Sumitomo Drive Technologies

HF-430NEO Series

High-performance Inverter
5.5～55kW/200V Class
5.5～55kW/400V Class

User's Guide

NOTICE

1. Make sure that this user's guide is delivered to the end user of inverter unit.
2. Read the instruction manual and user's guide before installing or operating the inverter unit, and store it in a safe place for reference.

Sumitomo Heavy Industries, Ltd. User's Guide DM3402E-1

Introduction

Thank you for purchasing HF-430NEO Inverter.
This is a guide that describes the handling and maintenance of HF-430NEO.

For the purpose of reduction paper consumption and provision of the latest information, we enclose the Instruction manual only, while providing the User's Guide for more detailed description through electronic means instead of CD or a printed document.

■About the Instruction manual (Bundled in product)

The Instruction manual provides the minimum information necessary for handling the product. Please make sure to read this document as well as the User's Guide for more detailed information.

■About the User's Guide (This document)

The User's Guide provides detailed information necessary for handling the product. Please make sure to read the User's Guide for proper use.
If future updated descriptions differ from the Instruction manual, the description in the User's Guide will have higher priority. Always use HF-430NEO strictly within the range described in the User’s Guide and perform proper inspection and maintenance to prevent failures or accidents.
The latest version of the User’s Guide can be obtained through our website. In case it is not available or cannot be downloaded, please contact the nearest sales office.

■Handling an optional products

If you use the inverter with optional products, you should also read the instruction enclosed in those products.

■For a proper use

Before using the inverter, please read carefully the Instruction manual, User’s Guide and each optional products instruction manuals.
In addition any personnel handling or performing maintenance of the product must read carefully the Instruction manual, User’s Guide and each optional products instruction manuals.

Before any attempt to install, operate, maintain or inspect this equipment, a complete understanding of the equipment specifications, safety instructions, precautions, handling and operation instructions is required. Please follow all the specifications and instructions for a proper use. Additionally, review the Instruction manual, User’s Guide and each optional product instruction manuals periodically.

■Precautions

It is prohibited to reproduce or reform this document partially or totally in any form without the publisher's permission.
The contents of the document are subject to change without prior notice.
Any handling, maintenance or operation method NOT described on the Instruction manual, User’s Guide and each optional product instruction manuals is not covered by the product warranty. Please DO NOT performs any procedure NOT described on HF-430NEO and optional product guides since it can be the cause of unexpected failures or accidents.
We are not responsible for any impact from operations regardless of unexpected failure or accident due to operation or handling of the product in a manner not specified on the Instruction manual, User’s Guide and each optional product instruction manuals. We appreciate your understanding.

Note that, in case the Instruction manual, User's Guide and each optional product instruction manuals are enclosed, they should be delivered to the end user of the inverter. Also make sure to download and keep accessible any other related guides or instruction for the end user.

Chapter 10 Test Run

Chapter 11 Examples of Settings by Operation Command

Chapter 12 Inverter Functions

Chapter 13 Information Monitor Functions

Chapter 14 RS485 Communication

Chapter 15 Optional Cassettes

Chapter 16 PC software SAFS002

Chapter 17 Connection with PLC

Chapter 18 Troubleshooting

Chapter 19 Maintenance and Inspection

Chapter 20 Specifications

Chapter 21 Technical Notes

Appendix

Chapter 1 Safety Instructions/Risks

1

1.1 What This Chapter Explains

This chapter includes instructions for installation, wiring, operation, maintenance, inspection and use of the inverter.
Be sure to read this User's Guide and appended documents thoroughly before installing, wiring, operating, maintaining, inspecting or using the inverter.

1.2 Types of Warnings

In the User's Guide, the severity levels of safety precautions and residual risks are classified as follows: "DANGER", "WARNING" and "CAUTION".

Meanings of the Displays

⚠ **DANGER**	Indicates that incorrect handling may cause hazardous situations, which have a high chance of resulting in serious personal injury or death, and may result in major physical loss or damage.
⚠ **WARNING**	Indicates that incorrect handling may cause hazardous situations, which may result in serious personal injury or death, and may result in major physical loss or damage.
⚠ **CAUTION**	Indicates that incorrect handling may cause hazardous situations, which may result in moderate or slight personal injury or damage, and may result in physical loss or damage alone.

Note that even a "⚠**CAUTION**" level situation may lead to serious danger according to circumstances. Be sure to follow every safety instruction, which contains important safety information.

The text includes notes using a safety symbol "⚠". Also be sure to pay attention to the meaning of this symbol to follow.

1.3 Description of Safety Symbols

The text includes notes using safety symbols.
Also be sure to pay attention to the meaning of each symbol to follow.

Meanings of the Symbols

<table>
<tr><td rowspan="3"></td><td colspan="2">Indicates a danger, warning or caution notice for fire, electric shock and high temperature in the operation of the product.
Details are indicated in or near △ by pictures or words.</td></tr>
<tr><td></td><td>The drawing on the left indicates "a non-specific and general danger or caution".</td></tr>
<tr><td></td><td>The drawing on the left indicates "a possible damage due to electric shock".</td></tr>
<tr><td></td><td colspan="2">Indicates "what you must not do" to prohibit the described acts in the operation of the product.</td></tr>
<tr><td></td><td colspan="2">Indicates "what you must do" according to the instructions in the operation of the product.</td></tr>
</table>

1.4 Cautions

1.4.1 Caution!

DANGER

Caution

Do

- Incorrect handling may result in personal death or severe injury, or may result in damage to the inverter, motor or the whole system.
- Be sure to read the Guide and appended documents thoroughly before installing, wiring, operating, maintaining, inspecting or using the inverter.

Caution

Do

- Notes for possible causes of danger or damage are also provided for each explanation in other sections.
- Be sure to read the corresponding explanation thoroughly before installing, wiring, operating, maintaining, inspecting or using the inverter.

Caution

Do

- Many of the drawings in the Guide show the inverter with covers and/or parts blocking your view removed to illustrate the details of the product.
- Do not operate the inverter in the status shown in those drawings. If you have removed the covers and/or parts, be sure to reinstall them in their original positions before starting operation, and follow all instructions in this guide when operating the inverter.

1.4.2 Precautions for installation

Warning

Fire

Prohibited

Do

- **Otherwise, you run the risk of fire.**

- Do not place flammable materials near the installed inverter.
- Prevent foreign matter (e.g., cut pieces of wire, sputtering welding materials, iron chips, wire, and dust) from entering the inverter.

- Install the inverter on a non-flammable surface, e.g., metal.
- Install the inverter in a well-ventilated indoor site not exposed to direct sunlight. Avoid places where the inverter is exposed to high temperature, high humidity, condensation, dust, explosive gases, and corrosive gases, flammable gases, grinding fluid mist, hydrogen sulfide or salt water.

Injury

Prohibited

- **Otherwise, you run the risk of injury.**

- Do not install and operate the inverter if it is damaged or parts are missing.

Fall Injury

- **Otherwise, you run the risk of injury due to the fall of an inverter.**

Prohibited

- - When carrying the inverter, do not hold its cover parts.

Do

- Install the inverter on a structure able to bear the weight specified in the User's Guide.
- Install the inverter on a vertical wall that is free of vibrations.

Failure

- **Otherwise, the inverter may fail.**

Prohibited

- The inverter is precision equipment. Do not allow it to fall or be subject to high impacts.
- Also do not step on it, or place a heavy load on it.
- Avoid places where static electricity discharges often occur (for example, on a rug) for the operation of the product.

Do

- In order to discharge static electricity from your body, touch a safe metal surface first before starting the operation.

1.4.3 Precautions for Wiring

DANGER

Electric shock Fire

- **Otherwise, you run the risk of electric shock or fire.**

Do

- Be sure to ground the inverter.
- Entrust wiring work to a qualified electrician.
- Before the wiring work make sure to turn off the power supply and wait for more than 10 or 15 minutes depending on the invertor model(*1) (Confirm than the charge lamp is OFF and the DC voltage between terminals P and N is 45V or less.)

Failure

- **Otherwise, the inverter may fail.**

Prohibited

- Do not pull the wire after wiring.

Electric shock Injury

- **Otherwise, you run the risk of electric shock and injury.**

Do

- Perform wiring only after installing the inverter.

Short circuit Ground fault

- **Otherwise, you run the risk of short circuit and ground fault.**

Prohibited

- Do not remove rubber bushings from the wiring section. Otherwise, the edges of the wiring cover may damage the wire.

⚠Warning

Injury Fire	● **Otherwise, you run the risk of injury or fire.**
Prohibited	• Do not connect AC power supply to any of the output terminals (U, V, and W).
Do	• Make sure that the voltage and frequency of AC power supply match the rated voltage (AC input voltage) and frequency of your inverter.

Electric shock Injury	● **Otherwise, you run the risk of electric shock and injury.**
Do	• Before operating the slide switch (SW*) in the inverter, be sure to turn off the power supply. • Since the inverter supports two modes of cooling-fan operation, the inverter power is not always off, even when the cooling fan is stopped. Before operating the switch, be sure to turn off the power supply and wait for more than 10 or 15 minutes depending on the invertor model(*1). (Confirm that the Charge lamp on the inverter is off and the DC voltage between terminals P and N is 45 V or less.) • Prevent the distribution cable from being compressed or getting caught to avoid damage to the cable.

Fire	● **Otherwise, you run the risk of fire.**
Prohibited	• Do not use a single-phase input. • Do not connect a resistor directly to any of the DC terminals (P1, P, and N). • Do not use the magnetic contactor installed on the primary and secondary sides of the inverter to stop its operation.
Do	• Tighten each screw and bolt to the specified torque. • No screws and bolts must be left loose. • Connect an earth-leakage breaker to the power input circuit. • Use only the power cables, earth-leakage breaker, and magnetic contactors that have the specified capacity (ratings).

Burnout	● **Otherwise, you run the risk of damage to the inverter and motor burnout.**
Prohibited	• Do not operate the inverter when an output phase is lost (output phase loss).

*1) For HF4322-5A5 to HF4322-022, HF4324-5A5 to HF4324-022 models the wait time is 10 minutes.
For HF4322-030 to HF4322-055, HF4324-030 to HF4324-055 models the wait time is 15 minutes

1.4.4 Precautions for Running and Test Running

DANGER

Electric shock
Fire
Prohibited

- **Otherwise, you run the risk of electric shock or fire.**
  - While power is supplied to the inverter, do not touch any internal part or the terminal of the inverter. Also do not check signals, or connect or disconnect any wire or connector.
  - While power is supplied to the inverter, do not touch any internal part of the inverter. Also do not insert a bar in it.

Electric shock
Prohibited

- **Otherwise, you run the risk of electric shock.**
  - Be sure to close the terminal block cover before turning on the inverter power. Do not open the terminal block cover while power is being supplied to the inverter or voltage remains inside. Do not touch the internal PCB, terminal block or connector while power is being supplied to the inverter or voltage remains inside.
  - Do not operate switches in the inverter or on the board with wet hands.

Injury
Fire
Prohibited

- **Otherwise, you run the risk of injury or fire.**
  - While power is supplied to the inverter, do not touch the terminal of the inverter, even if it has stopped.

Injury
Damage
Prohibited

- **Otherwise, you run the risk of injury and damage to the machine.**
  - Do not select the retry mode for controlling an elevating or traveling device because free-running status occurs in retry mode.

Injury
Prohibited
Do

- **Otherwise, you run the risk of injury.**
  - If the retry mode has been selected, the inverter will restart suddenly after a break upon detection of an error. Stay away from the machine controlled by the inverter when the inverter is under such circumstances. (Design the machine so that human safety can be ensured, even when the inverter restarts suddenly.)
  - - The [STOP] key on the operator keypad can be enabled/disabled using the [AA-13] STOP key and is effective only when the normal communication is established with the main unit. Prepare an emergency stop switch separately.
  - If an operation command has been input to the inverter before a short-term power failure, the inverter may restart operation after the power recovery. If such a restart may put persons in danger, design a system configuration that disables the inverter from restarting after power recovery.
  - If an operation command has been input to the inverter before the inverter enters alarm status, the inverter will restart suddenly when the alarm status is reset (by terminal, key operation or communication). Before resetting the alarm status, make sure that no operation command has been input.
  - When an unexpected event occurs, do not touch the inverter or cable.
  - Make sure to understand and check the functions the inverter provides to confirm safety. Be careful that operation commands or resetting operation do not cause an unexpected restart.
  - When an error (alarm) occurs, before moving to the next operation (resetting the alarm status or reapplying the power), make sure that no operation command has been input. If the inverter has received an operation command, it restarts automatically.

Warning

Injury Damage	**Otherwise, you run the risk of injury and damage to the machine.** • The inverter allows you to easily control the speed of the motor or machine operations. Before operating the inverter, confirm the capacity and ratings of the motor or machine controlled by the inverter. • When using the inverter to operate a motor at a high frequency, check the allowable motor speeds with the manufacturers of the motor and the machine to be driven and obtain their consent before starting inverter operation. • During inverter operation, check the motor for the direction of rotation, abnormal sound, and vibrations.
Burn injury Prohibited	**Otherwise, you run the risk of burn injury.** • Do not touch the heat sink, which heats up during the inverter operation.
Injury Do	**Otherwise, you run the risk of injury.** • Install an external brake system if needed.

1.4.5 Precautions for Maintenance/Daily Inspection

DANGER

Electric shock Do Prohibited	**Otherwise, you run the risk of electric shock.** • Before inspecting the inverter, be sure to turn off the power supply and more than 10 or 15 minutes depending on the invertor model(*1). (Confirm that the Charge lamp on the inverter is off and the DC voltage between terminals P and N is 45 V or less.) • Entrust only a designated person for maintenance, inspection, and the replacement of parts. (Be sure to remove wristwatches and metal accessories, e.g., bracelets, before maintenance and inspection work and to use insulated tools for the work.)

*1) For HF4322-5A5 to HF4322-022, HF4324-5A5 to HF4324-022 models the wait time is 10 minutes.
For HF4322-030 to HF4322-055, HF4324-030 to HF4324-055 models the wait time is 15 minutes

1.4.6 Precautions for disposal

DANGER

Injury Explosion	● **Otherwise, you run the risk of injury and explosion.**
Do	・For disposal of the inverter, outsource the disposal to a qualified industrial waste disposal contractor. Disposing of the inverter on your own may result in an explosion of the capacitor or produce poisonous gas. Contact us or your distributor for fixing the inverter. ・A qualified waste disposer includes “industrial waste collector/transporter” and “industrial waste disposal operator”. Follow the procedures stipulated in the “Waste Management and Public Cleansing Act” for disposing of the inverter.

1.4.7 Other Cautions

DANGER

Electric shock Fire Injury	● **Otherwise, you run the risk of electric shock, fire and injury.**
Prohibited	・ Never modify the inverter.

* For risks other than the above, also refer to “Chapter 8 Operation Check”.

Caution

Life cycle	● **Otherwise, you run the risk of significantly shortening the life cycle of the product.**
Do	・ If wood materials for packaging are needed to be sterilized and disinfected, make sure to use a means other than the wood fumigation method. If the product is included in the fumigation treatment, electronic parts could receive critical damage from the emitted gases or vapors. Especially, halogen disinfectants (including fluorine, chlorine, bromine and iodine) can cause corrosion in the capacitor.

1.5 Compliance to European Directive (CE)

1.5.1 CAUTION for EMC (Electromagnetic Compatibility)

HF-430NEO inverter conforms to requirements of the Electromagnetic Compatibility (EMC) Directive (2014/30/EU). However, when using the inverter in Europe, you must comply with the following specifications and requirements to meet the EMC Directive and other standards in Europe:

⚠ WARNING: This equipment must be installed, adjusted, and maintained by qualified engineers who have expert knowledge of electric work, inverter operation, and the hazardous circumstances that can occur. Otherwise, personal injury may result.

1. Power supply requirements
   a. Voltage fluctuation must be -15% to +10% or less.
   b. Voltage imbalance must be ±3% or less.
   c. Frequency variation must be ±4% or less.
   d. Total harmonic distortion (THD) of voltage must be ±10% or less.

2. Installation requirement
   a. SJ series P1 includes a built-in EMC filter. The built-in EMC filter must be activated.
   b. According to EN61800-3 it is mandatory to mention that any inverter with only C3 filter inside may NOT be connected to a low voltage public power supply in residential areas since for these installations C1 is required.
   c. In case of external filter for C2, an additional note is required according to EN61800-3 that “this product may emit high frequency interference in residential areas which may require additional EMC measures”.
   d. According to the EN6100-3-12, an additional AC reactor or DC choke should be installed for reducing harmonics in power line.

