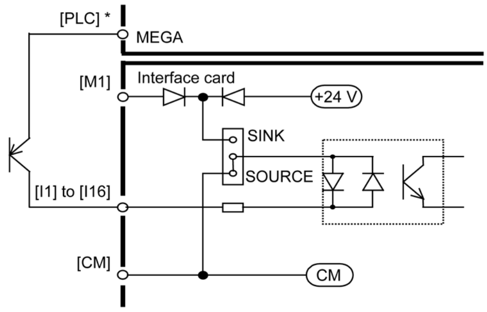
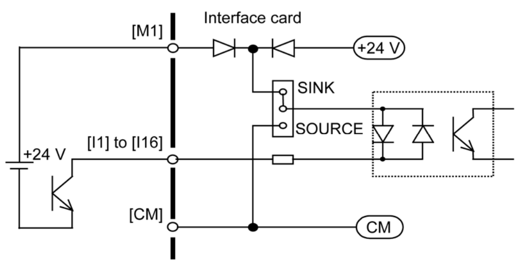
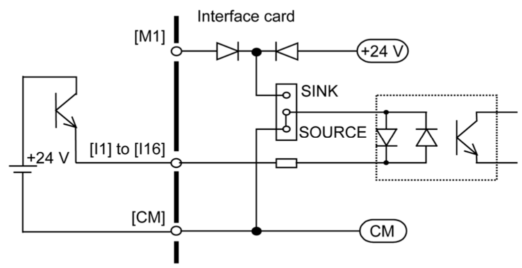
Terminal functions

Table 11.4-52

Terminal Signal	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 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 terminals for digital input signals (Equipotent with the inverter's terminal [CM])

Connection example

Table 11.4-53

Power supply	Connection example	
	SINK mode	SOURCE mode
Internal		 * The maximum allowable current for terminal [PLC] on the FRENIC-MEGA is 100 mA.
External		

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 by using function codes o19 (DI polarity) and o20 (DI mode), respectively.

Turning the terminal input OFF or ON sets each bit data to "0" or "1," respectively.

Table 11.4-54

No.	o19	o20	Input signal name	Terminal function and configuration details
1)	0	0	8-bit binary frequency command	Setting resolution = Maximum output frequency (1/255)
2)	0	1	12-bit binary frequency command	Setting resolution = Maximum output frequency (1/4095)
3)	0	2	15-bit binary frequency command	Setting resolution = Maximum output frequency (1/32767)
4)	0	3	16-bit binary frequency command	Setting resolution = Maximum output 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 output frequency is input, the maximum output frequency applies.

No.	o19	o20	Input signal name	Terminal function and configuration details
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 output frequency is input, the maximum output frequency applies.
7)	1	0	8-bit binary frequency command	Frequency setting range: -(Maximum output frequency) to +(Maximum output frequency) -128 to +127 Setting resolution = Maximum output frequency (1/127)
8)	1	1	12-bit binary frequency command	Frequency setting range: -(Maximum output frequency) to +(Maximum output frequency) -2048 to +2047 Setting resolution = Maximum output frequency (1/2047)
9)	1	2	15-bit binary frequency command	Frequency setting range: -(Maximum output frequency) to +(Maximum output frequency) -16384 to +16383 Setting resolution = Maximum output frequency (1/16383)
10)	1	3	16-bit binary frequency command	Frequency setting range: -(Maximum output frequency) to +(Maximum output frequency) -32768 to +32767 Setting resolution = Maximum output frequency (1/32767)

Note: "Without polarity" when o20 = 4 or 5 (BCD).

[10] 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).

Applicable ports

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

Table 11.4-55

Terminal Signal	Item		Specifications Max.
[O1] to [O8]	Operating voltage	ON level	2 V
		OFF level	27 V
	Operating current at ON		50 mA
	Leakage current at OFF		0.1 mA

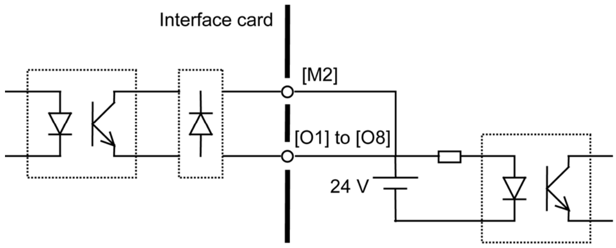
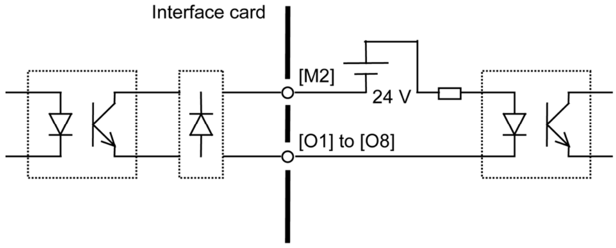
Terminal functions

Table 11.4-56

Terminal Signal	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], and [CMY] of the inverter.

Connection example

Table 11.4-57

SINK mode	
SOURCE mode	

Configuring inverter's function codes

Function code o21 (DO mode selection) 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.

Table 11.4-58

Function Code	Data	Output signal name	Terminal function and configuration details
o21	0	Output frequency (before slip compensation)	Terminal output = (Output frequency/Maximum output frequency) × 255
	1	Output frequency (after slip compensation)	Terminal output = (Output frequency/Maximum output frequency) × 255
	2	Output current	Terminal output = (Output current/(Inverter rated output current x 2)) x 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 value/100% of feedback value) × 255
	8	PG feedback value	Terminal output = (PG feedback value/100% of synchronous speed at maximum output 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 output frequency) × 255

[11] 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 communications 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

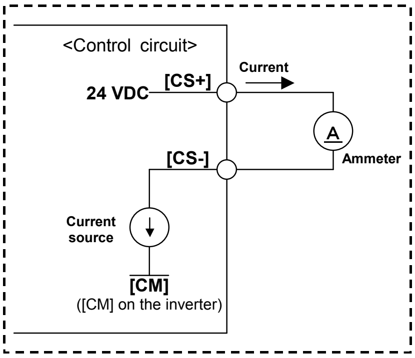
Table 11.4-59

Class	Terminal Signal	Name	Explanation	Remarks
Analog input	[P10]	Power supply for the potentiometer	Used as power supply for frequency command potentiometer (Variable resistor: 1 to 5 kΩ) (10 VDC, 10 mA DC max.)	
	[32]	Analog voltage input	• Used as voltage input for frequency command 0 to ±10 VDC/0 to±100% (0 to ±5 VDC/0 to ±100%) • One of the followings can be assigned to this terminal. • Auxiliary frequency command • PID command • PID feedback value • Ratio setting • Torque limiter level • Analog input monitor • Resolution: 1/3000	Input impedance : 22 kΩ Max. input: ±15 VDC
	[C2]	Analog current input	• Used as current input for frequency command 4 to 20 mA DC/0 to 100% • One of the followings can be assigned to this terminal. • Auxiliary frequency command • PID command • PID feedback value • Ratio setting • Torque limiter level • Analog input monitor • Resolution: 1/3000	Input impedance : 250 Ω Max. input: 30 mA DC
	[31]	Analog common	• Reference terminal for frequency command signals [P10], [32], [C2].	Equipotent with the inverter's terminal [11]

Class	Terminal Signal	Name	Explanation	Remarks

Analog output	[Ao+]	Voltage output (+)	• Outputs the monitor signal of analog DC voltage (0 to ±10 VDC)
			• One of the followings 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 value
			  • 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 10 kΩ input impedance.	

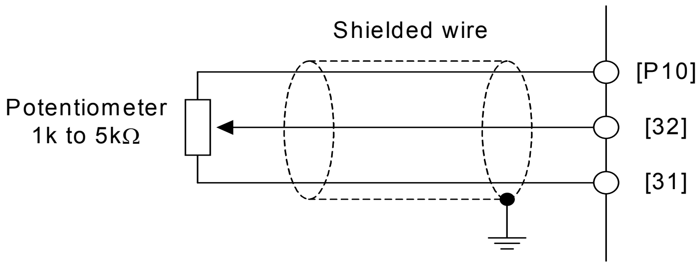
	[Ao-]	Analog voltage output -	• Reference terminal for analog voltage output +[Ao+]	Equipotent with the inverter's terminal [11]

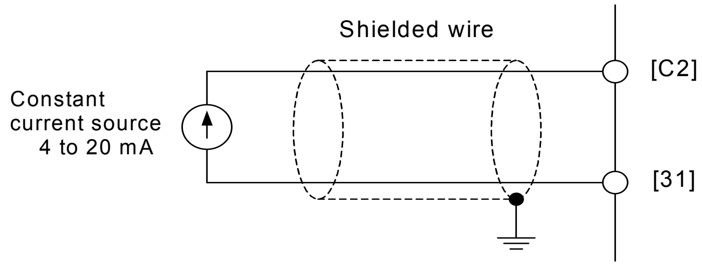
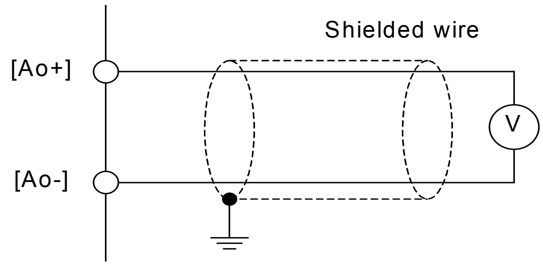
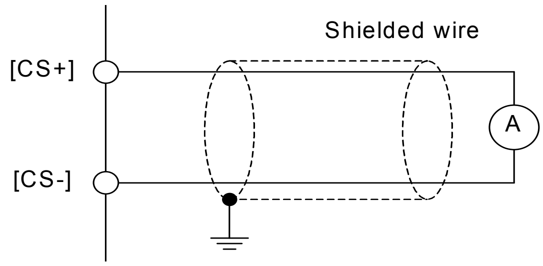
	[CS+]	Analog current output +	• Outputs the monitor signal of analog DC current (4 to 20 mA DC)
			• One of the followings can be issued from this terminal.
			  • Output frequency (before slip compensation, after slip compensation)
			  • Output current
			  • Output voltage
			  • Output torque
			  • Load factor
			  • Input power
			  • PID feedback value
			  • PG feedback value
			  • DC link bus voltage
			  • Universal AO
			  • Motor output
			  • Analog output test
			  • PID command
			  • PID output
			  • Resolution: 1/3000
			
			* Input impedance of the external device: Max. 500 Ω
				Isolated from terminals [31], [Ao-], and [11] (the inverter's terminals)

	[CS-]	Analog current output -		

Connection example

Table 11.4-60

Terminal Signal	Connection method
[32]	

Terminal Signal	Connection method
[C2]	
[Ao]	
[CS]	

Configuring inverter's function codes

Table 11.4-61 Function Codes and Their Parameters for Terminal [32]

Function Code	Function code description	Data	Description	Remarks
o60	Terminal [32] (Function 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	
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 selection)	0	Bipolar	
		1	Unipolar	

Table 11.4-61 Function Codes and Their Parameters for Terminal [32]

Function Code	Function code description	Data	Description	Remarks
o66	Terminal [C2] (Function 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	
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	

Table 11.4-62 Function Codes and Their Parameters for Terminal [Ao]

Function Code	Function code description	Data	Description	Remarks
o71	Terminal [Ao] (Function selection)	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 value	
		8	PG feedback value (speed)	
		9	DC link bus voltage	
		10	Universal AO	
		13	Motor output	
		14	Analog output test (+)	
		15	PID command (SV)	
		16	PID output (MV)	
o72	(Output gain)	0 to 300%	-	
o73	(Polarity selection)	0	Bipolar	
		1	Unipolar	

Table 11.4-63 Function Codes and Their Parameters for Terminal [CS]

Function Code	Function code description	Data	Description	Remarks
o74	Terminal [CS] (Function selection)	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 value	
		8	PG feedback value (speed)	
		9	DC link bus voltage	
		10	Universal AO	
		13	Motor output	
		14	Analog output test (+)	
		15	PID command (SV)	
		16	PID output (MV)	
o75	(Output gain)	0 to 300%	-	

[12] 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.

Applicable ports

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 Er-4 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

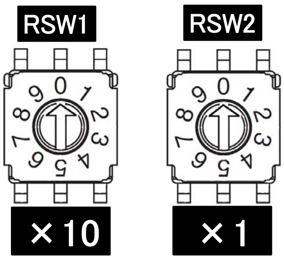
Table 11.4-64

Item	Specifications
Applicable controller	MICREX series
Transmission requirements	T-Link slave I/O transmission
Number of words occupied in transmission	Total 8 words (MICREX to Inverter: 4 W, Inverter to 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). The setting range is from 00 to 99 in decimal.



RSW1: Upper bit (x10)
RSW2: Lower bit (x1)

Figure 11.4-34

* 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)

Function codes dedicated to T-Link interface

Table 11.4-65

<table>
<tr><th>No.</th><th>Name</th><th>Data setting range *1</th><th>Function</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 11.4-66<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>T-Link</td><td>Inverter</td></tr><tr><td>2</td><td>Inverter</td><td>T-Link</td></tr><tr><td>3</td><td>T-Link</td><td>T-Link</td></tr></table></td></tr>
<tr><td rowspan="7">o27</td><td rowspan="7">Select error processing for T-Link 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 trip with Er-5.)</td></tr>
<tr><td>10</td><td>Immediately decelerate to a stop. Trip with Er-5 after stopping.</td></tr>
<tr><td>11</td><td>After the time specified by o28, coast to a stop and trip with Er-5.</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>Timer operation time for setting o27 = 1, 2, 11, or 12.</td></tr>
<tr><td rowspan="3">o30</td><td rowspan="3">Select communications format of T-Link communications card</td><td>0</td><td>G11 standard format</td></tr>
<tr><td>2</td><td>G9 compatible format</td></tr>
<tr><td>1, 3 to 255</td><td>Specification not allowed</td></tr>
</table>

*1 The underlined value are factory defaults.

Communications formats

■ G11 standard format data allocation address

When the G11 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.

Address	(MSB)	(LSB)	Direction
WB00** +0	Running status monitor		INV ↓ MICREX
+1	Output frequency monitor (Motor speed monitor)		
+2	Polling communications #	Empty (All fixed at 0)	
+3	Polling data		
+4	Run command, Di, RESET input		MICREX ↓ INV
+5	Frequency command (Motor speed command)		
+6	Selecting communication #	Polling communication #	
+7	Selecting data		

Note: Asterisks (**) denote a T-Link bus station address configured by the RSW1 and RSW2.

Figure 11.4-35

■ G9 compatible format data allocation address

When the 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.

Address	(MSB) (LSB)	Direction
WB00**	Running status monitor, Extended data read	INV ↓ MICREX
	Output frequency	
	Read/write function code monitor	
	Read function code data monitor	
	Run command, Extended data written	MICREX ↓ INV
	Frequency command	
	Read/write function code	
WB00**+7	Written function code data	

Note: Asterisks (**) denote a T-Link bus station address configured by the RSW1 and RSW2.

Figure 11.4-36

[13] 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 automatic running and monitoring of the inverter and configuring and checking of function codes required for inverter running, from the MICREX-SX.

Applicable ports

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 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 cards on the inverter at the same time causes the communication error alarm Er-4.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S11000 or later.

Hardware specifications

Table 11.4-67

Item	Specifications
Name	SX-bus communications card
Transmission requirements	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,OUT/SX bus dedicated cable * NP1C-P3(0.3 m) to NP1C-25(25 m)
Station address switches RSW1 and RSW2 (Rotary switches)	Station address setting switches for assigning 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.

Function codes dedicated to SX-bus communication card

Table 11.4-68

<table>
<tr><th>No.</th><th>Name</th><th>Data setting range *1</th><th>Function</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 11.4-69<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><u>0</u>, 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 trip with Er-5.)</td></tr>
<tr><td>10</td><td>Immediately decelerate to a stop. Trip with Er-5 after stopping.</td></tr>
<tr><td>11</td><td>After the time specified by o28, coast to a stop and trip with 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 SX-bus network breaks</td><td><u>0.0</u> to 60.0 sec</td><td>Timer operation time for setting o27 = 1, 2, 11, or 12</td></tr>
<tr><td rowspan="2">o30</td><td rowspan="2">Select communications format of SX-bus communications card</td><td>0</td><td>Standard format</td></tr>
<tr><td>1 to 255</td><td>Specification not allowed</td></tr>
</table>

*1 <u>The underlined</u> value 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.

Figure 11.4-37

Address	(MSB)	(LSB)	Direction
%IW****.0	Function code group (1) polled	Function code number (1) polled	INV ↓ MICREX-SX
%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)	MICREX-SX ↓ INV
%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)	

Note: Asterisks (****) denote a SX bus station address configured by the RSW1 and RSW2.

Figure 11.4-38

[14] 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 unit 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.

Applicable ports

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 Er-4 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

Table 11.4-70

Item	Specifications				
Applicable controller	Mitsubishi Electric sequencer, etc. (CC-Link master)				
Transmission system	CC-Link version 1.10 and 2.0 (Broadcast polling system)				
No. of supported inverters	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	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.

Function codes dedicated to CC-Link

Table 11.4-71

<table>
<tr><th>No.</th><th>Name</th><th>Data setting range *1</th><th>Function</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 11.4-72
<table><tr><th></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>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 trip with Er-5.)</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, coast to a stop and trip with Er-5.</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>Timer operation time for setting o27 = 1, 2, 11, or 12</td></tr>
<tr><td rowspan="5">o30</td><td rowspan="5">CC-Link extension setting (multiple setting)</td><td>5 to 255</td><td>No operation</td></tr>
<tr><td>0, 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 setting *2</td><td>0, 1 to 64</td><td>Any of 1 to 64 should be specified for a slave station address. Specifying any other value causes the L.ERR LED to light.</td></tr>
<tr><td>o32</td><td>Transmission baud rate *2</td><td>0 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 The underlined value are factory defaults.

*2 If the station address or the transmission baud rate is modified when the inverter power is ON, the L.ERR LED flashes and the communications link is lost. Inputting reset “RST” from the terminal block or restarting both the inverter and the communications card validates the new setting.

[15] 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 unit via PROFIBUS. Mounting the communications card on the FRENIC-MEGA enables the user to monitor run and frequency commands and running status, change and refer to all function codes of FRENIC-MEGA.

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

Applicable ports

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 Er-4 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

Table 11.4-73

Item		Specification	Remarks
Transmission section	Lines	RS-485 (insulated cable)	
	Cable length	See the table below.	
	Transmission speed	9.6, 19.2, 45.45, 93.75, 187.5, 500 kbps 1.5, 3, 6, 12 Mbps (auto configuration)	To be specified in the master node
	Protocol	PROFIBUS-DP (DP-V0)	IEC 61158, 61784
Connector		Six-pin terminal block	Manufactured by Phoenix Contact Inc.
Control Block	Controller	SPC3 (Siemens)	
	Comm. buffer	1472 bytes (SPC3 built-in memory)	
Addressing		Set by rotary switches (0 to 99) or by inverter’s function code o31 (0 to 125)	Setting rotary switches 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.

Table 11.4-74

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

Configuring inverter's function codes

The inverter's function codes should be configured for specifying run and frequency commands via PROFIBUS. Table 4.75 lists the function codes.

Table 11.4-75 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>Run/frequency command from PROFIBUS</td><td>0</td><td>3</td><td>Select from the following choices:
Table 11.4-76
<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>Run/frequency command from the 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 X□ Function (□: Terminal number)</td><td>-</td><td>Set any data except 24,1024 (except "LE" selection)
(For function codes of all terminals X)</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>

The other related inverter's function codes are listed below.

Table 11.4-77 Related Inverter's Function Codes

Function code	Description	Factory default	Data setting range	Remarks
o27	Select error processing for PROFIBUS communications	0	0 to 15	
o28	Set the operation timer to be used in error processing for PROFIBUS communications	0.0s	0.0 to 60.0 s	
o30	PPO type	0	0 to 255	Refer to the instruction manual of the DeviceNet communications card.
o31	Select PROFIBUS station address	0	0 to 125	Valid station address when rotary switches on the circuit board are set to "00."
o40 to o43	Assign the function code writing data, 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 the function code reading data, 1 to 4.	0000	0x0000 to 0xFFFF	Configure function codes for reading from the data mapped I/O. Functionally equivalent to PNU916.

Node address

(1) Configuring with rotary switches (SW1 and SW2)

Before the inverter power is turned ON, the node address of the communications card should be specified with SW1 and SW2 (rotary switches) on the card. The setting range is from 1 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: Changing node address requires restarting the inverter.
Note: To specify a node address exceeding 99, use the function code o31 as described in (2) below.

(2) Configuring with o31

The code set with o31 takes affect after setting the rotary switch on the communication card to "00" and then powering on the communication card. When the rotary switch is set to other than "00", the value of the rotary switch takes effect.

The setting range is from 0 to 125. Setting the value 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 FRENIC-MEGA 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

Use the o code of the inverter function code to configure the PROFIBUS-DP interface. The o code can be accessed from the inverter keypad after installing this communication card.

The PPO type of the communications card can be specified with the inverter's function code o30. After the setting of the PPO type is modified, the inverter should be restarted to validate the new setting.

Table 11.4-78

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-DP master sends the definition of the module in its configuration frame. The definition is stored in the GSD file. For the configuration procedure, refer to the PROFIBUS-DP master's manual.

[16] 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 configure and monitor run and frequency commands and change and check inverter's function codes required for running from the DeviceNet master.

Applicable ports

This communications 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 Er-4 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

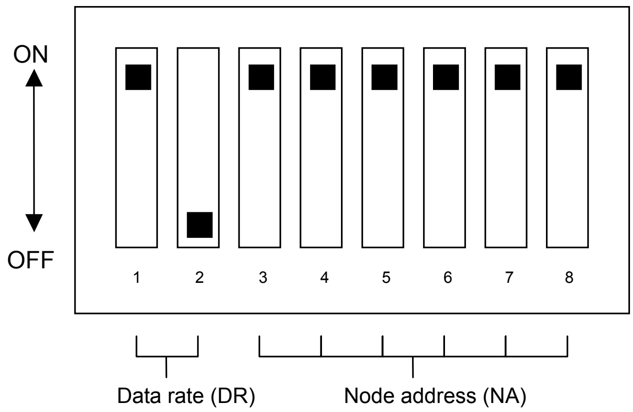
Table 11.4-79

Item	Specifications			
Number of nodes connectable	Max. 64 (including the master)			
MAC ID	0 to 63			
Insulation	500 VDC (photocoupler insulation)			
Transmission speed	500, 250, 125 kbps			
Maximum cable length (When using thick cables)	Transmission speed	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 11-106.			
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.

DIP switch configuration

The DIP switch specifies the communication data rate and the node address as shown below. It offers a choice of data rates (125, 250, and 500 kbps) and a choice of node address 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
Prohibited	11

NA	DIP 3-8
0	000000
1	000001
2	000010
3	000011
…	…
62	111110
63	111111

Figure 11.4-39 DIP Switch Configuration (showing an example of Data Rate = 500 kbps and Node Address = 63)

Configuring inverter's function codes

Table 11.4-80

<table>
<tr><th>Function code</th><th>Description</th><th>Factory default</th><th>Function</th><th>Remarks</th></tr>
<tr><td>y98</td><td>Select run/frequency command sources</td><td>0</td><td>Select from the following choices:
Table 11.4-81<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>DeviceNet</td><td>Inverter</td></tr><tr><td>2</td><td>Inverter</td><td>DeviceNet</td></tr><tr><td>3</td><td>DeviceNet</td><td>DeviceNet</td></tr></table></td><td></td></tr>
<tr><td>o27</td><td>Select error processing for DeviceNet breaks</td><td>0</td><td>Refer to the instruction manual of the DeviceNet communications card.</td><td></td></tr>
<tr><td>o28</td><td>Set the operation timer to be used in error processing for network breaks</td><td>0.0s</td><td>0.0 to 60.0 s</td><td></td></tr>
<tr><td>o31</td><td>Select output instance</td><td>0</td><td>Refer to 11.4-83.</td><td rowspan="4">Restart the inverter to validate the new settings.</td></tr>
<tr><td>o32</td><td>Select input instance</td><td>0</td><td>Refer to 11.4-83.</td></tr>
<tr><td>o40 to 43</td><td>Assign the function code writing data, 1 to 4</td><td>0000</td><td>See Note below.</td></tr>
<tr><td>o48 to 51</td><td>Assign the function code reading data, 1 to 4</td><td>0000</td><td>See Note below.</td></tr>
</table>

Note: Configuring inverter's function codes o40 to o43 and o48 to o51
Specify the function code group (Table 11.4-82) and number in a 4-digit hexadecimal notation.

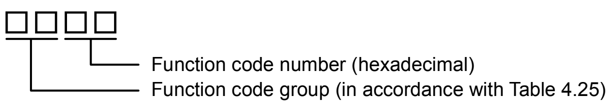


Figure 11.4-40

Table 11.4-82 Function Code Group

Group	Function code		Name	Group	Function code		Name	Group	Function code		Name
S	2	02h	Command/function data	A	9	09h	Motor 2 parameter	b	19	13h	Motor 3 parameter
M	3	03h	Monitored data	o	10	0Ah	Option functions	r	12	0Ch	Motor 4 parameter
F	4	04h	Basic function	J	14	0Eh	Application functions 1	d	20	14h	Application functions 2
E	5	05h	Terminal functions	y	15	0Fh	Link function				
C	6	06h	Control function	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

The communications formats supported are listed below. 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 11.4-83 List of Communications Formats

o31, o32	Type	Instance ID	Details	Words occupied
o31=20	Output (from master to inverter)	20	Basic I/O Instance Output	4
o31=21 or 0 (Default)		21	Extended I/O Instance Output	4
o31=100		100	Fuji Drive Assembly Output	4
o31=102		102	Data Mapped I/O (Write)	8
o31=104 *		104	Request for Access to Function Codes	8
o32=70	Input (from inverter to master)	70	Basic I/O Instance Input	4
o31=71 or 0 (Default)		71	Extended I/O Instance Input	4
o32=101		101	Fuji Drive Assembly Input	4
o32=103		103	Data Mapped I/O (Monitor)	8
o32=105 *		105	Response to Function Codes Access	8

* When o31 is set at 104 (Request for Access to Function Codes) as the output format, o32 should be set at 105 (Response to Function Codes Access). For details, refer to the instruction manual of the DeviceNet communications card.

[17] 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 all function codes from the CANopen master unit.

Applicable ports

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 Er-4 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

Table 11.4-84

Item	Specifications	Remarks
Physical layer	CAN (ISO11898)	
Baud rate	20, 50, 125, 250, 500, 800 kbps or 1 Mbps	Specified by o32
Maximum cable length	2500 m (at 20 kbps) to 25 m (at 1 Mbps)	
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	

Configuring inverter's function codes

Inverter's Function Codes Required for CANopen Communication

The inverter's function codes listed below should be configured for performing communication between the communications card and CANopen master unit.

Table 11.4-85

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 kbps 1: 20 kbps 2: 50 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 800 kbps 7: 1 Mbps 8 to 255: 1 Mbps

*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.

Other related function codes

The table below lists the other related inverter's function codes which can be set by CANopen communications.

Table 11.4-86

<table>
<tr><th>Function Code</th><th>Name</th><th>Factory default</th><th>Data setting range</th><th>Description</th></tr>
<tr><td>o27</td><td>Select error processing for CANopen network breaks</td><td>0</td><td>0 to 15</td><td></td></tr>
<tr><td>o28</td><td>Set the operation timer to be used in error processing for network breaks</td><td>0</td><td>0 to 60.0 s</td><td></td></tr>
<tr><td>o40 to o43 *2</td><td>Assign the function code to be written via RPDO 3</td><td>0x0000</td><td>0x0000 to 0xFFFF</td><td>Specify the function code as follows:
0xXX■■
XX: Group (Refer to the table below)
■■: Number
ex. F07 to 0x0407</td></tr>
<tr><td>o48 to o51 *2</td><td>Assign the function code to be monitored via TPDO 3</td><td>0x0000</td><td>0x0000 to 0xFFFF</td><td>Same as above.</td></tr>
<tr><td>y98</td><td>Select run/frequency command sources</td><td>0</td><td>0 to 3</td><td>Select from the following choices:
Table 11.4-87
<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>CANopen</td><td>Inverter</td></tr>
<tr><td>2</td><td>Inverter</td><td>CANopen</td></tr>
<tr><td>3</td><td>CANopen</td><td>CANopen</td></tr>
</table>
</td></tr>
</table>

*2 After configuring the function code o40 or o43 and o48 to o51, restart the inverter or send ResetNode command from the CANopen master to validate the new setting.

Table 11.4-88 Function Code Group (Function codes o40 to o43 and o48 to o51)

Group	Function code		Name	Group	Function code		Name	Group	Function code		Name
S	2	02h	Command/function data	A	9	09h	Motor 2 parameters	b	19	13h	Motor 3 parameter
M	3	03h	Monitored data	o	10	0Ah	Option functions	r	12	0Ch	Motor 4 parameter
F	4	04h	Basic function	J	14	0Eh	Application functions 1	d	20	14h	Application functions 2
E	5	05h	Terminal functions	y	15	0Fh	Link function				
C	6	06h	Control function	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				

Communications

The communications card is a slave of CANopen and supports the following services.

Table 11.4-89

Item	Services	Remarks
PDO	3 RPDOs/3 TPDOs TPDO supports Sync, Cyclic and Async	All PDO cannot be remapped
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

11.4.3 Option cards for operation and communication

[1] About option cards for operation and communication

The table below lists the option card connection ports of FRENIC-MEGA to which various option cards can be connected and applicable ROM 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.)

Table 11.4-90

Type	Model name	Option card connection port			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).
Feedback	OPC-G1-PG	×	×	○	0100 or later	*1	
	OPC-G1-PG2	×	×	○	0100 or later	*1	
	OPC-G1-PG22	×	*3	○	3510 or later	*4	
	OPC-G1-PMPG	×	*3	○	0900 or later	-	Exclusively designed for MEGA for synchronous motor driving (Type: FRN□□□GX1□-□□ only)
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.)
	OPC-G1-TL	○	×	×	0500 or later	*2	
	OPC-G1-COP	○	×	×	1000 or later	*5	
	OPC-G1-PDP	○	×	×	1000 or later	*5	
	OPC-G1-CCL	○	×	×	0500 or later	*2	
	OPC-G1-SX	○	×	×	1000 or later	*5	When the OPC-G1-SX is connected to the A-port, the OPC-G1-RY only can be connected to the B-port.

*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.
*3 This card occupies both the B- and C ports and no other options can be installed in the B-ports.
*4 Applicable to the product version I or later. For versions earlier than I, it is necessary to check the ROM version.
*5 Applicable to the product version C or later.

Note: Mounting an IP40 kit and NEMA 1 kit (NEMA1-22G1-**) 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).

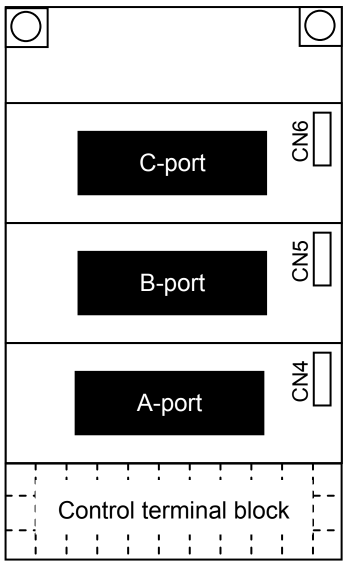


Figure 11.4-41

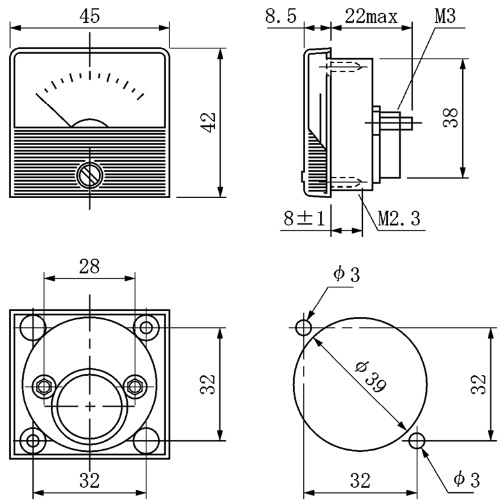
11.4.4 Meter options

[1] Frequency meters

Connect a frequency meter to control circuit terminals [FMA] and [11] of the inverter to measure the output frequency. The type is the same as the normal meters, however, the frequency meter for the inverter is provided.

Model: TRM-45 (10 VDC, 1 mA)

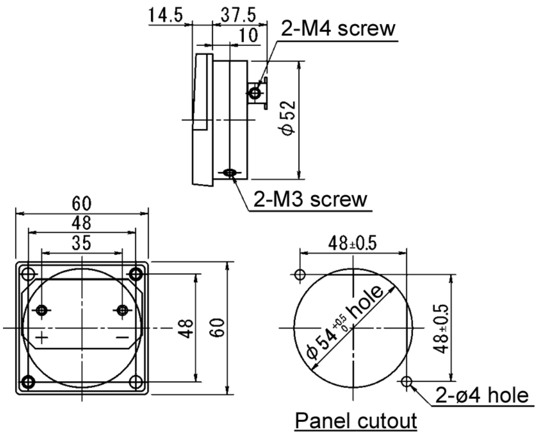
This model has two types of calibration: "0 to 60/120 Hz" and "60/120/240 Hz."



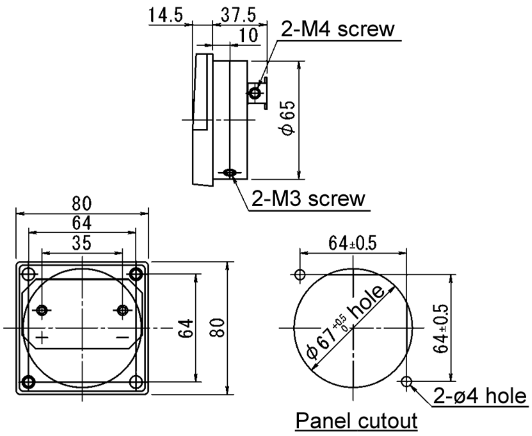
Available from Fuji Electric Technica Co., Ltd.

Figure 11.4-42

Model: FMN-60 (10 VDC, 1 mA)



Model: FMN-80 (10 VDC, 1 mA)



Available from Fuji Electric Technica Co., Ltd.

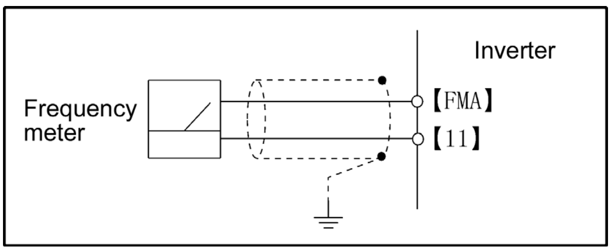


Figure 11.4-43 Frequency Meter External Dimensions and Connection Example

Chapter 12

SPECIFICATIONS

This chapter describes specifications of the output ratings, control system, and external dimensions for the FRENIC-MEGA series of inverters.

Contents

12.1 Standard Model 1 (Basic Type)

12.1.1 Three-phase 200 V class series

HD (High Duty)-mode inverters for heavy load

Item		Specifications																
Type (FRN***G1S-2J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor (kW) *1 (Output rating)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
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	107	131
	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	283	346
	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) *5, Frequency: +5 to -5%																
	Required capacity (with DCR) (kVA) *6	0.6	1.2	2.2	3.1	5.2	7.4	10	15	20	25	30	40	48	58	71	98	116
Braking	Torque (%) *7	150%		100%					20%				10 to 15%					
	Braking transistor	Built-in											–					
	Built-in braking resistor / Braking time (s)	5 s							–									
	Duty cycle (%ED)	5	3	5	3	2	3	2	–									
DC reactor (DCR) *8		Option																Provided as standard
Applicable safety standards		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007																
Enclosure (IEC60529)		IP20, UL enclosed 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	62	105

LD (Low Duty)-mode inverters for light load

Item		Specifications																
Type (FRN***G1S-2J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor (kW) *1 (Output rating)		–					7.5	11	15	18.5	22	30	37	45	55	75	90	110
Output ratings	Rated capacity (kVA) *2	–					11	16	20	25	30	43	55	68	81	107	131	158
	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) *4	–					31.8 (29)	46.2 (42)	59.4 (55)	74.8 (68)	88 (80)	115 (107)	146	180	215	283	346	415
	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) *5, Frequency: +5 to -5%											
	Required capacity (with DCR) (kVA) *6	–					10	15	20	25	30	40	48	58	71	98	116	143
Braking	Torque (%) *7	–					70%		15%				7 to 12%					
	Braking transistor	–					Built-in						–					
	Built-in braking resistor / Braking time (s)	–					3.7 s	3.4 s	–									
	Duty cycle (%ED)	–					2.2	1.4	–									
DC reactor (DCR) *8		–					Option										Provided as standard	
Applicable safety standards		–					UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–					IP20, UL enclosed type						IP00, UL open type					
Cooling method		–					Fan cooling											
Weight / Mass (kg)		–					6.5	6.5	5.8	9.5	9.5	10	25	32	42	43	62	105

*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 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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.