3. Wiring requirements
   a. A shielded wire (screened cable) must be used for motor wiring, and the length of the cable must be according to the following table (Table 1 on page 1-12).
   b. The carrier frequency must be set according to the following table to meet an EMC requirement (Table 1 on page 1-12).
   c. The main circuit wiring must be separated from the control circuit wiring.

4. Environmental requirements
   (to be met when a filter is used)
   a. HF-430NEO inverter that is an activated built-in EMC filter must be according to HF-430NEO specifications.

Table 1

<table>
<tr><th>Model</th><th>Cat.</th><th>Cable length</th><th>Carrier frequency</th><th>Model</th><th>Cat.</th><th>Cable length</th><th>Carrier frequency</th></tr>
<tr><td>HF4322-5A5</td><td rowspan="9">C3</td><td rowspan="3">5m</td><td rowspan="3">2kHz</td><td>HF4324-5A5</td><td rowspan="9">C3</td><td rowspan="3">5m</td><td rowspan="9">2kHz</td></tr>
<tr><td>HF4322-7A5</td><td>HF4324-7A5</td></tr>
<tr><td>HF4322-011</td><td>HF4324-011</td></tr>
<tr><td>HF4322-015</td><td rowspan="2">10m</td><td rowspan="2">1kHz</td><td>HF4324-015</td><td rowspan="2">10m</td></tr>
<tr><td>HF4322-022</td><td>HF4324-022</td></tr>
<tr><td>HF4322-030</td><td rowspan="4">5m</td><td rowspan="4">2kHz</td><td>HF4324-030</td><td rowspan="4">5m</td></tr>
<tr><td>HF4322-037</td><td>HF4324-037</td></tr>
<tr><td>HF4322-045</td><td>HF4324-045</td></tr>
<tr><td>HF4322-055</td><td>HF4324-055</td></tr>
</table>

1.6.2 Caution for Machinery Directive (Functional Safety)

HF-430NEO series conforms to STO (Safe Torque Off) defined in Functional Safety IEC 61800-5-2.

1.6 Compliance to UL standards

UL CAUTION

GENERAL:

HF-430NEO inverter is an open type AC Inverter with three phase input and three phase output. It is intended to be used in an enclosure. It is used to provide both an adjustable voltage and adjustable frequency to the AC motor. The inverter automatically maintains the required Volts-Hz ratio allowing the capability through the motor speed range. It is a multi-rated device and the ratings are selectable according to load types by operator with key pad operation.

Markings:

Maximum Surrounding Temperature:

- ND (Normal Duty) : 50degC
- LD (Low Duty) : 45degC
- VLD (Very Low Duty): 40degC

Storage Environment rating:

- 65degC (for transportation)

Instruction for installation:

- pollution degree 2 environment and Overvoltage category III

Electrical Connections:

- See [7.5 Connect Wire to the Main Circuit Terminal Block] of the User's Guide.

Interconnection and wiring diagrams:

- See [7.7 Control Circuit Terminal Area] of the User's Guide.

Short circuit rating and overcurrent protection device rating:

200V class models

- Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 240 V maximum".

400V class models

- Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 500 V maximum".

Integral:

- 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.

Field wiring terminal conductor size and Torque Values making for field wiring terminal:

<table>
<tr><th>Model</th><th>Load Type</th><th>Required Torque (N.m)</th><th>Conductor size (AWG)</th><th>Model</th><th>Load Type</th><th>Required Torque (N.m)</th><th>Conductor size (AWG)</th></tr>
<tr><td rowspan="3">HF4322-5A5</td><td>VLD</td><td rowspan="6">3</td><td rowspan="3">8</td><td rowspan="3">HF4324-5A5</td><td>VLD</td><td rowspan="6">3</td><td>10</td></tr>
<tr><td>LD</td><td>LD</td><td rowspan="2">12</td></tr>
<tr><td>ND</td><td>ND</td></tr>
<tr><td rowspan="3">HF4322-7A5</td><td>VLD</td><td>6</td><td rowspan="3">HF4324-7A5</td><td>VLD</td><td>8</td></tr>
<tr><td>LD</td><td rowspan="2">8</td><td>LD</td><td rowspan="2">10</td></tr>
<tr><td>ND</td><td>ND</td></tr>
<tr><td rowspan="3">HF4322-011</td><td>VLD</td><td rowspan="3">4</td><td rowspan="2">4</td><td rowspan="3">HF4324-011</td><td>VLD</td><td rowspan="9">4</td><td rowspan="6">8</td></tr>
<tr><td>LD</td><td>LD</td></tr>
<tr><td>ND</td><td>6</td><td>ND</td></tr>
<tr><td rowspan="3">HF4322-015</td><td>VLD</td><td rowspan="3">2.5 – 3.0</td><td rowspan="2">3</td><td rowspan="3">HF4324-015</td><td>VLD</td></tr>
<tr><td>LD</td><td>LD</td></tr>
<tr><td>ND</td><td>4</td><td>ND</td></tr>
<tr><td rowspan="3">HF4322-022</td><td>VLD</td><td rowspan="3">5.5 – 6.6</td><td>2/0</td><td rowspan="3">HF4324-022</td><td>VLD</td><td rowspan="2">4</td></tr>
<tr><td>LD</td><td>1/0</td><td>LD</td></tr>
<tr><td>ND</td><td>1</td><td>ND</td><td>6</td></tr>
<tr><td rowspan="3">HF4322-030</td><td>VLD</td><td rowspan="3">6.0</td><td>Parallel of 1/0</td><td rowspan="3">HF4324-030</td><td>VLD</td><td rowspan="3">6</td><td>1</td></tr>
<tr><td>LD</td><td>Parallel of 1/0</td><td>LD</td><td>2</td></tr>
<tr><td>ND</td><td>2/0</td><td>ND</td><td>3</td></tr>
<tr><td rowspan="3">HF4322-037</td><td>VLD</td><td rowspan="2">6.0 – 10.0</td><td>Parallel of 1/0</td><td rowspan="3">HF4324-037</td><td>VLD</td><td rowspan="3">15.0</td><td rowspan="3">1</td></tr>
<tr><td>LD</td><td>Parallel of 1/0</td><td>LD</td></tr>
<tr><td>ND</td><td>15.0</td><td>4/0</td><td>ND</td></tr>
<tr><td rowspan="3">HF4322-045</td><td>VLD</td><td rowspan="3">6.0 – 10.0</td><td>Parallel of 2/0</td><td rowspan="3">HF4324-045</td><td>VLD</td><td rowspan="3">15.0</td><td>1/0</td></tr>
<tr><td>LD</td><td>Parallel of 1/0</td><td>LD</td><td>1/0</td></tr>
<tr><td>ND</td><td>Parallel of 1/0</td><td>ND</td><td>1</td></tr>
<tr><td rowspan="3">HF4322-055</td><td>VLD</td><td rowspan="3">10.0 – 12.0</td><td>Parallel of 3/0</td><td rowspan="3">HF4324-055</td><td>VLD</td><td>6.0 – 10.0</td><td>Parallel of 1/0</td></tr>
<tr><td>LD</td><td>Parallel of 3/0</td><td>LD</td><td rowspan="2">15.0</td><td>2/0</td></tr>
<tr><td>ND</td><td>350kcmil</td><td>ND</td><td>1/0</td></tr>
</table>

・The temperature rating of field wiring installed conductors is only 75degC.
Use Copper conductors only.

Required protection by Fuse and circuit-breakers:

■200V class

Model	Fuse			Circuit Breaker	
	Type	Maximum Rating		Maximum Rating	
		Voltage (V)	Current (A)	Voltage (V)	Current (A)
HF4324-5A5	Class J or T	600	100	600	50
HF4324-7A5			150		60
HF4324-011					75
HF4324-015					100
HF4324-022			200		175
HF4324-030			300		200
HF4324-037					250
HF4324-045			400		300
HF4324-055			500		350

■400V class

Model	Fuse			Circuit Breaker	
	Type	Maximum Rating		Maximum Rating	
		Voltage (V)	Current (A)	Voltage (V)	Current (A)
HF4324-5A5	Class J or T	600	75	600	20
HF4324-7A5					30
HF4324-011					40
HF4324-015			100		50
HF4324-022					75
HF4324-030			200		100
HF4324-037					125
HF4324-045					150
HF4324-055			250		200

Chapter 2 Handling of this User’s Guide

2

2.1 What This Chapter Explains

This chapter includes explanations of applicable products, knowledge required for reading the Guide, those who should read the Guide, and the purpose, overview and glossary of the Guide.

2.2 Applicable Products

The contents of this guide are applicable to HF-430NEO.
Refer to the corresponding instruction manuals for other products and optional parts.

2.3 Before Reading the Guide

The Guide is meant to be read by those who have knowledge of electricity (certified electrician or equivalent) and those who are in charge of introduction, installation or connection of control equipment, system design and workplace management.
The Guide is written in SI units.

2.4 Purpose of the Guide

The Guide is meant to provide necessary information for the following:

- Installation and wiring of the product;
- Parameter settings;
- Running and test running; and
- Maintenance and inspection

2.5 Glossary

*Note concerning trademarks
Proper names such as the product name and function names mentioned in the Guide may be used by each company as its trademark or registered trademark. In this guide, no ® and TM symbols are used.

Name	Description
Basic Guide	Basic instruction manual including only information required for handling the inverter.
Braking resistor	A power consuming resistor connected to a regenerative unit.
Charge lamp	Indicate the status of power input to the main circuit of the inverter. Power remains when the lamp is lit even after the power is off.
Intelligent (relay) output terminal	Multi-functional contact output terminal. Multiple functions are available according to settings.
Intelligent input terminal	Multi-functional contact input terminal. Multiple functions are available according to settings.
Inverter model	The model indicated on the specification label of the inverter.
Main circuit power supply	Power supply required for running the inverter.
Open phase	A part of the power line is down, leading to unstable input/output.
Operator keypad	A control panel on the front side to operate the inverter.
Optional cassette	A cassette-type optional part to be loaded in the slot on the front side of the product.
Potentiometer	A regulating device with a variable resistor. Connect to the analog input terminal.
Power supply for control circuit	Power supply required for settings using the operator keypad. Control circuit is supplied with power via r1 and t1 or P+ and P-.
Regenerating	Returning of power generated in the motor to the inverter when fans are rotated by wind or the motor speed is decreased.
Regenerative converter	An optional element to return regenerated power to the power supply. Significantly reduce harmonic current.
Regenerative braking unit	Consume regenerated power with a separately-placed braking resistor.
Sink logic	Logic to turn a signal on by a current that flows out of the signal input terminal. This varies depending on systems.
Source logic	Logic to turn a signal on by a current that flows into the signal input terminal. This varies depending on regions or systems.
Specification label	A label on the side the product, on which the specifications of the inverter are indicated.
User's Guide	Instruction manual including detailed information required for handling the inverter.

Name	Description
CE logo	A logo used on the product that meets the requirements of the applicable EC directives. This is required for products sold within the European Economic Area.
EMC	Electromagnetic compatibility Properties that neither cause errors in other equipment nor cause errors due to noise.
IGBT	Insulated gate bipolar transistor One of switching devices of the inverter.
IM	Induction motor
I/O	Input/output
LAD	Lead to acceleration and deceleration. Accelerate or decelerate the motor.
LD rated	Low duty: A type of load rating that indicates overload capacity. This can drive a higher current motor than ND but has a relatively lower overload capacity. This can be used for low load capacity.
MFG No.	Manufacturing No.
ND rated	Normal Duty: A type of load rating that indicates overload capacity. Generally this is used in severe load conditions.
PLC	Programmable logic controller
PMM	Permanent magnet synchronous motor PM motor. PM stands for permanent magnet.
PWM	Pulse Width Modulation Pulse output method of the inverter.
RTU	Remote terminal unit. The Modbus protocol name here.
SM	Synchronous motor. PMM is a type of SM.
VLD rated	Very low duty: A type of load rating that indicates overload capacity. This can drive a higher current motor than LD but has a relatively lower overload capacity. This can be used for lower load capacity than LD.

3

Chapter 3 Preparation of Operation

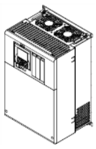
3.1 What This Chapter Explains

This chapter provides an operational process (flow) to do a test run.
For installation, wiring and settings for operation and detailed information of inverter functions, see the corresponding sections.
Make sure to carefully read “Chapter 1 Safety Instructions/Risks” and corresponding sections for safety work.

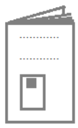
3.2 Flow for Preparation of Operation

3.2.1 Check the Inverter

Check the contents in the package, and also check the model of your inverter on the specification label.
See “Chapter 4 Main Body of the Product” and “Chapter 5 Included Items” for details.

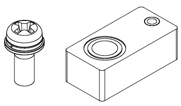


HF-430NEO



Instruction Manual

Included items that vary depending on models (enclosed in the package)



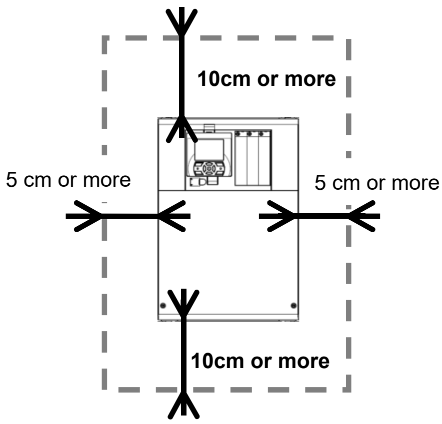
Available only for HF4322-022

Eye bolts for hanging the inverter
HF4322-037 to HF4322-055
HF4324-037 to HF4324-055

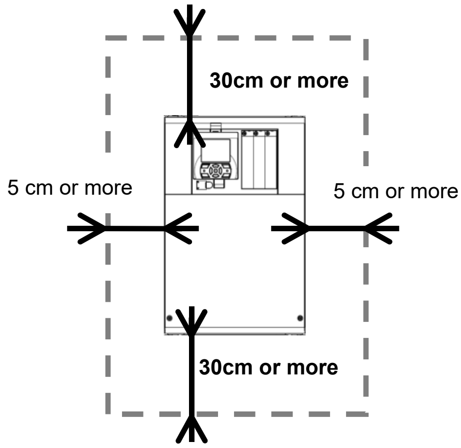
3.2.2 Install the Inverter

Install the inverter. Leave sufficient space around the inverter for enough ventilation.
See “Chapter 6 Installation” for details.

For HF4322-5A5 to HF4322-022, HF4324-5A5 to HF4324-022



For HF4322-030 to HF4322-055, HF4324-030 to HF4324-055

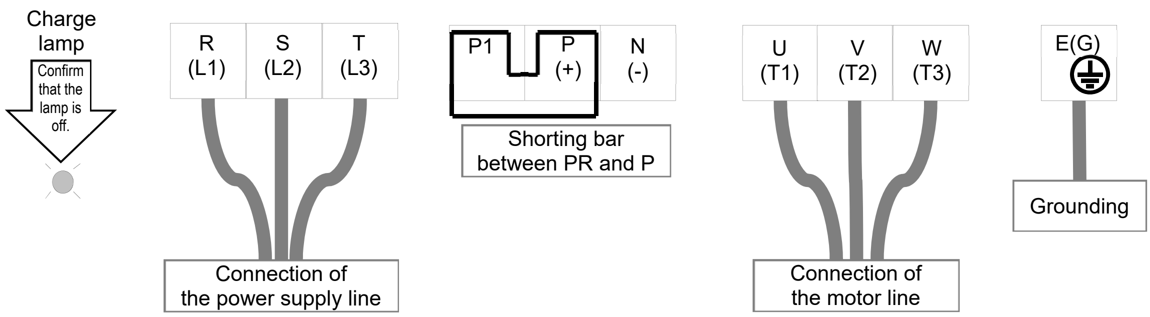


A clearance of 22 cm or more is required below the inverter to replace aged parts for the following models:
HF4322-5A5 to HF4322-022 : HF4324-5A5 to HF4324-022
The inverter needs to be removed to replace aged parts for the following models:
HF4322-5A5 to HF4322-011 : HF4324-5A5 to HF4324-011

3.2.3 Wire the Inverter to Check the Power Supply

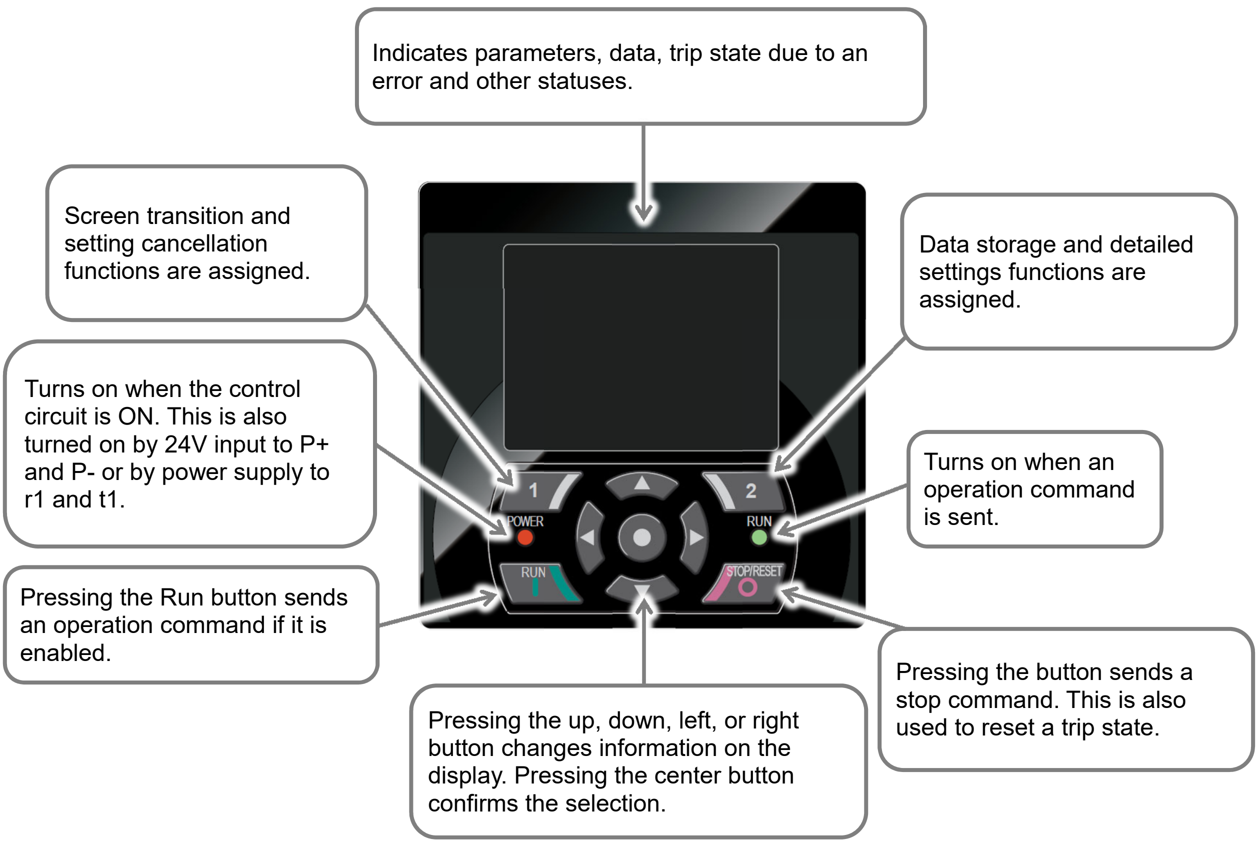
- Wire the main circuit of the inverter.
- Before supplying the power, make sure to carefully read the safety instructions and be aware of your safety. The following illustration shows the power supply and wiring connections to a motor only.
- Follow the following steps to prevent miss wiring.
- See "Chapter 1 Safety Instructions", "Chapter 7 Wire Connection and Optional Devices" and "Chapter 11 Examples of Settings by Operation Command Destination" for details.
  *Allocation of terminals varies depending on models.
  *This example shows a state with a J51 connector connected.

(1) Check the position of the charge lamp and make sure that the lamp is turned off.
(2) Connect the inverter to the ground (G) and power supply line (R,S,T), and close the front cover.
(3) Turn on the power and confirm that the POWER lamp on the operator keypad is lit.
(4) Turn off the power.
(5) Make sure that the charge lamp is off and that the voltage between P and N is 45Vdc or less.
(6) Connect the inverter to the motor line (U,V,W), and close the front cover.
(3) Turn on the power to operate the operator keypad.



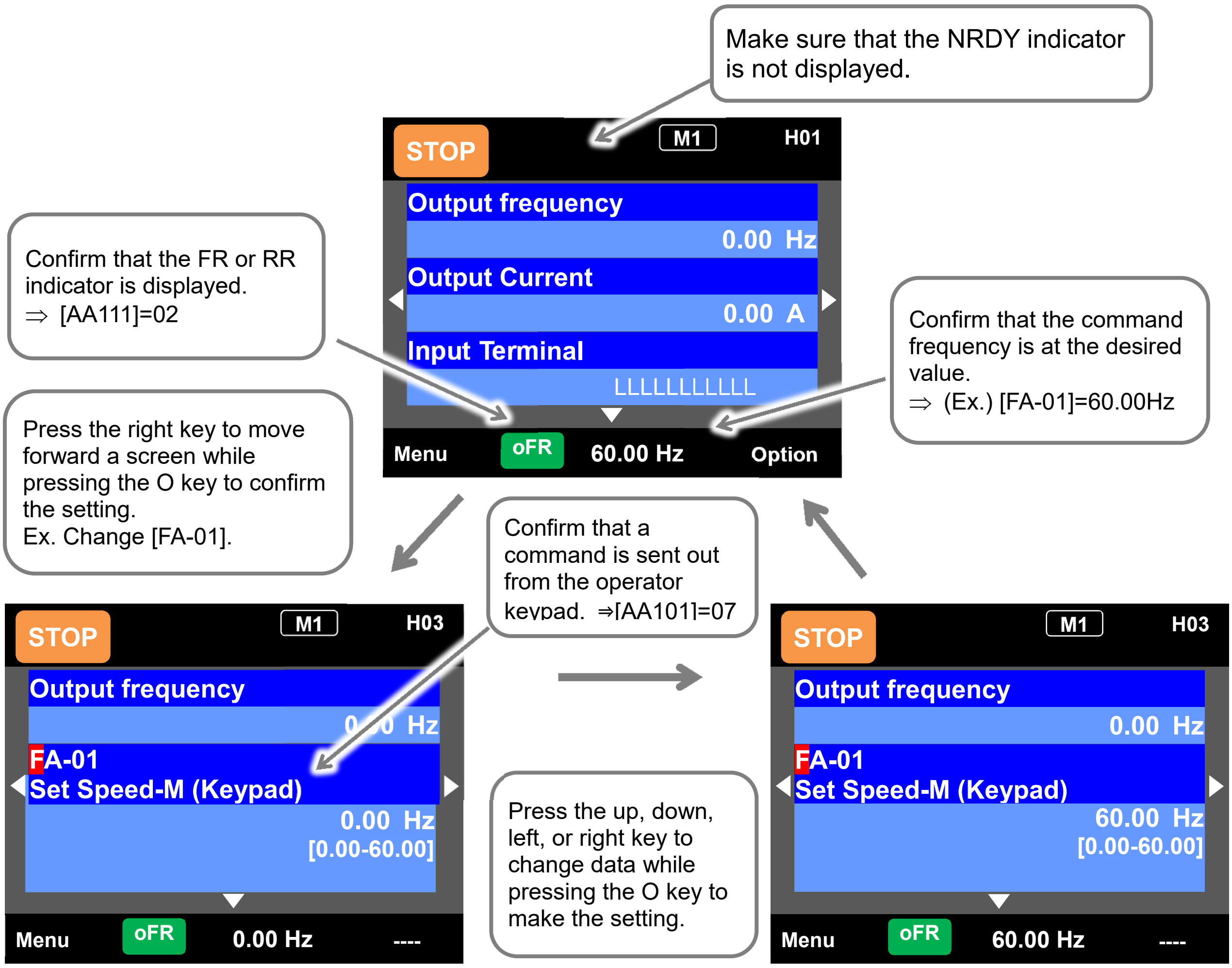
3.2.4 Operate the Operator Keypad

Confirm how to operate the operator keypad.
See "Chapter 9 Operating Instructions" for details.



3.2.5 Prepare for Rotating the Motor

Only operating procedures using the operator keypad are shown here.
Refer to "Chapter 10 Test Runs" for details.



Ready to operate! Press the Run button to accelerate the motor.

3.2.6 Troubleshooting

The motor does not rotate!
An error indication appears on the inverter.
See "Chapter 18 Troubleshooting".

How to operate the operator keypad.
See "Chapter 9 Operating".

How to reduce noise, suppress harmonics and increase regenerative potential.
See "Chapter 7 Wire Connection and Optional Devices".

How to run our inverter using external signals.
See "Chapter 10 Test Run" and "Chapter 11 Examples of Settings by Operation Command Destination".

How to run our inverter with communications.
See "Chapter 14 RS485 Communication".

How to use the inverter functions.
How to monitor the operating status.
See "Chapter 12 Inverter Functions" and "Chapter 13 Information Monitoring Functions".

4

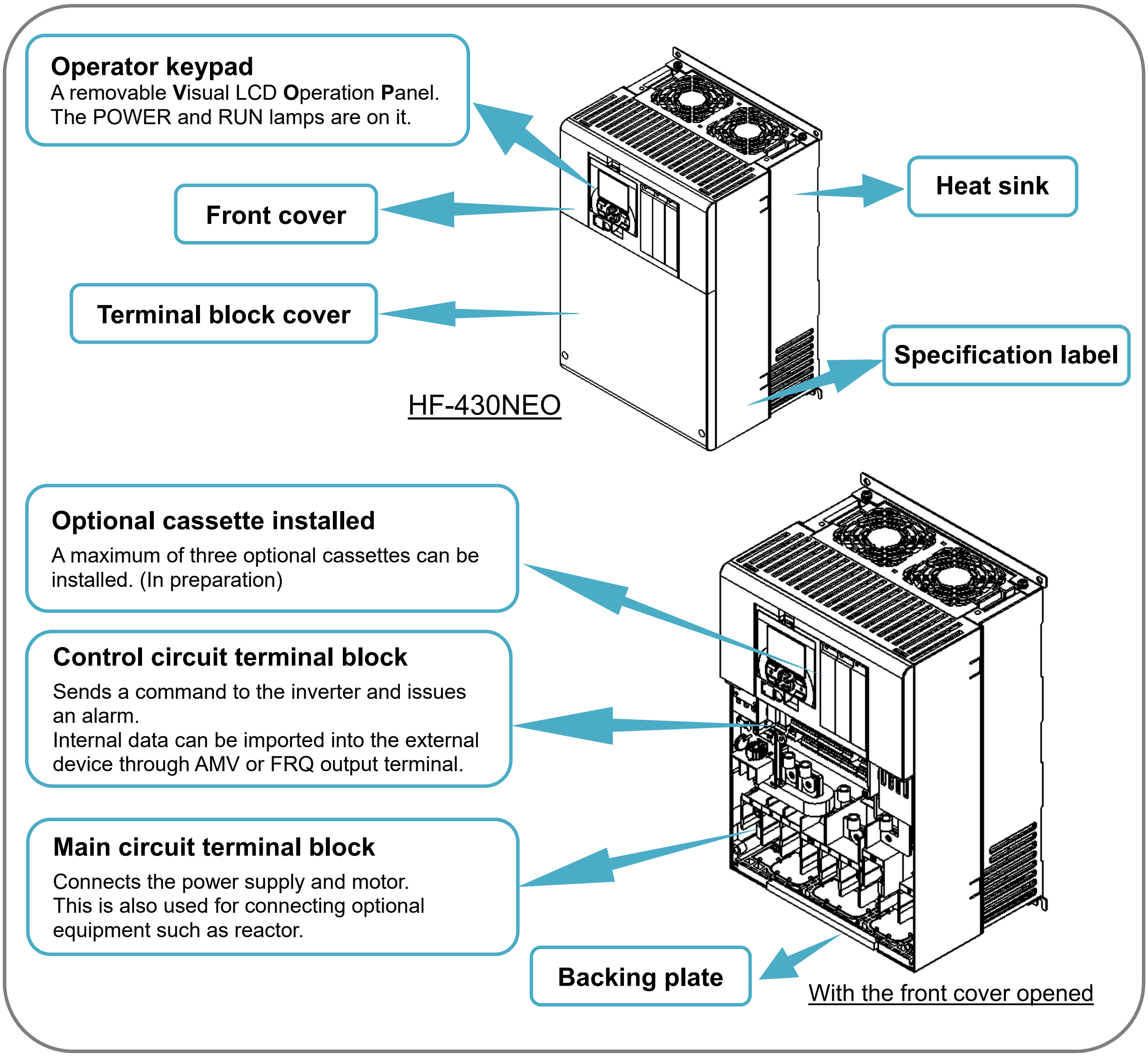
Chapter 4 Product

4.1 What This Chapter Explains

The chapter provides explanations of the inverter of the product.
The explanations include: the external appearance and model of the product, what's written on the specification label and inspection instruction upon purchase.

4.2 External Appearance of the Product

This chapter describes the product nameplate etc. In this chapter, there are some figures with the front cover removed for illustration.
* An example of HF4322-5A5



4.3 Model of the Product and Specification Label

4.3.1 Model of the Product

The unit number of the product is as follows:

HF432	4	-	5	A	5
(1)	(2)		(3)		

(3) Applicable motor

5A5 : 5.5kW	030 : 30kW
7A5 : 7.5kW	037 : 37kW
011 : 11kW	045 : 45kW
015 : 15kW	055 : 55kW
022 : 22kW	

(2) Input power specification

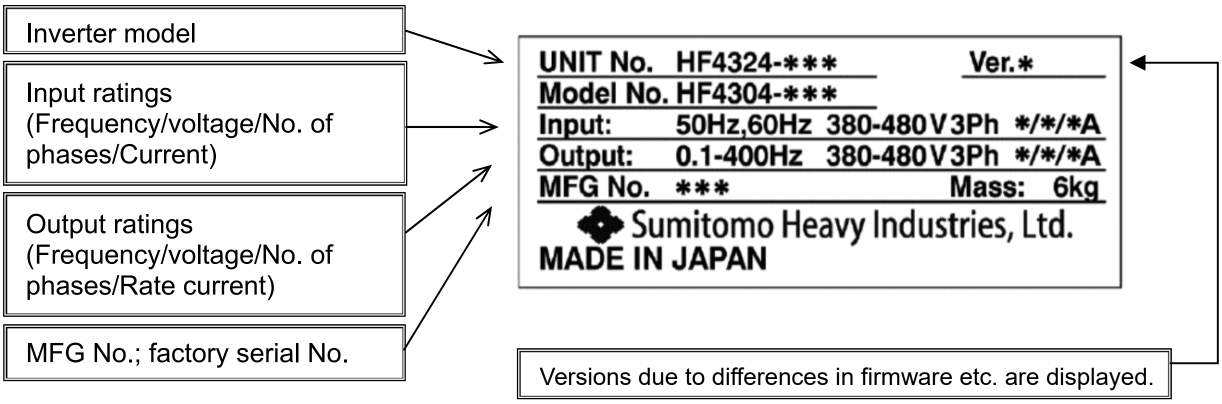
2 : Three-phase 200V class
4 : Three-phase 400V class

(1) Series name HF-430NEO

4.3.2 Specification Label

・The model of the product is indicated on the specification label on the side of the product. The details on the specification label are as follows:

・Specification label example



5

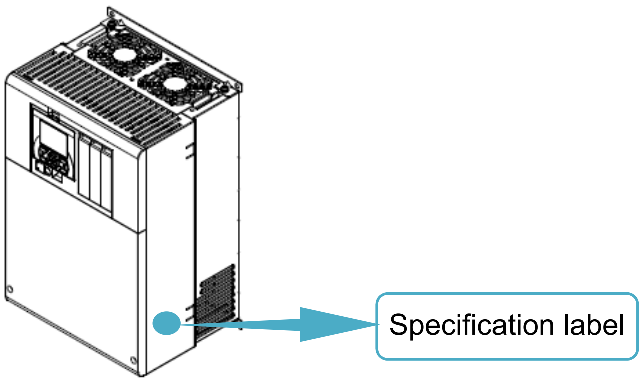
Chapter 5 Included Items

5.1 What This Chapter Explains

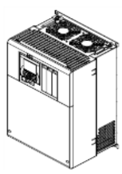
This chapter describes included items that need to be checked upon purchase.

5.2 Included Items

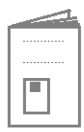
- Check included items.
  The following is included in the package:



- Included Items

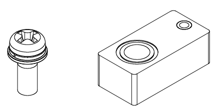


HF-430NEO



Instruction Manual
(Supplementary instructions and/or etc may be bundled in some cases.)

- Included items that vary depending on models (enclosed in the package)



* Available only for HF4322-022
M3×8 screw: 4
Spacer: 4

Eye bolts for hanging the inverter
HF4322-037 to HF4322-055
HF4324-037 to HF4324-055

Inverter HF-430NEO
Confirm that the model you ordered and the model name on the specification label are the same.
Find an inverter in the package.

Instruction Manual
Enclosed as a booklet. Following this guide allows you to do a test run and set simple settings.

Caution
- Applying a different inverter voltage class or motor rated voltage from the specified input power voltage may lead to damage to your inverter or motor burnout.