*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.

12.1.2 Three-phase 400 V class series

HD (High Duty)-mode inverters for heavy load (0.4 to 75 kW)

Item		Specifications															
Type (FRN***G1S-4J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Nominal applied motor (kW) *1 (Output rating)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Output ratings	Rated capacity (kVA) *2	1.1	1.9	2.8	4.1	6.8	10	14	18	24	29	34	45	57	69	85	114
	Rated voltage (V) *3	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
	Overload capability	150%-1 min, 200%-3.0 s															
Input power	Voltage, frequency	380 to 480 V, 50/60 Hz															*9
	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
Braking	Torque (%) *7	150%		100%					20%				10 to 15%				
	Braking transistor	Built-in											—				
	Built-in braking resistor / Braking time (s)	5 s							—								
	Built-in braking resistor / Duty cycle (%ED)	5	3	5	3	2	3	2	—								
DC reactor (DCR) *8		Option															Provided as standard
Applicable safety standards		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP20, UL enclosed 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

(90 to 630 kW)

Item		Specifications															
Type (FRN***G1S-4J)		90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor (kW) *1 (Output rating)		90	110	132	160	200	220	280	315	355	400	500	630				
Output ratings	Rated capacity (kVA) *2	134	160	192	231	287	316	396	445	495	563	731	891				
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	176	210	253	304	377	415	520	585	650	740	960	1170				
	Overload capability	150%-1 min, 200%-3.0 s															
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	114	140	165	199	248	271	347	388	436	489	611	773				
Braking	Torque (%) *7	10 to 15%															
	Braking transistor	—															
	Built-in braking resistor / Braking time (s)	—															
	Built-in braking resistor / Duty cycle (%ED)	—															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330	530	530				

*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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.

*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.

*9 380 to 440 V, 50 Hz; 380 to 480 V, 60 Hz

*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1□-4J to FRN220G1□-4J, FRN355G1□-4J, FRN400G1□-4J

MD (Medium Duty)-mode inverters for medium load (90 to 400 kW)

Item		Specifications															
Type (FRN***G1S-4J)		90	110	132	160	200	220	280	315	355	400						
Nominal applied motor (kW) *1 (Output rating)		110	132	160	200	220	250	315	355	400	450						
Output ratings	Rated capacity (kVA) *2	160	192	231	287	316	356	445	495	563	640						
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	210	253	304	377	415	468	585	650	740	840						
	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	388	436	489	547						
Braking	Torque (%) *7	7 to 12%															
	Braking transistor	–															
	Built-in braking resistor	–															
	Braking time (s)																
	Duty cycle (%ED)	–															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330						

*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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.

*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.

*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1□-4J to FRN220G1□-4J, FRN355G1□-4J, FRN400G1□-4J

LD (Low Duty)-mode inverters for light load (5.5 to 75 kW)

Item		Specifications															
Type (FRN***G1S-4J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Nominal applied motor (kW) *1 (Output rating)		–					7.5	11	15	18.5	22	30	37	45	55	75	90
Output ratings	Rated capacity (kVA) *2	–					12	17	22	28	33	45	57	69	85	114	134
	Rated voltage (V) *3	–					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
	Overload capability	–					120%-1 min										
Input power	Voltage, frequency	–					380 to 480 V, 50/60 Hz										*9
	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
Braking	Torque (%) *7	–					70%		15%				7 to 12%				
	Braking transistor	–					Built-in						–				
	Built-in braking resistor / Braking time (s)	–					3.7 s	3.4 s	–								
	Duty cycle (%ED)	–					2.2	1.4	–								
DC reactor (DCR) *8		–					Option									Provided as standard	
Applicable safety standards		–					UL508C, C22.2 No.14, IEC/EN61800-5-1:2007										
Enclosure (IEC60529)		–					IP20, UL enclosed type						IP00, UL open type				
Cooling method		–					Fan cooling										
Weight / Mass (kg)		–					6.5	6.5	5.8	9.5	9.5	10	25	26	31	33	42

(90 to 630 kW)

Item		Specifications															
Type (FRN***G1S-4J)		90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor (kW) *1 (Output rating)		110	132	160	200	220	280	355	400	450	500	630	710				
Output ratings	Rated capacity (kVA) *2	160	192	231	287	316	396	495	563	640	731	891	1044				
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	210	253	304	377	415	520	650	740	840	960	1170	1370				
	Overload capability	120%-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	347	436	489	547	611	773	871				
Braking	Torque (%) *7	7 to 12%															
	Braking transistor	–															
	Built-in braking resistor / Braking time (s)	–															
	Duty cycle (%ED)	–															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330	530	530				

*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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.

*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.

*9 380 to 440 V, 50 Hz; 380 to 480 V, 60 Hz

*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1☐-4J to FRN220G1☐-4J, FRN355G1☐-4J, FRN400G1☐-4J

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

12.2.1 Three-phase 200 V class series

HD (High Duty)-mode inverters for heavy load

	Item	Specifications																
Type (FRN***G1E-2J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor (kW) *1 (Output rating)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
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	107	131
	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	283	346
	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) *5, Frequency: +5 to -5%																
	Required capacity (with DCR) (kVA) *6	0.6	1.2	2.2	3.1	5.2	7.4	10	15	20	25	30	40	48	58	71	98	116
Braking	Torque (%) *7	150%		100%					20%				10 to 15%					
	Braking transistor	Built-in											–					
	Built-in braking resistor / Braking time (s)	5 s							–									
	Duty cycle (%ED)	5	3	5	3	2	3	2	–									
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR) *8		Option															Provided as standard	
Applicable safety standards		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007																
Enclosure (IEC60529)		IP20, UL enclosed 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	62	105

LD (Low Duty)-mode inverters for light load

	Item	Specifications																
Type (FRN***G1E-2J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor (kW) *1 (Output rating)		–					7.5	11	15	18.5	22	30	37	45	55	75	90	110
Output ratings	Rated capacity (kVA) *2	–					11	16	20	25	30	43	55	68	81	107	131	158
	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) *4	–					31.8 (29)	46.2 (42)	59.4 (55)	74.8 (68)	88 (80)	115 (107)	146	180	215	283	346	415
	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) *5, Frequency: +5 to -5%											
	Required capacity (with DCR) (kVA) *6	–					10	15	20	25	30	40	48	58	71	98	116	143
Braking	Torque (%) *7	–					70%		15%				7 to 12%					
	Braking transistor	–					Built-in						–					
	Built-in braking resistor / Braking time (s)	–					3.7 s	3.4 s	–									
	Duty cycle (%ED)	–					2.2	1.4	–									
EMC filter							Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)											
DC reactor (DCR) *8		–					Option										Provided as standard	
Applicable safety standards		–					UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–					IP20, UL enclosed type						IP00, UL open type					
Cooling method		–					Fan cooling											
Weight / Mass (kg)		–					6.7	7.0	6.4	10.9	10.9	11.0	25	32	42	43	62	105

*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 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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.
*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.

12.2.2 Three-phase 400 V class series

HD (High Duty)-mode inverters for heavy load (0.4 to 75 kW)

Item		Specifications															
Type (FRN***G1E-4J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Nominal applied motor (kW) *1 (Output rating)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Output ratings	Rated capacity (kVA) *2	1.1	1.9	2.8	4.1	6.8	10	14	18	24	29	34	45	57	69	85	114
	Rated voltage (V) *3	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
	Overload capability	150%-1 min, 200%-3.0 s															
Input power	Voltage, frequency	380 to 480 V, 50/60 Hz															*9
	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
Braking	Torque (%) *7	150%		100%					20%				10 to 15%				
	Braking transistor	Built-in											–				
	Built-in braking resistor / Braking time (s)	5 s							–								
	Duty cycle (%ED)	5	3	5	3	2	3	2	–								
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)															
DC reactor (DCR) *8		Option															Provided as standard
Applicable safety standards		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP20, UL enclosed 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

(90 to 630 kW)

Item		Specifications															
Type (FRN***G1E-4J)		90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor (kW) *1 (Output rating)		90	110	132	160	200	220	280	315	355	400	500	630				
Output ratings	Rated capacity (kVA) *2	134	160	192	231	287	316	396	445	495	563	731	891				
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	176	210	253	304	377	415	520	585	650	740	960	1170				
	Overload capability	150%-1 min, 200%-3.0 s															
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	114	140	165	199	248	271	347	388	436	489	611	773				
Braking	Torque (%) *7	10 to 15%															
	Braking transistor	–															
	Built-in braking resistor / Braking time (s)	–															
	Duty cycle (%ED)	–															
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330	530	530				

*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.
*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.
*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.
*9 380 to 440 V, 50 Hz; 380 to 480 V, 60 Hz
*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1□-4J to FRN220G1□-4J, FRN355G1□-4J, FRN400G1□-4J

MD (Medium Duty)-mode inverters for medium load (90 to 400 kW)

Item		Specifications															
Type (FRN***G1E-4J)		90	110	132	160	200	220	280	315	355	400						
Nominal applied motor (kW) *1 (Output rating)		110	132	160	200	220	250	315	355	400	450						
Output ratings	Rated capacity (kVA) *2	160	192	231	287	316	356	445	495	563	640						
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	210	253	304	377	415	468	585	650	740	840						
	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	388	436	489	547						
Braking	Torque (%) *7	7 to 12%															
	Braking transistor	–															
	Built-in braking resistor / Braking time (s)	–															
	Duty cycle (%ED)	–															
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330						

*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.
*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).
*6 Required when a DC reactor (DCR) is used.
*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.
*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1□-4J to FRN220G1□-4J
FRN355G1□-4J, FRN400G1□-4J

LD (Low Duty)-mode inverters for light load (5.5 to 75 kW)

Item		Specifications															
Type (FRN***G1E-4J)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Nominal applied motor (kW) *1 (Output rating)		–					7.5	11	15	18.5	22	30	37	45	55	75	90
Output ratings	Rated capacity (kVA) *2	–					12	17	22	28	33	45	57	69	85	114	134
	Rated voltage (V) *3	–					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
	Overload capability	–					120%-1 min										
Input power	Voltage, frequency	–					380 to 480 V, 50/60 Hz										*9
	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
Braking	Torque (%) *7	–					70%		15%				7 to 12%				
	Braking transistor	–					Built-in						–				
	Built-in braking resistor: Braking time (s)	–					3.7 s	3.4 s	–								
	Duty cycle (%ED)	–					2.2	1.4	–								
EMC filter		–					Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)										
DC reactor (DCR) *8		–					Option									Provided as standard	
Applicable safety standards		–					UL508C, C22.2 No.14, IEC/EN61800-5-1:2007										
Enclosure (IEC60529)		–					IP20, UL enclosed type						IP00, UL open type				
Cooling method		–					Fan cooling										
Weight / Mass (kg)		–					6.8	6.9	6.2	10.5	10.5	11.2	26	27	32	33	42

(90 to 630 kW)

Item		Specifications															
Type (FRN***G1E-4J)		90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor (kW) *1 (Output rating)		110	132	160	200	220	280	355	400	450	500	630	710				
Output ratings	Rated capacity (kVA) *2	160	192	231	287	316	396	495	563	640	731	891	1044				
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)															
	Rated current (A)	210	253	304	377	415	520	650	740	840	960	1170	1370				
	Overload capability	120%-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	347	436	489	547	611	773	871				
Braking	Torque (%) *7	7 to 12%															
	Braking transistor	–															
	Built-in braking resistor: Braking time (s)	–															
	Duty cycle (%ED)	–															
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)															
DC reactor (DCR) *8		Provided as standard															
Applicable safety standards *10		UL508C, C22.2 No.14, IEC/EN61800-5-1:2007															
Enclosure (IEC60529)		IP00, UL open type															
Cooling method		Fan cooling															
Weight / Mass (kg)		62	64	94	98	129	140	245	245	330	330	530	530				

*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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

*6 Required when a DC reactor (DCR) is used.

*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.

*9 380 to 440 V, 50 Hz; 380 to 480 V, 60 Hz

*10 Inverters with the following capacity are not compliant with the safety standards C22.2 No.14.
FRN160G1□-4J to FRN220G1□-4J, FRN355G1□-4J, FRN400G1□-4J

12.3 Standard Model 3 (DC Reactor Built-in Type)

12.3.1 Three-phase 200 V class series

HD (High Duty)-mode inverters for heavy load (5.5 to 55 kW)

Item			Specifications											
Type (FRN***G1H-2J)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Nominal applied motor (kW) *1 (Output rating)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Output ratings	Rated capacity (kVA) *2	–	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)	–	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) *5, Frequency: +5 to -5%											
	Required capacity (kVA)	–	7.8	11	16	22	27	32	43	53	65	78	–	–
Braking	Torque (%) *6	–	100%		20%				10 to 15%					
	Braking transistor	–	Built-in						–					
	Built-in braking resistor [Ω]	–	20Ω		–									
	Braking time (s)	–	5 s		–									
	Duty cycle (%ED)	–	3	2	–									
DC reactor (DCR)		–	Built-in (Power factor: 80% or more *7)											
Applicable safety standards		–	UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–	IP20, UL enclosed type						IP00, UL open type					
Cooling method		–	Fan cooling											
Mass (kg)		–	10.7	11.1	11.5	17.3	17.6	18.5	31	39	51	52	–	–

LD (Low Duty)-mode inverters for light load (5.5 to 55 kW)

Item			Specifications											
Type (FRN***G1H-2J)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Nominal applied motor (kW) *1 (Output rating)		–	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) *4	–	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) *5, Frequency: +5 to -5%											
	Required capacity (kVA)	–	11	15	21	26	31	41	51	63	75	99	–	–
Braking	Torque (%) *6	–	70%		15%				7 to 12%					
	Braking transistor	–	Built-in						–					
	Built-in braking resistor [Ω]	–	20Ω		–									
	Braking time (s)	–	3.7 s	3.4 s	–									
	Duty cycle (%ED)	–	2.2	1.4	–									
DC reactor (DCR)		–	Built-in (Power factor: 80% or more *7)											
Applicable safety standards		–	UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–	IP20, UL enclosed type						IP00, UL open type					
Cooling method		–	Fan cooling											
Mass (kg)		–	10.7	11.1	11.5	17.3	17.6	18.5	31	39	51	52	–	–

*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 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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

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

*7 Calculated when the interphase voltage unbalance ratio of the power supply is 0% at the rated output

12.3.2 Three-phase 400 V class series

HD (High Duty)-mode inverters for heavy load (5.5 to 55 kW)

Item		Specifications												
Type (FRN***G1H-4J)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Nominal applied motor (kW) *1 (Output rating)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Output ratings	Rated capacity (kVA) *2	–	10	14	18	24	29	34	45	57	69	85	–	–
	Rated voltage (V) *3	–	Three-phase 380 to 480 V (with AVR function)											
	Rated current (A)	–	13.5	18.5	24.5	32	39	45	60	75	91	112	–	–
	Overload capability	–	150%-1 min, 200%-3.0 s											
Input power	Voltage, frequency	–	380 to 480 V, 50/60 Hz											
	Allowable voltage/frequency	–	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%											
	Required capacity (kVA)	–	7.8	11	16	22	27	32	42	53	65	80	–	–
Braking	Torque (%) *6	–	100%		20%				10 to 15%					
	Braking transistor	–	Built-in						–					
	Built-in braking resistor [Ω]	–	80Ω		–									
	Braking time (s)	–	5 s		–									
	Duty cycle (%ED)	–	3	2	–									
DC reactor (DCR)		–	Built-in (Power factor: 80% or more *7)											
Applicable safety standards		–	UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–	IP20, UL enclosed type						IP00, UL open type					
Cooling method		–	Fan cooling											
Mass (kg)		–	10.8	11.9	11.6	17.6	18.1	18.6	32	33	39	42	–	–

LD (Low Duty)-mode inverters for light load (5.5 to 55kW)

Item		Specifications												
Type (FRN***G1H-4J)		–	5.5	7.5	11	15	18.5	22	30	37	45	55	–	–
Nominal applied motor (kW) *1 (Output rating)		–	7.5	11	15	18.5	22	30	37	45	55	75	–	–
Output ratings	Rated capacity (kVA) *2	–	12	17	22	28	33	45	57	69	85	114	–	–
	Rated voltage (V) *3	–	Three-phase 380 to 480 V (with AVR function)											
	Rated current (A) *4	–	16.5	23	30.5	37	45	60	75	91	112	150	–	–
	Overload capability	–	120%-1 min											
Input power	Voltage, frequency	–	380 to 480 V, 50/60 Hz											
	Allowable voltage/frequency	–	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%											
	Required capacity (kVA)	–	11	15	21	26	31	42	50	62	75	101	–	–
Braking	Torque (%) *6	–	70%		15%				7 to 12%					
	Braking transistor	–	Built-in						–					
	Built-in braking resistor [Ω]	–	80Ω		–									
	Braking time (s)	–	3.7 s	3.4 s	–									
	Duty cycle (%ED)	–	2.2	1.4	–									
DC reactor (DCR)		–	Built-in (Power factor: 80% or more *7)											
Applicable safety standards		–	UL508C, C22.2 No.14, IEC/EN61800-5-1:2007											
Enclosure (IEC60529)		–	IP20, UL enclosed type						IP00, UL open type					
Cooling method		–	Fan cooling											
Mass (kg)		–	10.8	11.9	11.6	17.6	18.1	18.6	32	33	39	42	–	–

*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.

*5 Voltage unbalance (%) = Max. voltage (V) - Min. voltage (V) / Three-phase average voltage (V) × 67 (IEC/EN61800-3)
If this value is 2 to 3%, use an optional AC reactor (ACR).

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

*7 Calculated when the interphase voltage unbalance ratio of the power supply is 0% at the rated output

12.4 Common Specifications

Table 12.4-1

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 V/f control with speed sensor or vector control with speed sensor)	
Output frequency	Setting range	Base frequency		25 to 500 Hz variable (in conjunction with the maximum frequency)	
Output frequency	Setting range	Starting frequency		0.1 to 60.0 Hz variable (0.0 Hz under vector control with/without speed sensor)	
Output frequency	Setting range	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 10k Hz variable setting (HD mode: 75 to 400 kW, LD mode: 22 to 55 kW) • 0.75 to 6 kHz variable setting (HD mode: 500 kW and 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 400 kW) Note: The carrier frequency may automatically drop depending upon the surrounding temperature or the output current to protect the inverter. (The automatic drop function can be disabled.)	
Output frequency	Output frequency accuracy			• Analog setting: ±0.2% of maximum frequency (at 25±10ºC) • Keypad setting: ±0.01% of maximum frequency (at -10 to +50ºC)	
Output frequency	Frequency setting resolution			• Analog setting: 1/3000 of maximum frequency (1/1500 with V2 input) • 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)	
Output frequency	Under V/f control with speed sensor Under dynamic torque vector control with speed sensor		Speed control range	• 1 : 100 (Minimum speed : Base speed, 4P, 15 to 1500 r/min) • 1 : 2 (Constant torque range : Constant output range)	*8
Output frequency	Under V/f control with speed sensor Under dynamic torque vector control with speed sensor		Speed control accuracy	• Analog setting: ±0.2% of maximum frequency (at 25±10ºC) • Digital setting: ±0.01% of maximum frequency (at -10 to +50ºC)	*8
Output frequency	Under vector control without speed sensor		Speed control range	• 1 : 200 (Minimum speed : Base speed, 4P, 7.5 to 1500 r/min) • 1 : 2 (Constant torque range : Constant output range)	*8
Output frequency	Under vector control without speed sensor		Speed control accuracy	• Analog setting: ±0.5% of base speed (at 25±10ºC) • Digital setting: ±0.5% of base speed (at -10 to +50ºC)	*8
Output frequency	Under vector control with speed sensor		Speed control range	• 1 : 1500 (Minimum speed : Base speed, 4P, 1 to 1500 r/min) • 1 : 4 (Constant torque range : Constant output range)	*8
Output frequency	Under vector control with speed sensor		Speed control accuracy	• Analog setting: ±0.2% of maximum frequency (at 25±10ºC) • Digital setting: ±0.01% of maximum frequency (at -10 to +50ºC)	*8
Control	Control method			• V/f control • Dynamic torque vector control • V/f control with speed sensor or dynamic torque vector control with speed sensor • Vector control without speed sensor (Not available for MD-mode inverters) • Vector control with speed sensor (with an optional PG interface card mounted)	*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	
	Voltage/frequency characteristic		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.

Table 12.4-2

	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), (digital input) 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	
		External volume: Can be set with external frequency command potentiometer.(1 to 5 kΩ 1/2 W)	
		Analog input: 0 to ±10 VDC (±5 VDC)/ 0 to ±100% (terminals [12] and [V2]), 0 to +10 VDC (+5 VDC)/ 0 to +100% (terminals [12] and [V2]) ("+1 to +5VDC" can be adjusted with bias and analog input gain.) +4 to +20 mA DC/ 0 to 100% (terminal [C1]) 0 to +20 mA DC/ 0 to 100% (terminal [C1]) *11	
		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)	
		Pattern operation: Automatic operation according to the preset operating time, rotational direction, acceleration/deceleration time and reference frequency. Up to 7 stages can be set. *12	
		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. : Switchable from "0 to +20 mA DC/0 to 100%" to "+20 to 0 mA DC/0 to 100%" by external command. *11	
		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. 25kHz	
	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)	
		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.
*11 Available in inverters having a ROM version 3600 or later.
*12 Available in inverters having a ROM version 3800 or later.

Table 12.4-3

	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. (Holding the output frequency at the low level specified by F16/decelerating the motor to a stop)	
	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 0.00 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 *2, *3	Compensates for decrease in speed according to the load.	
	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: Analog input (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 *1 to *3 and *6	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 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 in inverters having a ROM version 1000 or later.

Table 12.4-4

Item		Explanation	Remarks
Control	Anti-regenerative 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.	
	Onine tuning *2, *3	Compensates for the change of motor parameters caused by temperature rise.	*10
	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 *7	Notch filter for vibration suppression	*9
	Constant peripheral speed control *4, *5	Controls the rotating speed to keep the peripheral speed (line speed) constant so that an increase in the peripheral speed is suppressed.	*10
	Synchronous operation *4, *5, *7	Synchronizes the positioning of two motors.	*10
	Pre-excitation *6, *7	Excitation is carried out to create the motor flux before starting the motor.	
	Zero speed control *7	The motor speed is held to zero by forcibly zeroing the speed command.	
	Servo lock *7	Stops the motor and holds the motor in the stopped position.	*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 limitation	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
	Battery-powered operation	Drives the inverter in a low voltage status by the battery power.	*11

*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 in inverters having a ROM version 1000 or later.
*10 Available in inverters having a ROM version 3000 or later.
*11 Available in inverters having a ROM version 3600 or later.

Table 12.4-5

	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: 40ºC 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. This protection is not assured if extremely large AC line voltage is applied inadvertently.	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	• Protects the inverter or stops the inverter output when an input phase loss is detected. • 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 caused by a cooling fan fault or overload. Stop the inverter output detecting a fault of inner agitating fan. (200 V 45 kW, 400 V 75 kW or above)	OH1
		Stop the inverter output detecting an abnormal temperature inside the inverter unit caused by 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
	Charger 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)

Table 12.4-6

Item			Explanation	Remarks
Protection	Braking transistor broken		Stop the inverter detecting the brake transistor abnormality. (DB transistor built-in type only)	dbA
	Overspeed protection		• When d35 = 999, stops the inverter if the detected speed is 120% or over of the maximum output frequency × (d32 or d33). *4 to *7 • When d35 ≠ 999, stops the inverter if the detected speed is greater than or equal to the maximum output frequency × (d35). *6 • Stops the inverter if the detected speed is 120% or over of 120 Hz. *6 • Stops the inverter if the detected speed is 120% or over of 200 Hz. *7	OS *11
	PG wire break *4, *5, *7		Stop the inverter output if a PG wire break is detected.	PG
	Motor protection	Electronic thermal	The inverter is stopped with the 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.)	OL1 to OL4
		PTC thermistor	The PTC thermistor input stops the inverter to protect the motor. Connect the 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 the 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 (0L) is output at the predetermined level before stopping the inverter with electronic thermal function. This function exclusively applies to the 1st motor.	
	Memory error detection		Data is checked upon power-on and data writing to detect any fault in the memory and to stop the inverter if any.	Er1
	Keypad communications error		When the keypad is used to enter run commands to the inverter, this function stops the inverter upon detecting a communication fault between the keypad and inverter.	Er2
	CPU error (detection)		Stop the inverter detecting a CPU error or LSI error caused by noise.	Er3
	Option communications error (detection)		When each option is used, a fault of communication with the inverter main body is detected to stop the inverter.	Er4
	Option error (detection)		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. 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.	Er6
	Tuning error detection		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 inverter is connected to a communications network via the RS-485 port designed for the keypad, detecting a communications error stops the inverter output.	Er8
	Speed mismatch or excessive speed deviation *4 to *7		Stop the inverter output if the speed deviation (difference between the speed command value and the feedback value) exceeds the preset value.	ErE
	Data save error upon undervoltage		If the data could not be properly saved during activation of the undervoltage protection function, the inverter displays the alarm code.	ErF
	Excessive position deviation *4,*5,*7		Stop the inverter output if the position deviation (difference between the target position and the current position) exceeds the preset value.	Ero *10
	RS-485 communications error (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.	ErP
	Hardware error		Stop the inverter output upon detecting a malfunction of LSI on the power printed circuit board, which is mainly caused by noise.	ErH

*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)
*10 Available in inverters having a ROM version 3000 or later.
*11 Available in inverters having a ROM version 3600 or later.

Table 12.4-7

	Item	Explanation	Remarks
Protection	Mock alarm	Mock alarm can be generated with keypad operations.	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
	Alarm relay output	• 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 occur. The operation is continued. Light alarm object: Heat sink overheat (OH1), External alarm (OH2), Inverter internal overheat (OH3), Braking resistor overheat (dbH), Overload of motor 1 through 4 (OL1 to OL4), Option communications error (Er4), Option error (Er5), RS-485 communications error (COM port 1) (Er8), RS-485 communications error (COM port 2) (ErP), Speed mismatch or excessive speed deviation (ErE), Excessive position deviation (Ero)*10, PID feedback wire break (CoF), DC fan locked (FAL), Motor overload early warning (OL), Heat sink overheat early warning (OH), Lifetime alarm (LiF), Reference command loss detected (rEF), PID alarm (PID), Low torque output (UTL), PTC thermistor activated (PTC), Inverter life (cumulative run time) (rTE), Inverter life (number of startups) (CnT)	L-AL
	Stall prevention	When the output current exceeds the current limiter level during acceleration/deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	
	Retry	When the motor is tripped and stopped, this function automatically resets the tripping state and restarts operation. (You can specify the number of retries and the latency between stop and reset.)	
	Surge protection	The inverter is protected against surge voltage intruding between the main circuit power line and ground.	
	Command loss detection	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).	
	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, this function invokes a restart process when power has been restored within a predetermined period (allowable momentary power failure 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 +50ºC (-10 to +40ºC 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 +70ºC	
	Storage humidity	5 to 95% RH (without condensation)	

*10 Available in inverters having a ROM version 3000 or later.

12.5 External Dimensions

12.5.1 Basic type and EMC filter built-in type

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)

Note: A box (◻) in the inverter types replaces an alphabetic letter depending on the enclosure.

◻: S (Basic type), E (EMC filter built-in type)

Unit: mm

■ FRN0.4G1◻-2J/4J

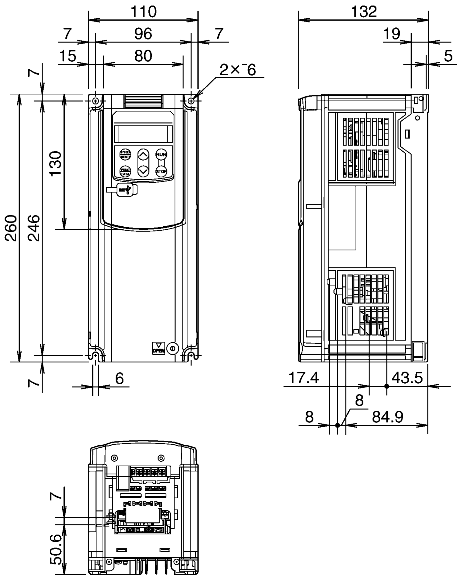


Figure 12.5-1

■ FRN0.75G1◻-2J/4J

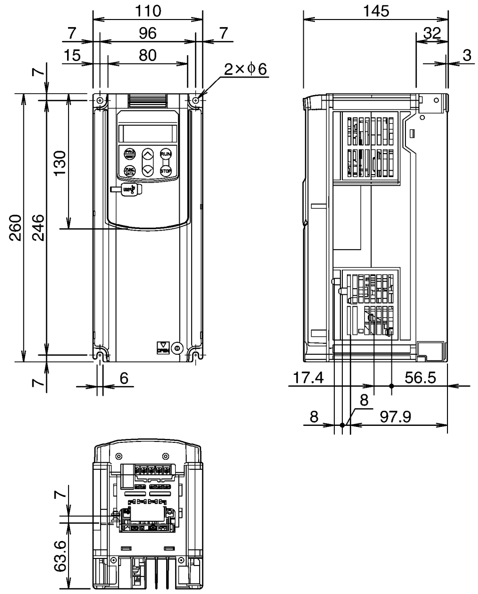


Figure 12.5-2

■ FRN1.5G1◻-2J/4J

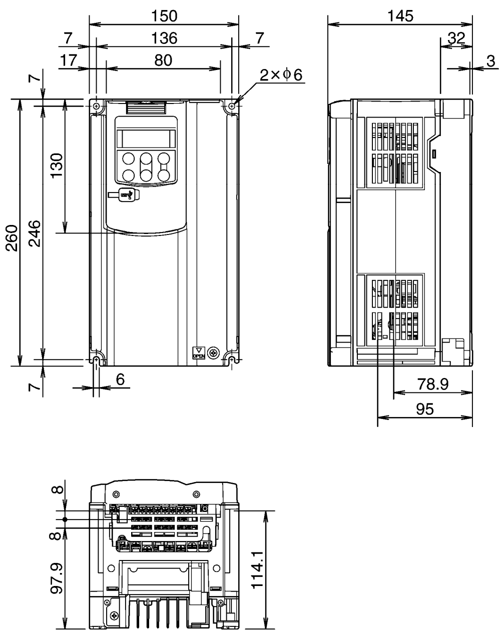


Figure 12.5-3

■ FRN2.2G1◻-2J/4J, FRN3.7G1◻-2J/4J

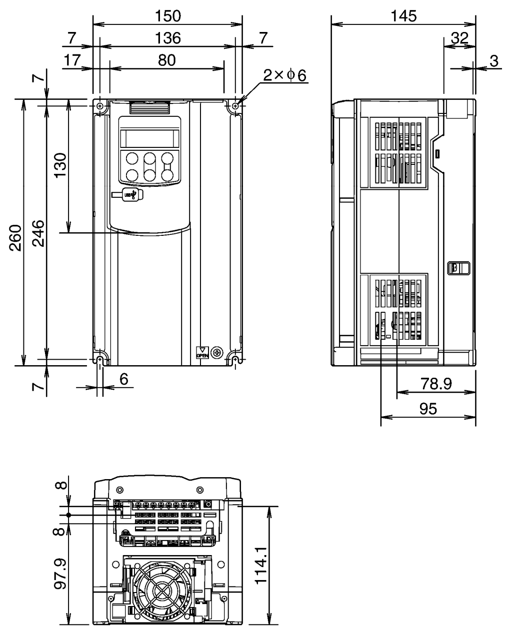


Figure 12.5-4

Unit: mm

■ FRN5.5G1□-2J/4J, FRN7.5G1□-2J/4J,
FRN11G1□-2J/4J

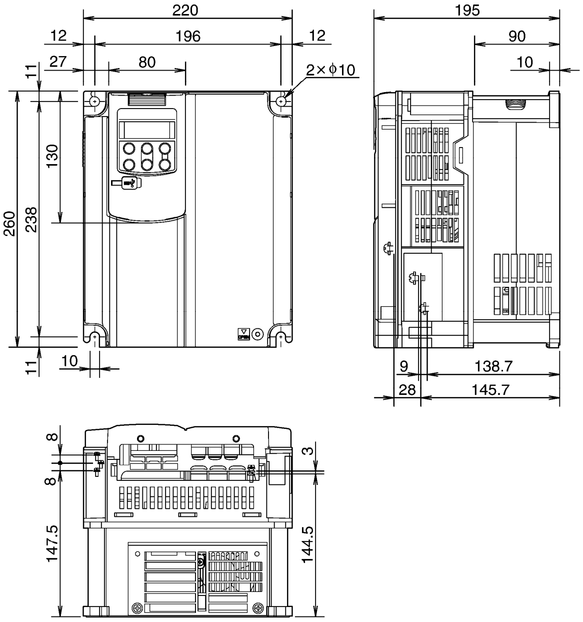


Figure 12.5-5

■ FRN15G1□-2J/4J, FRN18.5G1□-2J/4J,
FRN22G1□-2J/4J

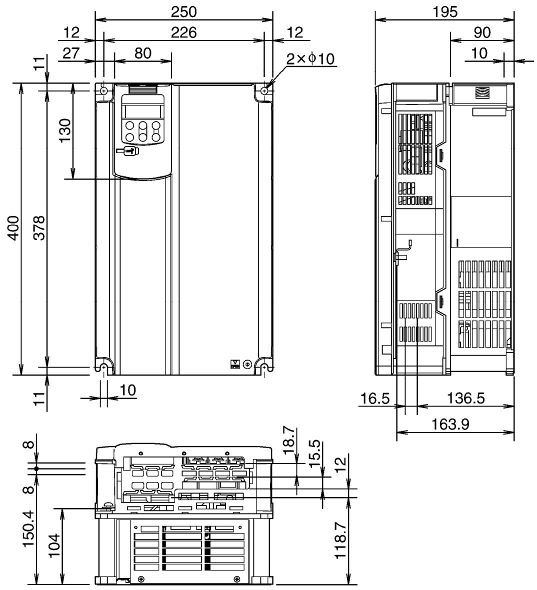


Figure 12.5-6

■ FRN30G1□-2J/4J, FRN37G1□-4J

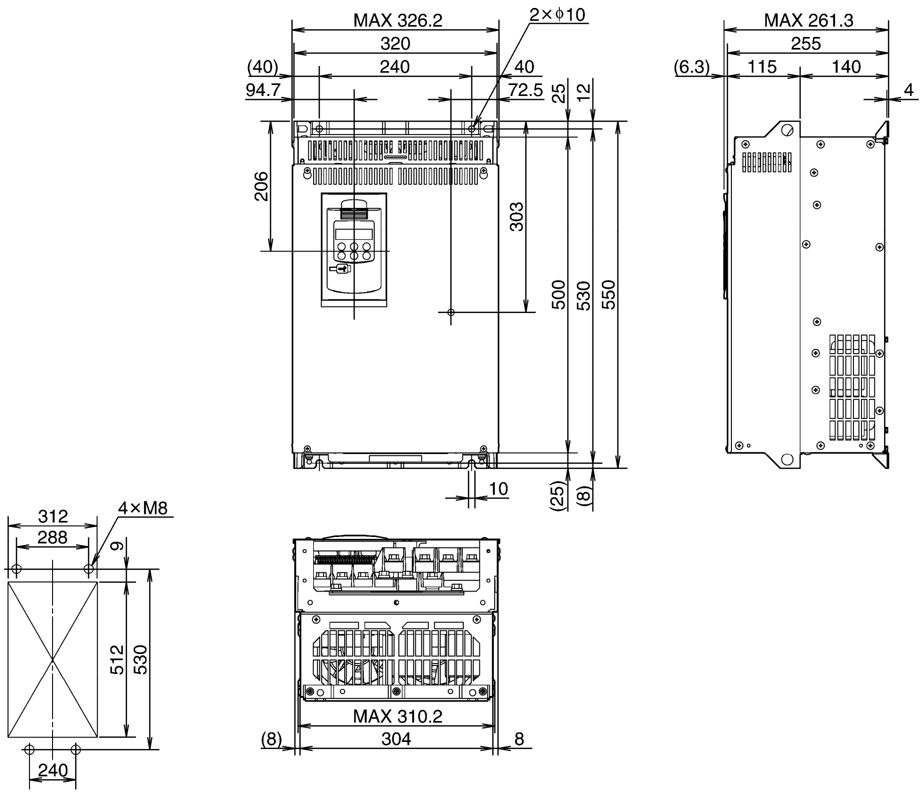


Figure 12.5-7

Unit: mm

■ FRN37G1□-2J, FRN45G1□-4J

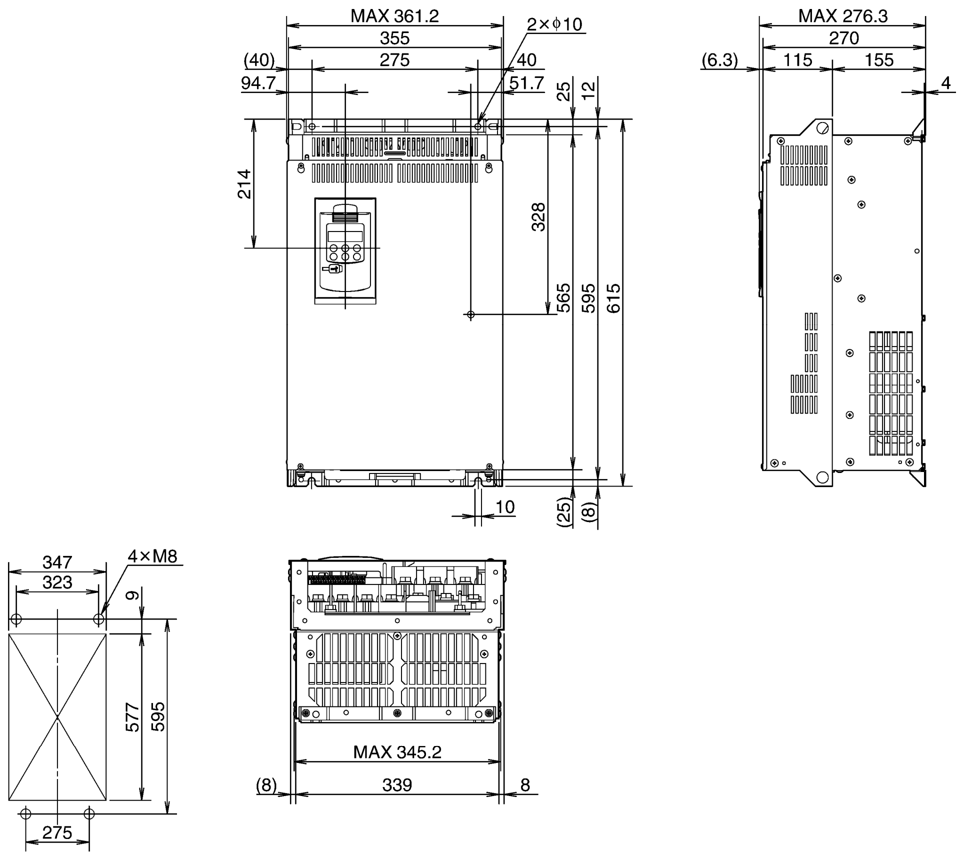


Figure 12.5-8

■ FRN55G1□-4J

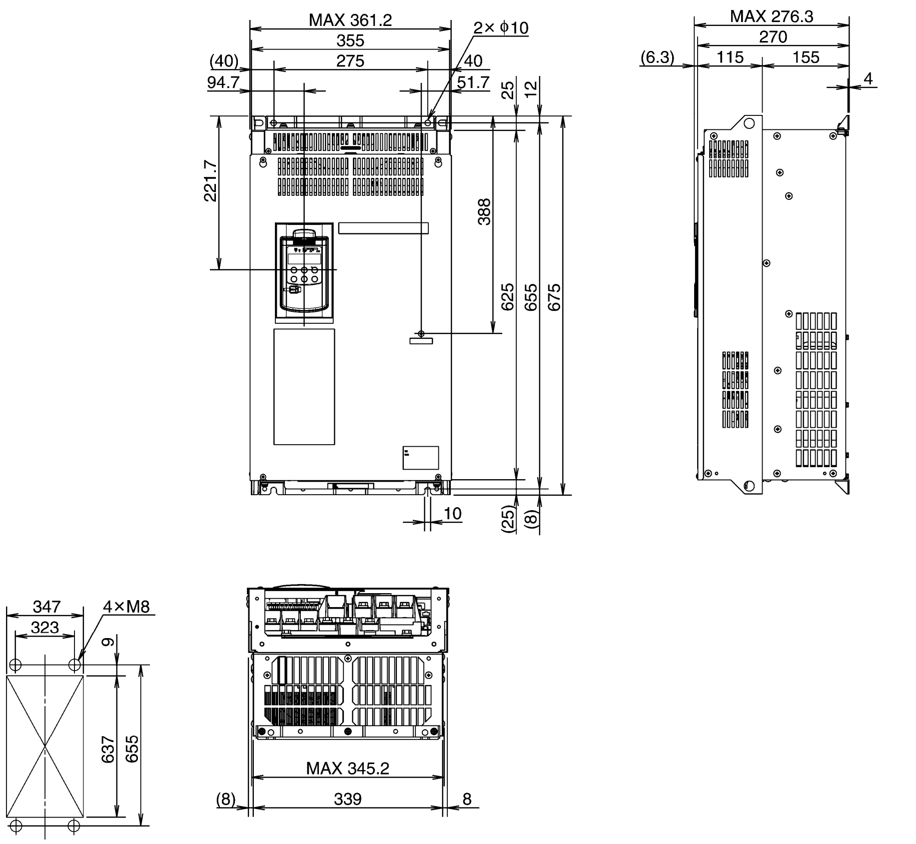


Figure 12.5-9

Unit: mm

■ FRN45G1□-2J, FRN55G1□-2J, FRN75G1□-4J

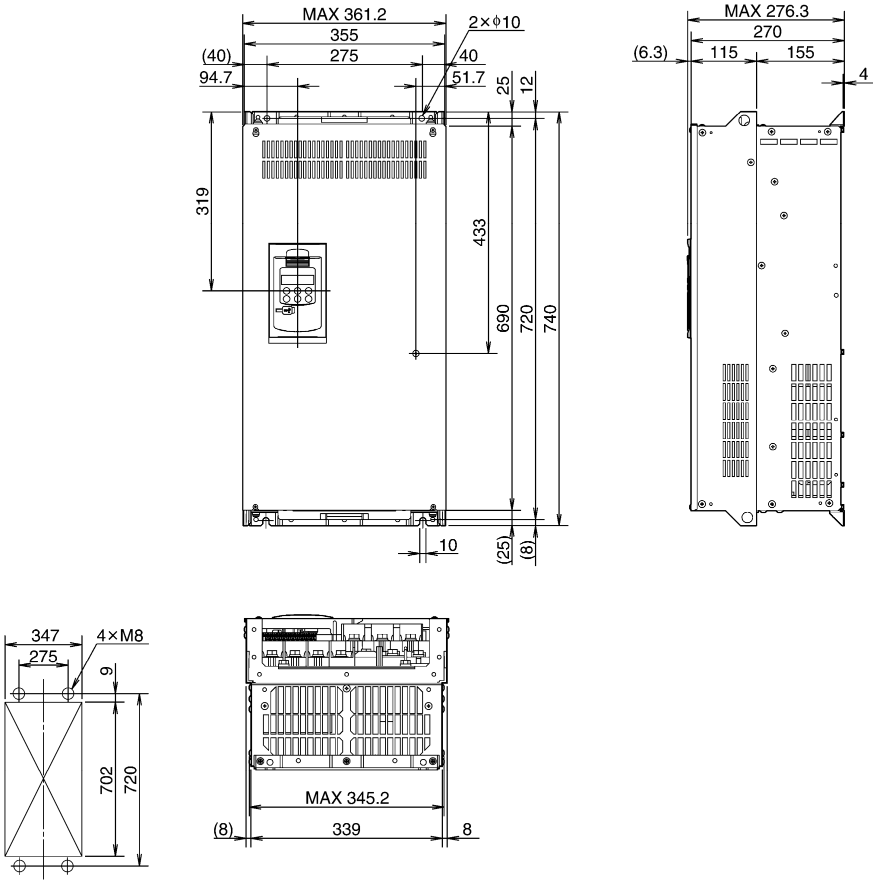


Figure 12.5-10

■ FRN75G1□-2J

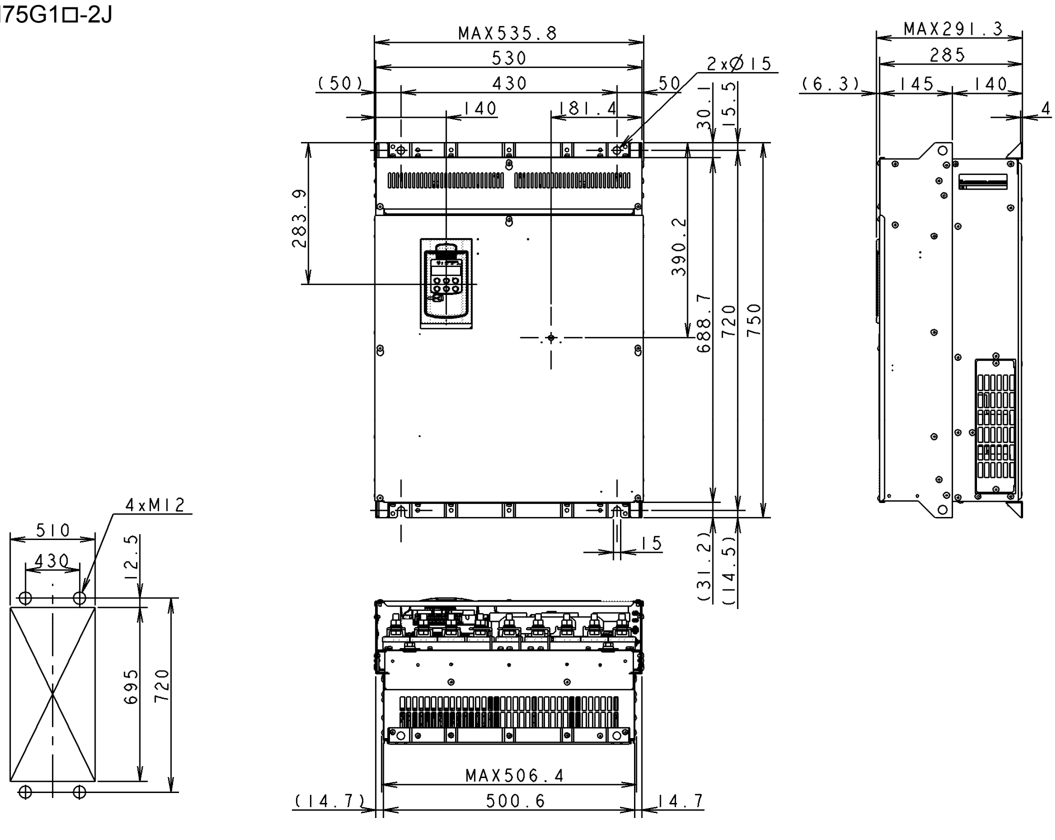


Figure 12.5-11

Unit: mm

■ FRN90G1□-2J

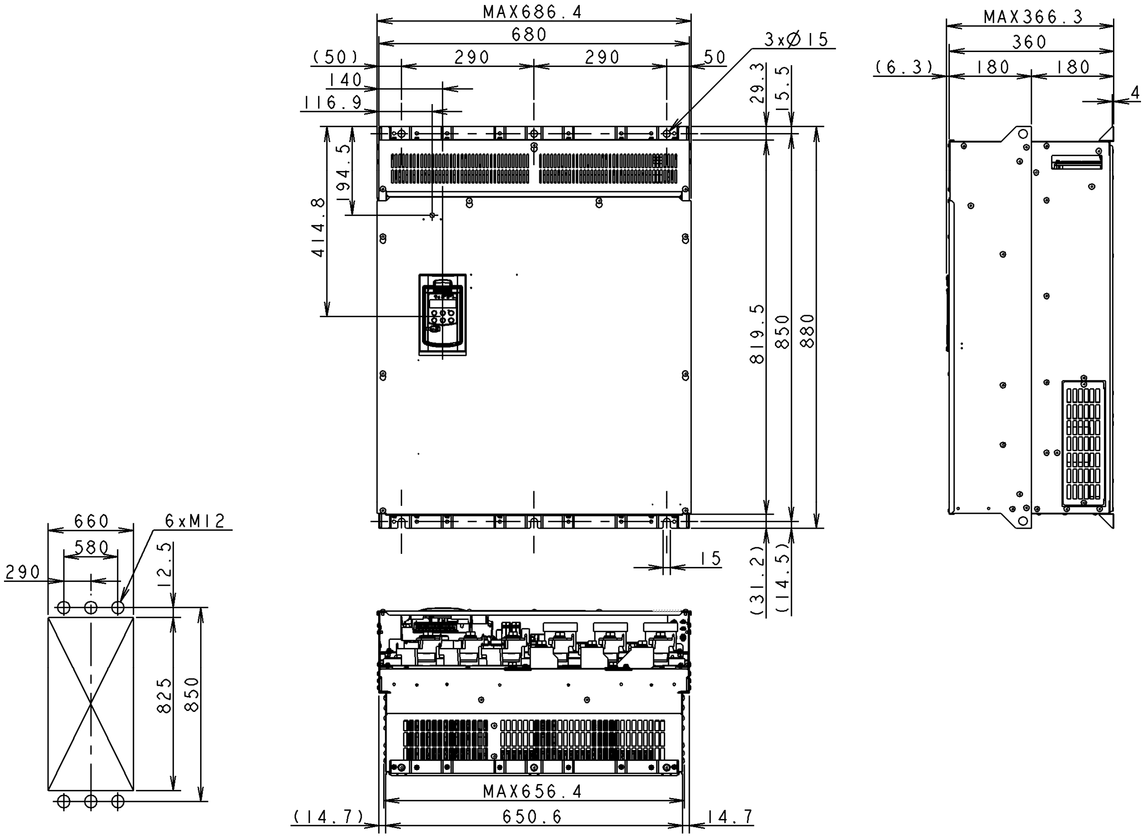


Figure 12.5-12

■ FRN90G1□-4J, FRN110G1□-4J

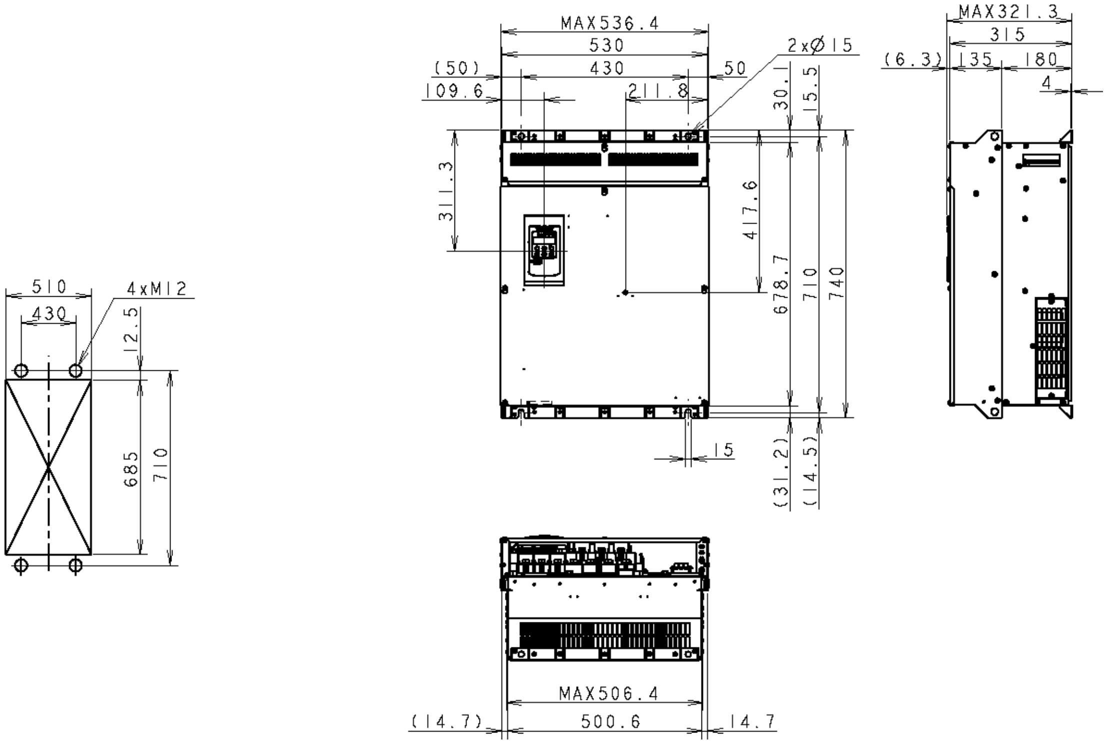


Figure 12.5-13

Unit: mm

■ FRN132G1□-4J, FRN160G1□-4J

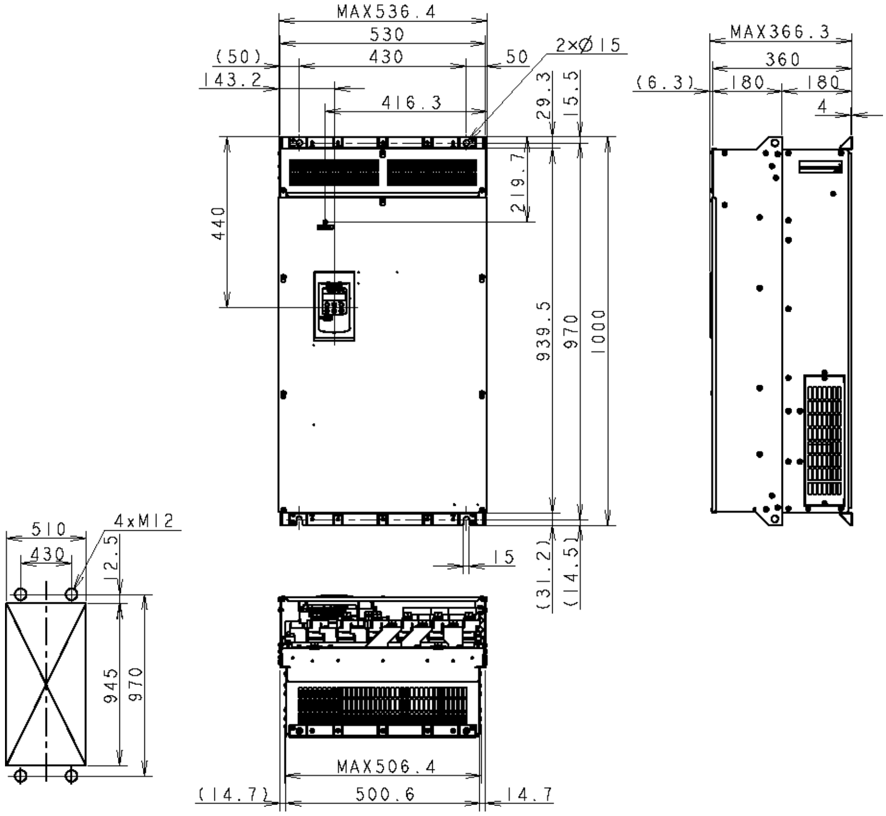


Figure 12.5-14

■ FRN200G1□-4J, FRN220G1□-4J

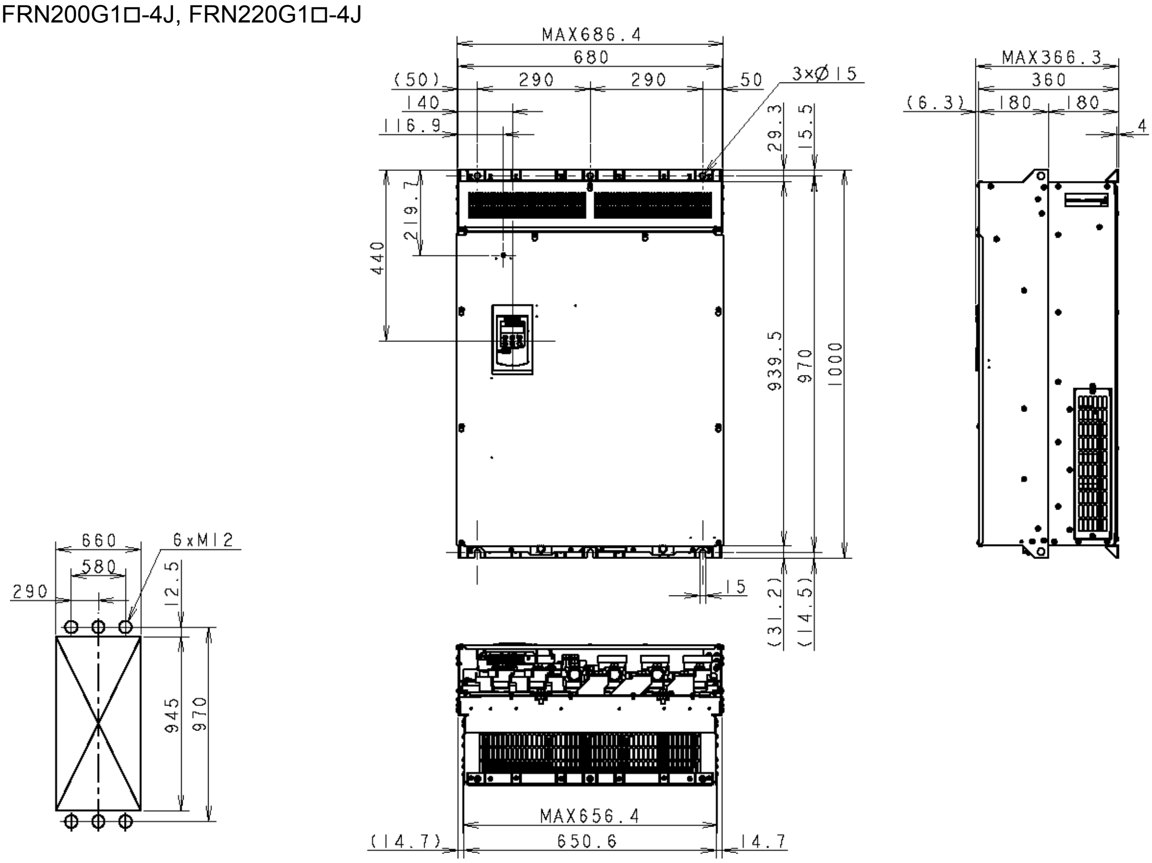


Figure 12.5-15

Unit: mm

■ FRN280G1□-4J, FRN315G1□-4J

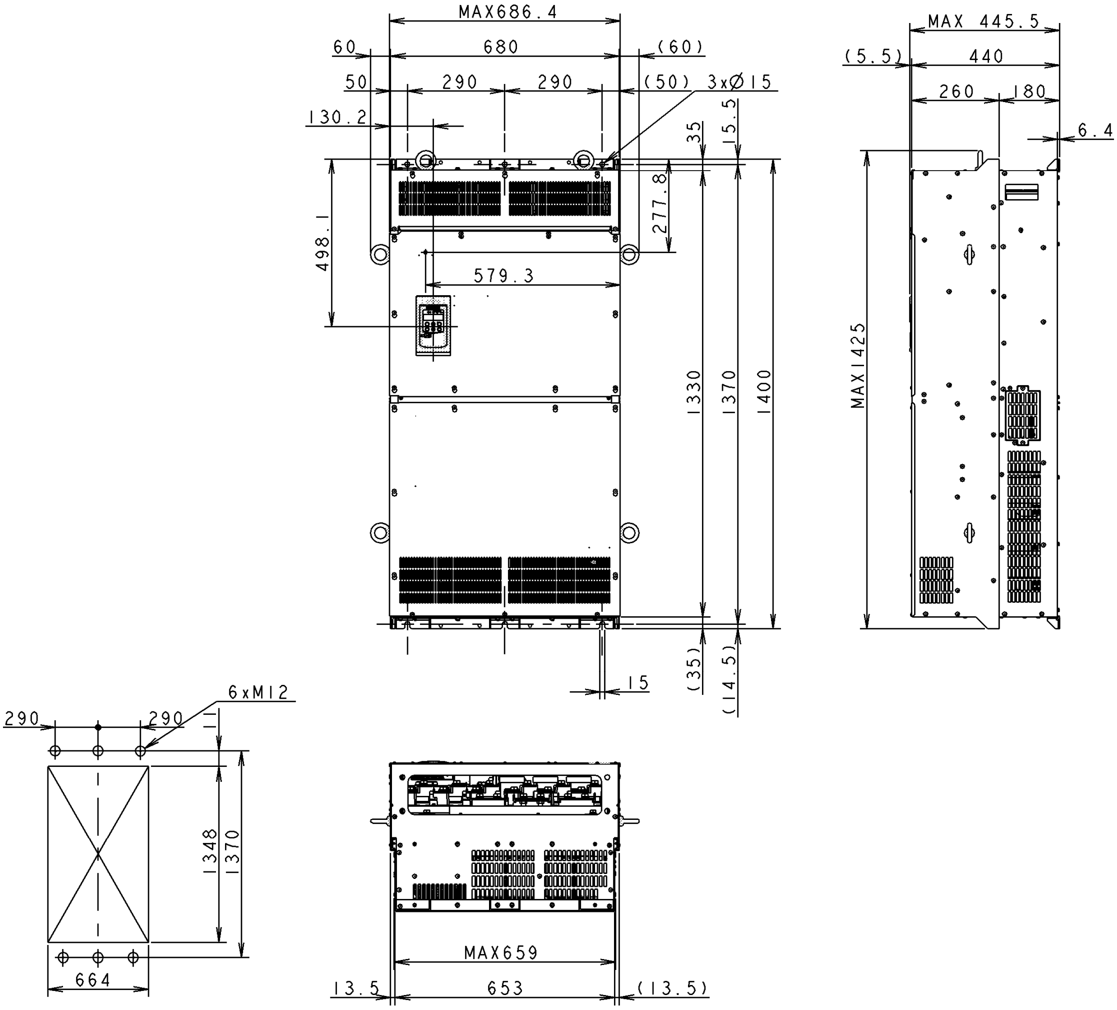


Figure 12.5-16

Unit: mm

■ FRN355G1□-4J, FRN400G1□-4J

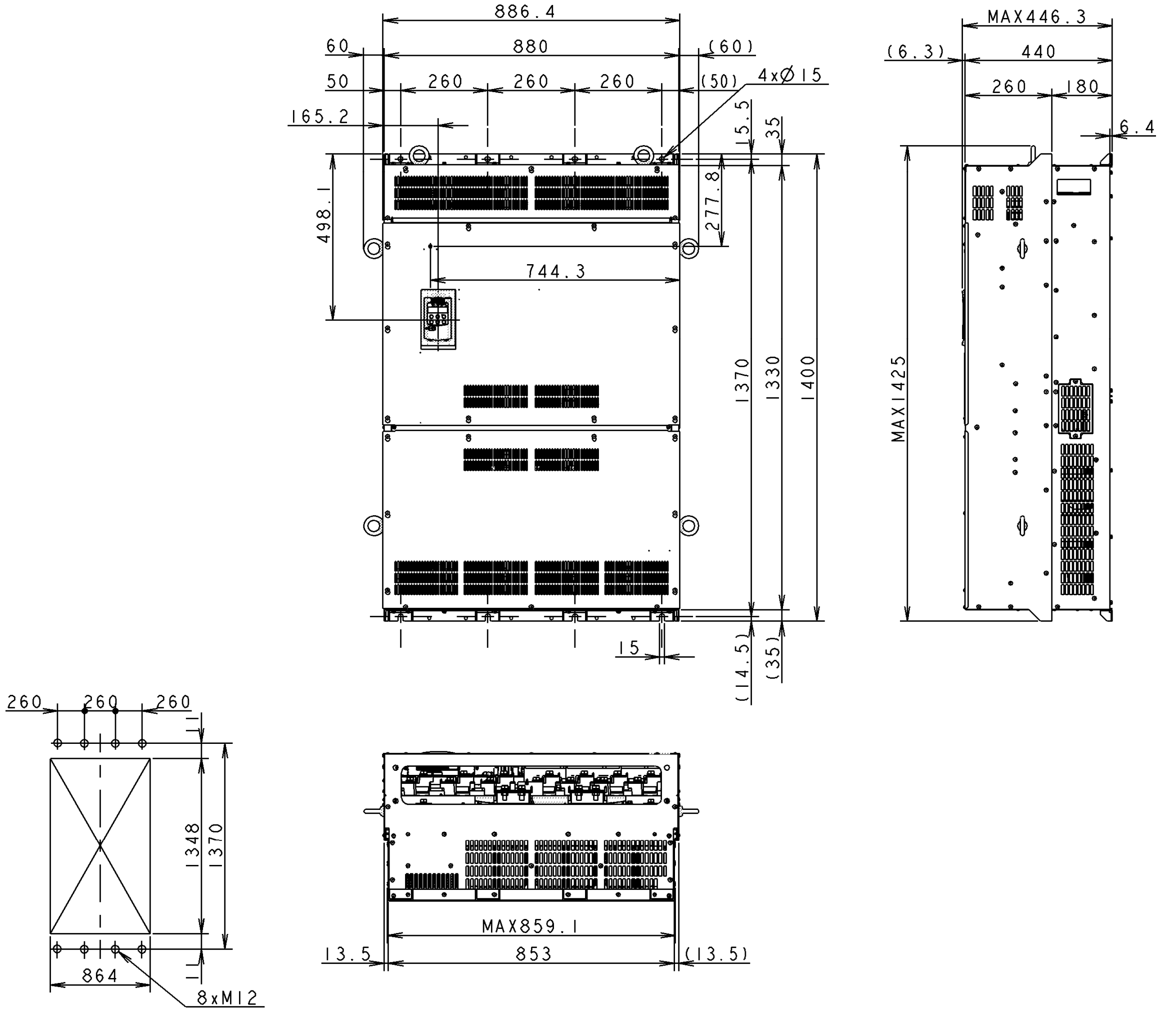


Figure 12.5-17

Unit: mm

■ FRN500G1□-4J, FRN630G1□-4J

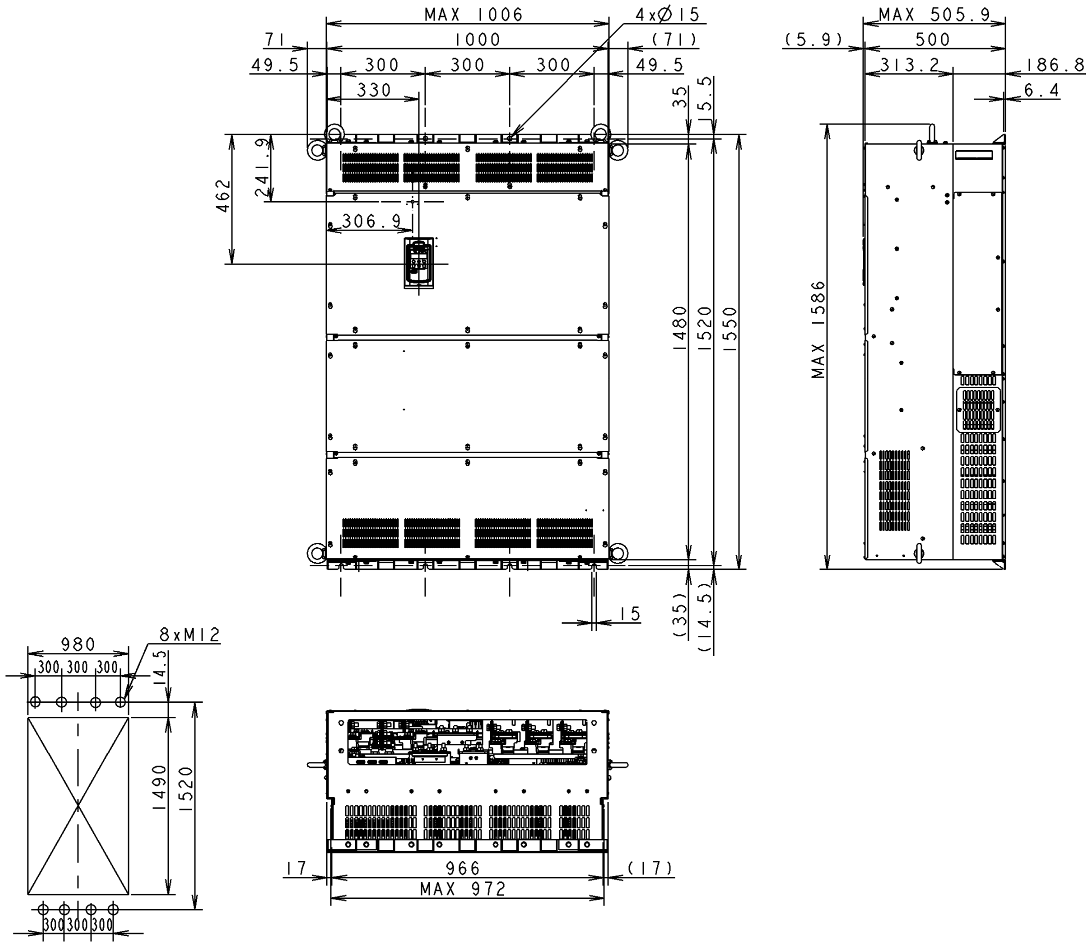


Figure 12.5-18

12.5.2 DC reactor built-in type

Unit: mm

■ FRN5.5G1H-2J/4J, FRN7.5G1H-2J/4J, FRN11G1H-2J/4J

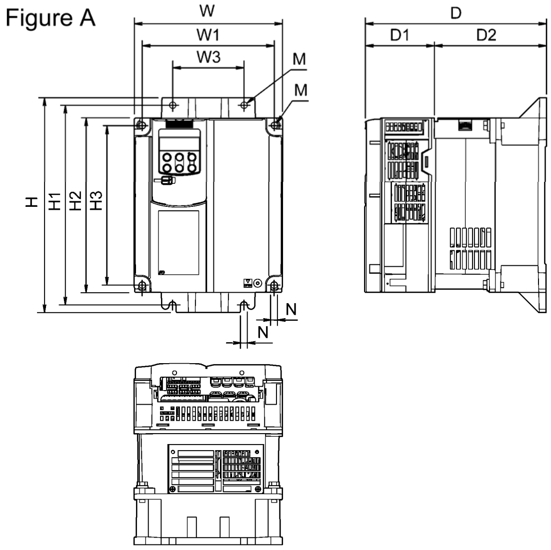


Figure 12.5-19

■ FRN15G1H-2J/4J, FRN18.5G1H-2J/4J, FRN22G1H-2J/4J

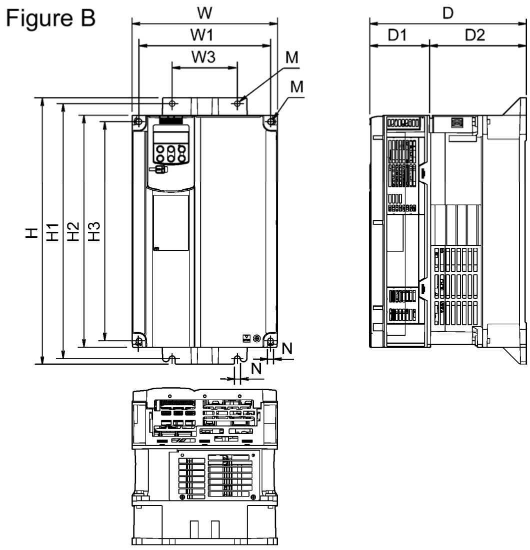


Figure 12.5-20

■ FRN30G1H-2J/4J, FRN37G1H-2J/4J, FRN45G1H-2J/4J, FRN55G1H-2J/4J

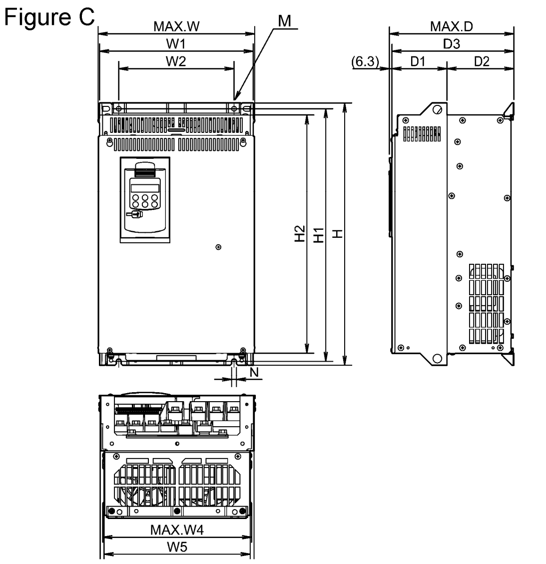


Figure 12.5-21

Table 12.5-1

Power supply voltage	Inverter type	Diagram number	External dimensions of main unit															
			W	W1	W2	W3	W4	W5	H	H1	H2	H3	D	D1	D2	D3	M	N
Three-phase 200 V	FRN5.5G1H-2J	A	220	196	–	106	–	–	320	298	260	238	270	103.5	166.5	–	2×φ10	10
	FRN7.5G1H-2J	A																
	FRN11G1H-2J	A																
	FRN15G1H-2J	B	250	226		112			460	440	400	378	270					
	FRN18.5G1H-2J	B																
	FRN22G1H-2J	B																
	FRN30G1H-2J	C	326.2	320	240	–	310.2	304	550	530	500	–	261.3	115	140	255		
	FRN37G1H-2J	C																
	FRN45G1H-2J	C	361.2	355	275		345.2	339	740	720	690	–	276.3		155	270		
	FRN55G1H-2J	C																
Three-phase 400 V	FRN5.5G1H-4J	A	220	196	–	106	–	–	320	298	260	238	270	103.5	166.5	–	2×φ10	10
	FRN7.5G1H-4J	A																
	FRN11G1H-4J	A																
	FRN15G1H-4J	B	250	226		112			460	440	400	378	270					
	FRN18.5G1H-4J	B																
	FRN22G1H-4J	B																
	FRN30G1H-4J	C	326.2	320	240	–	310.2	304	550	530	500	–	261.3	115	140	255		
	FRN37G1H-4J	C																
	FRN45G1H-4J	C	361.2	355	275		345.2	339	615	595	565	–	276.3		155	270		
	FRN55G1H-4J	C							675	655	625							

12.5.3 Keypad

Unit: mm

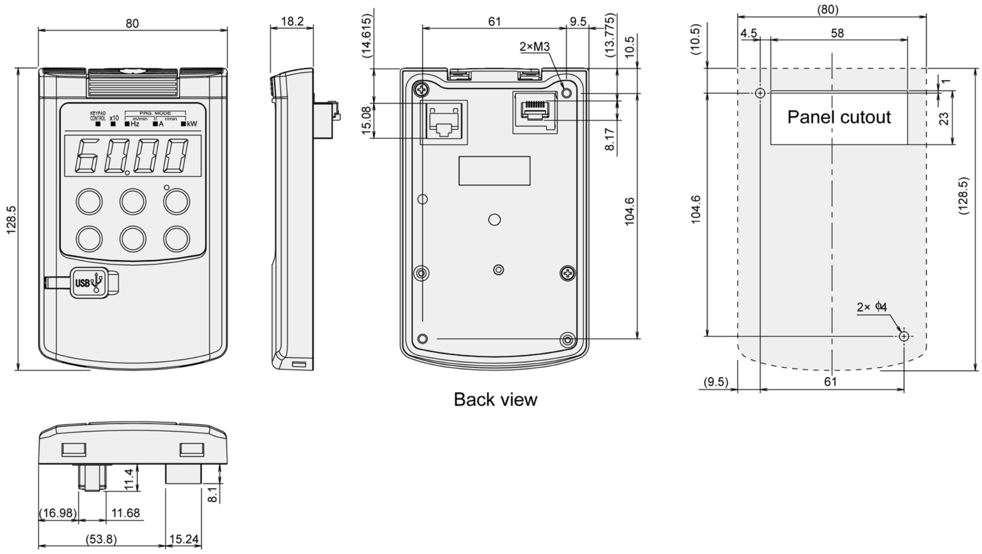


Figure 12.5-22

Chapter 13

COMPLIANCE WITH STANDARDS

Contents

13.1 Compliance with UL Standards and Canadian Standards (cUL certification)

13.1.1 General

The UL standards, established by Underwriters Laboratories, Inc. are safety standards to protect operators, service personnel and the general populace from fires and other accidents in the USA.

cUL certification is given to products that are certified by UL as meeting CSA Standards. cUL certified products are equivalent to those compliant with CSA Standards.