Do
- Check with the specification label to be sure that the inverter voltage class is correct.

* See “4.3.2 Specification Label”.

5.3 Inspection upon Purchase

5.3.1 Checking When Opening the Package

- Check the items on the right when you open the package.
- If you find any faults or defects in the product or have any question about the product, contact your supplier or our sales department shown on the back cover.

5.3.2 User’s Guide (this Guide)

- The Guide describes how to handle and maintain HF-430NEO.
  Read the Guide carefully before using the inverter. Keep the “User’s Guide” at hand.
- If you use the inverter with optional products, you should also read the instruction manuals enclosed with those products.
- Note that the instruction manuals for each optional product to be used should be delivered to the end user of the inverter. For the User’s Guide and instruction manual, download the latest version.

✔ Check the product for damage (including falling of parts and dents in the inverter) caused during transportation.

✔ Upon opening the product package, check that the package contains an inverter set and the Instruction Manual.

✔ Check the specification label again to confirm that the product is the one you have ordered.

Chapter 6 Installation

6

6.1 What This Chapter Explains

This chapter describes the installation of the inverter. Before installing the inverter, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

6.2 Installation Environment

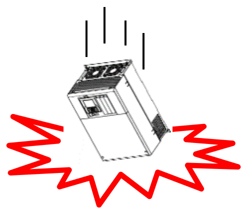
◆ Transportation

The inverter uses plastic parts. When carrying the inverter, handle it carefully to prevent damage to the parts.

Do not carry the inverter by holding the front or terminal block cover.
Doing so may cause the inverter to fall.

Fall

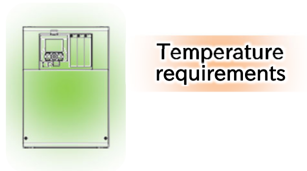
Do not install and operate the inverter if it is damaged or parts are missing.



◆ Ambient temperature

Avoid installing the inverter in a place where the ambient temperature goes above or below the allowable range, as defined by the standard inverter specification.

Leave sufficient space around the inverter.
Measure the temperature in a position about 5 cm from the bottom-center point of the inverter, and check that the measured temperature is within the allowable range.
Operating the inverter at a temperature outside this range will shorten the inverter life (especially the capacitor life).

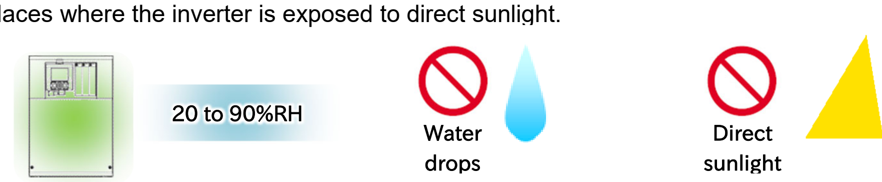


* Temperature requirements vary depending on the “Load type selection [Ub-03]”.
See “Chapter 20 Specifications”.
Carrier derating may be required.

◆ Humidity

Avoid installing the inverter in a place where the relative humidity goes above or below the allowable range (20% to 90% RH), as defined by the standard inverter specification. Avoid a place where the inverter is subject to condensation.

Condensation inside the inverter will result in short circuits and malfunctioning of electronic parts. Also avoid places where the inverter is exposed to direct sunlight.



◆ Ambient air

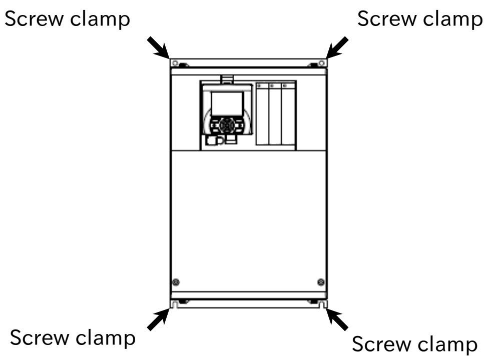
Avoid installing the inverter in a place where the inverter will be subject to dust, water drops, corrosive gases, combustible gases, flammable gases, grinding fluid mist, or salt water.

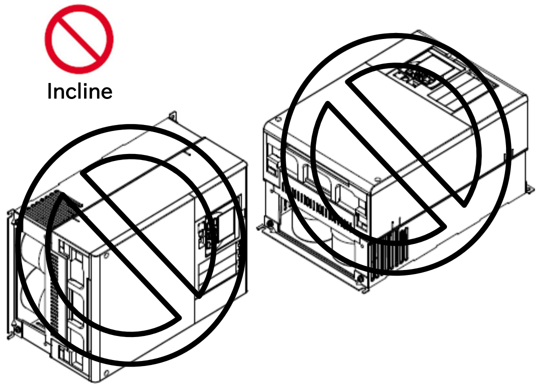
Foreign particles entering the inverter will cause it to fail. If you use the inverter in a considerably dusty environment, install the inverter inside a totally enclosed panel.

◆ Installation method and position

Install the inverter vertically and securely with screws or bolts on a surface that can bear the inverter weight and is free from vibrations.

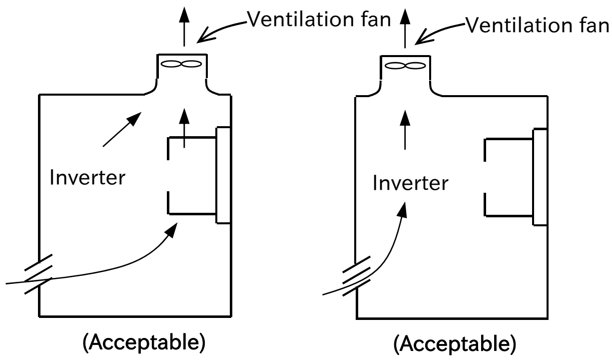
If the inverter is not installed vertically, its cooling performance may be degraded and tripping or inverter damage may result.





◆ Mounting in an enclosure

When mounting multiple inverters in an enclosure with a ventilation fan, carefully design the layout of the ventilation fan, air intake port, and inverters. An inappropriate layout will reduce the inverter-cooling effect and raise the ambient temperature. Plan the layout so that the inverter ambient temperature will remain within the allowable range.
A ventilation fan located directly above the inverter could drop dust on it. To prevent this, move the inverter horizontally to a suitable position.

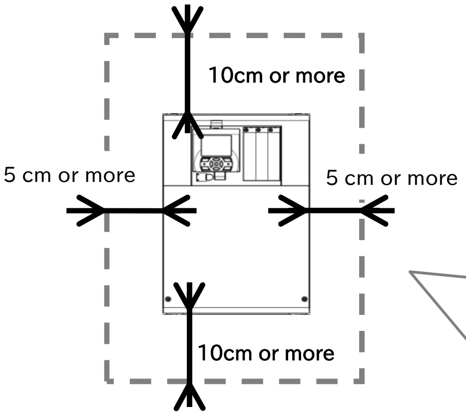


Position of ventilation fan

◆ Surface on which to install the inverter

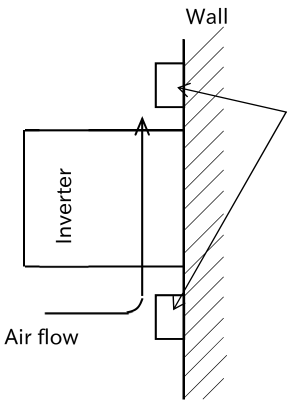
The inverter will reach a high temperature (up to about 150°C) during operation. Install the inverter on a vertical wall surface made of nonflammable material (e.g., metal) to avoid the risk of fire.

Leave sufficient space around the inverter.
Keep sufficient distance between the inverter and other heat sources (e.g., braking resistors and reactors) so that the heat discharged from the heat sources does not affect the inverter.



* A clearance of 22 cm or more is required below the inverter to replace aged parts for the following models:
- HF4322-5A5 to HF4322-022 (5.5 to 22kW)
- HF4324-5A5 to HF4324-022 (5.5 to 22kW)

* The inverter needs to be removed to replace aged parts for the following models:
- HF4322-5A5 to HF4322-011 (5.5 to 11kW)
- HF4324-5A5 to HF4324-011 (5.5 to 11kW)



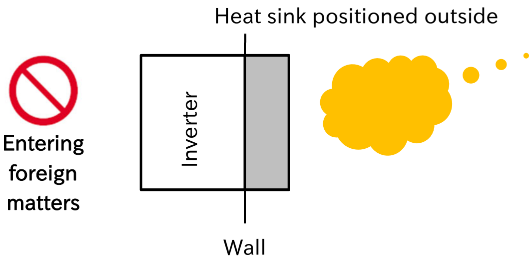
Keep enough clearance between the inverter and the wiring ducts located above and below the inverter to prevent the latter from obstructing the ventilation of the inverter.

* See "Chapter 20 Specifications" for the dimension drawing of the inverter.

◆ Reduction of enclosure size

External heat sink installation may reduce internal heat emission and reduce the enclosure size.
It is able to reattach the mounting bracket that is originally attached to the inverter body to the position for external heat sink installation.
To mount the inverter in an enclosure with the heat sink positioned outside, cut out the enclosure panel according to the specified cutting dimensions.

The cooling section (including the heat sink) positioned outside the enclosure has a cooling fan.
Therefore, do not place the enclosure in any environment where it will be subject to dust, water drops, corrosive gases, combustible gases, flammable gases, grinding fluid mist, or salt water.
Even if the enclosure designed by external heat sink installation, please considering that 30% of the loss by the inverter is radiated into the enclosure.



* Approximate loss (At 100% load, reference) : 200V class

Model name : HF4322-		5A5	7A5	011	015	022	030	037	045	055
Applicable Motor (kW)		5.5	7.5	11	15	22	30	37	45	55
Watt loss (W)	ND	348	376	498	742	1163	1317	1534	1625	1878
	LD	365	400	625	922	1263	1536	1801	1940	2669
	VLD	420	520	754	1059	1377	1698	2092	2300	3046

* Approximate loss (At 100% load, reference) : 400V class

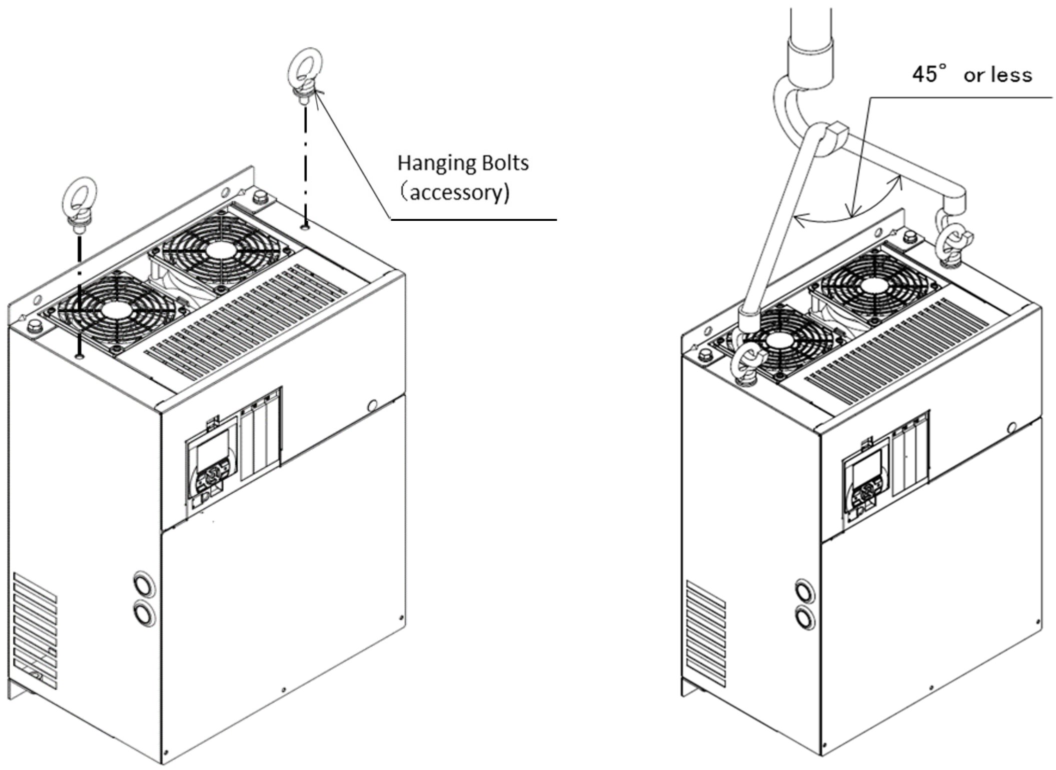
Model name : HF4324-		5A5	7A5	011	015	022	030	037	045	055
Applicable Motor (kW)		5.5	7.5	11	15	22	30	37	45	55
Watt loss (W)	ND	235	240	260	361	687	783	812	1047	1130
	LD	260	280	306	444	805	854	880	1218	1488
	VLD	290	306	380	482	860	920	971	1300	1592

This data is a reference value of our factory test facility.
This data varies depending on the power supply environment and the motor power factor.

◆ Be careful when lifting the inverter !

Eyebolts for lifting are attached to HF4322-037 to HF4322-055 and HF4324-037 to HF4324-055.
When lifting the inverter, please lift according to the figure below.

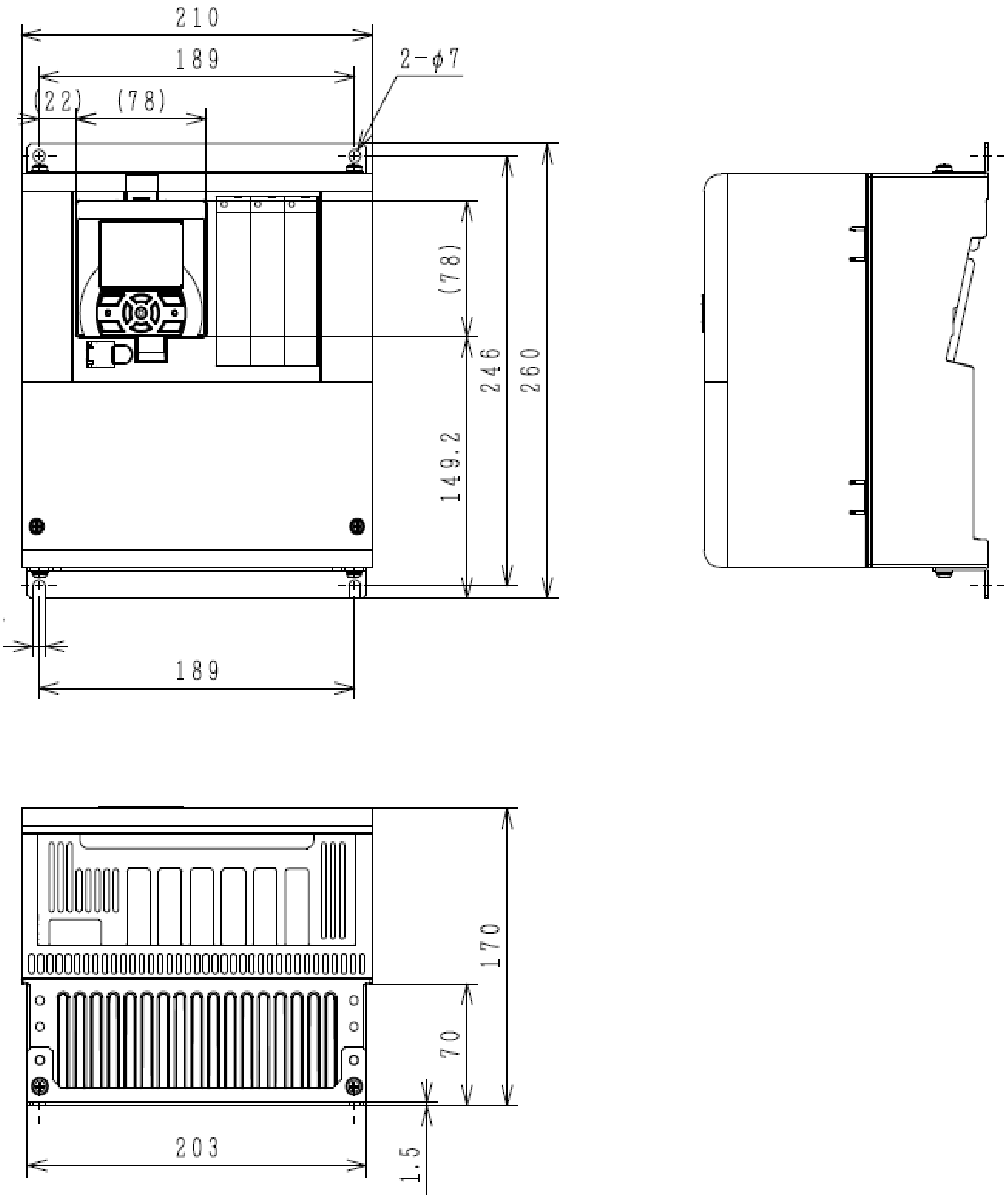
(1) Rigidly tighten the accessory hanging bolts to top of left and right.
(2) Keep an angle less than 45 degree when hanging with wire.