13.1.2 Conformity with UL standards and Canadian standards (cUL certification)

A Fuji inverter with a UL/cUL mark should be installed according to the following requirements to conform to UL Standards and Canadian Standards (cUL certification).

Conformity with UL Standards and Canadian Standards (cUL certification)

⚠CAUTION

1. Solid state motor overload protection (motor protection by electronic thermal overload relay) is provided in each model.
   Use function codes F10 to F12 to set the protection level.
2. Use Cu wire only.
3. Use Class 1 wire only for control circuits.
4. Short circuit rating

   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 240 Volts Maximum for 200V class input 22 kW or less, 230 Volts maximum for 200V class input 30 kW or above when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 240 Volts Maximum." Models FRN; rated for 200V class input.

   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 480 Volts Maximum." Models FRN; rated for 400V class input.

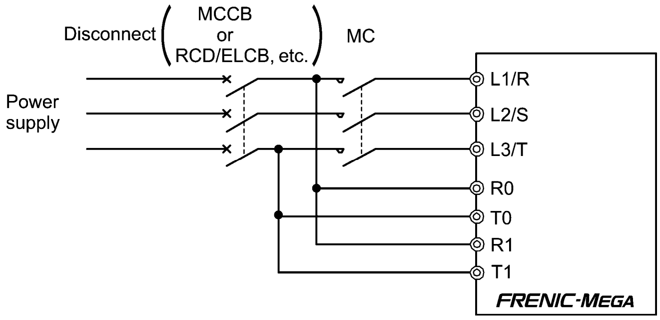
   "Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes."
5. Field wiring connections must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.

(To be continued)

Conformity with UL Standards and Canadian Standards (cUL certification) (cont.)

⚠CAUTION

6. All circuits with terminals L1/R, L2/S, L3/T, R0, T0, R1, T1 must have a common disconnect and be connected to the same pole of the disconnect if the terminals are connected to the power supply.



7. Environmental Requirements
   - Surrounding/ambient temperature
     Maximum Surrounding Air Temperature 50°C
   - Atmosphere
     For use in pollution degree 2 environments. (for Open-Type models)

(To be continued)

Conformity with UL Standards and Canadian Standards (cUL certification) (cont.)

⚠CAUTION

8. Install UL certified fuses or circuit breaker between the power supply and the inverter, referring to the table below.

Power supply voltage	Nominal applied motor	Inverter type	HD/LD mode	Class J fuse size (A)	Circuit breaker trip size (A)	Required torque lb-in (N・m): Main terminal	Required torque lb-in (N・m): Aux. control power supply	Required torque lb-in (N・m): Aux. fan power supply	Wire size AWG (mm²) Main terminal Cu Wire L1/R, L2/S, L3/T: 60°C wire	L1/R, L2/S, L3/T: 75°C wire	L1/R, L2/S, L3/T: Remarks	U, V, W: 60°C wire	U, V, W: 75°C wire	U, V, W: Remarks	P1, P(+): 75°C wire	P1, P(+): Remarks	Wire size: Aux. control power supply	Wire size: Aux. fan power supply
Three-phase 200V	0.4	FRN0.4G1□-2J	HD	10	5	10.6 (1.2)	—	—	14 (2.1)	14 (2.1)	*1	14 (2.1)	14 (2.1)	*1	—	—	—	—
	0.75	FRN0.75G1□-2J	HD	15	10	10.6 (1.2)	—	—	14 (2.1)	14 (2.1)	*1	14 (2.1)	14 (2.1)	*1	—	—	—	—
	1.5	FRN1.5G1□-2J	HD	20	15	15.9 (1.8)	10.6 (1.2)	—	14 (2.1)	14 (2.1)	*1	14 (2.1)	14 (2.1)	*1	—	—	14 (2.1) *1 *2	—
	2.2	FRN2.2G1□-2J	HD	30	20	15.9 (1.8)	10.6 (1.2)	—	14 (2.1)	14 (2.1)	*1	14 (2.1)	14 (2.1)	*1	—	—	14 (2.1) *1 *2	—
	3.7	FRN3.7G1□-2J	HD	40	30	15.9 (1.8)	10.6 (1.2)	—	10 (5.3)	10 (5.3)	*1	12 (3.3)	12 (3.3)	*1	—	—	14 (2.1) *1 *2	—
	5.5	FRN5.5G1□-2J	HD	60	50	30.9 (3.5)	10.6 (1.2)	—	—	8 (8.4)	*1 *2 *3	—	8 (8.4)	*1 *2 *3	—	—	14 (2.1) *1 *2	—
	7.5	FRN5.5G1□-2J	LD	75	75	30.9 (3.5)	10.6 (1.2)	—	—	8 (8.4)	*1 *2 *3	—	8 (8.4)	*1 *2 *3	—	—	14 (2.1) *1 *2	—
	7.5	FRN7.5G1□-2J	HD	75	75	30.9 (3.5)	10.6 (1.2)	—	—	8 (8.4)	*1 *2 *3	—	8 (8.4)	*1 *2 *3	—	—	14 (2.1) *1 *2	—
	11	FRN7.5G1□-2J	LD	100	100	30.9 (3.5)	10.6 (1.2)	—	—	6 (13.3)	*2 *3	—	8 (8.4)	*1 *2 *3	—	—	14 (2.1) *1 *2	—
	11	FRN11G1□-2J	HD	100	100	30.9 (3.5)	10.6 (1.2)	—	—	6 (13.3)	*2 *3	—	8 (8.4)	*1 *2 *3	—	—	14 (2.1) *1 *2	—
	15	FRN11G1□-2J	LD	150	125	30.9 (3.5)	10.6 (1.2)	—	—	4 (21.2)	*2 *3	—	6 (13.3)	*2 *3	—	—	14 (2.1) *1 *2	—
	15	FRN15G1□-2	HD	150	125	51.3 (5.8)	10.6 (1.2)	—	3 (26.7)	4 (21.2)	—	4 (21.2)	6 (13.3)	-	—	—	14 (2.1) *1 *2	—
	18.5	FRN15G1□-2	LD	175	150	51.3 (5.8)	10.6 (1.2)	—	1 (42.4)	3 (26.7)	—	3 (26.7)	4 (21.2)	-	—	—	14 (2.1) *1 *2	—
	18.5	FRN18.5G1□-2	HD	175	150	51.3 (5.8)	10.6 (1.2)	—	1 (42.4)	3 (26.7)	—	3 (26.7)	4 (21.2)	-	—	—	14 (2.1) *1 *2	—
	22	FRN18.5G1□-2	LD	200	175	51.3 (5.8)	10.6 (1.2)	—	—	2 (33.6)	*2 *3	2 (33.6)	3 (26.7)	-	—	—	14 (2.1) *1 *2	—
	22	FRN22G1□-2J	HD	200	175	51.3 (5.8)	10.6 (1.2)	—	—	2 (33.6)	*2 *3	2 (33.6)	3 (26.7)	-	—	—	14 (2.1) *1 *2	—
	30	FRN22G1□-2J	LD	250	200	51.3 (5.8)	10.6 (1.2)	—	—	2/0 (67.4)	*2 *3	—	2 (33.6)	*2 *3	—	—	14 (2.1) *1 *2	—
	30	FRN30G1□-2J	HD	250	200	119.4 (13.5)	10.6 (1.2)	—	—	2/0 (67.4)	*2 *3	—	1 (42.4)	*2 *3	—	—	14 (2.1) *1 *2	—
	37	FRN30G1□-2J	LD	350	250	119.4 (13.5)	10.6 (1.2)	—	—	3/0 (85)	*2 *3	—	1/0 (53.5)	*2 *3	—	—	14 (2.1) *1 *2	—
	37	FRN37G1□-2J	HD	350	250	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	3/0 (85)	*2 *3	—	4/0 (107.2)	*2 *3	—	—	14 (2.1) *1 *2	14 (2.1)
	45	FRN37G1□-2J	LD	400	300	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	4/0 (107.2)	*2 *3	—	4/0 (107.2)	*2 *3	—	—	14 (2.1) *1 *2	14 (2.1)
	45	FRN45G1□-2J	HD	400	300	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	4/0 (107.2)	*2 *3	—	4/0 (107.2)	*2 *3	—	—	14 (2.1) *1 *2	14 (2.1)
	55	FRN45G1□-2J	LD	450	350	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	2/0×2 (67.4×2)	*2 *3	—	4/0 (107.2)	*2 *3	—	—	14 (2.1) *1 *2	14 (2.1)
	55	FRN55G1□-2J	HD	450	350	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	2/0×2 (67.4×2)	*2 *3	—	4/0 (107.2)	*2 *3	—	—	14 (2.1) *1 *2	14 (2.1)
	75	FRN55G1□-2J	LD	500	350	238.9 (27)	10.6 (1.2)	10.6 (1.2)	—	3/0×2 (85×2)	*2 *3	—	3/0×2 (85×2)	*2 *3	4/0×2 (107.2×2)	*2 *3	14 (2.1) *1 *2	14 (2.1)
	75	FRN75G1□-2J	HD	500	350	424.7 (48)	10.6 (1.2)	10.6 (1.2)	—	3/0×2 (85×2)	*2 *3	—	3/0×2 (85×2)	*2 *3	4/0×2 (107.2×2)	*2 *3	14 (2.1) *1 *2	14 (2.1)
	90	FRN75G1□-2J	LD	600	400	424.7 (48)	10.6 (1.2)	10.6 (1.2)	—	4/0×2 (107.2×2)	*2 *3	—	4/0×2 (107.2×2)	*2 *3	300×2 (152×2)	*2 *3	14 (2.1) *1 *2	14 (2.1)
	90	FRN90G1□-2J	HD	600	400	424.7 (48)	10.6 (1.2)	10.6 (1.2)	—	4/0×2 (107.2×2)	*2 *3	—	4/0×2 (107.2×2)	*2 *3	300×2 (152×2)	*2 *3	14 (2.1) *1 *2	14 (2.1)
	110	FRN90G1□-2J	LD	700	500	424.7 (48)	10.6 (1.2)	10.6 (1.2)	—	300×2 (152×2)	*2 *3	—	300×2 (152×2)	*2 *3	400×2 (203×2)	*2 *3	14 (2.1) *1 *2	14 (2.1)

(Note) Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N・m), recommended wire size: AWG18 (0.8 mm²)

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

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

(To be continued)

Conformity with UL Standards and Canadian Standards (cUL certification) (cont.)

⚠CAUTION

Power supply voltage	Nominal applied motor	Inverter type	HD/MD/LD mode	Class J fuse size (A)	Circuit breaker trip size (A)	Required torque lb-in (N・m): Main terminal	Required torque lb-in (N・m): Aux. control power supply	Required torque lb-in (N・m): Aux. fan power supply	Wire size AWG (mm²) Main terminal Cu Wire L1/R, L2/S, L3/T: 60°C wire	L1/R, L2/S, L3/T: 75°C wire	L1/R, L2/S, L3/T: Remarks	U, V, W: 60°C wire	U, V, W: 75°C wire	U, V, W: Remarks	P1, P(+): 75°C wire	P1, P(+): Remarks	Wire size: Aux. control power supply	Wire size: Aux. fan power supply
Three-phase 400V	0.4	FRN0.4G1□-4J	HD	3	5	10.6 (1.2)	–	–	14 (2.1)	14 (2.1)	*1	14 (2.1)	14 (2.1)	*1	–	–	–	–
	0.75	FRN0.75G1□-4J		6														
	1.5	FRN1.5G1□-4J		10	10	15.9 (1.8)	10.6 (1.2)										14 (2.1) *1 *2	
	2.2	FRN2.2G1□-4J		15	15													
	3.7	FRN3.7G1□-4J		20	20													
	5.5	FRN5.5G1□-4J	HD	30	30	30.9 (3.5)			–	12 (3.3)	*1 *2 *3	–	12 (3.3)	*1 *2 *3				
	7.5	FRN5.5G1□-4J	LD	40	40					10 (5.3)								
		FRN7.5G1□-4J	HD															
	11	FRN7.5G1□-4J	LD	60	50					8 (8.4)			10 (5.3)					
		FRN11G1□-4J	HD															
	15	FRN11G1□-4J	LD	70	60								8 (8.4)					
		FRN15G1□-4J	HD			51.3 (5.8)			6 (13.3)	6 (13.3)	–	6 (13.3)	6 (13.3)	–				
	18.5	FRN15G1□-4J	LD	90	75													
		FRN18.5G1□-4J	HD															
	22	FRN18.5G1□-4J	LD	100	100				4 (21.2)									
		FRN22G1□-4J	HD															
	30	FRN22G1□-4J	LD	125	125				3 (26.7)	4 (21.2)		4 (21.2)						
		FRN30G1□-4J	HD			119.4 (13.5)						2 (33.6)	2 (33.6)					
	37	FRN30G1□-4J	LD	175					2 (33.6)	3 (26.7)								
		FRN37G1□-4J	HD															
	45	FRN37G1□-4J	LD	200	150				–	2 (33.6)	*2 *3							
		FRN45G1□-4J	HD															
	55	FRN45G1□-4J	LD	250	200					1/0 (53.5)		–		*2 *3				
		FRN55G1□-4J	HD															
	75	FRN55G1□-4J	LD		175								1/0 (53.5)		2/0 (67.4)	*2 *3		
		FRN75G1□-4J	HD			238.9 (27)		10.6 (1.2)		2/0 (67.4)			4/0 (107.2)					14 (2.1) *1 *2
	90	FRN75G1□-4J	LD	300	200										4/0 (107.2)			
		FRN90G1□-4J	HD															
	110	FRN90G1□-4J	MD/LD	350	250					1/0×2 (53.5×2)			1/0×2 (53.5×2)		2/0×2 (67.4×2)			
		FRN110G1□-4J	HD															
	132	FRN110G1□-4J	MD/LD	400	300								2/0×2 (67.4×2)		3/0×2 (85×2)			
		FRN132G1□-4J	HD			424.7 (48)												
	160	FRN132G1□-4J	MD/LD	500	350					3/0×2 (85×2)			3/0×2 (85×2)		4/0×2 (107.2×2)			
		FRN160G1□-4J	HD															
	200	FRN160G1□-4J	MD/LD	600	500					4/0×2 (107.2×2)			250×2 (127×2)		300×2 (152×2)			
		FRN200G1□-4J	HD															
	220	FRN200G1□-4J	MD/LD	700						250×2 (127×2)			300×2 (152×2)		350×2 (177×2)			
		FRN220G1□-4J	HD															

(Note) Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N・m), recommended wire size: AWG18 (0.8 mm²)

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

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

(To be continued)

Conformity with UL Standards and Canadian Standards (cUL certification) (cont.)

⚠CAUTION

Power supply voltage	Nominal applied motor	Inverter type	HD/MD/LD mode	Class J fuse size (A)	Circuit breaker trip size (A)	Required torque lb-in (N・m): Main terminal	Required torque lb-in (N・m): Aux. control power supply	Required torque lb-in (N・m): Aux. fan power supply	Wire size AWG (mm²): Main terminal Cu Wire: L1/R, L2/S, L3/T: 60°C wire	L1/R, L2/S, L3/T: 75°C wire	L1/R, L2/S, L3/T: Remarks	U, V, W: 60°C wire	U, V, W: 75°C wire	U, V, W: Remarks	P1, P(+): 75°C wire	P1, P(+): Remarks	Wire size AWG (mm²): Aux. control power supply	Wire size AWG (mm²): Aux. fan power supply
Three-phase 400V	250	FRN220G1□-4J	MD	800	600	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	300×2 (152×2)	*2 *3	–	350×2 (177×2)	*2 *3	500×2 (253×2)	*2 *3	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	280	FRN220G1□-4J	LD	1000	600	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	400×2 (203×2)	*2 *3	–	400×2 (203×2)	*2 *3	600×2 (304×2)	*2 *3	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	280	FRN280G1□-4J	HD	1000	600	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	250×2 (127×2)	*2 *4	–	300×2 (152×2)	*2 *4	350×2 (177×2)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	315	FRN280G1□-4J	MD	1000	800	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	300×2 (152×2)	*2 *4	–	350×2 (177×2)	*2 *4	4/0×3 (107.2×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	315	FRN315G1□-4J	HD	1000	800	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	300×2 (152×2)	*2 *4	–	350×2 (177×2)	*2 *4	4/0×3 (107.2×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	355	FRN280G1□-4J	LD	1200	800	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	400×2 (203×2)	*2 *4	–	400×2 (203×2)	*2 *4	300×3 (152×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	355	FRN315G1□-4J	MD	1200	800	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	400×2 (203×2)	*2 *4	–	400×2 (203×2)	*2 *4	300×3 (152×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	355	FRN355G1□-4J	HD	1200	800	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	400×2 (203×2)	*2 *4	–	400×2 (203×2)	*2 *4	300×3 (152×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	400	FRN315G1□-4J	LD	1200	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	500×2 (253×2)	*2 *4	–	500×2 (253×2)	*2 *4	350×3 (177×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	400	FRN355G1□-4J	MD	1200	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	500×2 (253×2)	*2 *4	–	500×2 (253×2)	*2 *4	350×3 (177×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	400	FRN400G1□-4J	HD	1200	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	500×2 (253×2)	*2 *4	–	500×2 (253×2)	*2 *4	350×3 (177×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	450	FRN355G1□-4J	LD	1400	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	600×2 (304×2)	*2 *4	–	600×2 (304×2)	*2 *4	400×3 (203×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	450	FRN400G1□-4J	MD	1400	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	600×2 (304×2)	*2 *4	–	600×2 (304×2)	*2 *4	400×3 (203×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	500	FRN400G1□-4J	LD	1600	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	350×3 (177×3)	*2 *4	–	400×3 (203×3)	*2 *4	500×3 (253×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	500	FRN500G1□-4J	HD	1600	1200	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	350×3 (177×3)	*2 *4	–	400×3 (203×3)	*2 *4	500×3 (253×3)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	630	FRN500G1□-4J	LD	2000	1400	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	500×3 (253×3)	*2 *4	–	600×3 (304×3)	*2 *4	500×4 (253×4)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	630	FRN630G1□-4J	HD	2000	1400	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	500×3 (253×3)	*2 *4	–	600×3 (304×3)	*2 *4	500×4 (253×4)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2
Three-phase 400V	710	FRN630G1□-4J	LD	2200	1600	424.7 (48)	10.6 (1.2)	10.6 (1.2)	–	600×3 (304×3)	*2 *4	–	500×4 (253×4)	*2 *4	600×4 (304×4)	*2 *4	14 (2.1) *1 *2	14 (2.1) *1 *2

(Note) Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N・m), recommended wire size: AWG18 (0.8 mm²)
(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

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

*4 It is showing the wire size for UL Open Type.
See additional material INR-SI47-1365 for UL Enclosed Type (Pack with TYPE1 kit).

(End)

13.2 Conformity with European Standards

The CE marking on Fuji products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC and the Low Voltage Directive (LVD) 2006/95/EC issued by the Council of the European Communities.

Conformity with standards

Table 13.2-1

	Basic type	EMC filter built-in type
EMC Directive	Depends upon a Fuji proprietary filter*	EN61800-3: 2004 Immunity: Second environment (Industrial) Emission: Category C3
Low Voltage Directive	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy EN61800-5-1: 2007	

* Basic-type inverters without a built-in EMC filter comply with the EMC Directive only if the inverter is combined with a Fuji proprietary external filter.

Note EMC filter built-in type inverters are put in the Category C3 of EN61800-3. They are not intended for home or office use. Use of this type of inverter under home or office environment may cause the inverter to generate noise, resulting in malfunctions.

13.3 Conformity with EMC Directives in Europe

13.3.1 General

The CE mark on our inverter does not certify that an entire piece of machinery including our product complies with EMC Directives. Thus, a CE mark can be affixed to and indicated on a piece of machinery only under the responsibility of the manufacturer. This is because CE marking is indicated on our products on condition that the product is used under specific conditions.

A piece of machinery generally includes various units other than our products. Thus, the manufacturer should design the whole system to be compliant with the relevant directives.

To conform to the directives, use an inverter with a built-in EMC filter or a basic-type inverter without a built-in EMC filter in combination with a Fuji proprietary external filter (option). In either case, install the inverter in accordance with the recommended installation method described below. It is recommended that the inverter be installed in a metal control panel to more closely conform to the directives.

Tip EMC qualification testing is performed under a condition that the wiring length (shielded wire) between the inverter (EMC filter built-in type) and motor is 5 m.

Note When combining an inverter with a PWM converter, use an inverter without a built-in EMC filter. Using an EMC filter built-in type inverter may increase the generation of heat by capacitors and other electronic parts inside the inverter, leading to a damage of the product. In addition, the effect of the EMC filter can no longer be expected.

13.3.2 Recommended installation method

Electrical engineers should install wiring for inverters and motors. Perform installation and wiring in accordance with the following method as much as possible to conform to the EMC Directives.

■ For EMC filter built-in type

1) Install the inverter on a metal plate or other grounded panel. Use shielded wires for the motor and minimize the wiring as short as possible. Ground the shield of the shielded wires by securely clamping it to the metal plate and establish an electrical connection between the shield and the ground terminal of the motor. Use wiring guides to keep the input line away from the output line as far as possible.

   For inverters with a capacity of 5.5 to 11 kW, connect the input grounding wire to the grounding terminal at the front, left-hand side, and the output grounding wire to that on the main circuit terminal block. (Refer to Figure 13.3-1)

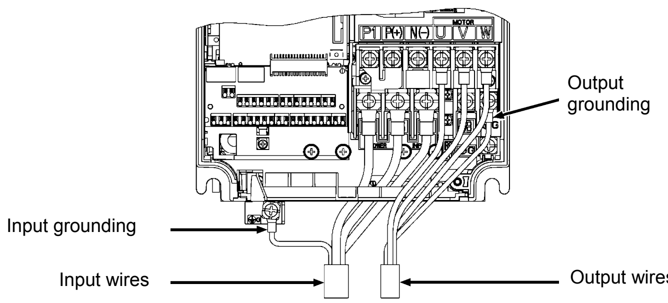


Figure 13.3-1 Wiring for the EMC Filter Built-in Type with a Capacity of 5.5 to 11 kW

2) Use shielded wires for the wiring of the inverter's control terminals and for the RS-485 communication signal cable. Securely clamp the shields of the both lines to the grounded panel as in the wiring for the motor.

3) If the radiation noise exceeds the standards, install the inverter and peripheral equipment into a metal panel as shown in Figure 13.3-2.

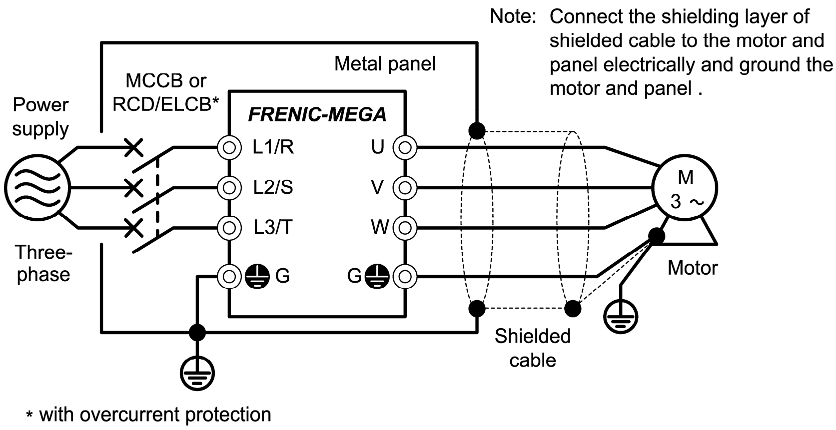


Figure 13.3-2 Installing inside Panel

■ For using an external EMC compliant filter (option)

1) Install the inverter and the filter on a metal plate or other grounded panel. Use shielded wires for the motor and minimize the wiring as short as possible. Securely clamp the shield of the shielded wires to the metal plate. Establish an electrical connection between the shield and the ground terminal of the motor.

2) Use shielded wires for the wiring of the inverter's control terminals and for the RS-485 communication signal cable. Securely clamp the shields of the both lines to the grounded panel as in the wiring for the motor.

3) If the radiation noise exceeds the standards, install the inverter and peripheral equipment into a metal panel as shown in Figure 13.3-3.

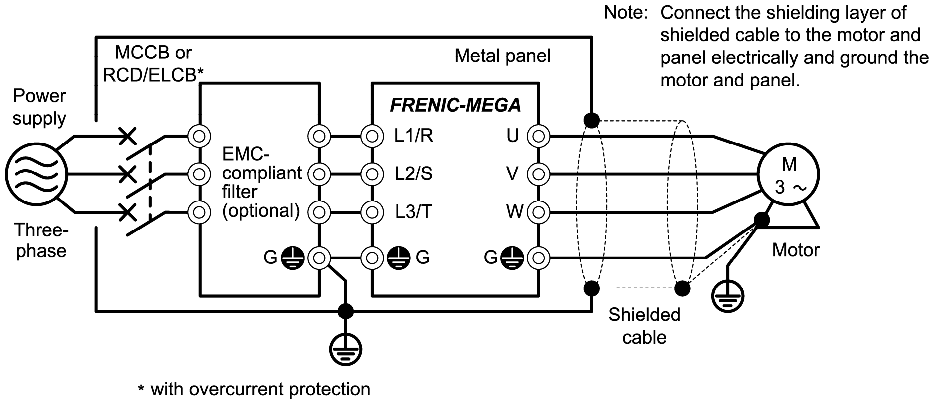


Figure 13.3-3 Installing the EMC Compliant Filter (option)

13.3.3 Leakage current from the EMC filter built-in type

The EMC filter built-in type includes a grounded capacitor to suppress noise. Since the grounded capacitor increases leakage current, make sure that no problem occurs in the power supply line and other systems.

⚠CAUTION

Leakage current from the EMC filter built-in type is relatively high, thus establish protective grounding properly. (Table 13.3-1 shows current values.) The critical value: ≥ 3.5 mA AC or ≥ 10 mA DC (IEC 61800-5-1)

The minimum cross sectional areas of protective grounding wires are shown below:
- 10 mm^2 (copper wire)
- 16 mm^2 (aluminium wire)

Electric shock may occur.

Table 13.3-1 Leakage Current from the EMC Filter Built-in Type

<table>
<tr><th>Power supply voltage</th><th>Inverter type</th><th>Leakage current (mA)</th></tr>
<tr><td rowspan="17">Three-phase 200 V Note 1)</td><td>FRN0.4G1E-2J</td><td rowspan="2">2</td></tr>
<tr><td>FRN0.75G1E-2J</td></tr>
<tr><td>FRN1.5G1E-2J</td><td rowspan="3">4</td></tr>
<tr><td>FRN2.2G1E-2J</td></tr>
<tr><td>FRN3.7G1E-2J</td></tr>
<tr><td>FRN5.5G1E-2J</td><td rowspan="3">23</td></tr>
<tr><td>FRN7.5G1E-2J</td></tr>
<tr><td>FRN11G1E-2J</td></tr>
<tr><td>FRN15G1E-2J</td><td rowspan="9">25</td></tr>
<tr><td>FRN18.5G1E-2J</td></tr>
<tr><td>FRN22G1E-2J</td></tr>
<tr><td>FRN30G1E-2J</td></tr>
<tr><td>FRN37G1E-2J</td></tr>
<tr><td>FRN45G1E-2J</td></tr>
<tr><td>FRN55G1E-2J</td></tr>
<tr><td>FRN75G1E-2J</td></tr>
<tr><td>FRN90G1E-2J</td></tr>
</table>

Note 1: The leakage currents for 200 V class series are calculated based on 240 V/60 Hz (one-phase grounding) and 2% (interphase voltage unbalance).

Note 2: The leakage currents for 400V class series are calculated based on 480 V/60 Hz (neutral grounding) and 2% (interphase voltage unbalance).

<table>
<tr><th>Power supply voltage</th><th>Inverter type</th><th>Leakage current (mA)</th></tr>
<tr><td rowspan="28">Three-phase 400 V Note 2)</td><td>FRN0.4G1E-4J</td><td rowspan="2">3</td></tr>
<tr><td>FRN0.75G1E-4J</td></tr>
<tr><td>FRN1.5G1E-4J</td><td rowspan="3">2</td></tr>
<tr><td>FRN2.2G1E-4J</td></tr>
<tr><td>FRN3.7G1E-4J</td></tr>
<tr><td>FRN5.5G1E-4J</td><td rowspan="6">4</td></tr>
<tr><td>FRN7.5G1E-4J</td></tr>
<tr><td>FRN11G1E-4J</td></tr>
<tr><td>FRN15G1E-4J</td></tr>
<tr><td>FRN18.5G1E-4J</td></tr>
<tr><td>FRN22G1E-4J</td></tr>
<tr><td>FRN30G1E-4J</td><td rowspan="3">11</td></tr>
<tr><td>FRN37G1E-4J</td></tr>
<tr><td>FRN45G1E-4J</td></tr>
<tr><td>FRN55G1E-4J</td><td rowspan="14">5</td></tr>
<tr><td>FRN75G1E-4J</td></tr>
<tr><td>FRN90G1E-4J</td></tr>
<tr><td>FRN110G1E-4J</td></tr>
<tr><td>FRN132G1E-4J</td></tr>
<tr><td>FRN160G1E-4J</td></tr>
<tr><td>FRN200G1E-4J</td></tr>
<tr><td>FRN220G1E-4J</td></tr>
<tr><td>FRN280G1E-4J</td></tr>
<tr><td>FRN315G1E-4J</td></tr>
<tr><td>FRN355G1E-4J</td></tr>
<tr><td>FRN400G1E-4J</td></tr>
<tr><td>FRN500G1E-4J</td></tr>
<tr><td>FRN630G1E-4J</td></tr>
</table>

13.4 Regulations on Harmonics in Europe

13.4.1 General

When general-purpose inverters, which are industrial products, are used in Europe, harmonics are regulated as follows.

Inverters with an input power of 1 kW or below connected to commercial low-voltage power lines are subject to the harmonic regulations. Note that inverters connected to industrial low-voltage power lines fall outside the regulations. (Refer to Figure 13.4-1)

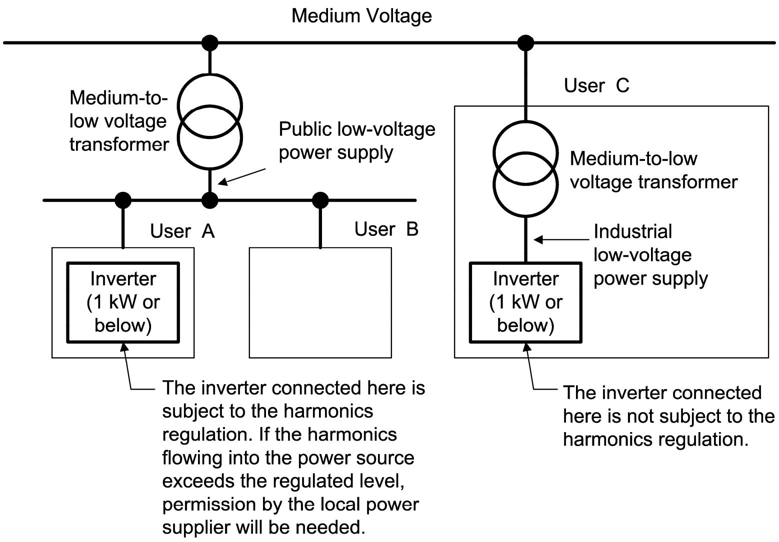


Figure 13.4-1 Power Supply Systems

13.4.2 Compliance

Table 13.4-1 Conformity with Regulations on Harmonics

Power supply voltage	Inverter type Note 1)	w/o DCR	w/ DCR	Applicable DC reactor type
Three-phase 200 V	FRN0.4G1□-2J	Y Note2)	Y Note2)	DCR2-0.4
	FRN0.75G1□-2J	Y Note2)	Y Note2)	DCR2-0.75
Three-phase 400 V	FRN0.4G1□-4J	N	Y	DCR4-0.4
	FRN0.75G1□-4J	N	Y	DCR4-0.75

Y: Allowed to be connected to a commercial low-voltage power line as the standard of EN61000-3-2 (+A14) is satisfied.

N: The standard of EN61000-3-2 (+A14) is not satisfied. If you wish to connect the inverter to a commercial low-voltage power line, you need to obtain permission from your local power company. If you need the data of harmonic current, contact your Fuji Electric representative.

Note 1: A box (□) in the above table replaces an alphabetic letter depending on the type.

Note 2: A power source of three-phase 400 V is transformed to supply a power source of three-phase 200 V to the inverter, then the harmonics that flow into the power source of 400 V are evaluated.

13.5 Conformity with Low Voltage Directive in Europe

13.5.1 General

General-purpose inverters are subject to the Low Voltage Directive in Europe. A Fuji inverter affixed with a CE mark makes a self-declaration of conformity with the Low Voltage Directive.

13.5.2 Note

A Fuji inverter with a CE mark should be installed according to the requirements on the following pages to conform to the Low Voltage Directive 2006/95/EC in Europe.

Conformity with low voltage directive in Europe

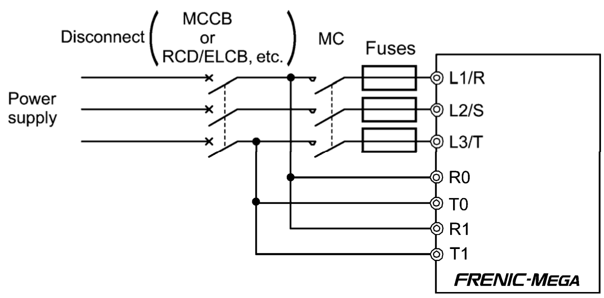
⚠WARNING⚠

1. Always ground the ground terminals ⏚G. Do not use only a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)* as the sole method of electric shock protection. Use a wire the size of a power wire or larger for the ground lines.
   * With overcurrent protection
2. To protect your power systems from a danger of high voltage or accidents caused by the broken inverter, install fuses according to the specifications listed in the table below, on the power supply side.

• Breaking capacity: Min. 10 kA; Rated voltage: Min. 500 V

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD mode	Fuse rating (A)
Three-phase 200V	0.4	FRN0.4G1□-2J	HD	10(IEC60269-2)
	0.75	FRN0.75G1□-2J		15(IEC60269-2)
	1.5	FRN1.5G1□-2J		20(IEC60269-2)
	2.2	FRN2.2G1□-2J		30(IEC60269-2)
	3.7	FRN3.7G1□-2J		40(IEC60269-2)
	5.5	FRN5.5G1□-2J	HD	125(IEC60269-4)
	7.5		LD	
	7.5	FRN7.5G1□-2J	HD	160(IEC60269-4)
	11		LD	
	11	FRN11G1□-2J	HD	160(IEC60269-4)
	15		LD	
	15	FRN15G1□-2	HD	200(IEC60269-4)
	18.5		LD	
	18.5	FRN18.5G1□-2	HD	250(IEC60269-4)
	22		LD	
	22	FRN22G1□-2J	HD	250(IEC60269-4)
	30		LD	
	30	FRN30G1□-2J	HD	350(IEC60269-4)
	37		LD	
	37	FRN37G1□-2J	HD	400(IEC60269-4)
	45		LD	
	45	FRN45G1□-2J	HD	450(IEC60269-4)
	55		LD	
	55	FRN55G1□-2J	HD	500(IEC60269-4)
	75		LD	
	75	FRN75G1□-2J	HD	
	90		LD	
	90	FRN90G1□-2J	HD	
	110		LD	

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.



Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/MD/LD mode	Fuse rating (A)
Three-phase 400 V	0.4	FRN0.4G1□-4J	HD	3(IEC60269-2)
	0.75	FRN0.75G□-4J		6(IEC60269-2)
	1.5	FRN1.5G1□-4J		10(IEC60269-2)
	2.2	FRN2.2G1□-4J		15(IEC60269-2)
	3.7	FRN3.7G1□-4J		20(IEC60269-2)
	5.5	FRN5.5G1□-4J	HD	80(IEC60269-4)
	7.5		LD	
	7.5	FRN7.5G1□-4J	HD	80(IEC60269-4)
	11		LD	
	11	FRN11G1□-4J	HD	125(IEC60269-4)
	15		LD	
	15	FRN15G1□-4J	HD	125(IEC60269-4)
	18.5		LD	
	18.5	FRN18.5G□-4J	HD	160(IEC60269-4)
	22		LD	
	22	FRN22G1□-4J	HD	160(IEC60269-4)
	30		LD	
	30	FRN30G1□-4J	HD	250(IEC60269-4)
	37		LD	
	37	FRN37G1□-4J	HD	315(IEC60269-4)
	45		LD	
	45	FRN45G1□-4J	HD	315(IEC60269-4)
	55		LD	
	55	FRN55G1□-4J	HD	350(IEC60269-4)
	75		LD	
	75	FRN75G1□-4J	HD	350(IEC60269-4)
	90		LD	
	90	FRN90G1□-4J	HD	350(IEC60269-4)
	110		MD/LD	
	110	FRN110G□-4J	HD	400(IEC60269-4)
	132		MD/LD	
	132	FRN132G□-4J	HD	450(IEC60269-4)
	160		MD/LD	
	160	FRN160G□-4J	HD	500(IEC60269-4)
	200		MD/LD	
	200	FRN200G□-4J	HD	550(IEC60269-4)
	220		MD/LD	
	220	FRN220G□-4J	HD	630(IEC60269-4)
	250		MD	
	280		LD	
	280	FRN280G□-4J	HD	900(IEC60269-4)
	315		MD	
	355		LD	
	315	FRN315G□-4J	HD	
	355		MD	
	400		LD	
	355	FRN355G□-4J	HD	1250 (IEC60269-4)
	400		MD	
	450		LD	
	400	FRN400G□-4J	HD	
	450		MD	
	500		LD	
	500	FRN500G□-4J	HD	2000 (IEC60269-4)
	630		LD	
	630	FRN630G□-4J	HD	
	710		LD	

(To be continued)

Conformity with low voltage directive in Europe (cont.)

⚠WARNING⚠

3. Use an EN- or IEC-compliant molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) or magnetic contactor (MC).
4. When using a RCD/ELCB to provide protection against electric shock caused by direct or indirect contact, install a RCD/ELCB of type B in the input (primary) circuit of the inverter (three-phase 200 V/ 400 V class series).
5. Use the inverter in a pollution degree 2 environment. To use the inverter in a pollution degree 3 or 4 environment, install it in a panel having IP54 rating or above.
6. To prevent humans from receiving electric shock by touching the live parts, install the inverter, AC reactor (ACR) or DC reactor (DCR), and input filter or output filter in a panel having IP2X rating or above. If a human can easily touch the panel, the upper surface of the panel should be IP4X rating or above.
7. Do not connect copper wires directly to the ground terminals. Use crimp terminals plated with tin or equivalent for the connection.
8. If you use the inverter in an altitude above 2000 m, basic insulation should be applied to the control circuit. No inverter can be used in an altitude above 3000 m.
9. Use wires specified in IEC60364-5-52.

Power supply voltage	Nominal applied motors	Inverter type	HD/LD mode	Molded case circuit breaker (MCCB) or Earth leakage breaker (RCD/ELCB) *1 Rated current		Recommended wire size (mm^2)							
						Main terminal					Control circuit terminal	Aux. control power supply R0, T0	Aux. fan power supply R1, T1
						Main circuit power inputs [L1/R,L2/S, L3/T] *2 Grounding for inverter[⏚]*3		Inverter outputs [U,V,W] *2	DC reactor connection [P1,P(+)] *2	Braking resistor [P(+),DB] *2			
				w/ DCR	w/o DCR	w/ DCR	w/o DCR						
Three-phase 200 V	0.4	FRN0.4G1□-2J	HD	5	5	1	1	1	1	1	0.75	—	—
	0.75	FRN0.75G1□-2J			10								
	1.5	FRN1.5G1□-2J		10	15							2.5	
	2.2	FRN2.2G1□-2J			20		1.5						
	3.7	FRN3.7G1□-2J		20	30	2.5	4	2.5	2.5				
	5.5	FRN5.5G1□-2J	HD	30	50	4	6	4	4				
	7.5		LD	40	75	6	10	6	6				
		FRN7.5G1□-2J	HD					10					
	11		LD	50	100	10	16		16				
		FRN11G1□-2J	HD										
	15		LD	75	125	16	25	16	25				
		FRN15G1□-2	HD										
	18.5		LD	100	150	25	35	25	35				
		FRN18.5G1□-2	HD							1.5			
	22		LD		175	35	50	35					
		FRN22G1□-2J	HD										
	30		LD	150	200	50	70	50	70				
		FRN30G1□-2J	HD							2.5			
	37		LD	175	250	70	95	70	95				
		FRN37G1□-2J	HD							4			2.5
	45		LD	200	300	95	70×2	95	50×2				
		FRN45G1□-2J	HD							6			
	55		LD	250	350	50×2	95×2	70×2	70×2				
		FRN55G1□-2J	HD							10			
	75		LD	350	—	95×2	—	95×2	95×2				
		FRN75G1□-2J	HD							—			
	90		LD	400		120×2		120×2	120×2				
		FRN90G1□-2J	HD										
	110		LD	500		150×2		150×2	150×2				

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 The frame size and type of a MCCB or RCD/ELCB (with overcurrent protection) vary with the capacity of the power supply transformer. Refer to the related technical documents for detailed selection.

*2 The recommended wire sizes for the main circuit terminals are examples of using a PVC wire (for 70ºC, 600 V) at a surrounding temperature of 40ºC.

*3 Only one piece of wire with a recommended size can be connected to a ground terminal.

(To be continued)

Conformity with low voltage directive in Europe (cont.)

⚠WARNING⚠

<table>
<tr><th rowspan="4">Power supply voltage</th><th rowspan="4">Nominal applied motors</th><th rowspan="4">Inverter type</th><th rowspan="4">HD/MD/LD mode</th><th colspan="2" rowspan="3">Molded case circuit breaker (MCCB) or Earth leakage breaker (RCD/ELCB) *1 Rated current</th><th colspan="8">Recommended wire size (mm^2)</th></tr>
<tr><th colspan="5">Main terminal</th><th rowspan="3">Control circuit terminal</th><th rowspan="3">Aux. control power supply R0, T0</th><th rowspan="3">Aux. fan power supply R1, T1</th></tr>
<tr><th colspan="2">Main circuit power inputs [L1/R,L2/S, L3/T]*2 Grounding for inverter[⏚]*3</th><th rowspan="2">Inverter outputs [U,V,W] *2</th><th rowspan="2">DC reactor connection [P1,P(+)] *2</th><th rowspan="2">Braking resistor [P(+),DB] *2</th></tr>
<tr><th>w/ DCR</th><th>w/o DCR</th><th>w/ DCR</th><th>w/o DCR</th></tr>
<tr><td rowspan="38">Three-phase 400V</td><td>0.4</td><td>FRN0.4G1□-4J</td><td rowspan="5">HD</td><td rowspan="3">5</td><td rowspan="2">5</td><td rowspan="6">1</td><td rowspan="4">1</td><td rowspan="5">1</td><td rowspan="5">1</td><td rowspan="19">1</td><td rowspan="38">0.75</td><td rowspan="2">—</td><td rowspan="25">—</td></tr>
<tr><td>0.75</td><td>FRN0.75G1□-4J</td></tr>
<tr><td>1.5</td><td>FRN1.5G1□-4J</td><td>10</td><td rowspan="36">2.5</td></tr>
<tr><td>2.2</td><td>FRN2.2G1□-4J</td><td rowspan="2">10</td><td>15</td></tr>
<tr><td>3.7</td><td>FRN3.7G1□-4J</td><td>20</td><td>1.5</td></tr>
<tr><td>5.5</td><td rowspan="2">FRN5.5G1□-4J</td><td>HD</td><td>15</td><td>30</td><td>2.5</td><td>1.5</td><td>1.5</td></tr>
<tr><td rowspan="2">7.5</td><td>LD</td><td rowspan="2">20</td><td rowspan="2">40</td><td rowspan="2">1.5</td><td rowspan="2">4</td><td rowspan="2">2.5</td><td rowspan="2">2.5</td></tr>
<tr><td rowspan="2">FRN7.5G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">11</td><td>LD</td><td rowspan="2">30</td><td rowspan="2">50</td><td rowspan="2">4</td><td rowspan="2">6</td><td rowspan="2">4</td><td rowspan="2">4</td></tr>
<tr><td rowspan="2">FRN11G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">15</td><td>LD</td><td rowspan="4">40</td><td rowspan="2">60</td><td rowspan="4">6</td><td rowspan="2">10</td><td rowspan="2">6</td><td rowspan="2">6</td></tr>
<tr><td rowspan="2">FRN15G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">18.5</td><td>LD</td><td rowspan="2">75</td><td rowspan="4">16</td><td rowspan="4">10</td><td rowspan="2">10</td></tr>
<tr><td rowspan="2">FRN18.5G1□-4J</td><td>HD</td></tr>
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<tr><td rowspan="2">FRN22G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">30</td><td>LD</td><td rowspan="2">75</td><td rowspan="4">125</td><td rowspan="2">16</td><td rowspan="2">25</td><td rowspan="2">16</td><td rowspan="4">25</td></tr>
<tr><td rowspan="2">FRN30G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">37</td><td>LD</td><td rowspan="4">100</td><td rowspan="4">25</td><td rowspan="2">35</td><td rowspan="2">25</td></tr>
<tr><td rowspan="2">FRN37G1□-4J</td><td>HD</td><td rowspan="4">1.5</td></tr>
<tr><td rowspan="2">45</td><td>LD</td><td rowspan="2">150</td><td rowspan="2">50</td><td rowspan="2">35</td><td rowspan="2">35</td></tr>
<tr><td rowspan="2">FRN45G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">55</td><td>LD</td><td rowspan="2">125</td><td rowspan="2">200</td><td rowspan="2">35</td><td rowspan="2">70</td><td rowspan="2">50</td><td rowspan="2">70</td></tr>
<tr><td rowspan="2">FRN55G1□-4J</td><td>HD</td><td rowspan="2">2.5</td></tr>
<tr><td rowspan="2">75</td><td>LD</td><td rowspan="2">175</td><td rowspan="14">—</td><td rowspan="2">70</td><td rowspan="14">—</td><td rowspan="2">70</td><td rowspan="2">95</td></tr>
<tr><td rowspan="2">FRN75G1□-4J</td><td>HD</td><td rowspan="2">4</td><td rowspan="13">2.5</td></tr>
<tr><td rowspan="2">90</td><td>LD</td><td rowspan="2">200</td><td rowspan="2">95</td><td rowspan="2">95</td><td rowspan="2">120</td></tr>
<tr><td rowspan="2">FRN90G1□-4J</td><td>HD</td><td rowspan="11">-</td></tr>
<tr><td rowspan="2">110</td><td>MD/LD</td><td rowspan="2">250</td><td rowspan="2">50×2</td><td rowspan="4">70×2</td><td rowspan="2">150</td></tr>
<tr><td rowspan="2">FRN110G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">132</td><td>MD/LD</td><td rowspan="2">300</td><td rowspan="2">70×2</td><td rowspan="2">70×2</td></tr>
<tr><td rowspan="2">FRN132G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">160</td><td>MD/LD</td><td rowspan="2">350</td><td rowspan="2">185</td><td rowspan="2">240</td><td rowspan="2">300</td></tr>
<tr><td rowspan="2">FRN160G1□-4J</td><td>HD</td></tr>
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<tr><td rowspan="2">FRN200G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">220</td><td>MD/LD</td><td rowspan="2">150×2</td><td rowspan="2">150×2</td></tr>
<tr><td>FRN220G1□-4J</td><td>HD</td></tr>
</table>

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 The frame size and type of a MCCB or RCD/ELCB (with overcurrent protection) vary with the capacity of the power supply transformer. Refer to the related technical documents for detailed selection.

*2 The recommended wire sizes for the main circuit terminals are examples of using a PVC wire (for 70ºC, 600 V) at a surrounding temperature of 40ºC.

*3 Only one piece of wire with a recommended size can be connected to a ground terminal.

(To be continued)

Conformity with low voltage directive in Europe (cont.)

⚠WARNING⚠

<table>
<tr><th rowspan="3">Power supply voltage</th><th rowspan="3">Nominal applied motors</th><th rowspan="3">Inverter type</th><th rowspan="3">HD/MD/LD mode</th><th colspan="2" rowspan="2">Molded case circuit breaker (MCCB) or Earth leakage breaker (RCD/ELCB) *1 Rated current</th><th colspan="8">Recommended wire size (mm^2)</th></tr>
<tr><th colspan="5">Main terminal</th><th rowspan="2">Control circuit terminal</th><th rowspan="2">Aux. control power supply R0, T0</th><th rowspan="2">Aux. fan power supply R1, T1</th></tr>
<tr><th>w/ DCR</th><th>w/o DCR</th><th>Main circuit power inputs [L1/R,L2/S, L3/T]*2 Grounding for inverter[⏚]*3 w/ DCR</th><th>Main circuit power inputs w/o DCR</th><th>Inverter outputs [U,V,W] *2</th><th>DC reactor connection [P1,P(+)] *2</th><th>Braking resistor [P(+),DB] *2</th></tr>
<tr><td rowspan="18">Three-phase 400V</td><td>250</td><td rowspan="2">FRN220G1□-4J</td><td>MD</td><td rowspan="3">600</td><td rowspan="18">—</td><td>185×2</td><td rowspan="18">—</td><td>185×2</td><td>185×2</td><td rowspan="18">—</td><td rowspan="18">0.75</td><td rowspan="18">2.5</td><td rowspan="18">2.5</td></tr>
<tr><td rowspan="2">280</td><td>LD</td><td rowspan="4">240×2</td><td rowspan="2">240×2</td><td rowspan="4">240×2</td></tr>
<tr><td rowspan="2">FRN280G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">315</td><td>MD</td><td rowspan="5">800</td><td rowspan="5">300×2</td></tr>
<tr><td>FRN315G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="3">355</td><td>FRN280G1□-4J</td><td>LD</td><td rowspan="3">300×2</td><td rowspan="3">300×2</td></tr>
<tr><td>FRN315G1□-4J</td><td>MD</td></tr>
<tr><td>FRN355G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="3">400</td><td>FRN315G1□-4J</td><td>LD</td><td rowspan="7">1200</td><td rowspan="3">240×3</td><td rowspan="3">240×3</td><td rowspan="3">300×3</td></tr>
<tr><td>FRN355G1□-4J</td><td>MD</td></tr>
<tr><td>FRN400G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">450</td><td>FRN355G1□-4J</td><td>LD</td><td rowspan="4">300×3</td><td rowspan="2">300×3</td><td rowspan="2">240×4</td></tr>
<tr><td rowspan="2">FRN400G1□-4J</td><td>MD</td></tr>
<tr><td rowspan="2">500</td><td>LD</td><td rowspan="2">240×4</td><td rowspan="5">300×4</td></tr>
<tr><td rowspan="2">FRN500G1□-4J</td><td>HD</td></tr>
<tr><td rowspan="2">630</td><td>LD</td><td rowspan="2">1400</td><td rowspan="3">300×4</td><td rowspan="3">300×4</td></tr>
<tr><td rowspan="2">FRN630G1□-4J</td><td>HD</td></tr>
<tr><td>710</td><td>LD</td><td>1600</td></tr>
</table>

(Note) A box (□) in the above table replaces an alphabetic letter depending on the type.

*1 The frame size and type of a MCCB or RCD/ELCB (with overcurrent protection) vary with the capacity of the power supply transformer. Refer to the related technical documents for detailed selection.

*2 The recommended wire sizes for the main circuit terminals are examples of using a PVC wire (for 70ºC, 600 V) at a surrounding temperature of 40ºC.

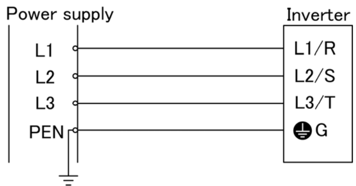
*3 Only one piece of wire with a recommended size can be connected to a ground terminal.

10. The inverter has been tested with IEC61800-5-1 2007 5.2.3.6.3 Short-circuit Current Test under the following conditions.

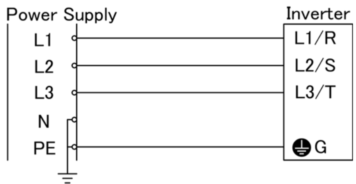
    Short-circuit current in the supply: 10,000 A

    Maximum 240 V for 200 V class series with 22 kW or below
    Maximum 230 V for 200 V class series with 30 kW or above
    Maximum 480 V for 400 V class series

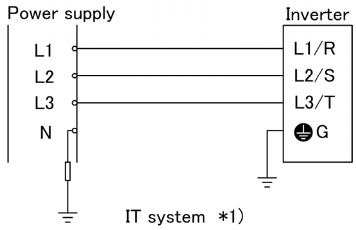
11. Use the inverter in the following power systems.



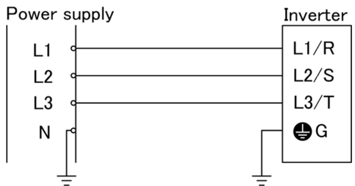
TN−C system



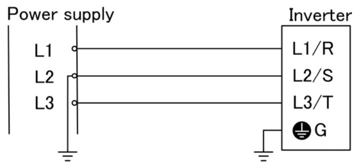
TN−S system



IT system *1)



TT system
(Earthed neutral)



TT system
(corner earthed/phase−earthed)
(Applicable for 200V type only) *2)

*1 Compatible with the IT power systems given below

<table>
<tr><td>The power system is not grounded at all.</td><td rowspan="2">Compatible.
Basic insulation needs to be applied between the main circuits of the control interface and the inverter. Thus, do not connect a SELV circuit to the system directly from the external controller. (The use of supplementary insulation is necessary to establish the connection.)
Install an earth detector. If a ground-fault current is detected, turn off the power within 5 seconds.</td></tr>
<tr><td>The neutral is impedance grounded.</td></tr>
<tr><td>One phase of the power supply is impedance grounded.</td><td>Incompatible.</td></tr>
</table>

*2 Incompatible with a TT system in which one phase of the 400 V power supply is directly grounded

13.6 (End) Radio Waves Act (South Korea)

한국 전파법 대응

본제품은 한국전파법에 적합한 제품입니다.
한국에서 사용시는 아래에 주의하여 주시길 바랍니다.
“ 이 기기는 업무용(A 급) 전자파 적합기기로서 판매자 또는 사용자는
이점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적
으로 합니다. 해당제품은 형식 FRN△△△G1S-□J/□DR 의 제품만 대상이 됩니다.
(△는 인버터용량, □는 전압시리즈를 표시하는 숫자 2 또는 4 가 표기됩니다.)

Compliance with the Radio Waves Act (South Korea)

This product complies with the Radio Waves Act (South Korea)

Note the following when using the product in South Korea

(The product is for business-use (Class A) and meets the electromagnetic compatibility requirement. The seller and the user must note the above point, and use the product in a place except for home.)

Only the following type of the products is applicable to this certification.

Type: FRN△△△G1S-□J/□DR

(△: is filled with inverter output power and □: is also for what power supply voltage 2 or 4 is.)

Appendices

Contents

App. A Advantageous Use of Inverters (Notes on Electrical Noise)

This document provides you with a summary of the Technical Document of the Japan Electrical Manufacturers' Association (JEMA) (December, 2008).

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

Problem: 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.)

Possible cause: Radios may receive noise radiated from the inverter.

Measure: Inserting a noise filter on the power supply side of the inverter is effective.

[2] Effect on telephones

Problem: If an inverter operates, nearby telephones may pick up noise radiated from the inverter in conversation so that it may be difficult to hear.

Possible cause: A high-frequency leakage current radiated from the inverter and motors enters shielded telephone cables, causing noise.

Measure: 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 pressure sensors

Problem: If an inverter operates, pressure sensors may malfunction.

Possible cause: Noise may penetrate through a grounding wire into the signal line.

Measure: It is effective to install a noise filter on the power supply side of the inverter or to separate the input and output wires or grounding wires from the control circuit.

[4] Effect on position detectors (pulse generators)

Problem: If an inverter operates, pulse encoders may produce erroneous pulses that shift the stop position of a machine.

Possible 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.

[5] Effect on proximity switches

Problem: If an inverter operates, proximity switches (capacitance-type) may malfunction.

Possible cause: The capacitance-type proximity switches may provide inferior noise immunity.

Measure: It is effective to connect a filter to the input terminals of the inverter or to ground at the 0V-side capacitor of the power supply of the proximity switches. The proximity switches can be replaced with superior noise immunity types such as magnetic types.

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 Gated Bipolar Transistor).

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, I/O wires 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 spans several tens of MHz and may affect the AM radio, wireless communication, and/or telephone.

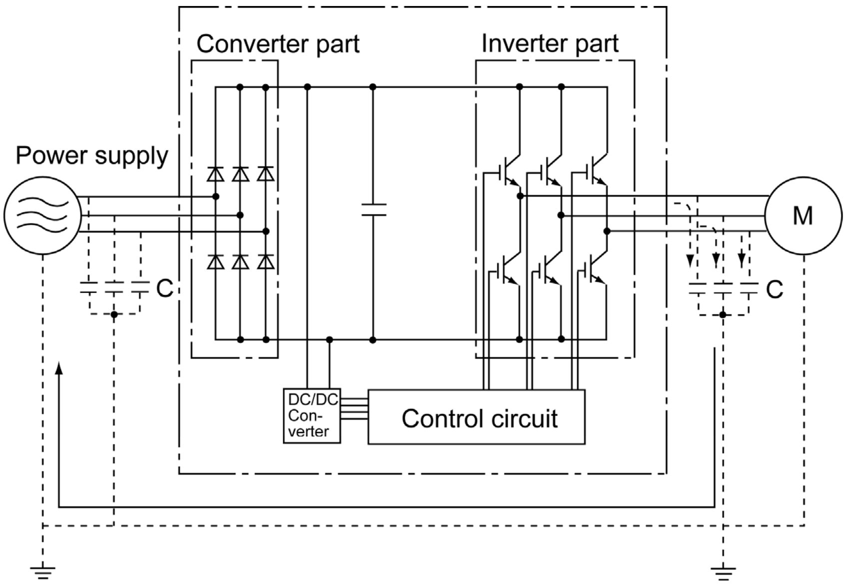


Figure A-1 Outline of Inverter Configuration

[2] Type 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.

① to ③ are conduction noises, ④ is induction noise, and ⑤ is radiation noise. The following provides the details of the function codes.

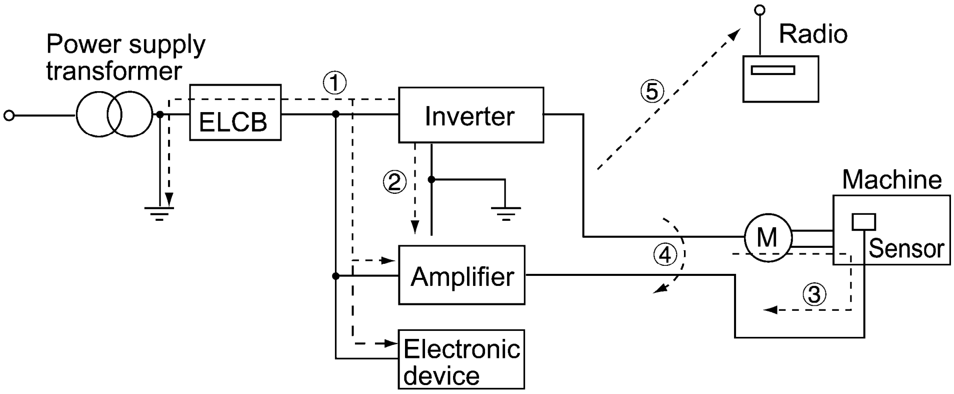


Figure A-2 Noise Propagation Route

(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.

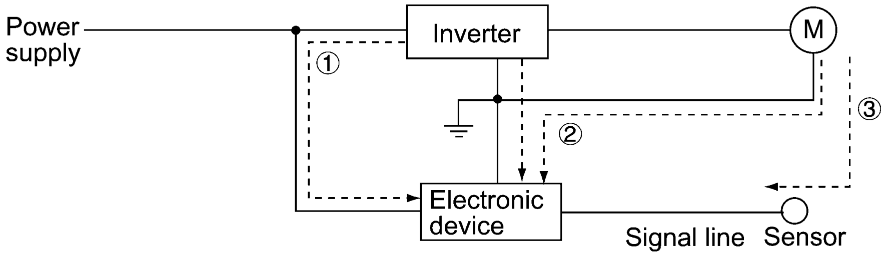


Figure A-3 Conduction Noise

(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.

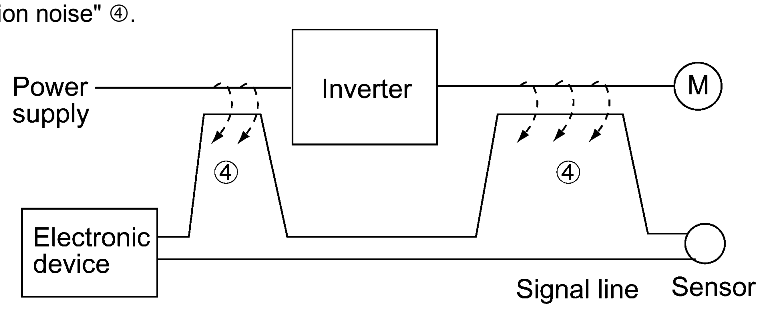


Figure A-4 Electromagnetic Induced Noise

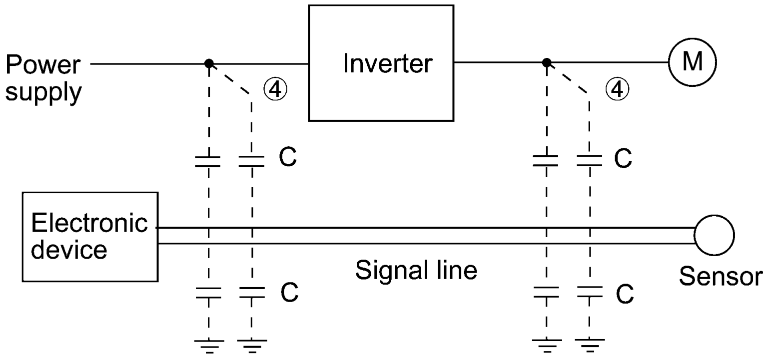


Figure A-5 Electrostatic Induced Noise

(3) Radiation Noise

Noise generated in an inverter may be radiated through the air from the main circuit and grounding wires (that act as antennas) at the input and output sides of the inverter so as to affect peripheral devices as well as broadcast and wireless communication. 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.

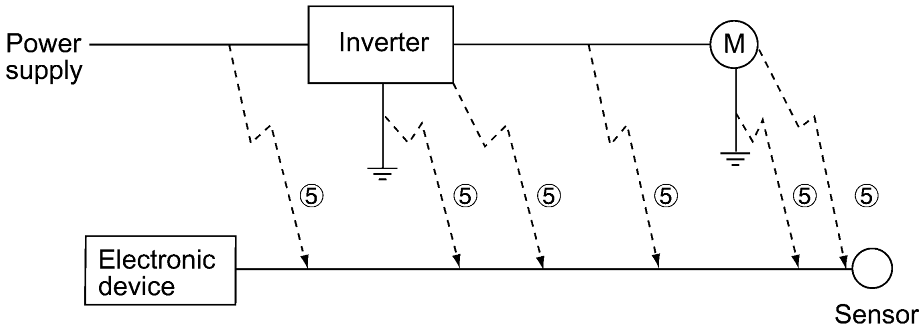


Figure A-6 Radiation Noise

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.

The basic measures for lessening the effect of noise at the receiving side include:

1. 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:

2. Inserting a noise filter that reduces the noise level.
3. Applying a metal conduit pipe or metal control panel that will confine noise, and
4. 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 measures		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
Cabling 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
	Use metal conduit pipe			Y			Y	Y
Control panel	Appropriate arrangement of devices in panel	Y					Y	Y
	Use metal control panel			Y			Y	Y
Anti-noise devices	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
	Line filter	Y				Y		
Others	Separate power supply systems	Y	Y			Y		
	Lower the carrier frequency				Y	Y	Y	Y

Y indicates effective measure. Blank indicates ineffective measure.

What follows is noise prevention measures for the inverter drive configuration.

(1) Cabling 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.

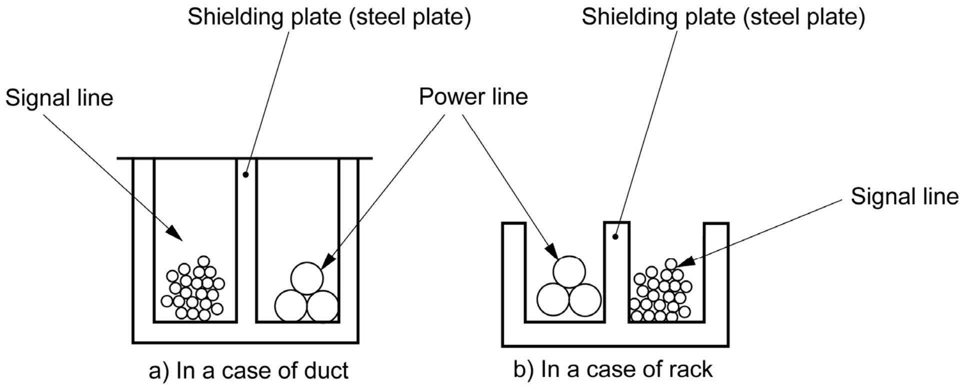
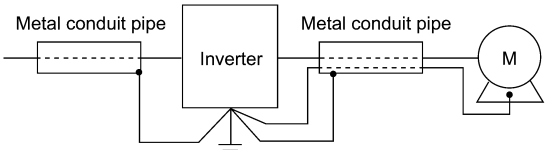


Figure A-7 Separate Wiring

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 C (300 to 600 VAC) or Class D (300 VAC or less). Each ground wire is to be provided with its own ground or separately wired to a grounding point.



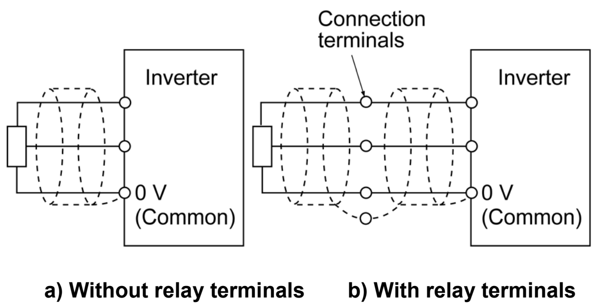


Figure A-8 Grounding of Metal Conduit Pipe

Figure A-9 Treatment of Braided Wire of Shielded Wire

(2) Control panel

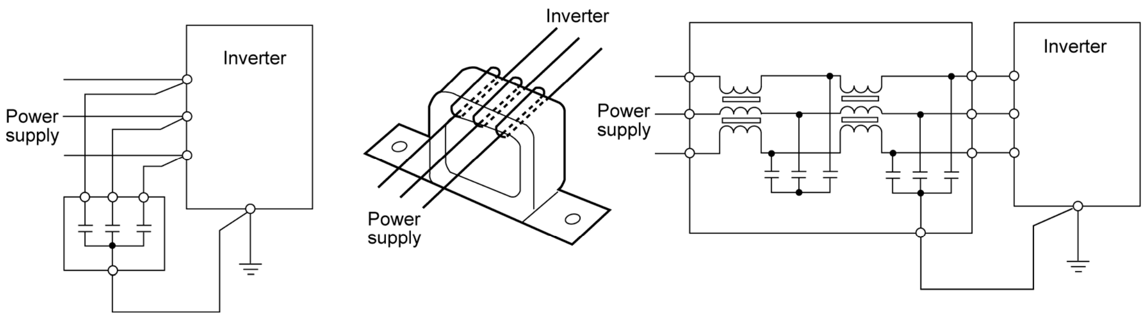
The system control panel containing an inverter is generally made of metal, which can shield noise radiated from the inverter itself.