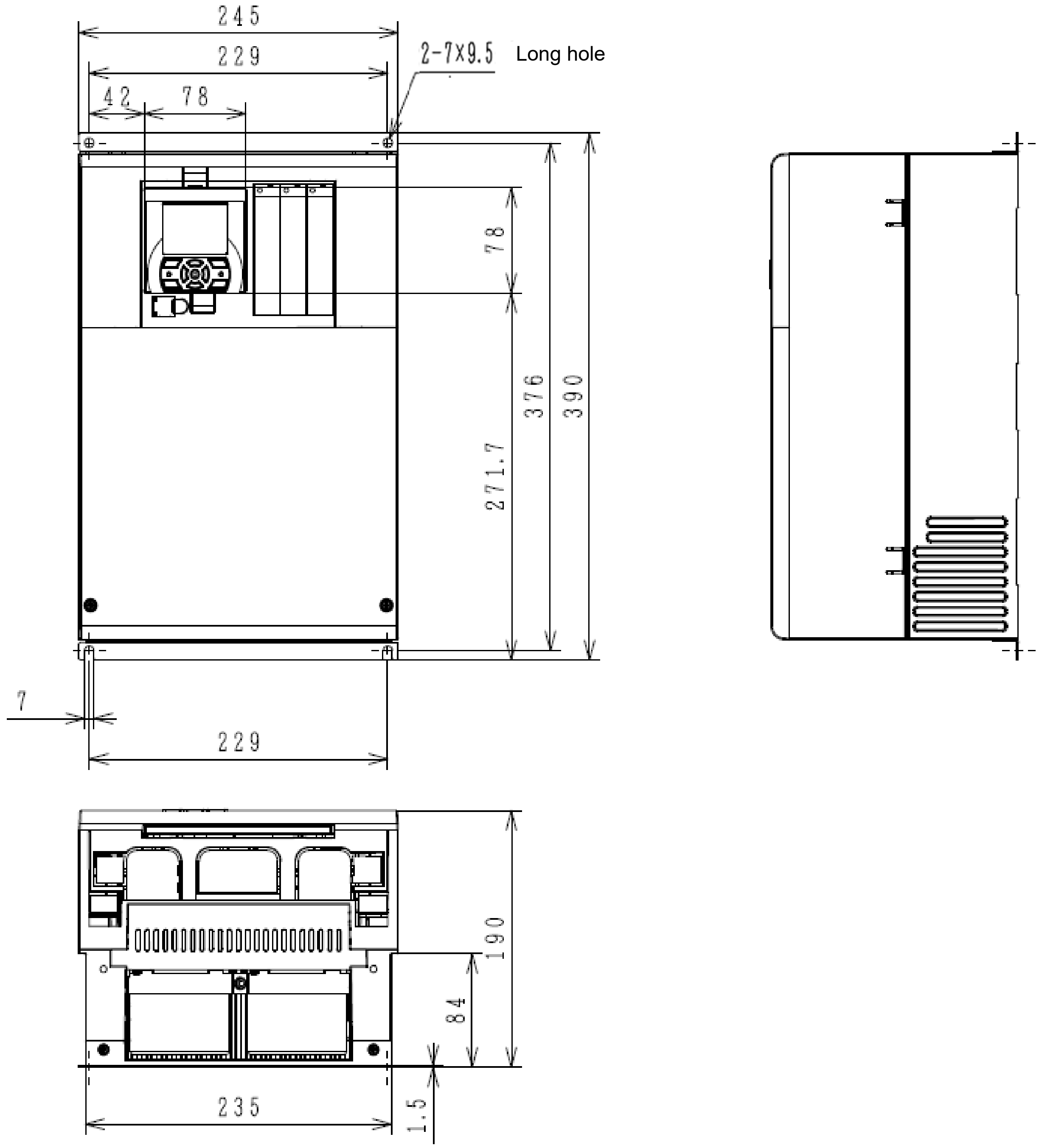
In the case of vertical hanging, when lifting the inverter with a crane, please hang two points.

6.3 External dimensions

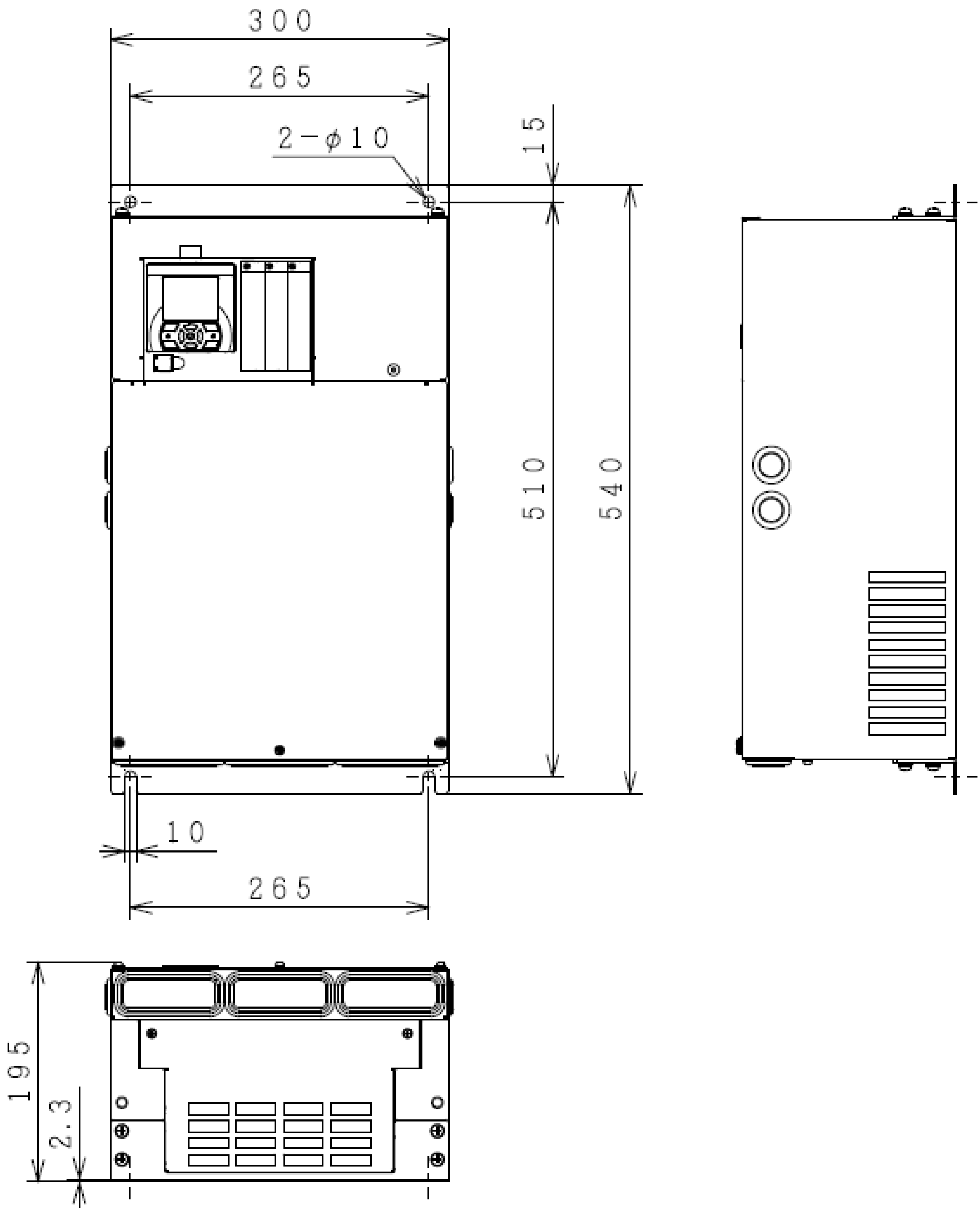
Model			
200V class: HF4322-5A5,7A5,011 (5.5 to 11kW) 400V class: HF4324-5A5,7A5,011 (5.5 to 11kW)			
Dimension	W (mm)	H (mm)	D (mm)
	210	260	170



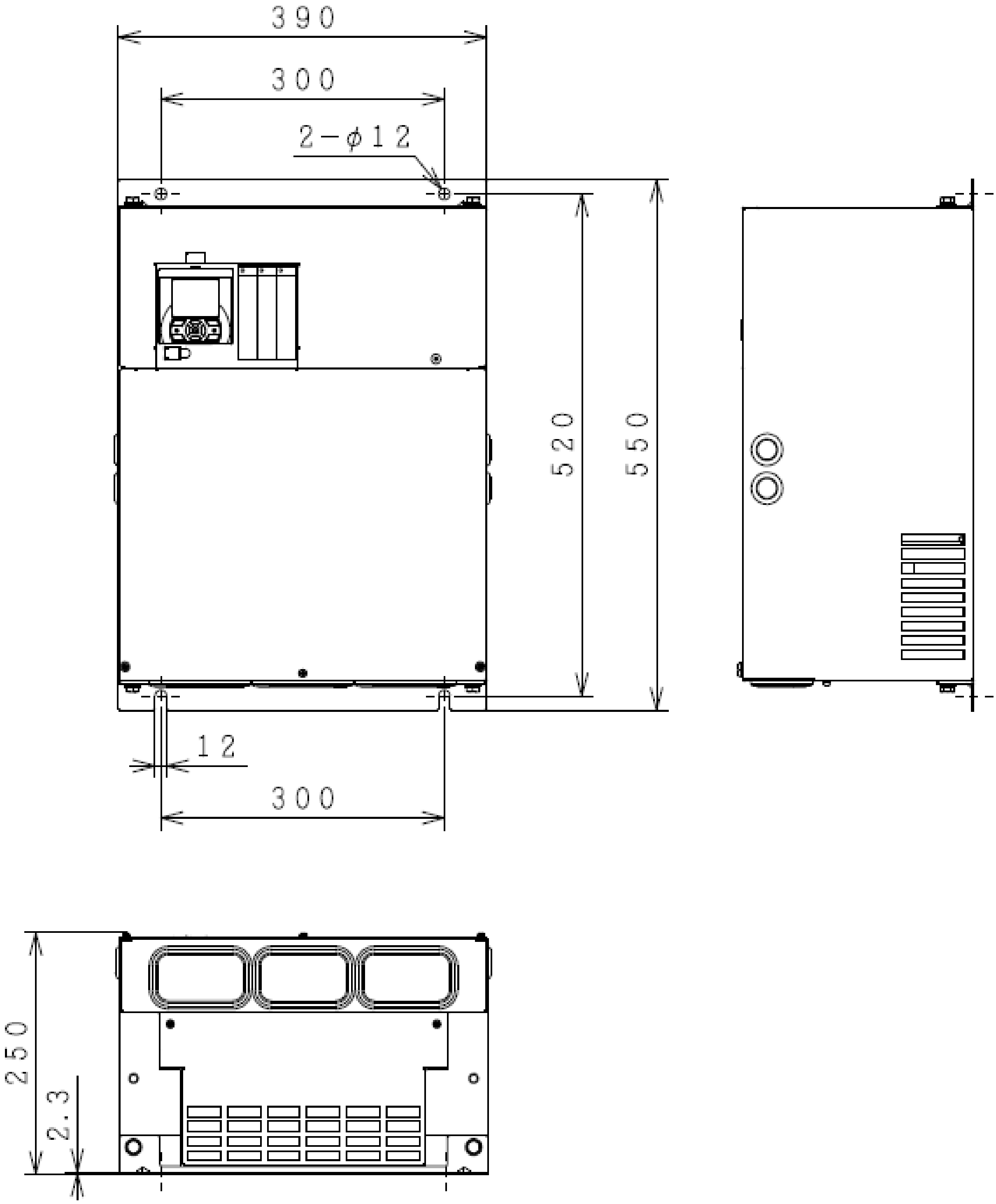
Model			
200V class: HF4322-015,022（15,22kW） 400V class: HF4324-015,022（15,22kW）			
Dimension	W (mm)	H (mm)	D (mm)
	245	390	190



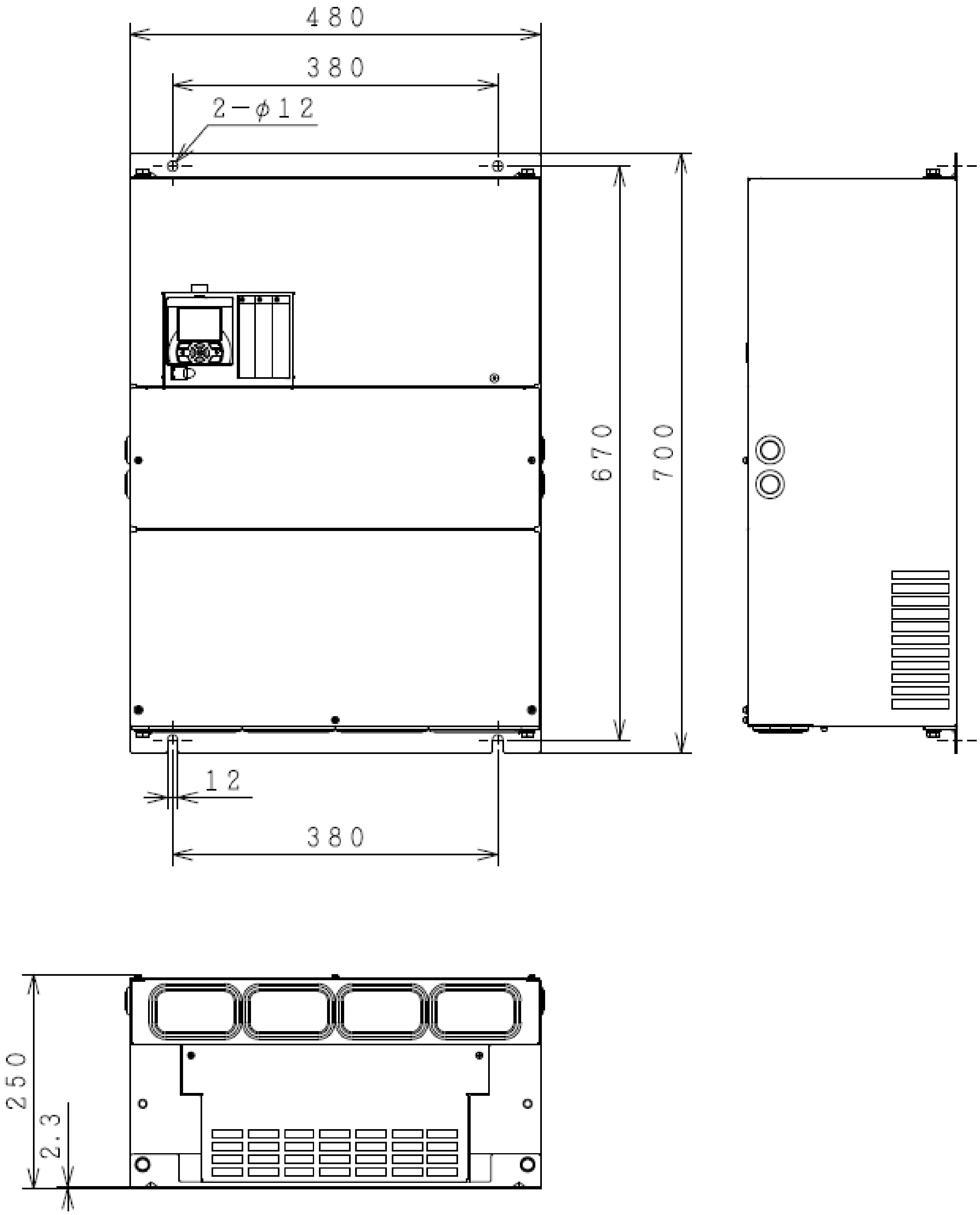
Model			
200V class: HF4322-030（30kW） 400V class: HF4324-030（30kW）			
Dimension	W (mm)	H (mm)	D (mm)
	300	540	195



Model			
200V class: HF4322-037, 045 (37,45kW) 400V class: HF4324-037, 045 , 055 (37,45,55kW)			
Dimension	W (mm)	H (mm)	D (mm)
	390	550	250



Model			
200V class: HF4322-055 (55kW)			
Dimension	W (mm)	H (mm)	D (mm)
	480	700	250



◆ Notes for HF4322-011 (200V class 11kW)

For the use of HF4322-011 at low duty (LD)/very low duty (VLD), follow the installation procedures shown in the figure below.
Change [Ub-03] to 00 and [Ub-03] to 01 to set VLD and LD, respectively.

Procedures:
(1) Remove four truss head screws that hold the (upper and lower) brackets provided by factory configuration.
(2) Change the position of the screw holes for the (upper and lower) brackets.
(3) Tighten the (upper and lower) brackets using four truss head screws removed in (1). (Tightening torque 2.2 to 2.5 Nm)
(4) Install HF4322-011 on the wall using four screws prepared on your own.

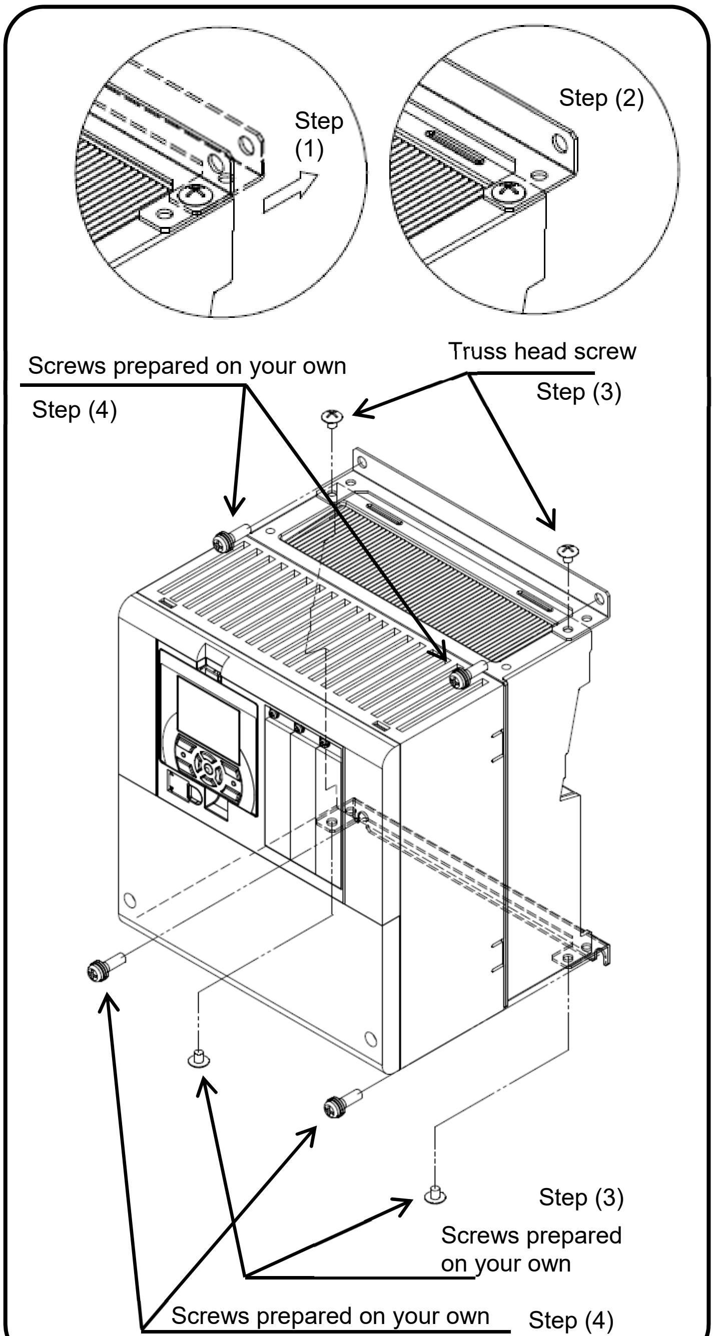


Figure How to install

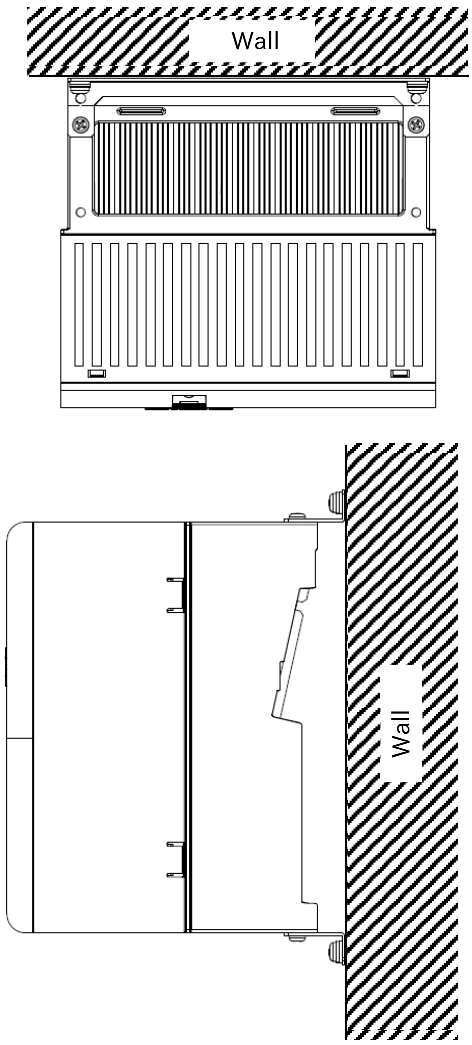


Figure Front and right side diagrams

*Note
By shifting the mounting bracket, the depth dimension of the inverter increases by 15 mm.
Please make sure that there are no problem with installation in the enclosure.

◆ Notes for HF4322-022 (200V class 22kW)

For the use of HF4322-022 at very low duty (VLD), follow the installation procedures shown in the drawings below.
Change [Ub-03] to 00 to set VLD.

Procedures:
(1) Tighten (four) spacers to the (upper and lower) brackets as shown in Figure 1 using (four) M3×8 screws included in the package. (Tightening torque 0.6 to 0.8 Nm)
(2) Install HF4322-022 on the wall using four screws prepared on your own.

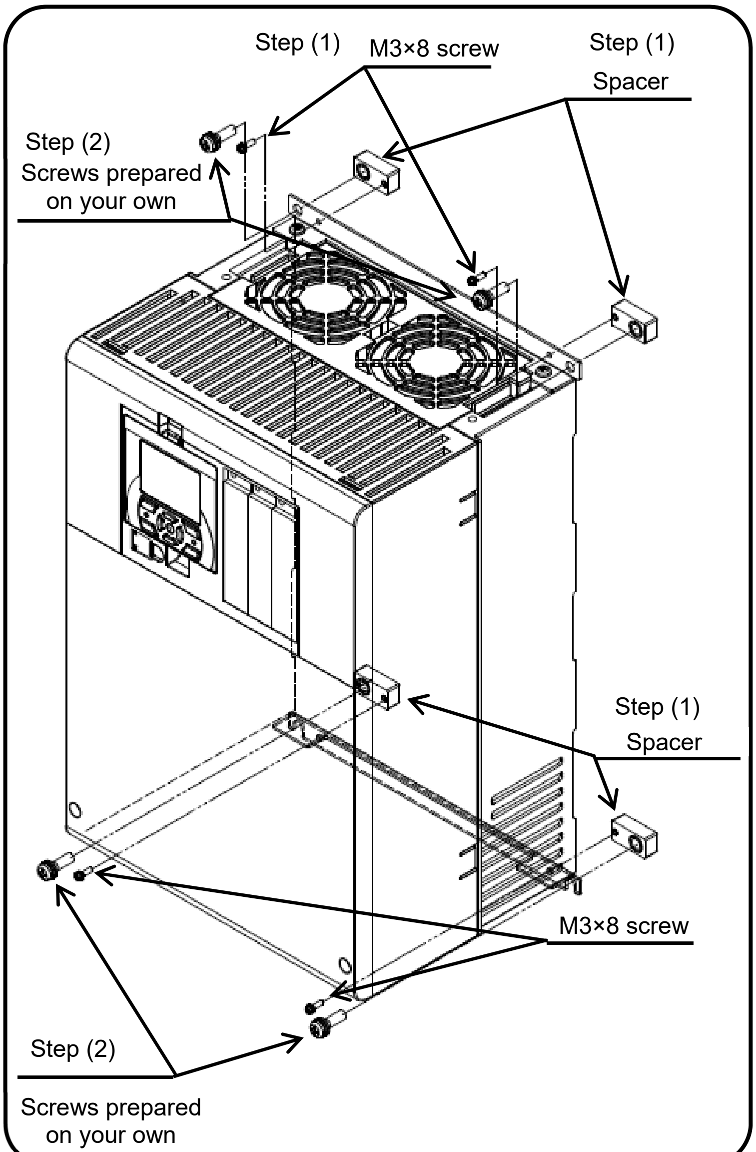


Figure How to install

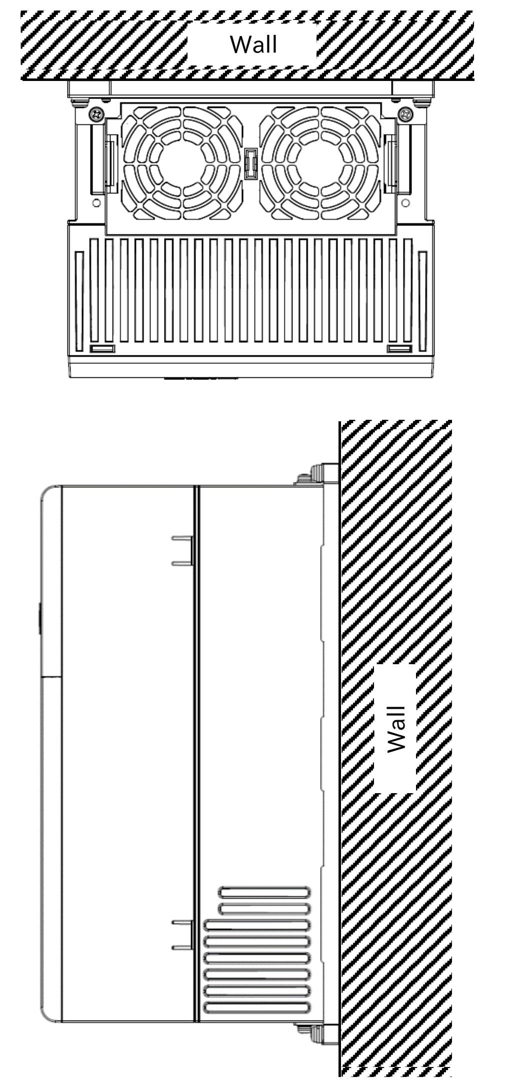


Figure Front and right side diagrams

＊Note
By inserting the spacer, the depth dimension of the inverter increases by 10 mm.
Please make sure that there are no problem with installation in the enclosure.

Chapter 7 Wire Connection and Optional Devices

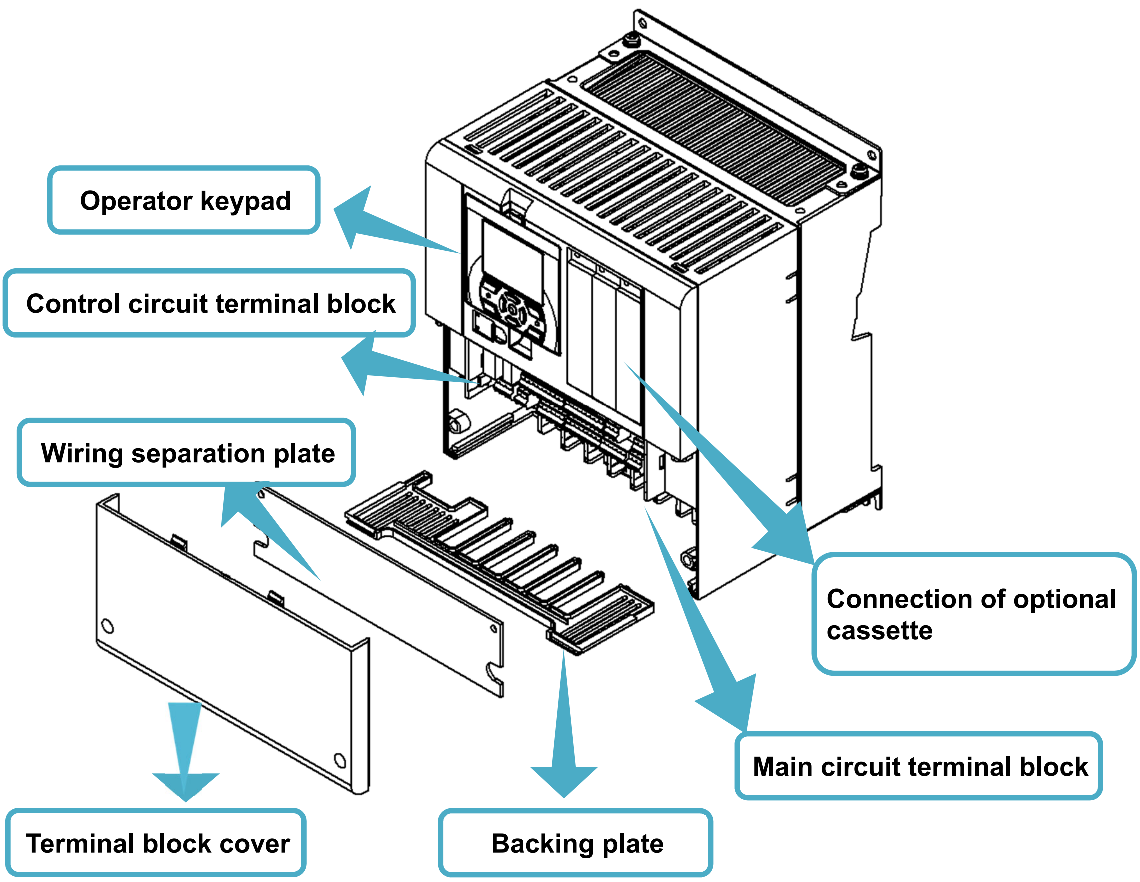
7

7.1 What This Chapter Explains

This chapter describes wiring to the inverter and peripheral options. Before connecting wires with the inverter and installing optional devices, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

7.2 Remove the Terminal Block Cover

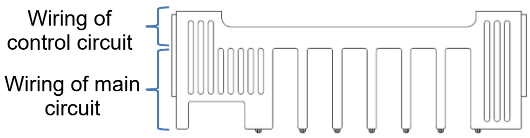
・By removing the cover of the terminal bock, you can check the control circuit terminal block.
By removing the wiring separation plate and backing plate, you can check the main circuit terminal block.



7.3 Use the Backing Plate

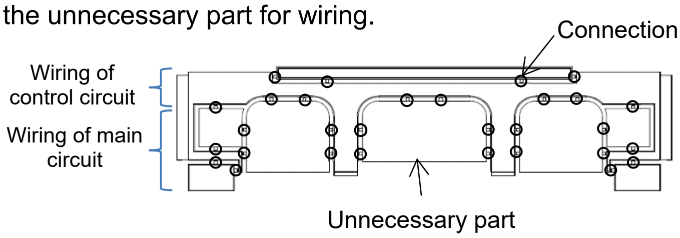
・When connecting wires to apply high voltage on the AL terminal, draw out the plate separately from the wiring of control circuit.

■Backing plate (i)
HF4322-5A5 to HF4322-011（200V 5.5～11kW）
HF4324-5A5 to HF4324-011（400V 5.5～11kW）



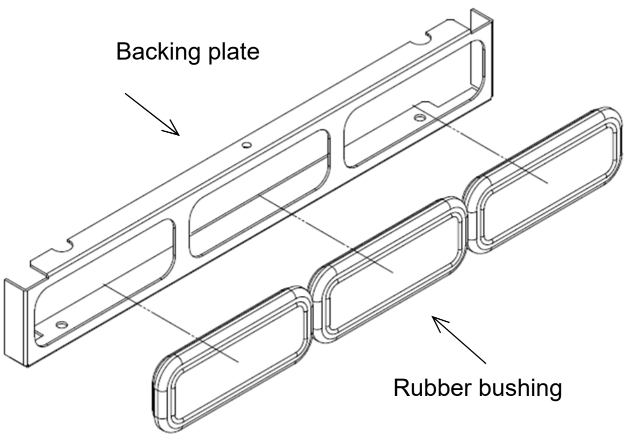
■Backing plate (ii)
HF4322-015, HF4322-022（200V 15, 22kW）
HF4324-015, HF4324-022（400V 15, 22kW）

・Cut the connections between the unnecessary part and backing plate using nippers, radio pliers, or cutter, to cut off the unnecessary part for wiring.