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.

(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 insulated 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. Insulated transformers include general insulated transformers and shielded transformers, among others, each of which offers a different effect to prevent noise propagation.



(a) Capacitive filter **(b) Inductive filter (Zero-phase reactor)** **(c) LC filter for input**

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 control circuit 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) Others

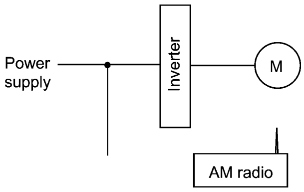
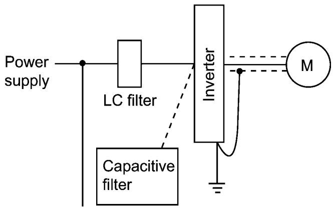
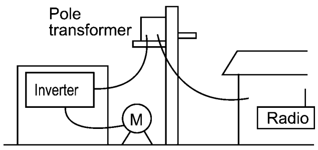
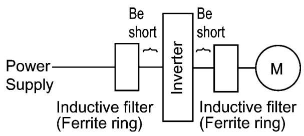
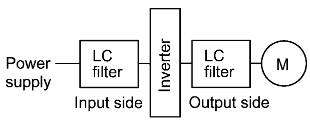
The level of generating/propagating noise will change with the carrier frequency of the inverter. The higher the carrier frequency, the higher the noise level.

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.

[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	Problem	Noise prevention	Notes
1	AM radio	When operating an inverter, noise enters into an AM radio broadcast (500 to 1500 kHz).  Figure A-11 <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.  Figure A-12 Note: Minimize the distance between the LC filter and inverter as short as possible (within 1 m).	1) The radiation noise of the wiring can be reduced. 2) The conduction noise to the power supply side can be reduced. Or use shielded cables. 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).  Figure A-13 <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.  Figure A-14 The number of turns of the zero-phase reactor should be as large as possible. In addition, wiring between the inverter and the zero-phase reactor should be as short as possible. (Within 1 m) 2) When further improvement is necessary, install LC filters.  Figure A-15	1) The radiation noise of the wiring can be reduced.

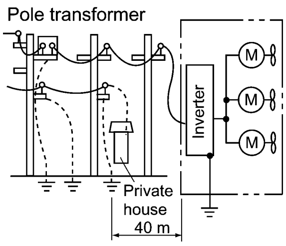
<table>
<tr><th>No.</th><th>Target device</th><th>Problem</th><th>Noise prevention</th><th>Notes</th></tr>
<tr>
<td>3</td>
<td>Telephone (in a common private residence at a distance of 40 m)</td>
<td>When driving a ventilation fan with an inverter, noise enters a telephone in a private residence at a distance of 40 m.


Figure A-16

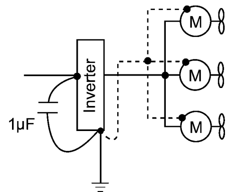
<Possible cause>
A high-frequency leakage current from the inverter and motor flowed to grounded part of the telephone cable shield. During the current's return trip, it flowed through a grounded pole transformer, and noise entered the telephone by electrostatic induction.</td>
<td>1) Connect the ground terminals of the motors in a common connection. Return to the inverter panel, and insert a 1μF capacitor between the input terminal of the inverter and ground.


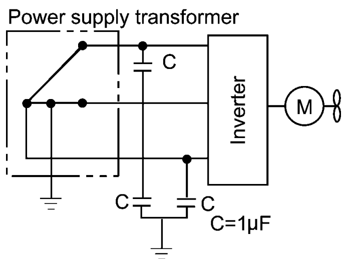
Figure A-17</td>
<td>1) The effect of the inductive filter and LC filter may not be expected because of sound frequency component.
2) In the case of a V-connection power supply transformer in a 200 V system, it is necessary to connect capacitors as shown in the following figure, because of different potentials to ground.


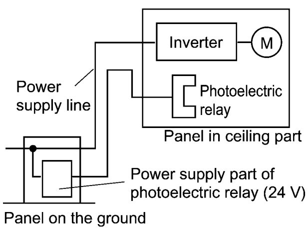
Figure A-18</td>
</tr>
<tr>
<td>4</td>
<td>Photo-electric relay</td>
<td>A photoelectric relay malfunctioned when the inverter runs the motor. [The inverter and motor are installed in the same place (for overhead traveling)]


Figure A-19

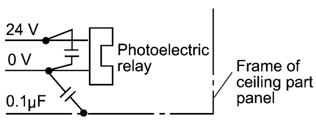
<Possible cause>
It is considered that induction noise entered the photoelectric relay since the inverter's input power supply line and the photoelectric relay's wiring are in parallel separated by approximately 25 mm over a distance of 30 to 40 m. Due to conditions of the installation, these lines cannot be separated.</td>
<td>1) As a temporary measure, Insert a 0.1μF 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.


Figure A-20

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.</td>
<td>1) Separate the cables. (30 cm or more)
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.</td>
</tr>
</table>

App.

<table>
<tr><th>No.</th><th>Target device</th><th>Problem</th><th>Noise prevention</th><th>Notes</th></tr>
<tr>
<td>5</td>
<td>Photo-electric relay</td>
<td>A photoelectric relay malfunctioned when the inverter was operated.

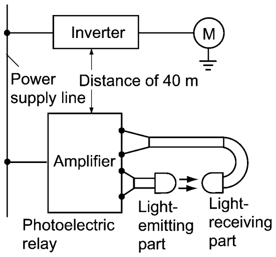



Figure A-21

<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.</td>
<td>1) Insert a 0.1μF capacitor between the output common terminal of the amplifier of the photoelectric relay and the frame.

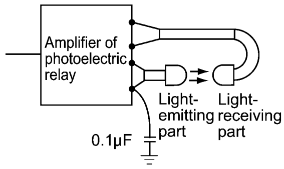



Figure A-22</td>
<td>1) If a low-current circuit at the malfunctioning side is observed, the measures may be simple and economical.</td>
</tr>
<tr>
<td>6</td>
<td>Proximity switch (capaci-tance type)</td>
<td>A proximity switch malfunctioned.

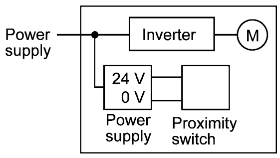



Figure A-23

<Possible cause>
It is considered that the capacitance type proximity switch is susceptible to conduction and radiation noise because of its low noise immunity.</td>
<td>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.

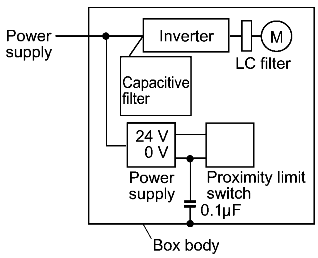



Figure A-24</td>
<td>1) Noise generated in the inverter can be reduced.
2) The switch is superseded by a proximity switch of superior noise immunity (such as a magnetic type).</td>
</tr>
</table>

<table>
<tr><th>No.</th><th>Target device</th><th>Problem</th><th>Noise prevention</th><th>Notes</th></tr>
<tr>
<td>7</td>
<td>Pressure sensor</td>
<td>The pressure sensor malfunctioned.

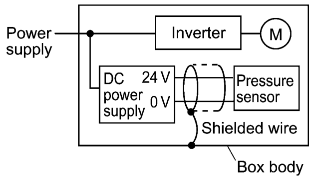


Figure A-25

<Possible cause>
The pressure sensor may malfunction due to noise that came from the box body through the shielded wire.</td>
<td>1) Install an LC filter at the input side of the inverter.
2) Disconnect the shielded cable for the pressure sensor from the machine enclosure to the pressure sensor 0 V line (common mode).

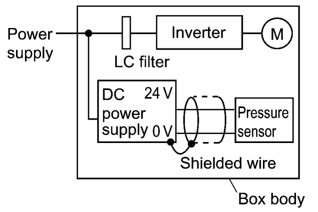


Figure A-26</td>
<td>1) Connect the shielded wire for the sensor signal to the common point of the system.
2) Reduce the conductive noise from the inverter.</td>
</tr>
<tr>
<td>8</td>
<td>Position detector (pulse generator)</td>
<td>The crane stop position got misaligned due to a wrong pulse from the pulse converter.

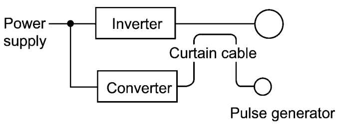


Figure A-27

<Possible cause>
The motor power cable and pulse generator signal wire are cabled together and the inductive noise may cause wrong pulses.</td>
<td>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.

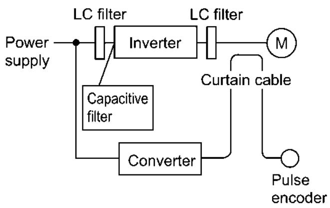


Figure A-28</td>
<td>1) This is an example of a measure where the power line and signal line cannot be separated.
2) Induction noise and radiation noise at the output side of the inverter can be reduced.</td>
</tr>
<tr>
<td>9</td>
<td>Program-mable logic controller (PLC)</td>
<td>The PLC program sometimes malfunctions.

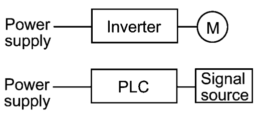


Figure A-29

<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.</td>
<td>1) Install a capacitive filter and an LC filter on the input side of the inverter.
2) Install an LC filter at the output side of the inverter.
3) Lower the carrier frequency of the inverter.

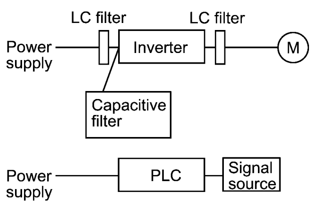


Figure A-30</td>
<td>1) Total conduction noise and induction noise in the electric line can be reduced.</td>
</tr>
</table>

App.

App. B Japanese Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage (General-purpose Inverter)

Agency of Natural Resource and Energy of Japan published the following two guidelines for suppressing harmonic noise on September 30 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. However, the following gives an overview of these guidelines by limiting the target device to the "general-purpose inverter".

B.1 Application to general-purpose inverters

[1] Application to general-purpose inverters

General-purpose inverters (with input current of 20A or less) were the products of which were restricted by the "Guideline for Suppressing Harmonics in Home Electric and General-purpose Appliances" (established in September 1994) issued by the Ministry of Economy, Trade and Industry. The above restriction, however, was lifted when the Guideline was revised in January 2004. For an inverter not regulated by the "Japanese Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage", we, as before, recommend that you connect a DC reactor listed in the User's Manual to your inverter.

[2] For "Japanese 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) Prediction timing

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.

  Input rated capacity = $\sqrt{3} \times$ (Power supply voltage) $\times I_1 \times 1.0228/1000$ (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.

App.

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

Applicable motor rating (kW)		22	30	37	45	55	75	90	110	132	160
Pi (kVA)	200 V	25.9	34.7	42.8	52.1	63.7	87.2	104	127		
	400 V	25.9	34.7	42.8	52.1	63.7	87.2	104	127	153	183

Applicable motor rating (kW)		200	220	250	280	315	355	400	450	500	630
Pi (kVA)	200 V										
	400 V	229	252	286	319	359	405	456	512	570	718

(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 a reactor	K31 = 3.4	• General-purpose inverters
		w/ a reactor (ACR)	K32 = 1.8	• Elevators
		w/ a reactor (DCR)	K33 = 1.8	• Refrigerators, air conditioning systems
		w/ reactors (ACR and DCR)	K34 = 1.4	• Other general appliances

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

Applicable motor rating (kW)		22	30	37	45	55	75	90	110	132	160
Input fundamental current (A)	200 V	73.1	98.0	121	147	180	245	293	357		
	400 V	36.6	49.0	60.4	73.5	89.9	123	147	179	216	258
6.6 kV converted value (mA)		2220	2970	73.5	4450	5450	7450	8910	10850	13090	15640

Applicable motor rating (kW)		200	220	250	280	315	355	400	450	500	630
Input fundamental current (A)	200 V										
	400 V	323	355	403	450	506	571	643	723	804	1013
6.6 kV converted value (mA)		19580	21500	24400	27300	30700	34600	39000	43800	48700	61400

(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

- AC reactor: 3%
- DC reactor: 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%

$$\text{n th harmonic current (A)} = \text{Fundamental current (A)} \times \frac{\text{n th generated harmonic current (\%)}}{100}$$

calculate the harmonic current of each degree using the following equation.

(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 below	0.55
	Over 200 kW	0.60
Sanitary pump	—	0.30
Elevator	—	0.25
Refrigerator, freezer	50 kW or below	0.60
UPS (6-pulse)	200 kVA	0.60

<u>Correction coefficient according to contract demand level</u>

Since the total availability factor decreases if the scale of a building increases, calculating reduced harmonics with the correction coefficient 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
1,000	0.85
2,000	0.80

Note: If the contract demand is between two specified values listed in Table B-7, calculate the value by interpolation.

Note: The correction coefficient 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) of 3. in Appendix of the guideline.

Therefore, "It is sufficient that the 5th and 7th harmonic currents should be calculated."

[3] Examples of calculation

(1) Equivalent capacity

Table B-8

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), maximum availability: 0.55

Table B-9

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%)	23th (1.7%)	25th (1.3%)
	823.5	314.2						
Refer to Tables B-4 and B-6.	Refer to Tables B-5.							

Example 2: 400 V, 3.7 kW, 15 units (w/ AC and DC reactor), maximum availability: 0.55

Table B-10

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

This document provides you with a summary of the Technical Document of the Japan Electrical Manufacturers' Association (JEMA) (March, 1995).

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 smooths 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.

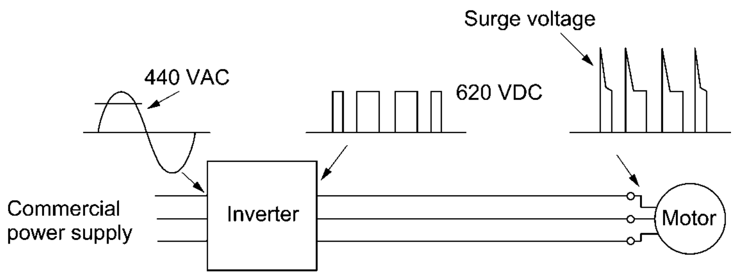
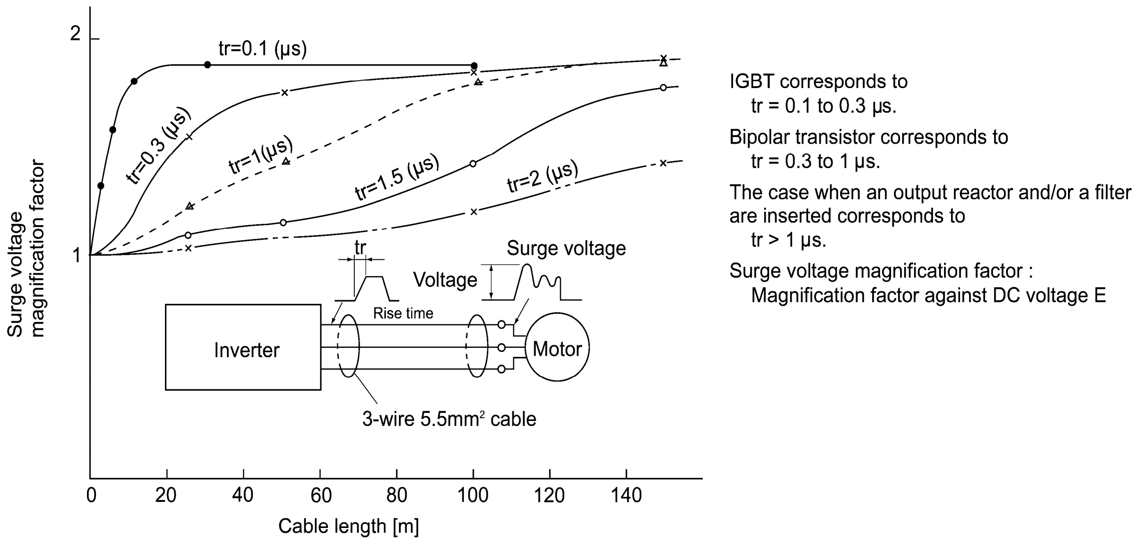


Figure C-1 Voltage Waveform of Individual Portions

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 surge voltage rises even in the case of a short wiring length.



Excerpt from [J. IEE Japan, Vol. 107, No. 7, 1987]

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.

Figure C-3 For 50 m of wiring length:
SSU 50TA-NS

Figure C-4 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.

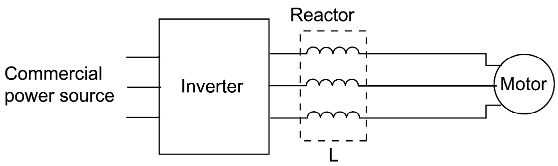
(1) Output reactor

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-5 (1).)

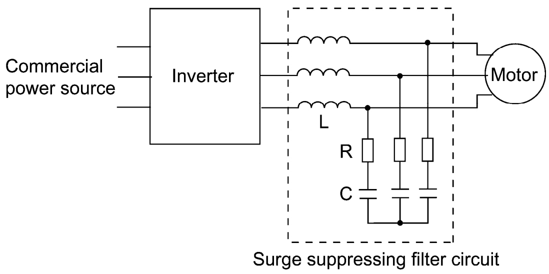
However, if the wiring length becomes long, suppressing the peak voltage due to surge voltage may be difficult.

(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-5 (2).)



(1) Output reactor



(2) Output filter

Figure C-5 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 11.4.1 [5] "Surge suppression unit (SSU)" in the Chapter 11.

[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.

App. D Inverter Generating Loss

The table below lists the inverter generating loss.

Table D-1

Power supply voltage	Inverter type	Generating loss (W)				
		HD mode		MD mode	LD mode	
		Low carrier:	High carrier:	Low carrier:	Low carrier:	High carrier:
Three-phase 200 V	FRN0.4G1□-2J	35	45	-	-	-
	FRN0.75G1□-2J	50	60	-	-	-
	FRN1.5G1□-2J	80	110	-	-	-
	FRN2.2G1□-2J	110	140	-	-	-
	FRN3.7G1□-2J	170	210	-	-	-
	FRN5.5G1□-2J	240	310	-	290	370
	FRN7.5G1□-2J	300	415	-	410	550
	FRN11G1□-2J	450	620	-	500	670
	FRN15G1□-2	540	700	-	630	840
	FRN18.5G1□-2J	660	860	-	770	970
	FRN22G1□-2J	790	1040	-	1120	1250*1
	FRN30G1□-2J	1300	1450	-	1650	1750*1
	FRN37G1□-2J	1300	1550	-	1650	1850*1
	FRN45G1□-2J	1450	1600	-	1850	1950*1
	FRN55G1□-2J	1750	1900	-	2250	2400*1
	FRN75G1□-2J	2300	2550*1	-	2700	2800*2
	FRN90G1□-2J	2750	3050*1	-	3250	3350*2
Three-phase 400 V	FRN0.4G1□-4J	35	60	-	-	-
	FRN0.75G1□-4J	45	80	-	-	-
	FRN1.5G1□-4J	60	110	-	-	-
	FRN2.2G1□-4J	80	140	-	-	-
	FRN3.7G1□-4J	130	230	-	-	-
	FRN5.5G1□-4J	170	300	-	210	370
	FRN7.5G1□-4J	230	400	-	300	520
	FRN11G1□-4J	300	520	-	360	610
	FRN15G1□-4J	360	610	-	460	770
	FRN18.5G1□-4J	440	770	-	510	870
	FRN22G1□-4J	510	900	-	710	1310*1
	FRN30G1□-4J	800	1150	-	1000	1250*1
	FRN37G1□-4J	1000	1450	-	1250	1550*1
	FRN45G1□-4J	1100	1600	-	1350	1700*1
	FRN55G1□-4J	1350	1950	-	1950	2400*1
	FRN75G1□-4J	1600	2150*1	-	2000	2250*2
	FRN90G1□-4J	1900	2600*1	2250	2250	2550*2
	FRN110G1□-4J	2300	3050*1	2700	2700	3050*2
	FRN132G1□-4J	2500	3300*1	3050	3050	3400*2
	FRN160G1□-4J	3100	4000*1	3900	3900	4350*2
	FRN200G1□-4J	3850	5000*1	4250	4250	4750*2
	FRN220G1□-4J	4350	5600*1	4850	5600	6200*2
	FRN280G1□-4J	5300	6900*1	5850	6500	7300*2
	FRN315G1□-4J	6000	7800*1	6650	7500	8350*2
	FRN355G1□-4J	6450	8450*1	7250	8100	9100*2
	FRN400G1□-4J	7350	9650*1	8250	9200	10350*2
	FRN500G1□-4J	9600	10700*2	-	11550	12950*2
	FRN630G1□-4J	11900	13300*2	-	13500	13800*3

Note: A box (□) in the above table replaces an alphabetic letter depending on the enclosure.

S (Basic type), E (EMC filter built-in type)

Low carrier:	2 kHz	
High carrier:	22 kW or less:	16 kHz (*1: 10 kHz)
	30 kW or above	15 kHz (*1: 10 kHz, *2: 6 kHz, *3: 4 kHz)

App. E Conversion from SI Units

All expressions given in Chapter 10, "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 [r/min] = $\frac{2\pi}{60}$[rad/s] ≈ 0.1047 [rad/s]
- 1 [rad/s] = $\frac{60}{2\pi}$[r/min] ≈ 9.549 [r/min]

(6) Inertia constant

J [kg•m^2] : Moment of inertia

GD^2 [kg•m^2] : Flywheel effect
- $GD^2 = 4J$
- $J = \frac{GD^2}{4}$

(7) Pressure and stress
- 1 [mmAq] ≈ 9.8 [Pa] ≈ 9.8 [N/m^2]
- 1 [Pa] ≈ 1 [N/m^2] ≈ 0.102 [mmAq]
- 1 [bar] ≈ 100000 [Pa] ≈ 1.02 [kg·cm^2]
- 1 [kg·cm^2] ≈ 98000 [Pa] ≈ 980 [mbar]
- 1 atmospheric pressure = 1013 [mbar] = 760 [mmHg] = 101300 [Pa] ≈ 1.033 [kg/cm^2]

App.

[2] Calculation formula

(1) Torque, power, and rotation speed

- $P\ [W] \approx \dfrac{2\pi}{60} \cdot N\ [r/min] \cdot \tau\ [N \cdot m]$

- $P\ [W] \approx 1.026 \cdot N\ [r/min] \cdot T\ [kgf \cdot m]$

- $\tau\ [N \cdot m] \approx 9.55 \cdot \dfrac{P\ [W]}{N\ [r/min]}$

- $T\ [kgf \cdot m] \approx 0.974 \cdot \dfrac{P\ [W]}{N [r/min]}$

(2) Kinetic energy

- $E\ [J] \approx \dfrac{1}{182.4} \cdot J[] \cdot N^2[(^{-1})]$

- $E\ [J] \approx \dfrac{1}{730} \cdot GD^2[kg \cdot m^2] \cdot N^2[(r/min)^2]$

(3) Torque of linear moving load

[Driving mode]

- $\tau\ [N \cdot m] \approx 0.159 \dfrac{V\ [m/min]}{NM\ [r/min] \cdot \eta\ G} \cdot F[N]$

- $T[kgf \cdot m] \approx 0.159 \dfrac{V\ [m/min]}{N_M[r/min] \cdot \eta_G} \cdot F[kgf]$

[Braking mode]

- $\tau\ [N \cdot m] \approx 0.159 \dfrac{V\ [m/min]}{N_M\ [r/min] / \eta_G} \cdot F[N]$

- $T[kgf \cdot m] \approx 0.159 \dfrac{V\ [m/min]}{N_M[r/min] / \eta_G} \cdot F[kgf]$

(4) Acceleration torque

[Driving mode]

- $\tau\ [N \cdot m] \approx \dfrac{J\ [kg \cdot m^2]}{9.55} \cdot \dfrac{\Delta N[r/min]}{\Delta t[s] \cdot \eta_G}$

- $T[kgf \cdot m] \approx \dfrac{GD^2[kg \cdot m^2]}{375} \cdot \dfrac{\Delta N[r/min]}{\Delta t[s] \cdot \eta_G}$

[Braking mode]

- $\tau\ [N \cdot m] \approx \dfrac{J[kg \cdot m^2]}{9.55} \cdot \dfrac{\Delta N[r/min] \cdot \eta_G}{\Delta t[s]}$

- $T[kgf \cdot m] \approx \dfrac{GD^2[kg \cdot m^2]}{375} \cdot \dfrac{\Delta N[r/min] \cdot \eta_G}{\Delta t[s]}$

(5) Acceleration time

- $t_{ACC}[s] \approx \dfrac{J_1+J_2/\eta_G[kg \cdot m^2]}{\tau_M - \tau_L/\eta_G[N \cdot m]} \cdot \dfrac{\Delta N[r/min]}{9.55}$

- $t_{ACC}[s] \approx \dfrac{GD_1^2+GD_2^2/\eta_G[kg \cdot m^2]}{T_M - T_L/\eta_G[kgf \cdot m]} \cdot \dfrac{\Delta N[r/min]}{375}$

(6) Deceleration time

- $t_{DEC}[s] \approx \dfrac{J_1+J_2 \cdot \eta_G[kg \cdot m^2]}{\tau_M - \tau_L \cdot \eta_G[N \cdot m]} \cdot \dfrac{\Delta N[r/min]}{9.55}$

- $t_{DEC}[s] \approx \dfrac{GD_1^2+GD_2^2 \cdot \eta_G[kg \cdot m^2]}{T_M - T_L \cdot \eta_G\ [kgf \cdot m]} \cdot \dfrac{\Delta N[r/min]}{375}$

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 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 ℃ (Io×0.91) (A)	40 ℃ (Io×0.82) (A)	45 ℃ (Io×0.71) (A)	50 ℃ (Io×0.58) (A)	55 ℃ (Io×0.40) (A)	35 ℃ (Io×0.63) (A)	40 ℃ (Io×0.57) (A)	45 ℃ (Io×0.49) (A)	50 ℃ (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-2 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 ℃ (Io×0.91) (A)	40 ℃ (Io×0.82) (A)	45 ℃ (Io×0.71) (A)	50 ℃ (Io×0.58) (A)	55 ℃ (Io×0.40) (A)	35 ℃ (Io×0.63) (A)	40 ℃ (Io×0.57) (A)	45 ℃ (Io×0.49) (A)	50 ℃ (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

■ 600 V Cross-linked Polyethylene Insulated wires (Maximum allowable temperature: 90°C)

Table F-3 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 ℃ (Io×0.91) (A)	40 ℃ (Io×0.82) (A)	45 ℃ (Io×0.71) (A)	50 ℃ (Io×0.58) (A)	55 ℃ (Io×0.40) (A)	35 ℃ (Io×0.63) (A)	40 ℃ (Io×0.57) (A)	45 ℃ (Io×0.49) (A)	50 ℃ (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 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.

- 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.

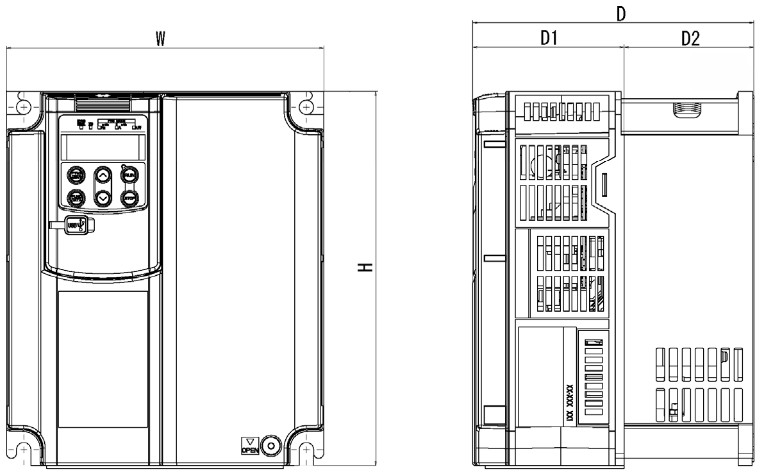


Figure G-1

■ Standard models

FRENIC-MEGA HD mode vs. FRENIC5000G9S

Table G-1

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA HD mode External dimensions (mm) W	H	D	D1	D2	Mounting area m^2 ($X10^{-2}$)	Volume m^3 ($X10^{-3}$)	FRENIC5000G9S External dimensions (mm) W	H	D	D1	D2	Mounting area m^2 ($X10^{-2}$)	/MEGA (%)	Volume 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%
	75	530	750	285	145	140	39.8	113.3	530	750	285	160	125	39.8	100.0%	113.3	100.0%
	90	680	880	360	180	180	59.8	215.4	680	880	360	245	115	59.8	100.0%	215.4	100.0%
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

Table G-2

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA LD mode External dimensions (mm) W	H	D	D1	D2	Mounting area m^2 ($X10^{-2}$)	Volume m^3 ($X10^{-3}$)	FRENIC5000P9S External dimensions (mm) W	H	D	D1	D2	Mounting area m^2 ($X10^{-2}$)	/MEGA (%)	Volume 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%
	90	530	750	285	145	140	39.8	113.3	680	880	360	245	115	59.8	150.5%	215.4	190.2%
	110	680	880	360	180	180	59.8	215.4	680	880	360	245	115	59.8	100.0%	215.4	100.0%
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

Table G-3

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA HD mode External dimensions (mm) W	H	D	D1	D2	Mounting area	Volume m3 (X10−3)	FRENIC5000G11S External dimensions (mm) W	H	D	D1	D2	Mounting area m2 (X10−2)	Mounting area /MEGA (%)	Volume m3 (X10−3)	Volume /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%
	75	530	750	285	145	140	39.8	113.3	530	750	285	145	140	39.8	100.0%	113.3	100.0%
	90	680	880	360	180	180	59.8	215.4	680	880	360	220	140	59.8	100.0%	215.4	100.0%
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%
	280	680	1400	440	260	180	95.2	418.9	680	1400	450	285	165	95.2	100.0%	428.4	102.3%
	315	680	1400	440	260	180	95.2	418.9	680	1400	450	285	165	95.2	100.0%	428.4	102.3%
	355	880	1400	440	260	180	123.2	542.1	880	1400	450	285	165	123.2	100.0%	554.4	102.3%
	400	880	1400	440	260	180	123.2	542.1	880	1400	450	285	165	123.2	100.0%	554.4	102.3%
	500	1000	1550	500	313	187	155.0	775.0	1000	1550	500	313.2	186.8	155.0	100.0%	775.0	100.0%
	630	1000	1550	500	313	187	155.0	775.0	1000	1550	500	313.2	186.8	155.0	100.0%	775.0	100.0%

FRENIC-MEGA LD mode vs. FRENIC5000P11S

Table G-4

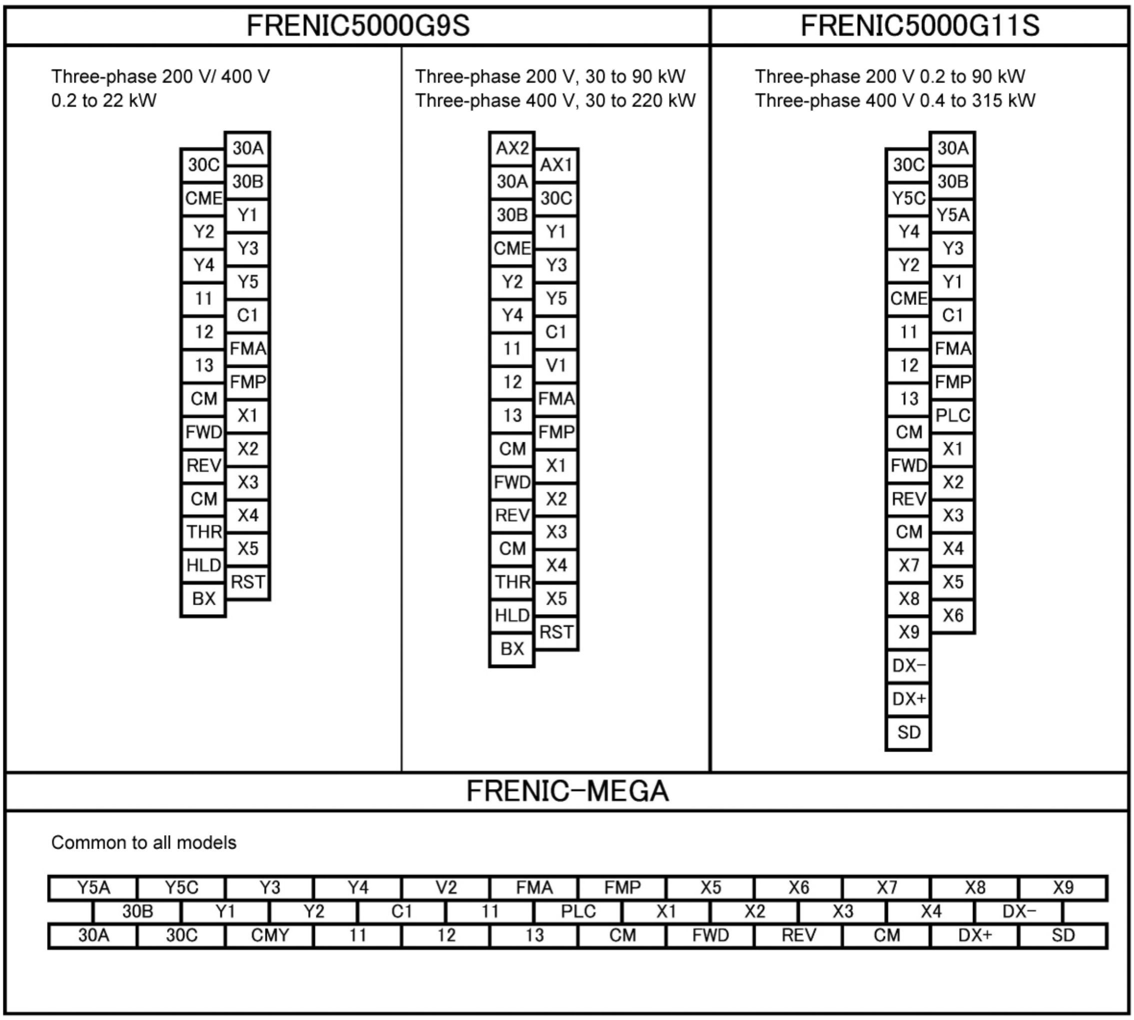
Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA LD mode							FRENIC5000P11S								
		External dimensions (mm)					Mounting area	Volume	External dimensions (mm)					Mounting area		Volume	
		W	H	D	D1	D2	m^2 ($X10^{-2}$)	m^3 ($X10^{-3}$)	W	H	D	D1	D2	m^2 ($X10^{-2}$)	/MEGA (%)	m^3 ($X10^{-3}$)	/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%
	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	750	285	145	140	39.8	113.3	530	750	285	145	140	39.8	100.0%	113.3	100.0%
	110	680	880	360	180	180	59.8	215.4	680	880	360	220	140	59.8	100.0%	215.4	100.0%
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%
	315	—	—	—	—	—	—	—	680	1400	450	285	165	95.2	—	428.4	—
	355	680	1400	440	260	180	95.2	418.9	680	1400	450	285	165	95.2	100.0%	428.4	102.3%
	400	680	1400	440	260	180	95.2	418.9	680	1400	450	285	165	95.2	100.0%	428.4	102.3%
	450	880	1400	440	260	180	123.2	542.1	880	1400	450	285	165	123.2	100.0%	554.4	102.3%
	500	880	1400	440	260	180	123.2	542.1	880	1400	450	285	165	123.2	100.0%	554.4	102.3%
	630	1000	1550	500	313	187	155.0	775.0	1000	1550	500	313	187	155.0	100.0%	775.0	100.0%
	710	1000	1550	500	313	187	155.0	775.0	1000	1550	500	313	187	155.0	100.0%	775.0	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