■Backing plate (iii)
HF4322-030 to HF4322-055（200V 30～55kW）
HF4324-030 to HF4324-055（400V 30～55kW）

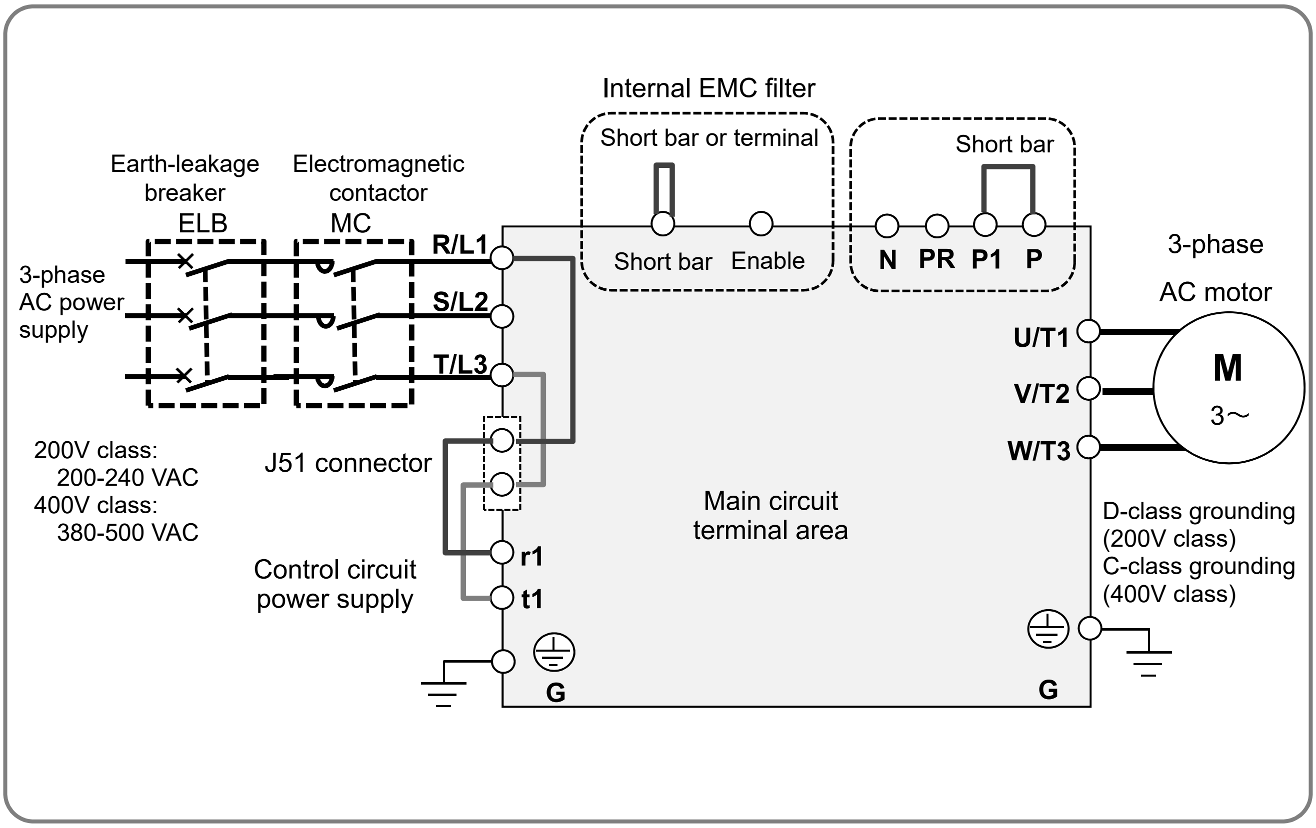
1. When a conduit tube is not connected
   Cut the rubber bushing to create a notch using nippers or a cutter for wiring.
2. When a conduit tube is connected
   Remove the rubber bushing in the portion where a conduit tube is to be connected, and then connect the conduit tube.



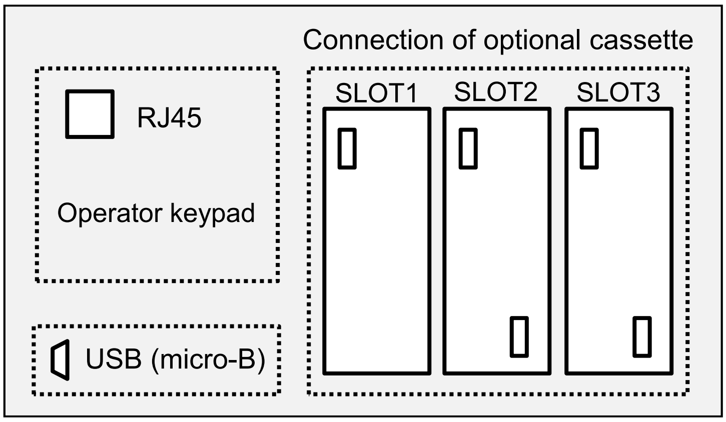
・Do not remove rubber busing from the wiring section unless a conduit tube is connected.
・Doing so may cause the edge of backing plate to damage the cable sheath, leading to short circuit or ground fault.

7.4 Check a Terminal Connection Example

■Outline of main circuit
The PR terminal is mounted only on models equipped with the drive circuit for braking resistor.

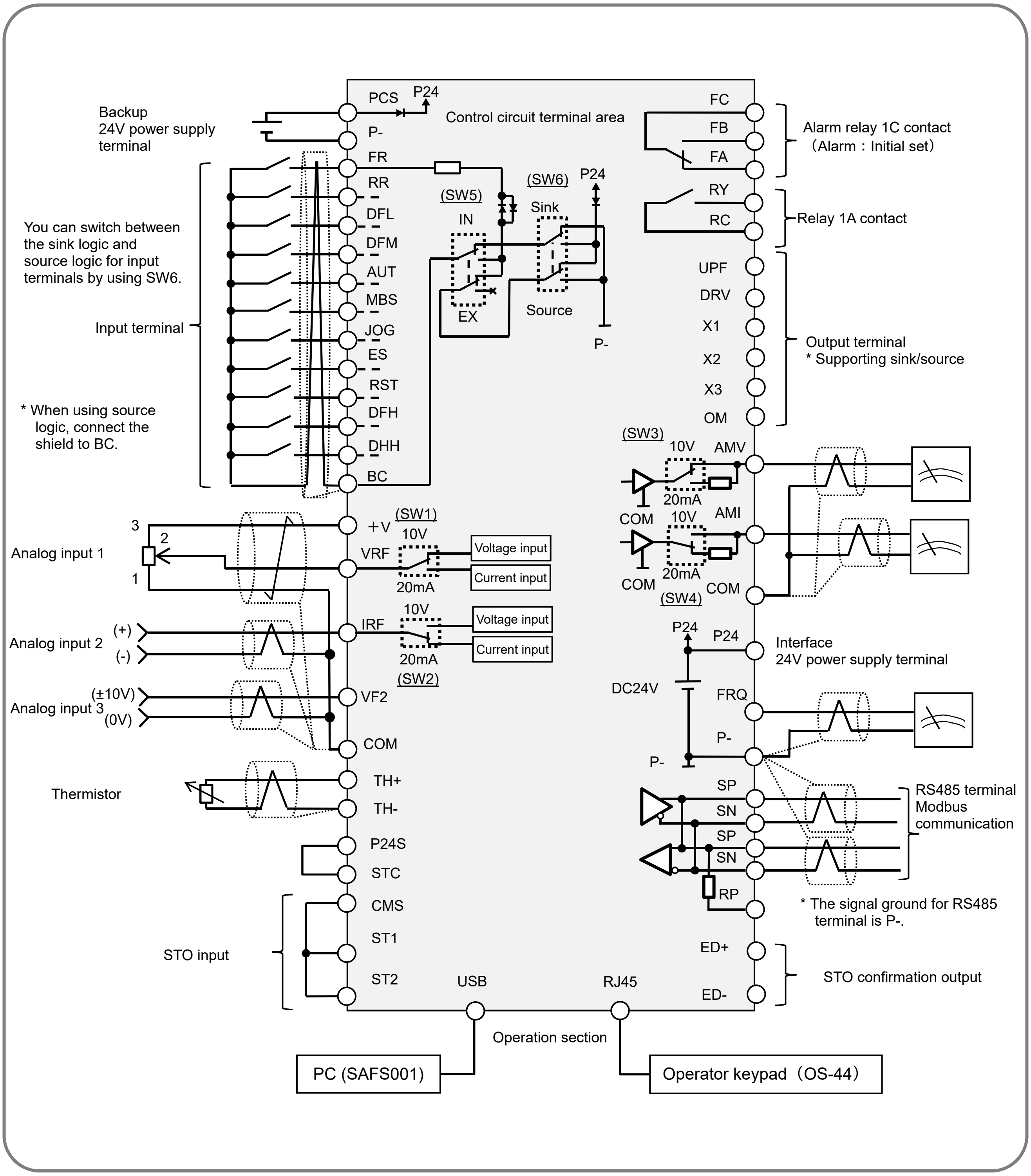


■Outline of operation section



■Outline of control circuit

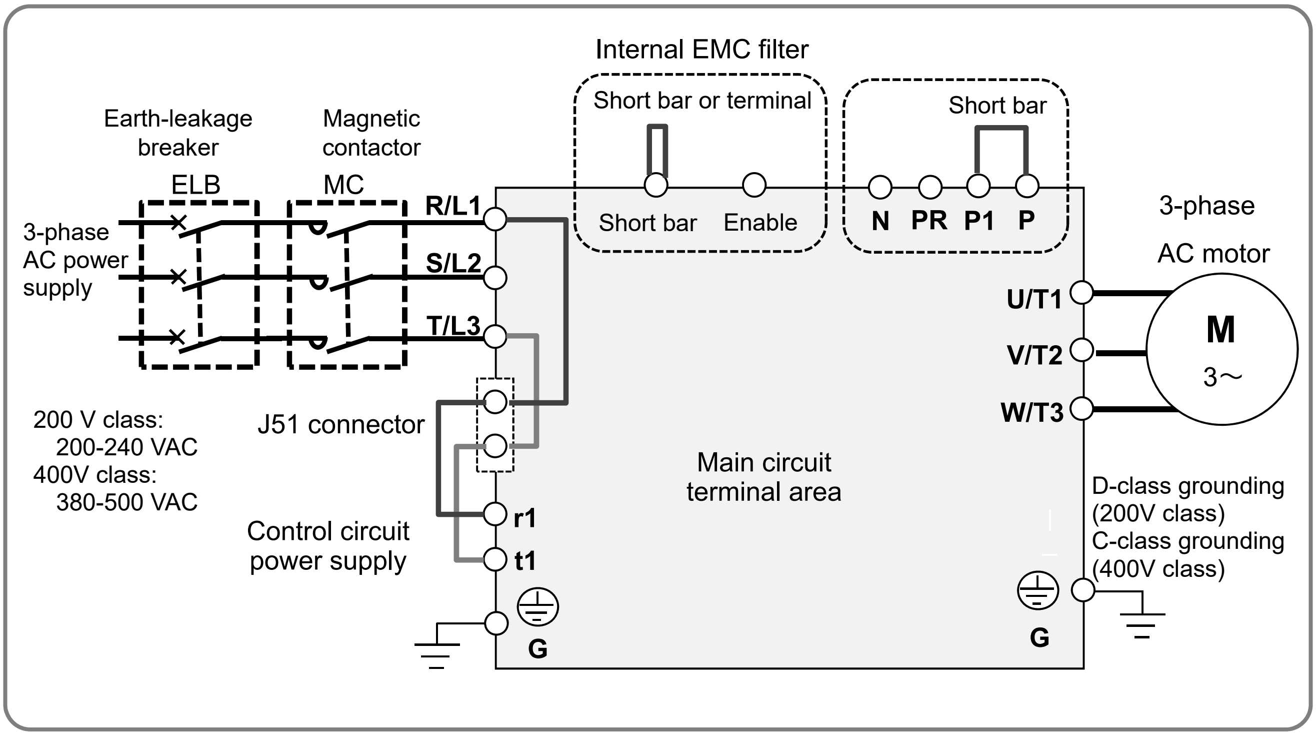
The following shows an example of sink logic



7.5 Connect Wire to the Main Circuit Terminal Block

7.5.1 Configuration of Main Circuit Terminal Block

The PR terminal is mounted only on models equipped with the drive circuit for braking resistor.



Selection of EMC filter (factory default state)
- The EMC filter is disabled.

Short circuit between P and P1 (factory default state)
- When shipped from the factory, P and P1 are short-circuited. If P and P1 are not connected, power is not supplied to the main circuit, which disables operation.

7.5.2 Description of Main Circuit Terminal Block

Terminal symbol	Terminal name	Description
R,S,T (L1,L2,L3)	Input terminal for main power supply	Connect to the AC power supply.
U,V,W (T1,T2,T3)	Inverter output terminal	Connect to the 3-phase motor.
P1,P (+)	DC reactor connection terminal	Remove the short bar between P1 and P terminals, and connect the optional reactor DCL for improving power factor.
P,PR (+)	Connection terminal for external braking resistor	Connect the optional external braking resistor. For models equipped with the braking resistor circuit, see “Chapter 20 Specifications”. Models not equipped with the braking resistor circuit does not have the PR terminal.
P,N (+,-)	Connection terminal for regenerative braking unit	Connect the optional regenerative braking unit BRD.
E(G) ⊜	Inverter earth terminal	The earth terminal for the Inverter case. Please connect this terminal to the ground. Conduct class-D ground work for 200V class, and class-C ground work for 400V class.

7.5.3 What Can Be Done with Main Circuit Terminal Block

Points to be noted on main circuit terminals

Electric shock

・Make sure to check that the charge lamp is off before performing wiring. Once the power is turned on, regardless of whether open phase is occurring or the device is running or not, it is very dangerous because the capacitor in the inverter is charged at high voltage for a certain period even after the power is shut off.

Input terminal for main power supply (R, S, T)

Do

・For connection between the power supply and main power terminals (R, S, T), use the earth-leakage breaker for protecting the circuit (wiring).

・If the protective function of the inverter is activated, it means a failure or an accident is occurring on your system. Connect the magnetic contactor that shuts off power supplied to the inverter.

・Since the earth-leakage breaker may malfunction due to effects of high frequency, please use a model with large high-frequency sensitive current value.

Failure / Prohibited / Do

・Do not turn on or off the magnetic contactor installed on the input (primary) and output (secondary) sides of the inverter to start or stop operation. Otherwise, you run the risk of damage to the inverter.

・To start or stop operation using an external signal, use the operation command (FR, RR) of the control circuit terminal block.

Do

・When performing work such as changing wiring after shutting off the power, wait for 10 minutes (*1) or 15 minutes (*2), and check that there is no residual voltage between P and N using a tester or other instrument to confirm safety.

*1) For models HF4322-5A5 to HF4322-022 and HF4324-5A5 to HF4324-022（5.5～22kW）
*2) For models HF4322-030 to HF4322-055 and HF4324-030 to HF4324-055（30～55kW）

Prohibited

・This device is compatible with 3-phase power supplies. It cannot be used with single-phase power supplies. If single-phase input is required, please contact our sales office.

Prohibited / Electric shock / Injury / Failure

・Do not operate the inverter when an input phase is lost. Otherwise, you run the risk of damage to the inverter.

・The internal capacitor is charged even when an input phase is lost. You run the risk of electric shock and injury.

・When shipped from the factory, the protective function for input phase loss is disabled, and the following conditions are applied.
R-phase or T-phase is lacking:
The inverter does not run.
S-phase is lacking:
It triggers single phase operation, which may cause insufficient voltage, frequent occurrence of over current errors, and the inverter may be burned.

Input terminal for main power supply (R, S, T) (continued)

Failure

Prohibited

・Do not use a power supply that is applicable to the following conditions. Otherwise, the internal converter module may be burned.
1. Unbalance of power supply voltage 3% or above.
2. The power supply capacity is 10 times or more the appropriate capacity of ND rating motor and it is not less than 500kVA.
3. If a rapid change of power supply is made to power.
   Example 1) If more than one inverters are installed and connected with each other by a short bus.
   Example 2) If a phase leading capacitor is inserted or shut off.

・Do not turn on and off the power frequently, which should not do more than once every 3 minutes.

Inverter output terminal (U, V, W)

DANGER

Do

・Perform wiring only with wires whose thickness is equivalent to or above that of the applicable wires. Otherwise, the output voltage may drop between the inverter and motor. Especially during output at low speed, voltage drop caused by wiring reduces the torque of motor.

Failure

Prohibited

・Do not attach a phase leading capacitor or surge absorber, because they may cause inverter errors or damage the capacitor or surge absorber.

Failure

Burnout

Do

・When you connect more than one motors, install a thermal relay for each of them.

・If the wire length exceeds 20m, due to stray capacity or inductance of the wire, surge voltage may be generated on the motor terminal (especially on 400V class), which may burn the motor.
・We have a special filter for suppressing surge voltage. Please contact our sales office.