Table G-5



■ Main circuit terminals arrangement and screw sizes comparison

vs. FRENIC5000G9S

Table G-6

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	–	R S T P1 P(+) DB N(–) U V W E(G) E(G)	0.4 0.75	M3.5	–	L1/R L2/S L3/T U V W DB P1 P(+) N(–) G G
	1.5 2.2 3.7	M4	–	R S T P1 P(+) DB N(–) U V W E(G) E(G)	1.5 2.2 3.7	M4	M3.5	R0 T0 G L1/R L2/S L3/T DB P1 P(+) N(–) U V W G
	5.5 7.5	M5	–	E(G) R S T P1 P(+) DB N(–) U V W	5.5 7.5 11	M5	M3.5	P1 P(+) N(–) U V W L1/R L2/S L3/T R0 DB G T0 G
	11 15 18.5 22	M6	–	E(G) R S T P1 P(+) N(–) U V W	15 18.5 22	M6	M3.5	U V W G L1/R L2/S L3/T R0 T0 DB P1 P(+) N(–) G
Three-phase 200 V	30 37	M8	M4	R0 T0 E(G) R S T U V W P1 P(+) N(–)	30	M8	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(–) G G
	45 55	M10	M4	R0 T0 R S T U V W E(G) P1 P(+) N(–)	37 45 55	M10	M3.5	R0 T0 U V W L1/R L2/S L3/T P1 P(+) N(–) G G
	75	M10	M4	R0 T0 R S T U V W E(G) P1 P(+) N(–)	75	M12	M3.5	R0 T0 L1/R L2/S L3/T P1 P+ N(–) U V W G G
	90	M12	M4	R0 T0 R S T U V W E(G) P1 P(+) N(–)	90	M12	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(–) G G
Three-phase 400 V	30 37 45 55	M8	M4	R0 T0 E(G) R S T U V W P1 P(+) N(–)	30 37 45 55	M8	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(–) G G
	75 90 110 132	M10	M4	R0 T0 R S T U V W E(G) P1 P(+) N(–)	75 90 110	M10	M3.5	R0 T0 U V W L1/R L2/S L3/T P1 P(+) N(–) G G
	160 200 220	M12	M4	R0 T0 R S T U V W E(G) P1 P(+) N(–)	132 160 200 220	M12	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(–) G G

vs. FRENIC5000G11S

Table G-7

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	—	L1/R L2/S L3/T DB P1 P+ N- U V W G G	0.4 0.75	M3.5	—	L1/R L2/S L3/T U V W DB P1 P(+) N(-) G G
	1.5 2.2 3.7	M4	M3.5	R0 T0 G L1/R L2/S L3/T DB P1 P(+) N(-) U V W G	1.5 2.2 3.7	M4	M3.5	R0 T0 G L1/R L2/S L3/T DB P1 P(+) N(-) U V W G
	5.5 7.5	M5	M3.5	R0 T0 G G L1/R L2/S L3/T DB P1 P(+) N(-) U V W	5.5 7.5 11	M5	M3.5	P1 P(+) N(-) U V W L1/R L2/S L3/T R0 DB G T0 G
	11 15 18.5 22	M6	M3.5	R0 T0 G L1/R L2/S L3/T P1 P(+) N(-) U V W G	15 18.5 22	M6	M3.5	U V W G L1/R L2/S L3/T R0 DB P1 P(+) N(-) T0 G
Three-phase 200 V	30	M8	M4	R0 T0 U V W L1/R L2/S L3/T P1 P(+) N(-) G G	30	M8	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G
	37 45 55	M10	M4	U V W R0 T0 L1/R L2/S L3/T P1 P+ N- G G	37 45 55	M10	M3.5	R0 T0 U V W L1/R L2/S L3/T P1 P(+) N(-) G G
	75	M12	M4	R0 T0 L1/R L2/S L3/T P1 P+ N(-) U V W G G	75	M12	M3.5	R0 T0 L1/R L2/S L3/T P1 P+ N(-) U V W G G
	90	M12	M4	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G	90	M12	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G
Three-phase 400 V	30 37 45 55	M8	M4	R0 T0 U V W L1/R L2/S L3/T P1 P+ N- G G	30 37 45 55	M8	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G
	75 90 110	M10	M4	U V W R0 T0 L1/R L2/S L3/T P1 P+ N- G G	75 90 110	M10	M3.5	R0 T0 U V W L1/R L2/S L3/T P1 P(+) N(-) G G
	132 160 200 220	M12	M4	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G	132 160 200 220	M12	M3.5	R0 T0 L1/R L2/S L3/T U V W P1 P(+) N(-) G G
	280 315	M12	M4	R0 T0 L1/R L2/S L3/T P1 U V W L1/R L2/S L3/T P1 U V W P+ P+ N(-) N(-) G G	280 315	M12	M3.5	R0 T0 L1/R L2/S L3/T U V W L1/R L2/S L3/T U V W G P1 P1 P(+) P(+) N(-) N(-) G
	355 400	M12	M4	R0 T0 L1/R L2/S L3/T P1 P+ N(-) U V W L1/R L2/S L3/T P1 P+ N(-) U V W G G	355 400	M12	M3.5	R0 T0 L1/R L2/S L3/T P1 U V W L1/R L2/S L3/T P1 U V W G G P+ P+ N(-) N(-)
	500 630	M12	M4	R0 T0 L1/R L2/S L3/T P+ P+ U V W L1/R L2/S L3/T U V W P1 P1 N(-) N(-) G G	500 630	M12	M3.5	R0 T0 L1/R L2/S L3/T L1/R L2/S L3/T P+ P+ P+ U V W L1/R L2/S L3/T U U V V W W P1 P1 P1 N(-) N(-) G G

■ Terminal symbols and functions comparison

vs. FRENIC5000G9S/P9S

Table G-8

Class	FRENIC5000G9S/P9S		FRENIC-MEGA	
	Terminal Signal	Name	Terminal Signal	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	External braking resistor connecting terminal (Up to 7.5 kW)	P(+), DB	External braking resistor connecting terminal (Up to 22 kW)
	⏚ G	Grounding for inverter	⏚ G	Grounding for inverter
Analog input	13	Power supply for the potentiometer	13	Power supply for the potentiometer
	12	Frequency setting voltage input	12	Frequency setting voltage input
	C1	Frequency setting current input	C1	Frequency setting current input
	V1	Voltage input for auxiliary setting (22 kW or below: option)	V2	Frequency setting voltage input
	11	Analog common	Analog input common 11 (2 terminals)	Analog common
Digital input	FWD	Run forward/stop command	FWD	Run forward/stop command
	REV	Run reverse/stop command	REV	Run reverse/stop command
	X1 (Digital input 1)	Select multi-frequency (7 steps)	X1 (Digital input 1) SS1	Multi-frequency selection
		UP command	UP	UP command
	X2 (Digital input 2)	Multi-frequency selection	X2 (Digital input 2) SS2	Multi-frequency selection
		DOWN command	DOWN	DOWN command
	X3 (Digital input 3)	Multi-frequency selection	X3 (Digital input 3) SS4	Multi-frequency selection
		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 power input	Hz2/Hz1	Frequency setting 2/ Frequency setting 1
		Enable DC braking	DCBRK	Enable DC braking
	X5 (Digital input 5)	Acceleration and deceleration time selection	X5 (Digital input 5) RT2	Select ACC/DEC time (4 steps)
		Select 2nd V/f	M2	Select motor 2
		Enable data change with keypad (data change allowed)	WE-KP	Enable data change with keypad (data can be modified)
	CM	Digital input common	CM (2 terminals)	Digital input common
	HLD	Self hold selection	X1 to X9, FWD, REV HLD	Self hold selection
	BX	Coast-to-stop command	X1 to X9, FWD, REV BX	Coast-to-stop command
	RST	Error reset	X1 to X9, FWD, REV RST	Reset alarm
	THR	External alarm	X1 to X9, FWD, REV THR	External alarm
Analog output	FMA (11)	Analog monitor (Analog common)	FMA (11)	Analog monitor (Analog common)
Pulse output	FMP (CM)	Pulse rate monitor (Pulse waveform output) (Digital common)	FMP (CM)	Pulse monitor (Digital common)

Class	FRENIC5000G9S/P9S		FRENIC-MEGA	
	Terminal Signal	Name	Terminal Signal	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)	Running	RUN	Running
	(FAR)	Frequency (speed) arrival signal	FAR	Frequency (speed) arrival signal
	(FDT)	Frequency (speed) detected	FDT	Frequency (speed) detected
	(LU)	Undervoltage detected	LU	Undervoltage detected
	(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)
		Pattern operation stage transfer	-	
		Pattern operation 1 cycle completion	-	
		Pattern operation stage No. 1	-	
		Pattern operation stage No. 2	-	
		Pattern operation stage No. 4	-	
		Trip factor display signal 1	-	
		Trip factor display signal 2	-	
		Trip factor display signal 4	-	
		Trip factor display signal 8	-	
	(TRY)	Auto-resetting	TRY	Auto-resetting
Contact output	30A, 30B, 30C	Alarm relay output	30A, 30B, 30C	Alarm relay output
	AX1, AX2	Power supply side contactor open command (30 kW or above)	(Y5A, Y5C) AX	AX terminal function

App.

vs. FRENIC5000G11S/P11S

Table G-9

Class	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Terminal Signal	Name	Terminal Signal	Name
Main circuit	L1/R, L2/S, L3/T	Main circuit power inputs	L1/R, L2/S, L3/T	Main circuit power inputs
	R0, T0	Auxiliary power input for the control circuit	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(-)	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	Grounding for inverter	⏚ G	Grounding for inverter
Analog input	13	Power supply for the potentiometer	13	Power supply for the potentiometer
	12	Frequency setting voltage input	12	Frequency setting voltage input
	C1	Frequency setting current input	C1	Frequency setting current input
	11	Analog common	Analog input common 11 (2 terminals)	Analog common
Digital input	FWD	Run forward/stop command	FWD	Run forward/stop command
	REV	Run reverse/stop command	REV	Run reverse/stop 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	Digital input common	CM (2 terminals)	Digital input common
	PLC	PLC signal power	PLC	PLC signal power
	(SS1)	Multi-frequency selection	SS1	Multi-frequency selection
	(SS2)		SS2	
	(SS4)		SS4	
	(SS8)		SS8	
	(RT1)	Select ACC/DEC time (2 steps)	RT1	Select ACC/DEC time (2 steps)
	(RT2)	Select ACC/DEC time (4 steps)	RT2	Select ACC/DEC time (4 steps)
	(HLD)	Self hold selection	HLD	Self hold selection
	(BX)	Coast-to-stop command	BX	Coast-to-stop command
	(RST)	Error reset	RST	Reset alarm
	(THR)	External alarm	THR	External alarm
	(JOG)	Jogging operation	JOG	Jogging operation
	(Hz2/Hz1)	Frequency setting 2/ Frequency setting 1	Hz2/Hz1	Frequency setting 1/ Frequency setting 2
	(Hz1/Hz2)	Frequency setting 1/ Frequency setting 2	Hz2/Hz1	Frequency setting 2/ Frequency setting 1 (negative logic setting)
	(M2/M1)	Motor 2/motor 1	M2	Select motor 2
	(DCBRK)	Enable DC braking	DCBRK	Enable DC braking
	(TL2/TL1)	Torque limiter 2/ Torque limiter 1	TL2/TL1	Torque limiter 2/ Torque limiter 1
	(SW50)	Switch to commercial power (50Hz)	SW50	Switch to commercial power (50 Hz)
	(SW60)	Switch to commercial power (60 Hz)	SW60	Switch to commercial power (60 Hz)
	(UP)	UP command	UP	UP command
	(DOWN)	DOWN command	DOWN	DOWN command
	(WE-KP)	Enable data change with keypad (WE-KP)	WE-KP	Enable data change with keypad (WE-KP)
	(Hz/PID)	Cancel PID control	Hz/PID	Cancel PID control
	(IVS)	Switch normal/inverse operation	IVS	Switch normal/inverse operation

Class	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Terminal Signal	Name	Terminal Signal	Name
Digital input	(IL)	Interlock	IL	Interlock
	(Hz/TRQ)	Cancel torque control	-	
	(LE)	Link operation selection	LE	Link operation selection
	(U-DI)	Universal DI	U-DI	Universal DI
	(STM)	Start characteristics selection	STM	Start characteristics selection
	(STOP1)	Force to stop	STOP	Force to stop
	(STOP2)	Force to stop		
	(PG/Hz)	SY-PG enable	-	
	(ZERO)	Zero speed command with PG option	-	
	(EXITE)	Pre-excitation	EXITE	Pre-excitation
	(Hz/LSC)	Cancel constant peripheral speed control	-	
	(LSC-HID)	Line speed frequency memory	-	
Analog output	FMA (11)	Analog monitor (Analog common)	FMA (11)	Analog monitor (Analog common)
Pulse output	FMP (CM)	Pulse rate monitor (Pulse waveform output) (Digital common)	FMP (CM)	Pulse monitor (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)	Running	RUN	Running
	(FAR)	Frequency (speed) arrival signal	FAR	Frequency (speed) arrival signal
	(FDT)	Frequency (speed) detected	FDT	Frequency (speed) detected
	(FDT2)	Frequency (speed) detected 2	FDT2	Frequency (speed) detected 2
	(LU)	Undervoltage detected	LU	Undervoltage detected
	(B/D)	Torque polarity detected	B/D	Torque polarity detected
	(TL)	Torque limiting	IOL	Inverter output limiting
	(IPF)	Auto-restarting after momentary power failure	IPF	Auto-restarting after momentary power failure
	(OL)	Motor overload early warning	OL	Motor overload early warning
	(OL2)	Motor overload early warning 2	-	
	(KP)	Keypad operation enabled	KP	Keypad operation enabled
	(STP)	Inverter stopped	RUN	Inverter running (negative logic setting)
	(RDY)	Inverter ready to run	RDY	Inverter ready to run
	(SW88)	Switch between commercial power/inverter operation	SW88	Switch between commercial power/inverter operation
	(SW52-2)	Switch between commercial power/inverter operation	SW52-2	Switch between commercial power/inverter operation
	(SW52-1)	Switch between commercial power/inverter operation	SW52-1	Switch between commercial power/inverter operation
	(SWM2)	Motor 2 selected	SWM2	Motor 2 selected
	(AX)	AX terminal function	AX	AX terminal function

Class	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Terminal Signal	Name	Terminal Signal	Name
Transistor output	(TU)	Pattern operation stage transfer	-	
	(TO)	Pattern operation 1 cycle completion	-	
	(STG1)	Pattern operation stage No. 1	-	
	(STG2)	Pattern operation stage No. 2	-	
	(STG4)	Pattern operation stage No. 4	-	
	(AL1)	Trip factor display signal 1	-	
	(AL2)	Trip factor display signal 2	-	
	(AL4)	Trip factor display signal 4	-	
	(AL8)	Trip factor display signal 8	-	
	(FAN)	Cooling fan ON/OFF control	FAN	Cooling fan ON/OFF control
	(TRY)	Auto-resetting	TRY	Auto-resetting
	(U-DO)	Universal DO	U-DO	Universal DO
	(OH)	Cooling fan overheat warning	OH	Cooling fan overheat warning
	(SY)	Synchronization completed by synchronous operation card	-	
	(LIFE)	Lifetime warning	LIFE	Lifetime warning
	(C1OFF)	Terminal [C1] wire break	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)	-	
Contact output	Y5A, Y5C	General-purpose relay output	Y5A, Y5C	General-purpose relay output
	30A, 30B, 30C	Alarm relay output	30A, 30B, 30C	Alarm relay output
Communications link	DX+, DX-, SD	RS-485 communication input-output	DX+, DX-, SD	Via RS-485 communications link (port 2)

G.3 Function code

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.

(1/12)

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
Basic function							
00	Frequency Command	0: Setting by keypad operation (∧ and ∨ keys)	0	F01	Frequency Command 1	0: Enable ∧/∨ keys on the 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] (0 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] (0 to ±10 VDC)	0
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C45	Analog Input Adjustment 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 input to terminals [12] and current input to [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 input to terminals [12] and current input to [C1]	0
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C45	Analog Input Adjustment Polarity	0: Bipolar	0
01	Operation Method	0: RUN/STOP keys on keypad	0	F02	Operation Method	0: Keypad operation (Rotational direction specified by terminal command)	2
						2: Keypad operation (Forward rotation)	
						3: Keypad operation (Reverse rotation)	
		1: Terminal command ([FWD] or [REV])				1: External signals (Digital input terminal commands)	
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: AVR control OFF (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: AVR disabled Output a voltage in proportion to input voltage	200 (200 V class series) 400 (400 V class series)
						80 to 240 V (200 V class series) 160 to 500 V (400 V class series)	
	(Maximum Output Voltage 1)	80 to 240 V: (200 V class) 320 to 480 V: (400 V class)		F06	Maximum Output Voltage 1	80 to 240 V (200 V class series) 160 to 500 V (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

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
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	
07	Torque Boost 1	0.0: Auto torque boost		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	2: Auto torque boost	1
		0.1 to 0.9: Square law reduction torque		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
		1.0 to 1.9: Proportional torque					
		2.0 to 20.0: Constant torque load		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	1: Constant torque load	1
		75 = 0 when the auto-energy saving operation is inactive		F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
		0.0: Auto torque boost		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	5: Auto energy saving (Auto torque boost during ACC/DEC)	1
		0.1 to 0.9: Square law reduction torque		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
		1.0 to 1.9: Proportional torque					
		2.0 to 20.0: Constant torque load		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	4: Auto energy saving (Constant torque load during ACC/DEC)	1
		75 = 1 when the auto-energy saving operation is active		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 1 (operation level)	0.00: Disable	Motor rated current
		1: Enable (for general-purpose motor)		F10	Electronic thermal 1 (mode selection)	1: For a general-purpose motor with shaft-driven cooling fan	1
		2: Enable (for inverter motor)				2: Enable (For an inverter (FV) motor with separately powered cooling fan)	
09	(Operation level)	20% to 105% of the rated current of the inverter	100% of motor rated current	F11	(Operation level)	1% to 135% of the rated current (0.01 to 2000) of the inverter	Motor rated current

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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)	0: Disable (Without restart, LU trip immediately) 1: Disable (Without restart, LU trip after a recovery from power failure) 2: Enable (Continue to run, for heavy inertia or general loads) 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)	0: Trip immediately 1: Trip after recovery from power failure 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 frequency at which the power failure occurred, for general loads	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 limit (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: Torque limiter level 999: Disable	999
16	(Braking)	20 to 180: The torque is limited to the set value (G9S) 999: Torque limiting disabled	G9S: 150/100	F41	Torque limiter 1-2	-300 to 300: Torque limiter level 999: Disable	999
		0: Automatic deceleration		H69	Anti-regenerative control (Automatic deceleration) (Mode selection)	4: Operation (torque limiter)	0
17	DC braking (Start frequency)	0.0 to 60.0 Hz	0.0	F20	DC braking 1 (Start frequency)	0.0 to 60.0 Hz	0.0
18	(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	0.00
20	Multi-frequency 1	G9S: 0.00, 0.20 to 400.0 Hz	5.0	C05	Multi-frequency 1	0.00 to 500.00 Hz	0.00
21	Multi-frequency 2	P9S: 0.00, 0.20 to 120.0 Hz	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

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
27	Electronic Thermal Overload (Protection for Braking Resistor)	Only for 7.5 kW or below 0: Disable	1	F50	Electronic Thermal Overload (Discharging capability) (Protection for Braking Resistor)	OFF: Cancel	7.5 kW or above: 11 kW or below: 0/OFF
		1: Enable (Braking resistor built-in type)				0: (Discharging capability)	
						1 to 9000 kWs	
28	Slip Compensation Control	-9.9 to -0.1 (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
		0.0		F42	Drive Control Selection 1	0: V/f control with slip compensation inactive	0
		0.1 to 5.0		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 (29 = 1 when the Torque Vector Control is enabled.)		F42	Drive Control Selection 1	1: Dynamic torque vector control	0
		0.1 to 5.0		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 motor poles	2 to 14 poles	4	P01	Motor 1 (No. of poles)	2 to 22 poles	4
Input terminal functions							
31	Function Block (32 to 41) Selection	0: Do not display the function codes 32 to 41	0				
		1: Display the function codes 32 to 41					
32	Terminals [X1] to [X5] (Function selection)	Function code 32 data consists of four digits, each of which is assigned a predetermined function and terminal. A terminal or function which can be assigned to each digit is fixed. 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], [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. Active OFF	
	Terminals [X1] to [X5] (Function selection) Most significant digit = [X1], [X2]	0###: Multi-frequency selection		E01	Terminal [X1] Function (Function selection)	0: Select multi-frequency (0 to 1 step)	0
				E02	Terminal [X2] Function	1: Select multi-frequency (0 to 3 steps)	1
		1###: UP/DOWN command		E01	Terminal [X1] Function	17: UP command	0
				E02	Terminal [X2] Function	18: DOWN command	1
				F01	Frequency Command 1	7: UP/DOWN control	0
				H61	UP/DOWN control initial value selection	0: Initial value is 0.00 Hz	1
		2###: UP/DOWN command		E01	Terminal [X1] Function	17: UP command	0

FRENIC5000G9S Code	Name	Data setting range	Default setting 22 kW or below/30 kW or above	FRENIC-MEGA Code	Name	Data setting range	Default setting 22 kW or below/30 kW or above
				E02	Terminal [X2] Function	18: DOWN command	1
				F01	Frequency Command 1	7: UP/DOWN control	0
				H61	UP/DOWN control initial value selection	1: Last UP/DOWN command value on releasing the run command	1
	Terminals [X1] to [X5] (Function selection) 3rd digit = [X3]	#0##: Multi-frequency selection		E03	Terminal [X3] Function	2: Select multi-frequency (0 to 3 steps)	2
		#1##: Switch to commercial power (50 Hz)				15: Switch to commercial power (50 Hz)	2
		#2##: Switch to commercial power (60 Hz)				16: Switch to commercial power (60 Hz)	2
	Terminals [X1] to [X5] (Function selection) 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] (Function selection) 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 parameter switching	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
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

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
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 500.0Hz	50.0
40	Rated Voltage 2	0: AVR function OFF (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: AVR disabled (Output a voltage in proportion to input voltage)	200 (200 V class series) 400 (400 V class series)
						80 to 240 V: (200 V series), 160 to 500 V: (400 V series)	
	(Maximum Output Voltage 2)	80 to 240 V: (200 V class), 320 to 480 V: (400 V class)		A04	Maximum Output Voltage 2	80 to 240 V: (200 V series), 160 to 500 V: (400 V series)	200 (200 V class series) 400 (400 V class series)
41	Torque Boost 2	0.1 to 0.9: Square law reduction torque	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					
		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	0				
		1: Display the function codes 43 to 51					
43	FMP (Pulse rate)	6 to 100	24	F33	Pulse Output [FMP] (Pulse rate)	25 to 6000 p/s	1440
44	(Voltage adjust)	50 to 120	100	F34	(Gain to output voltage)	0: Output pulse rate (Fixed at 50% duty)	0
						1 to 300	
45	FMA (Voltage adjust)	65 to 200	100	F30	Analog Output [FMA] (Gain to output voltage)	0 to 300	100
46	(Function selection)	0: Output frequency	0	F31	(Function selection)	0: Output frequency 1 (before slip compensation)	0
		1: Output current				2: Output current	
		2: Output torque				4: Output torque	
		3: Load factor				5: Load factor	

* For the torque boost settings, refer to the conversion tables on pages A-71 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 selection)	Data is 5-digit hexadecimal. A terminal is assigned to each digit, in the order of Y1, Y2, Y3, Y4, and Y5 from the most significant digit. 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 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal. (Active OFF)	
		Most significant digit = [Y1]		E20	Terminal [Y1] Function (Function selection)		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 [Y5] 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: 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				3: Undervoltage detected	
		5: Keypad operation enabled				8: Keypad operation enabled	
		6: Torque limiting				5: Inverter output limiting	
		7: What to be displayed when the inverter stopped				(1000): 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 stages moved during the pattern operation, 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.					

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
		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].					
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) (Operation level)	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	60	E31	Frequency Detection 3 (Operation 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 warning level (Operation level)	20% to 105% of the rated current of the inverter	100% of motor rated current	E34	Overload Early Warning/Current Detection (Operation level)	1% to 200% of the rated current (allowable continuous drive current) of the motor	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 (Holding Time)	0.0 to 60.0 Hz	0.5
58	(Holding Time)	0.0 to 10.0 s	0.0	F24		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)	0.00 to 5.00 s	0.05
				C38	Analog Input Adjustment for [C1] (Filter)	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 Switch 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: Motor synchronous speed (r/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	
				E48	LED Monitor (Speed monitor item)	3: Motor speed	

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
		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	
		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	
		6: Driving torque limit setting value (%)					
		7: Braking torque limit setting value (%)					
		8: Torque calculation value (%)		E43	LED Monitor (Item selection)	8: Calculated torque	
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	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: Operation guide display 1: Bar charts (speed, current and calculated torque)	0
Pattern operation							
65	Pattern operation (Mode)	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	Curvilinear acceleration/deceleration (Mode)	0: Linear acceleration/deceleration	0	H07	Curvilinear acceleration/deceleration	0: Disable (Linear)	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
		1: S-curve acceleration/deceleration 2: Curvilinear acceleration/deceleration				1: S-curve (Weak) 2: S-curve (Arbitrary) 3: Curvilinear acceleration/deceleration	
Special functions 1							
75	Auto energy saving operation	07: Refer to Torque Boost 1.					
76	Rev. Phase Sequence Lock	0: Disable 1: Enable (Reverse rotation inhibited)	0	H08	Rotational direction limitation	0: Disable 1: Enable (Reverse rotation inhibited)	0
77	Data initialization	0: Manually set value 1: Initialize all function code data to the factory defaults	0	H03	Data initialization	0: Manually set value 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) to to 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 to 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) to to 10: High carrier frequency (10 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor sound (Carrier frequency) 30 to 55 kW	2 kHz to 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) to to 10: High carrier frequency (6 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor sound (Carrier frequency) 75 kW or above	2 kHz to 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	Retry (Times)	0: Disable	0	H04	Retry (Times)	0: Disable	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
		1 to 7: No. of retries				1 to 10: No. of retries	
85	(Restart time)	2 to 20 s	5	H05	(Restart time)	0.5 to 20.0 s	5.0
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 the motor while it is stopped 2: Tune the motor while it is rotating under V/f control	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

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 2							
95	Data Protection	0: The data can be changed 1: 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 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)	0/20
				H72	Main Power Down Detection (Mode selection)	0: Disable	1

vs. FRENIC5000P9S

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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 the LD mode (data = 1). 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
The function code replacement is basically the same as the "Function code compatibility table (vs. FRENIC5000G9S)" (the table above). However, the available setting ranges for the following codes differ depending on the P9S and LD modes.							
18	DC braking (Braking level)		0	F21	DC braking (Braking level)		0
81	Motor sound adjustment (Carrier frequency)	0: Low carrier frequency (2 kHz)	10	F26	Motor sound (Carrier frequency)	2 kHz	2
		to to				to	
	P9 22 kW or below	10: High carrier frequency (15 kHz)				15 kHz (Up to 16 kHz can be specified.)	
		11: Extremely low carrier frequency (0.7 kHz)				0.75 kHz	
	Motor sound adjustment (Carrier frequency)	0: Low carrier frequency (2 kHz)			Motor sound (Carrier frequency)	2 kHz	
		to to				to	
	P9 30 to 75 kW	10: High carrier frequency (6 kHz)				6 kHz (Up to 10 kHz can be specified for inverters with a capacity of 55 kW or below)	
		11: Extremely low carrier frequency (0.7 kHz)				0.75 kHz	
	Motor sound (Carrier frequency)	0: Low carrier frequency (2 kHz)			Motor sound (Carrier frequency)	2 kHz	
		to to				to	
	P9 90 kW or above	10: High carrier frequency (4 kHz)				4 kHz (Up to 6 kHz can be specified.)	
		11: Extremely low carrier frequency (0.7 kHz)				0.75 kHz	

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: Data can be changed	0	F00	Data Protection	0: Disable both data protection and digital reference protection	0
		1: Data Protection				1: Enable data protection and disable digital reference protection	
F01	Frequency Command 1	0: Setting by keypad operation (∧ and ∨ keys)	0	F01	Frequency Command 1	0: Enable ∧/∨ keys on the keypad	0
		1: Setting by voltage input (terminal [12]) (0 to +10 V)				1: Voltage input to terminal [12] (0 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] (0 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] (0 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 to 0 V)		F01	Frequency Command 1	1: Voltage input to terminal [12] (0 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: UP/DOWN control	0
				H61	UP/DOWN control initial value selection	0: Initial value is 0.00 Hz.	1
		9: Setting by UP/DOWN control mode 2 (initial value = last final value)		F01	Frequency Command 1	7: UP/DOWN control	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
				H61	UP/DOWN control initial value selection	1: Last UP/DOWN command value on releasing the run command	1
		10: Pattern operation					
		11: Setting by digital input or pulse train input		F01	Frequency Command 1	11: Digital input interface card (option) 12: Pulse train input * Max: 100 kHz/Maximum frequency	0
F02	Operation Method	0: Setting by keypad operation (FWD, REV and STOP keys) 1: Operation by external input (terminals [FWD] and [REV])	0	F02	Operation Method	0: Keypad operation (Rotational direction specified by terminal command) 2: Keypad operation (Forward rotation) 3: Keypad operation (Reverse rotation) 1: External signals (Digital input terminal commands)	2
F03	Maximum Output Frequency 1	50 to 400 Hz	60	F03	Maximum Output 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	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 series) 400 (400 V class series)	F05	Rated Voltage at Base Frequency 1	0: AVR disabled Output a voltage in proportion to input voltage 80 to 240 V: (200 V class series) 160 to 500 V: (400 V class series)	200 (200 V class) 400 (400 V class)
F06	Maximum Output Voltage 1	80 to 240 V: (200 V class), 320 to 480 V: (400 V class)	200 (200 V class series) 400 (400 V class series)	F06	Maximum Output Voltage 1	80 to 240 V: (200 V class series) 160 to 500 V: (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

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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
F09	Torque Boost 1	0.0: Auto torque boost	H10 = 0 when the auto-energy saving operation is inactive	G11S : 0.0	F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	2: Auto torque boost	1
		0.1 to 0.9: Square law reduction torque			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
		1.0 to 1.9: Proportional torque						
		2.0 to 20.0: Constant torque load			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	H10 = 1 when the auto-energy saving operation is active		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	1
		0.1 to 0.9: Square law reduction torque			F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	3: Auto-energy saving operation (Variable torque load during ACC/DEC)	1
					F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
		1.0 to 1.9: Proportional torque						
		2.0 to 20.0: Constant torque load			F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	4: Auto-energy saving operation (Constant torque load during ACC/DEC)	1
					F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
F10	Electronic thermal 1 (Mode selection)	0: Disable		1	F11	Electronic thermal 1 (Operation level)	0.00: Disable	Motor rated current
		1: Enable (for general-purpose motor)			F10	(Select motor characteristics)	1: Enable (For a general-purpose motor with shaft-driven cooling fan)	1
		2: Enable (for inverter motor)					2: Enable (For an inverter (FV) motor with separately powered cooling fan)	
F11	(Operation level)	20% to 135% of the rated current of the inverter		Motor rated current	F11	(Operation 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 for Braking Resistor	0 to 2 (Up to 7.5 kW) 0: Disable		1	F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	0: When braking resistor is built in	7.5 kW or below 11 kW or above 0/OFF
		1: Enable (Braking resistor built-in type)					1 to 9000	

* For the torque boost settings, refer to the conversion tables on pages A-71 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
		2: Enable (DB***-2C/4C, external braking resistor)				OFF: Cancel	
		0 (11 kW and above)	0	F51	(Allowable average loss)	0.001 to 99.99 kW	0.001
		0: Disable		F52	(Resistance)	0.01 to 999 Ω	0.01
F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Disable (Immediate inverter trip)	1	F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately	1
		1: Disable (inverter trip after recovery from power failure)				1: Trip after recovery from power failure	
		2: Disable (inverter trip after deceleration to a stop at power failure)				2: Trip after decelerate-to-stop	
		3: Enable (operation continued, for high-inertia loads)				3: Continue to run, for heavy inertia or general loads	
		4: Enable (restart with the frequency at power failure)				4: Restart at the frequency at which the power failure occurred, for general loads	
		5: Enable (restart with the start frequency, for low-inertia loads)				5: Restart with the start 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 braking (Braking starting frequency)	0.0 to 60.0 Hz	0.0	F20	DC braking (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	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
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: Up to 55 kW 0.75 to 10 kHz: 75 kW or above	2	F26	Motor sound (Carrier frequency)	0.75 to 15 kHz: 55 kW or below (Up to 16 kHz can be specified.) 0.75 to 10 kHz: 75 kW or above	2
F27	(Tone)	0 to 3	0	F27	(Tone)	0 to 3	0
F30	FMA (Voltage adjust)	0 to 200%	100	F30	Analog Output [FMA] (Gain to output voltage)	0 to 300	100
F31	(Function selection)	0: Output frequency 1 (before slip compensation)	0	F31	(Function selection)	0: Output frequency 1 (before slip compensation)	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
		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 factor				5: Load factor	
		6: Input power				6: Input power	
		7: PID feedback amount				7: PID feedback value	
		8: PG feedback amount				8: PG feedback value	
		9: DC link bus 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: Output pulse rate (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 selection)	0: Output frequency 1 (before slip compensation)	0	F35	(Function selection)	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 factor				5: Load factor	
		6: Consumption power				6: Consumption power	
		7: PID feedback amount				7: PID feedback value	
		8: PG feedback amount				8: PG feedback value	
		9: DC link bus voltage				9: DC link bus voltage	
		10: Universal AO (Outputs arbitrary value via communications link)				10: Universal AO	
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	

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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
F40	Torque Limiter 1 (Driving)	20 to 200: The torque is limited to the set value 999: Torque limiting inactive	999	F40	Torque limiter 1-1	-300 to 300: Torque limiter level 999: Disable	999
F41	(Braking)	20 to 200: The torque is limited to the set value 999: Torque limiting inactive	999	F41	Torque limiter 1-2	-300 to 300: Torque limiter level 999: Disable	999
F41	Torque Limiter 1 (Braking)	0: Prevent 0 V trip due to power regeneration effect automatically	999	H69	Anti-regenerative control (Automatic deceleration) (Mode selection)	2: Operation (torque limiter)	0
U60	Regeneration Avoidance at Deceleration	0: Torque limiting (for high response)	0				
F41	Torque Limiter 1 (Braking)	0: Prevent 0 V trip due to power regeneration effect automatically	999	H69	Anti-regenerative control (Automatic deceleration) (Mode selection)	3: DC link bus voltage control	0
U60	Regeneration Avoidance at Deceleration	1: Prevent 0 V trip (only during deceleration, for high inertia)	0				
F42	Torque Vector Control 1	0: Disable 1: Enable	0	F42	Drive Control Selection 1	0: V/f control with slip compensation inactive 1: Dynamic torque vector control	0
E01	X1 Terminal Function (Function selection)	0 to 35	0	E01	Terminal [X1] Function (Function selection)	0 to 76 (1000 to 1076) * Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal. (Active OFF)	0
E02	X2 Terminal Function	0: Multi-frequency selection	1	E02	Terminal [X2] Function	0: Select multi-frequency (0 to 1 step)	1
E03	X3 Terminal Function	1: Multi-frequency selection	2	E03	Terminal [X3] Function	1: Select multi-frequency (0 to 3 steps)	2
E04	X4 Terminal Function	2: Multi-frequency selection	3	E04	Terminal [X4] Function	2: Select multi-frequency (0 to 7 steps)	3
E05	X5 Terminal Function	3: Multi-frequency selection	4	E05	Terminal [X5] Function	3: Select multi-frequency (0 to 15 steps)	4
E06	X6 Terminal Function	4: Acceleration and deceleration time selection	5	E06	Terminal [X6] Function	4: Select ACC/DEC time (2 steps)	5
E07	X7 Terminal Function	5: Acceleration and deceleration time selection	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: Self hold selection	7
E09	X9 Terminal Function	7: Coast-to-stop command	8	E09	Terminal [X9] Function	7: Coast-to-stop command	8
		8: Error reset				8: Reset alarm	
		9: External alarm				9: External alarm	
		10: Jogging operation				10: Jogging operation	
		11: Select frequency command 2/1				11: Select frequency command 2/1	
		12: Motor 2/motor 1				12: Select motor 2	
		13: Enable DC braking				13: Enable DC braking	
		14: Toque limiter 2/torque limiter 1				14: Toque limiter 2/torque limiter 1	
		15: Switching to commercial power (50Hz)				15: Switch to commercial power (50Hz)	
		16: Switching to commercial power (60 Hz)				16: Switch to commercial power (60 Hz)	

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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
		17: UP command				17: UP command	
		18: DOWN command				18: DOWN command	
E01 to E09	Terminals [X1] to [X9] (Function selection)	19: Enable data change with keypad		E01 to E09	Terminals [X1] to [X9] (Function selection)	19: Enable data change with keypad	
		20: Cancel PID control				20: Cancel PID control	
		21: Switch normal/inverse operation				21: Switch normal/inverse operation	
		22: Interlock (52-2)				22: Interlock	
		23: Cancel torque control					
		24: Enable communications link via RS-485 or fieldbus (option)				24: Enable communications link via RS-485 or fieldbus (option)	
		25: Universal DI				25: Universal DI	
		26: Start characteristics selection				26: Start characteristics selection	
		27: PG-SY enable (option)					
		28: Unused					
		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: Select frequency command 1/2				(1011): Select frequency command 2/1	
E01 to E09	Terminals [X1] to [X9]	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	Terminals [X1] to [X9]	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
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	999	E17	Torque limiter 2-2	-300 to 300: Torque limiter level	999

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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
		value 999: Torque limiting inactive				999: Disable	
E17	Torque Limiter 2 (Braking)	0: Prevent 0 V trip due to power regeneration effect automatically	999	H69	Anti-regenerative control (Automatic deceleration) (Mode selection)	2: Operation (torque limiter)	0
U60	Regeneration Avoidance at Deceleration	0: Torque limiting (for high response)	0				
E17	Torque Limiter 2 (Braking)	0: Prevent 0 V trip due to power regeneration effect automatically	999	H69	Anti-regenerative control (Automatic deceleration) (Mode selection)	3: DC link bus voltage control	0
U60	Regeneration Avoidance at Deceleration	1: Prevent 0 V trip (only during deceleration, for high inertia)	0				
E20	Y1 Terminal Function (Function selection)	0 to 37	0	E20	Terminal [Y1] Function (Function selection)	0 to 105 (1000 to 1105) * Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal. (Active OFF)	0
E21	Y2 Terminal Function	0: Running	1	E21	Terminal [Y2] Function	0: Running	1
E22	Y3 Terminal Function	1: Frequency arrival	2	E22	Terminal [Y3] Function	1: Frequency (speed) arrival signal	2
E23	Y4 Terminal Function	2: Frequency detection	7	E23	Terminal [Y4] Function	2: Frequency (speed) detected	7
E24	Y5A and Y5C Terminal Function (Relay output)	3: Undervoltage detected (Inverter stopped)	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 (output while limiting torque or current)	
		6: Restarting after momentary power failure (from recovery to operation at the specified frequency)				6: Recovering from momentary power failure (from occurrence of momentary power failure to arrival of frequency command)	
		7: Overload warning (E33 = 0: Thermal calculation)				7: Motor overload early warning	
		7: Overload warning (E33 = 1: Output current)				37: Current detected	
		8: Keypad operation enabled				8: Keypad operation enabled	
		9: Inverter stopped				(1000): Running	
		10: Ready				10: Inverter ready to run	
		11: Commercial line/inverter change over				11: Commercial line/inverter change over	
		12: Commercial line/inverter change over				12: Commercial line/inverter change over	
		13: Commercial line/inverter change over				13: Commercial line/inverter change over	
		14: Motor 2 switched				49: Motor 2 switched	
		15: AX terminal function				15: AX terminal function	

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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
		16: Time-up signal for pattern operation					
		17: Cycle completion signal for pattern operation					
		18: Pattern operation stage No.					
		19: Pattern operation stage No.					
		20: Pattern operation stage No.					
		21: Alarm details					
		22: Alarm details					
E20 to E24	Terminals [Y1] to [Y4] (Function selection) Terminals [Y5A] and [Y5C] (Relay output)	23: Alarm details		E20 to E24	Terminals [Y1] to [Y4] (Function selection) Terminal [Y5A/C] Function		
		24: Alarm details					
		25: Cooling fan operating time				25: Cooling fan ON/OFF control	
		26: Auto-resetting				26: Auto-resetting	
		27: Universal DO (option)				27: Universal DO	
		28: Cooling fan overheat warning				28: Cooling fan overheat warning	
		29: Synchronization completed by synchronous operation card (option)					
		30: Life expectancy detection signal				30: Lifetime warning	
		31: Frequency detection 2				31: Frequency (speed) detected 2	
		32: OL2 Function				38: Current detected 2	
		33: Terminal C1 off signal				33: Command 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 1: At signal OFF, [Y5A] - [Y5C]: ON At signal ON, [Y5A] -[Y5C]: OFF	0	E24	Terminal [Y5A/C] Function (Function selection)	0 to 105: At signal OFF, [Y5A] - [Y5C]: OFF At signal ON, [Y5A] -[Y5C]: ON 1000 to 1105 At signal OFF, [Y5A] - [Y5C]: ON At signal ON, [Y5A] -[Y5C]: OFF	-
E30	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
E31	Frequency detection (Operation level)	0 to 400 Hz	60	E31	Frequency detection (Operation level)	0.0 to 500.0 Hz	60.0
E32	(Hysteresis width)	0.0 to 30.0 Hz	1.0	E32	(Hysteresis width)	0.0 to 500.0 Hz	1.0
E33	Overload warning (Mode selection)	Refer to E20 to E24, data = 7					
E34	Overload warning (Operation level)	5% to 200% of inverter rated current	Motor rated current	E34	Overload Early Warning/ Current Detection 1 (Operation level)	1% to 200% of the rated current (allowable continuous drive current) of the motor	Motor rated current
E35	(Timer)	0.0 to 60.0 s	10.0	E35	(Timer)	0.01 to 600.00 s	10.00
E36	Frequency detection 2 (Operation level)	0 to 400 Hz	60	E36	Frequency Detection 2 (FDT2) (Operation level)	0.0 to 500.0 Hz	60.0

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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
E37	Overload warning 2 (Operation level)	5% to 200% of inverter rated current	Motor rated current	E37	Current Detection 2/ Low Current Detection (Operation level)	1% to 200% of the rated current (allowable continuous drive current) of the motor	Motor rated current
E35	Overload warning (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 Load shaft speed and line speed	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 (Item selection)	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	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	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	0
		8: Torque calculation value (%)		E43	LED monitor (Item selection)	8: Calculated torque	0
		9: Power consumption (kW)		E43	LED monitor (Item selection)	9: Power consumption	0
		10: PID command (instructed final value)		E43	LED monitor (Item selection)	10: PID command	0
		11: PID remote command (Value specified by F02)					
		12: PID feedback amount		E43	LED monitor (Item selection)	12: PID feedback value	0
E44	LED monitor (Display when stopped)	0: Specified value	0	E44	LED monitor (Display when stopped)	0: Specified value	0
		1: Output value				1: Output value	
E45	LCD monitor (Item selection)	0: Operation status, rotating direction, operation guide	0	E45	LCD monitor (Item selection)	0: Operation guide display	0
		1: Output frequency (before slip compensation), output current, calculated torque value in bar graph				1: Bar charts (speed, current and calculated torque)	

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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
E46	(Language selection)	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 control)	0 (Low) to 10 (High)	5	E47	LCD monitor (contrast control)	0 (Low) to 10 (High)	5
C01	Jump Frequency 1	0 to 400 Hz	0	C01	Jump Frequency 1	0.0 to 500.0 Hz	0.0
C02	Jump Frequency 2	0 to 400 Hz	0	C02	Jump Frequency 2	0.0 to 500.0 Hz	0.0
C03	Jump Frequency 3	0 to 400 Hz	0	C03	Jump Frequency 3	0.0 to 500.0 Hz	0.0
C04	(Hysteresis width)	0 to 30 Hz	3	C04	(Hysteresis width)	0.0 to 30.0 Hz	3.0
C20	Jogging 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	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 operation (∧ and ∨ keys)	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 input to terminals [12] and current input to [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
		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

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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
				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
C30	Frequency Command 2	8: Setting by UP/DOWN control mode 1 (initial value = 0)		C30	Frequency Command 2	7: UP/DOWN control	2
				H61	UP/DOWN control initial value selection	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: UP/DOWN control	2
				H61	UP/DOWN control initial value selection	1: Last UP/DOWN command value on releasing the run command	1
		10: 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 output 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)	0.00 to 5.00 s	0.05
				C38	Analog Input Adjustment for [C1] (Filter)	0.00 to 5.00 s	0.05
P01	Motor 1 (No. of poles)	2 to 14 poles	4	P01	Motor 1 (No. of poles)	2 to 22 poles	4
P02	(Rated capacity)	0.01 to 45.00 kW: 22 kW or below	Depending on inverter capacity	P02	(Rated capacity)	0.01 to 1000 kW	Depending on inverter capacity
		0.01 to 500 kW: 30 kW or above	Depending on inverter				

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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
			capacity				
P03	(Rated current)	0.00 to 2000 A	1.30	P03	(Rated current)	0.00 to 2000 A	Depending on inverter capacity
P04	(Auto-tuning)	0: Disable 1: Enable (Measure the %R1 and %X when the motor stops.) 2: Enable (Measure the %R1 and %X when the motor stops, then measure the Io when the motor is rotating.)	0	P04	(Auto-tuning)	0: Disable 1: Tune the motor while it is stopped 2: Tune the motor while it is rotating under V/f control	0
P05	(Online tuning)	0: Disable 1: Enable	0				
P06	(No-load current)	0.00 to 2000 A	Depending on inverter capacity	P06	Motor 1 (No-load current)	0.00 to 2000 A	Depending on inverter capacity
P07	(%R1)	0.00 to 50.00%	Depending on inverter capacity	P07	(%R1)	0.00 to 50.00%	Depending on inverter capacity
P08	(%X)	0.00 to 50.00%	Depending on inverter capacity	P08	(%X)	0.00 to 50.00%	Depending on inverter capacity
P09	(Slip compensation control)	0.00 to 15.00 Hz	0.00	P09	(Slip compensation gain for driving)	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
				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)	Specify the rated slip frequency for the 0.00 to 15.00 Hz motor. (Obtained also by auto-tuning by P04.)	0.00
H03	Data initialization	0: Disable 1: Initializing data	0	H03	Data initialization	0: Manually set value 1: Initialize all function code data to the factory defaults	0
H04	Retry (Times)	0: Disable 1 to 10: No. of retries	0	H04	Retry (Times)	0: Disable 1 to 10: No. of retries	0
H05	(Restart time)	2 to 20 s	5	H05	(Restart time)	0.5 to 20.0 s	5.0
H06	Cooling fan ON/OFF control	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
H07	Curvilinear acceleration/deceleration	0: Disable (Linear acceleration/deceleration)	0	H07	Curvilinear acceleration/deceleration	0: Disable (Linear acceleration/deceleration)	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
		1: S-curve (Weak) 2: S-curve (Arbitrary) 3: Curvilinear acceleration/deceleration				1: S-curve (Weak) 2: S-curve (Arbitrary) 3: Curvilinear acceleration/deceleration	
H08	Rev. Phase Sequence Lock	0: Disable 1: Enable	0	H08	Rotational direction limitation	0: Disable 1: Enable (Reverse rotation inhibited)	0
H09	Starting Mode (Auto search)	0: Disable 1: Enable (At restart after a momentary power failure or at switching from line to inverter) 2: Enable (Always)	0	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)	0
H10	Auto energy saving operation	Refer to F09, Torque Boost 1.					
H11	Deceleration Mode	0: Normal deceleration 1: Coast-to-stop	0	H11	Deceleration Mode	0: Normal deceleration 1: Coast-to-stop	0
H12	Instantaneous Overcurrent Limiting	0: Disable 1: Enable	1	H12	Instantaneous Overcurrent Limiting	0: Disable 1: Enable	1
H13	Restart Mode after Momentary Power Failure (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	(Frequency fall rate)	0.00: Deceleration time selected by F08 0.01 to 100.00 Hz/s	10.00	H14	(Frequency fall rate)	0.00: Deceleration time selected by F08 0.01 to 100.00 Hz/s 999: Follow the current limit command	999
H15	(Continuous running level)	200 to 300 V: (200 V class) 400 to 600 V: (400 V class)	235 470	H15	(Continuous running level)	200 to 300 V: (200 V class series) 400 to 600 V: (400 V class series):	235 470
H16	(OPR command selfhold time)	0.0 to 30.0 s 999: Automatically determined by inverter	999	H16	(Allowable momentary power failure time)	0.0 to 30.0 s 999: Automatically determined by inverter	999
H18	Torque control (Mode selection)	0: Disable (operation by frequency command) 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%)	0				
H19	Active Drive	0: Disable 1: Enable	0				
H20	PID control (Mode selection)	0: Disable 1: Forward operation (When the PID output rises, the output frequency rises.) 2: Reverse operation (When the PID output rises, the output frequency	0	J01	PID control (Mode selection)	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation)	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
		drops.)					
H21	(Feedback signal)	0: Control terminal [12], forward operation (0 to 10 V voltage input)	1	J02	PID control (Remote command)	1: PID process command 1 (Analog input terminals [12], [C1], and [V2])	0
				E61	Terminal [12] (Extended Function)	5: PID feedback value	
		1: Control terminal [C1], forward operation (4 to 20 mA current input)		J02	PID control (Remote command)	1: PID process command 1 (Analog input terminals [12], [C1], and [V2])	
				E62	Terminal [C1] (Extended Function)	5: PID feedback value	
		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 (Integral time)	0.0 to 3600.0 s	0.0	J04	I (Integral time)	0.0 to 3600.0 s	0.0
H24	D (Differential time)	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 selection)	0: Disable	0	H26	Thermistor (for motor) (Mode selection)	0: Disable	0
		1: Enable				1: PTC: The inverter immediately trips with OH4 displayed.	
H27	(Operation level)	0.00 to 5.00V	1.60	H27	(Operation level)	0.00 to 5.00 V	0.35
H28	Droop control	-9.9 to 0.0Hz	0.0	H28	Droop control	-60.0 to 0.0 Hz	0.0
H30	Link function (Mode selection)	0: Frequency command = Disabled, Operation command = Disabled	0	H30	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)	
H31	RS-485 Communication (Station address)	1 to 31	1	y11	RS-485 Communication 2 (Station address)	1 to 235	1
H32	(Communications error processing)	0: Immediately trip with alarm Er-8	0	y12	(Communications error processing)	0: Immediately trip with alarm Er-P	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
		1: Continue operation within timer time, Er-8 trip after timer time				1: Continue operation within timer time, Er-8 trip after timer time	
		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: Continuity of running				3: Continuity of running	
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 bps	1	y14	(Baud rate)	3: 19200 bps	3
		1: 9600 bps				2: 9600 bps	
		2: 4800 bps				1: 4800 bps	
		3: 2400 bps				0: 2400 bps	
		4: 1200 bps					
H35	(Data length)	0: 8 bit	0	y15	(Data length)	0: 8 bit	0
		1: 7 bit				1: 7 bit	
H36	(Parity check)	0: None	0	y16	(Parity check)	0: None (2 stop bits)	0
		1: Even parity				1: Even parity (1 stop bit)	
		2: Odd parity				2: Odd parity (1 stop bit)	
H37	(Stop bits)	0: 2 bit	0	y17	(Stop bits)	0: 2 bit	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 Output Frequency 2	50 to 400 Hz	60	A01	Maximum Output 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)	0: (Output voltage proportional to source voltage)	200 (200 V class series)	A03	Rated Voltage at Base Frequency 2	0: AVR disabled 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 series)			80 to 240 V: (200 V class series), 160 to 500 V : (400 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
A04	Maximum Output Voltage 2	80 to 240 V: (200 V class), 320 to 480 V: (400 V class)		200 (200 V class series) 400 (400 V class series)	A04	Maximum Output Voltage 2	80 to 240 V: (200 V class series), 160 to 500 V : (400 V class series)	200 (200 V class series) 400 (400 V class series)
A05	Torque Boost 2	0.0: Auto torque boost	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
		0.1 to 0.9: Square law reduction torque			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						
		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
		0.0: Auto torque boost	H10 = 1 when the auto-energy saving operation is active		A13	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 2	5: Auto torque boost	1
		0.1 to 0.9: Square law reduction torque			A13	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 2	3: Variable torque load	1
					A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
		1.0 to 1.9: Proportional torque						
		2.0 to 20.0: Constant torque load			A13	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 2	4: Constant torque load	1
					A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
A06	Electronic thermal 2 (Mode selection)	0: Disable		1	A07	Electronic thermal 2 (Operation level)	0.00: Disable	Motor rated current
		1: Enable (for general-purpose motor)			A06	(Select motor characteristics)	1: Enable (For a general-purpose motor with shaft-driven cooling fan)	1
		2: Enable (for inverter motor)					2: Enable (For an inverter (FV) motor with separately powered cooling fan)	
A07	(Operation level)	20% to 135% of the rated current of the inverter		Motor rated current	A07	(Operation 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

* For the torque boost settings, refer to the conversion tables on pages A-71 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
A09	Torque Vector Control 2	0: Disable 1: Enable	0	A14	Drive Control Selection 2	0: V/f control with slip compensation inactive 1: Dynamic torque vector control	0
A10	Motor 2 (No. of poles)	2 to 14 poles	4	A15	Motor 2 (No. of poles)	2 to 22 poles	4
A11	(Rated capacity)	0.01 to 45.00 kW: 22 kW or below 0.01 to 500 kW: 30 kW or above	Depending on inverter capacity Depending on inverter capacity	A16	(Rated capacity)	0.01 to 1000 kW	Depending on inverter capacity
A12	(Rated current)	0.00 to 2000 A	Depending on inverter capacity	A17	(Rated current)	0.00 to 2000 A	Depending on inverter capacity
A13	(Auto-tuning)	0: Disable 1: Enable (Measure the %R1 and %X when the motor stops.) 2: Enable (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 the motor while it is stopped 2: Tune the motor while it is rotating under V/f control	0
A14	(Online tuning)	0: Disable 1: Enable	0				
A15	(No-load current)	0.00 to 2000 A	Depending on inverter capacity	A20	Motor 2 (No-load current)	0.00 to 2000 A	Depending on inverter capacity
A16	(%R1)	0.00 to 50.00%	Depending on inverter capacity	A21	(%R1)	0.00 to 50.00%	Depending on inverter capacity
A17	(%X)	0.00 to 50.00%	Depending on inverter capacity	A22	(%X)	0.00 to 50.00%	Depending on inverter capacity
A18	(Slip compensation control)	0.00 to 15.00 Hz	0.00	A23	(Slip compensation gain for driving)	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
				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)	Specify the rated slip frequency for the 0.00 to 15.00 Hz 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-curve Level at Acceleration	1 to 50%	10	H57	1st S-curve Acceleration Range (Leading edge)	0 to 100%	10
U03	2nd S-curve Level at Acceleration	1 to 50%	10	H58	2nd S-curve Acceleration Range (Trailing 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
U04	1st S-curve Level at Deceleration	1 to 50%	10	H59	1st S-curve Deceleration Range (Leading edge)	0 to 100%	10
U05	2nd S-curve Level at Deceleration	1 to 50%	10	H60	2nd S-curve Deceleration Range (Trailing edge)	0 to 100%	10
U08	Initial capacitance of DC link bus 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	Pt 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	Current Fluctuation Damping	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	Continuity of Running (I)	0 to 65535 (Integral time (ms) = 2^{16}/U23 setting data)	1738/1000	H93	Continuity of Running (I)	999: Standard value	999
U24	(P)	0 to 65535 (1.000 time = 4096)	1024/1000	H92	(P)	999: Standard value	999
U48	Input Phase Loss Protection	0 to 1: Enable 2: Disable	55 kW or below/75 kW or above 0/1	H98	Protection/Maintenance function (Mode selection)	Bit1=1 (Input phase loss protection operation enabled) Bit1=0 (Input phase loss protection operation disabled)	83
U49	RS-485 Protocol Selection	0: Fuji general-purpose inverter protocol 1: Modbus RTU protocol	0	y20	RS-485 Communication 2 (Protocol selection)	2: Fuji general-purpose inverter protocol 0: Modbus RTU protocol	0
U56	Speed Agreement/PG Error (Hysteresis 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 processing	0: Continue to run (PG error signal output) 1: Stop running (Immediately PG trip)	1	d23	PG error processing	0: Continue to run (PG error signal output) 2: Alarm stop 2	2
U59	Braking-resistor Function Select	Standard applied resistor (one resistor is used) 1: DB0.75 - 2C (100 Ω 200 W) 2: DB2.2 - 2C (40 Ω 400 W) 3: DB3.7 - 2C (33 Ω 400 W) 4: DB5.5 - 2C (20 Ω 800 W) 5: DB7.5 - 2C (15 Ω 900 W) 6: DB0.75 - 4C (200 Ω 200 W)	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/11 kW or above 0/OFF
				F51	(Allowable average loss)		0.001
				F52	(Resistance)		0.01

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
		7: DB2.2 - 4C (160 Ω 400 W) 8: DB3.7 - 4C (130 Ω 400 W) 9: DB5.5 - 4C (80 Ω 800 W)					
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: Disable (fixed)	0				
		0 to 2 (30 kW or above) 0: Disable 1: Voltage detect offset adjustment 2: Voltage detect gain adjustment	0				
* 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	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

vs. FRENIC5000P11S

(1/1)

<table>
<tr><th colspan="4">FRENIC5000P11S</th><th colspan="4">FRENIC-MEGA</th></tr>
<tr><th rowspan="2">Code</th><th rowspan="2">Name</th><th rowspan="2">Data setting range</th><th>Default setting</th><th rowspan="2">Code</th><th rowspan="2">Name</th><th rowspan="2">Data setting range</th><th>Default setting</th></tr>
<tr><th>22 kW or below/ 30 kW or above</th><th>22 kW or below/ 30 kW or above</th></tr>
<tr><td colspan="4">When replacing the FRENIC5000P11S with the FRENIC-MEGA, set the F80 data of the FRENIC-MEGA to the LD mode (data = 1).
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.</td><td>F80</td><td>Switching between HD, MD, and LD drive modes</td><td>1: LD (Low Duty) mode</td><td>0</td></tr>
<tr><td colspan="8">The function code replacement is basically the same as the "Function code compatibility table (vs. FRENIC5000G11S)" (the table above). However, the available setting ranges for the following codes differ depending on the P11S and LD modes.</td></tr>
<tr><td rowspan="3">F26</td><td rowspan="3">Motor sound (Carrier frequency)</td><td>0.75 to 15 kHz: Up to 22 kW</td><td rowspan="3">2</td><td rowspan="3">F26</td><td rowspan="3">Motor sound (Carrier frequency)</td><td>0.75 to 15 kHz: 18.5 kW or below
(Up to 16 kHz can be specified.)</td><td rowspan="3">2</td></tr>
<tr><td>0.75 to 10 kHz: 30 to 75 kW</td><td>0.75 to 16 kHz: 30 to 55 kW</td></tr>
<tr><td>0.75 to 6 kHz: 90 kW or above</td><td>0.75 to 10 kHz: 75 kW or above</td></tr>
</table>

■ Torque boost conversion tables

FRENIC5000G9S/P9S (22kW or below) vs. FRENIC-MEGA

Table G-10

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%	Note: 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)

App.

FRENIC5000G9S/P9S (30 kW or above) vs. FRENIC-MEGA

Table G-11

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%	Note: 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)

FRENIC5000G11S/P11S (22 kW or below) vs. FRENIC-MEGA

Table G-12

G11S/P11S	FRENIC-MEGA		Remarks
Data for F09	F37	F09	
0.1	0	1.8%	Adjust the torque boost using H50 and H51 as needed.
0.2		2.1%	
0.3		2.4%	
0.4		2.7%	
0.5		3.0%	
0.6		3.3%	
0.7		3.7%	
0.8		4.0%	
0.9		4.3%	
1.0	0	1.8%	Adjust the torque boost using H50 and H51 as needed.
1.1		2.1%	
1.2		2.3%	
1.3		2.6%	
1.4		2.9%	
1.5		3.2%	
1.6		3.4%	
1.7		3.7%	
1.8		4.0%	
1.9		4.3%	
2.0	1	0.0%	Note: 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)

App.

FRENIC5000G11S/P11S (30 kW or above) vs. FRENIC-MEGA

Table G-13

G11S/P11S	FRENIC-MEGA		Remarks
Data for F09	F37	F09	
0.1	0	1.8%	Adjust the torque boost using H50 and H51 as needed.
0.2		2.1%	
0.3		2.4%	
0.4		2.7%	
0.5		3.0%	
0.6		3.3%	
0.7		3.7%	
0.8		4.0%	
0.9		4.3%	
1.0	0	1.8%	Adjust the torque boost using H50 and H51 as needed.
1.1		2.1%	
1.2		2.3%	
1.3		2.6%	
1.4		2.9%	
1.5		3.2%	
1.6		3.4%	
1.7		3.7%	
1.8		4.0%	
1.9		4.3%	
2.0	1	0.0%	Note: 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)

App. H Precautions for Inverter Connection (When Using the Power Regenerative PWM Converters (RHC Series))

When using the RHC series to replace the target inverters listed below, it is necessary to change the way to connect the control power supply auxiliary input terminals ([R0] and [T0]) of the inverter. If the connection method is not changed, the new inverter may not operate properly.

[1] Target inverters

Table H-1

Target inverter (to be replaced)	New inverter (be replaced with)
<FRENIC-G11S series> • FRN30G11S-2, FRN30P11S-2 or higher • FRN30G11S-4, FRN30P11S-4 or higher <FRENIC-VG7S series> • FRN18.5VG7S-2, FRN18.5VG7S-4 or higher	FRENIC-MEGA series (FRENIC-VG series) (FRENIC-Eco series) (FRENIC-Ace series) (FRENIC-Lift series)

App.

[2] Changing the connection method (the control power supply auxiliary input terminals ([R0] and [T0])) of the inverter)

(1) RHC series: When using ■RHC7.5-2C to RHC90-2C, ■RHC7.5-4C to RHC220-4C

Connection Diagram of Target inverter (to be replaced)

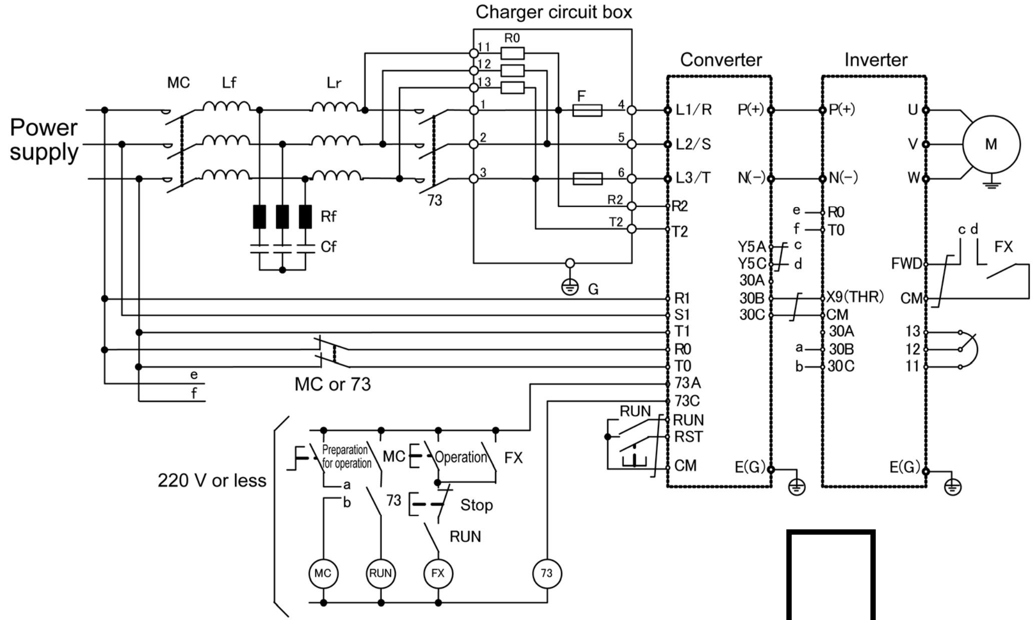

Figure H-1

Connection Diagram of New inverter (be replaced with)

Change the indicated connection.

1) Control power supply auxiliary input terminals ([R0] and [T0]) of the inverter
   Make sure to connect them to the main power supply via the b contact of the magnetic contactor for the power circuit (73 or MC).

2) Fan power supply auxiliary input terminals ([R1] and [T1]) of the inverter * For R1 and T1 terminal capacity only
   Make sure to connect them to the main power supply via the b contact of the magnetic contactor for the power circuit (73 or MC).

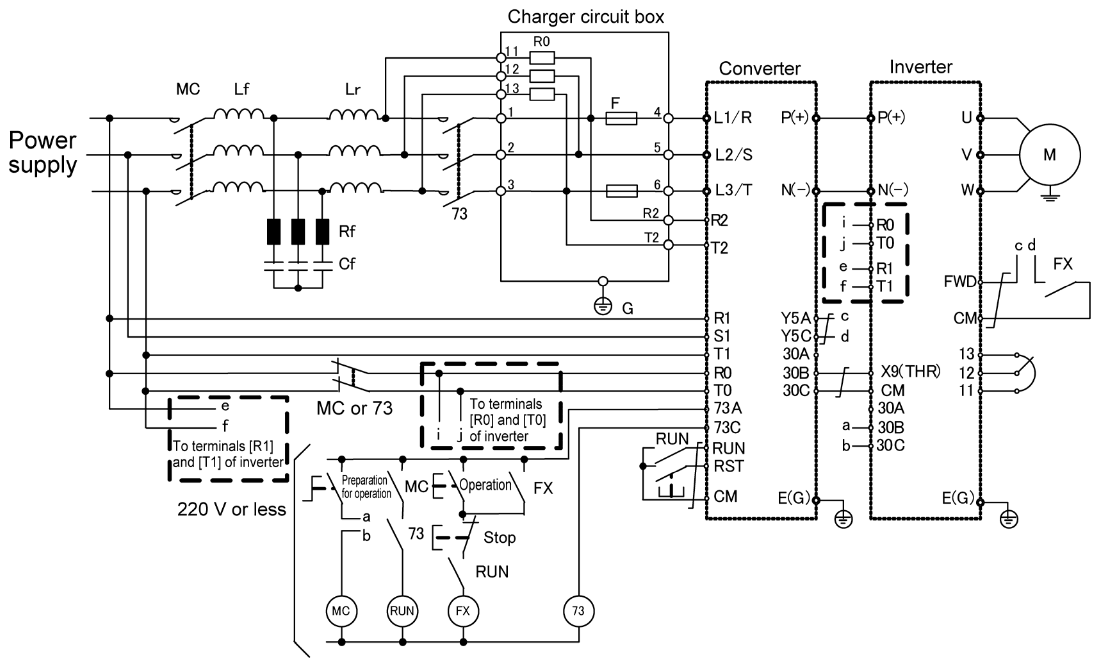

Figure H-2

(2) RHC series: When using ■RHC280-4C to RHC630-4C, ■RHC400-4C VT models
When using ■RHC500B to RHC800B-4C

Connection Diagram of Target inverter (to be replaced)

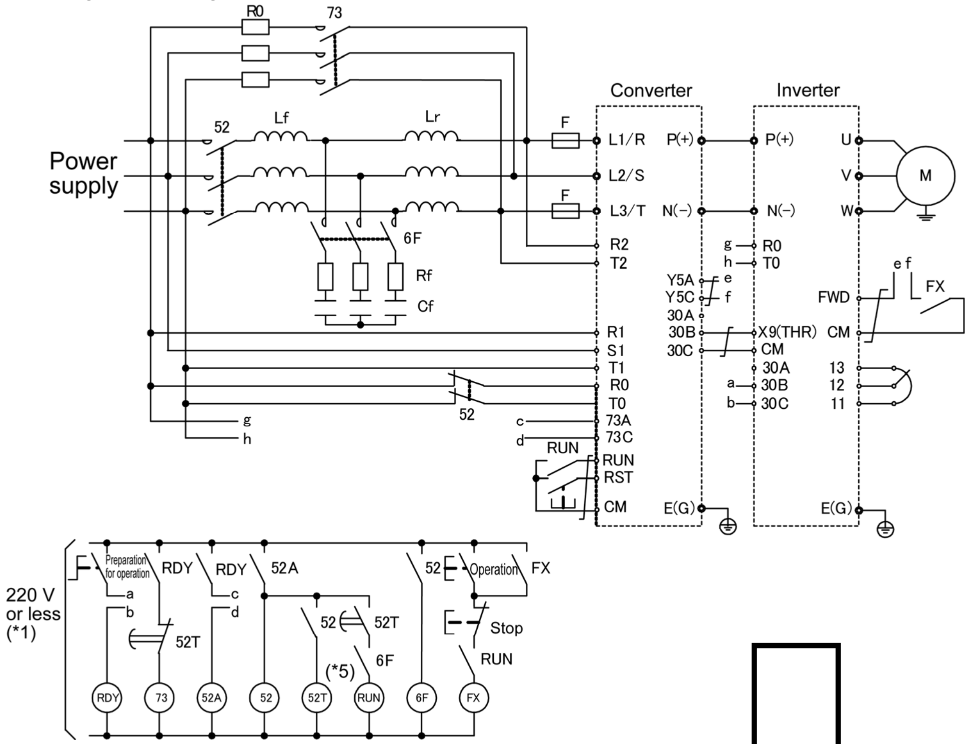

Figure H-3

Connection Diagram of New inverter (be replaced with)

Change the indicated connection.

1) Control power supply auxiliary input terminals ([R0] and [T0]) of the inverter
Make sure to connect them to the main power supply via the b contact of the magnetic contactor for the power circuit (52).

2) Fan power supply auxiliary input terminals ([R1] and [T1]) of the inverter * For [R1] and [T1] terminal capacity only
Make sure to connect them to the main power supply via the b contact of the magnetic contactor for the power circuit (73 or 52).

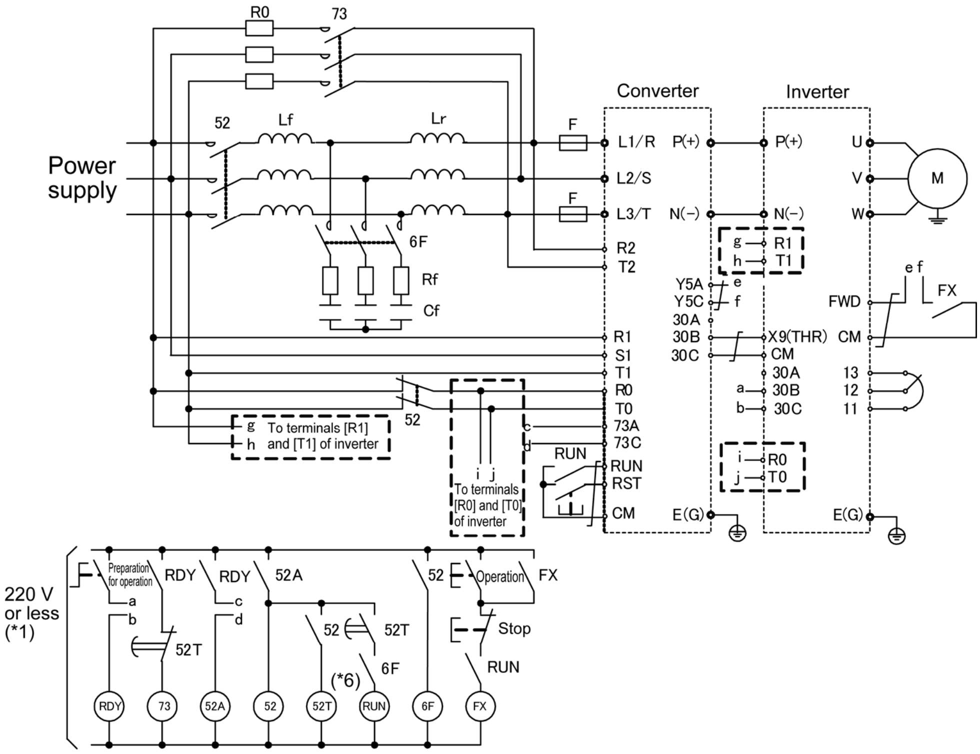

Figure H-4

High Performance, Multifunction Inverter

FRENIC-MEGA

User's Manual

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