・Set the RC value of the thermal relay to be 1.1 times the rated current of motor. The thermal relay may trip earlier than intended depending on the wire length. In such a case, attach an AC reactor on the output side of inverter.

* For compliance with CE standards and UL standards, check "1.6 Compliance with European Directive (CE)" and "1.7 Compliance with UL Standards".
* If export to the U.S. or Canada or compliance with UL/cUL standards is required, you need to use wires and breakers specified in the UL/cUL standards. When connecting wires to the main circuit terminal block, use a round crimping terminal (UL-certified item) suitable for the wires for use. Use a crimp tool recommended by the manufacturer of the crimping terminal to crimp the terminal.
* The screw size may differ depending on the terminal. For the terminal screw size of the power line, see "7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals. For others, see figures in "7.5.6 Wiring Locations".
* For wiring to the inverter, crimping terminal, and tightening torque of terminal screws, see tables in "7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals.
* The recommended wire diameter and crimp terminal size vary depending on the settings of load rating (ND/LD/VLD).
* The wire diameters shown in tables in "7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals" indicate design values for HIV wire (resistant to 75˚C heat).
* When connecting wires to the main circuit terminal block, use a round crimping terminal in accordance with the wires for use. Use a crimp tool recommended by the manufacturer of the crimping terminal to crimp the terminal.
* When replacing HF-430α with this device, for different wire diameter, etc., please contact the customer communication center described in the back cover.

7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals

■200V class

<table>
<tr><th>Model No.</th><th>Rating setting</th><th>Power line cable AWG(mm²) R,S,T,U,V,W, P,P1,N</th><th>Grounding cable AWG(mm²)</th><th>External braking resistor between P and PR AWG(mm²)</th><th>Power line cable Terminal screw size</th><th>Crimp terminal Power/Ground</th><th>Tightening torque(N•m) Power/Ground (maximum value)</th></tr>
<tr><td rowspan="3">HF4322-5A5</td><td>ND</td><td rowspan="3">8(8.4)</td><td rowspan="3">8(8.4)</td><td rowspan="3">8(8.4)</td><td rowspan="6">M5</td><td rowspan="3">8-5/8-5</td><td rowspan="6">3.0/3.0
(3.0/3.0)</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4322-7A5</td><td>ND</td><td rowspan="2">8(8.4)</td><td rowspan="15">6(13.3)</td><td rowspan="2">8(8.4)</td><td rowspan="2">8-5/8-5</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td><td>6(13.3)</td><td>6(13.3)</td><td>14-5/8-5</td></tr>
<tr><td rowspan="3">HF4322-011</td><td>ND</td><td>6(13.3)</td><td>6(13.3)</td><td rowspan="6">M6</td><td>14-6/14-6</td><td rowspan="3">4.0/4.0
(5.2/5.2)</td></tr>
<tr><td>LD</td><td rowspan="2">4(21.2)</td><td rowspan="2">4(21.2)</td><td rowspan="2">22-6/14-6</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4322-015</td><td>ND</td><td>4(21.2)</td><td>4(21.2)</td><td>22-6/14-6</td><td rowspan="3">2.5-3.0/4.9
(4.1/5.2)</td></tr>
<tr><td>LD</td><td rowspan="2">3(26.7)</td><td rowspan="2">3(26.7)</td><td rowspan="2">38-6/14-6</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4322-022</td><td>ND</td><td>1(42.4)</td><td>1(42.4)</td><td rowspan="12">M8</td><td rowspan="2">60-8/14-6</td><td rowspan="3">5.5-6.6/4.9
(9.0/5.2)</td></tr>
<tr><td>LD</td><td>1/0(53.5)</td><td>1/0(53.5)</td></tr>
<tr><td>VLD</td><td>2/0(67.4)</td><td>2/0(67.4)</td><td>70-8/14-6</td></tr>
<tr><td rowspan="3">HF4322-030</td><td>ND</td><td>2/0(67.4)</td><td rowspan="9">4(21.2)</td><td rowspan="12">-</td><td>70-8/22-8</td><td rowspan="3">6.0/11.7
(9.0/12.5)</td></tr>
<tr><td>LD</td><td rowspan="2">1/0×2(53.5×2)</td><td rowspan="2">60-8/22-8</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4322-037</td><td>ND</td><td>4/0(107.2)</td><td>100-8/22-8</td><td>15.0/11.7
(15.0/12.5)</td></tr>
<tr><td>LD</td><td rowspan="2">1/0×2(53.5×2)</td><td rowspan="2">60-8/22-8</td><td rowspan="5">6.0-10.0/11.7
(12.0/12.5)</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4322-045</td><td>ND</td><td rowspan="2">1/0×2(53.5×2)</td><td rowspan="2">60-8/22-8</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td><td>2/0×2(67.4×2)</td><td>70-8/22-8</td></tr>
<tr><td rowspan="3">HF4322-055</td><td>ND</td><td>350kcmil(177)</td><td rowspan="3">3(26.7)</td><td rowspan="3">M10</td><td>180-10/38-8</td><td rowspan="3">10.0-12.0/11.7
(16.5/12.5)</td></tr>
<tr><td>LD</td><td rowspan="2">3/0×2(85.0×2)</td><td rowspan="2">80-10/38-8</td></tr>
<tr><td>VLD</td></tr>
</table>

- The wire gauges in the above table shows the designed values based on HIV cables (with thermal resistance of 75°C).
- Please use the round type crimp terminals (for the UL standard) suitable for the use electric wire when you connect the electric wire with the main circuit terminal block. Please put on pressure to the crimp terminals with a crimp tool that the crimp terminal maker recommends.
- When applying the UL standard, please refer to "1.7 Compliance to UL standards ". Tightening torque is recommended “maximum value” in the above table.

■400V class

<table>
<tr><th>Model No.</th><th>Rating setting</th><th>Power line cable AWG(mm²) R,S,T,U,V,W, P,P1,N</th><th>Grounding cable AWG(mm²)</th><th>External braking resistor between P and PR AWG(mm²)</th><th>Power line cable Terminal screw size</th><th>Crimp terminal Power/Ground</th><th>Tightening torque(N•m) Power/Ground (maximum value)</th></tr>
<tr><td rowspan="3">HF-4324-5A5</td><td>ND</td><td rowspan="2">12(3.3)</td><td rowspan="2">12(3.3)</td><td rowspan="2">12(3.3)</td><td rowspan="6">M5</td><td rowspan="3">5.5-5/5.5-5</td><td rowspan="6">3.0/3.0
(3.0/3.0)</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td><td>10(5.3)</td><td>10(5.3)</td><td>10(5.3)</td></tr>
<tr><td rowspan="3">HF-4322-7A5</td><td>ND</td><td rowspan="2">10(5.3)</td><td rowspan="2">10(5.3)</td><td rowspan="2">10(5.3)</td><td rowspan="2">5.5-5/5.5-5</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td><td>8(8.4)</td><td>8(8.4)</td><td>8(8.4)</td><td>8-5/8-5</td></tr>
<tr><td rowspan="3">HF-4324-011</td><td>ND</td><td rowspan="3">8(8.4)</td><td rowspan="9">8(8.4)</td><td rowspan="3">8(8.4)</td><td rowspan="12">M6</td><td rowspan="6">8-6/8-6</td><td rowspan="6">4.0/4.0
(5.2/5.2)</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4324-015</td><td>ND</td><td rowspan="3">8(8.4)</td><td rowspan="3">8(8.4)</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4324-022</td><td>ND</td><td>6(13.3)</td><td>6(13.3)</td><td>14-6/8-6</td><td rowspan="3">4.0/4.0
(5.2/5.2)</td></tr>
<tr><td>LD</td><td rowspan="2">4(21.2)</td><td rowspan="2">4(21.2)</td><td rowspan="2">22-6/8-6</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4324-030</td><td>ND</td><td>3(26.7)</td><td rowspan="9">6(13.3)</td><td rowspan="12">-</td><td rowspan="2">38-6/14-6</td><td rowspan="3">2.5-3.0/4.9
(4.1/5.2)</td></tr>
<tr><td>LD</td><td>2(33.6)</td></tr>
<tr><td>VLD</td><td>1(42.4)</td><td>60-6/14-6</td></tr>
<tr><td rowspan="3">HF4324-037</td><td>ND</td><td rowspan="3">1(42.4)</td><td rowspan="9">M8</td><td rowspan="6">60-8/14-8</td><td rowspan="6">15.0/11.7
(15.0/12.5)</td></tr>
<tr><td>LD</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4324-045</td><td>ND</td><td>1(42.4)</td></tr>
<tr><td>LD</td><td rowspan="2">1/0(53.5)</td></tr>
<tr><td>VLD</td></tr>
<tr><td rowspan="3">HF4324-055</td><td>ND</td><td>1/0(53.5)</td><td rowspan="3">4(21.2)</td><td>60-8/22-8</td><td rowspan="2">15.0/11.7
(15.0/12.5)</td></tr>
<tr><td>LD</td><td>2/0(67.4)</td><td>70-8/22-8</td></tr>
<tr><td>VLD</td><td>1/0×2(53.5×2)</td><td>60-8/22-8</td><td>6.0-10.0/11.7
(12.0/12.5)</td></tr>
</table>

・The wire gauges in the above table shows the designed values based on HIV cable (with thermal resistance of 75°C).
・When applying the UL standard, please refer to
"1.7 Compliance to UL standards ". Tightening torque is recommended “maximum value” in the above table.
・Please use the round type crimp terminals (for the UL standard) suitable for the use electric wire when you connect the electric wire with the main circuit terminal block.
Please put on pressure to the crimp terminals with a crimp tool that the crimp terminal maker recommends.

7.5.5 Applicable Breakers

200V class

・For ND rating

<table>
<tr><th rowspan="4">Model</th><th rowspan="4">Applicable Motor (kW)</th><th colspan="4">Without reactor (DCL or ACL)</th><th colspan="4">With reactor (DCL or ACL)</th></tr>
<tr><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th></tr>
<tr><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th></tr>
<tr><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th></tr>
<tr><td>HF4322-5A5</td><td>5.5</td><td>NV63-SV</td><td>50</td><td>NF63-SV</td><td>SC-N1</td><td rowspan="2">NV63-SV</td><td>40</td><td rowspan="2">NF63-SV</td><td>SC-N1</td></tr>
<tr><td>HF4322-7A5</td><td>7.5</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td>SC-N2</td><td>50</td><td>SC-N2</td></tr>
<tr><td>HF4322-011</td><td>11</td><td>75</td><td>SC-N2S</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td>SC-N2S</td></tr>
<tr><td>HF4322-015</td><td>15</td><td>100</td><td>SC-N3</td><td>75</td><td>SC-N3</td></tr>
<tr><td rowspan="2">HF4322-022</td><td>18.5</td><td rowspan="3">NV250-SV</td><td>125</td><td rowspan="3">NF250-SV</td><td>SC-N4</td><td>100</td><td>SC-N4</td></tr>
<tr><td>22</td><td>175</td><td>SC-N5</td><td rowspan="3">NV250-SV</td><td>125</td><td rowspan="3">NF250-SV</td><td>SC-N5</td></tr>
<tr><td>HF4322-030</td><td>30</td><td>200</td><td>SC-N7</td><td>150</td><td>SC-N6</td></tr>
<tr><td>HF4322-037</td><td>37</td><td rowspan="3">NV400-CW</td><td>250</td><td rowspan="3">NF400-CW</td><td>SC-N8</td><td>175</td><td>SC-N7</td></tr>
<tr><td>HF4322-045</td><td>45</td><td>300</td><td>SC-N10</td><td rowspan="2">NV400-CW</td><td>225</td><td rowspan="2">NF400-CW</td><td>SC-N8</td></tr>
<tr><td>HF4322-055</td><td>55</td><td>350</td><td>SC-N11</td><td>300</td><td>SC-N10</td></tr>
</table>

・For LD/VLD rating

<table>
<tr><th rowspan="4">Model</th><th rowspan="4">Applicable Motor (kW)</th><th colspan="4">Without reactor (DCL or ACL)</th><th colspan="4">With reactor (DCL or ACL)</th></tr>
<tr><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th></tr>
<tr><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th></tr>
<tr><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th></tr>
<tr><td rowspan="2">HF4322-5A5</td><td>5.5</td><td rowspan="2">NV63-SV</td><td>40</td><td rowspan="2">NF63-SV</td><td>SC-N1</td><td>NV32-SV</td><td>30</td><td>NF32-SV</td><td>SC-5-1</td></tr>
<tr><td>7.5</td><td>50</td><td>SC-N2</td><td>NV63-SV</td><td>40</td><td>NF63-SV</td><td>SC-N1</td></tr>
<tr><td>HF4322-7A5</td><td>11</td><td>NV125-SV</td><td>75</td><td>NF125-SV</td><td>SC-N2S</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td>SC-N2</td></tr>
<tr><td>HF4322-011</td><td>15</td><td rowspan="4">NV250-SV</td><td rowspan="2">125</td><td rowspan="4">NF250-SV</td><td rowspan="2">SC-N4</td><td rowspan="2">100</td><td rowspan="2">SC-N3</td></tr>
<tr><td>HF4322-015</td><td>18.5</td></tr>
<tr><td rowspan="2">HF4322-022</td><td>22</td><td>150</td><td>SC-N5</td><td rowspan="3">NV250-SV</td><td>125</td><td rowspan="3">NF250-SV</td><td>SC-N4</td></tr>
<tr><td>30</td><td>200</td><td>SC-N7</td><td>150</td><td>SC-N5</td></tr>
<tr><td>HF4322-030</td><td>37</td><td rowspan="3">NV400-CW</td><td>250</td><td rowspan="3">NF400-CW</td><td>SC-N8</td><td>200</td><td>SC-N7</td></tr>
<tr><td>HF4322-037</td><td>45</td><td>300</td><td>SC-N10</td><td rowspan="3">NV400-CW</td><td>225</td><td rowspan="3">NF400-CW</td><td>SC-N8</td></tr>
<tr><td>HF4322-045</td><td>55</td><td>400</td><td>SC-N11</td><td>300</td><td>SC-N10</td></tr>
<tr><td>HF4322-055</td><td>75</td><td>NV630-CW</td><td>500</td><td>NF630-CW</td><td>SC-N12</td><td>400</td><td>SC-N11</td></tr>
</table>

- If export to the U.S. or Canada or compliance with UL/cUL standards is required, you need to use wires and breakers specified in the UL/cUL standards.
  For details, see "1.7 Compliance with UL Standards".
- The models described in the table are examples of selection.
  When using the device, choose a model that has appropriate breaking capacity and sensitive current by taking short circuit current and relevant laws and regulations into consideration based on the rated current shown in the table.
- The applicable motor capacity is a selection example when IE3 4-pole motor model 60HZ 200VAC (200V class) is used.
- For the power line diameter, see the "Power line" column in the table shown in "7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals".

- The electric durability ensured when the magnetic contactor is used in AC-1 class is 500,000 times, while emergency stop during motor operation is 25 times.
- If there is emergency stop during motor drive or commercial operation is performed, choose the magnetic contactor on the motor side in AC-3 class against the rated current of motor.
- If the rated capacity of inverter is larger than the motor capacity, choose instruments based on the inverter model.

■400V class

・For ND rating

<table>
<tr><th rowspan="4">Model</th><th rowspan="4">Applicable Motor (kW)</th><th colspan="4">Without reactor (DCL or ACL)</th><th colspan="4">With reactor (DCL or ACL)</th></tr>
<tr><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th></tr>
<tr><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th><th colspan="3">Mitsubishi Elec.</th><th>Fuji Elec.</th></tr>
<tr><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th><th>Model</th><th>Rated Current (A)</th><th>Model</th><th>Model</th></tr>
<tr><td>HF4324-5A5</td><td>5.5</td><td rowspan="2">NV32-SV</td><td rowspan="2">30</td><td rowspan="2">NF32-SV</td><td rowspan="2">SC-5-1</td><td rowspan="3">NV32-SV</td><td rowspan="2">20</td><td rowspan="3">NF32-SV</td><td rowspan="2">SC-5-1</td></tr>
<tr><td>HF4324-7A5</td><td>7.5</td></tr>
<tr><td>HF4324-011</td><td>11</td><td>NV63-SV</td><td>50</td><td>NF63-SV</td><td>SC-N1</td><td>30</td><td>SC-N1</td></tr>
<tr><td>HF4324-015</td><td>15</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td>SC-N2</td><td rowspan="2">NV63-SV</td><td>40</td><td rowspan="2">NF63-SV</td><td>SC-N2</td></tr>
<tr><td rowspan="2">HF4324-022</td><td>18.5</td><td>75</td><td rowspan="2">SC-N2S</td><td>50</td><td rowspan="2">SC-N2S</td></tr>
<tr><td>22</td><td>100</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td></tr>
<tr><td>HF4324-030</td><td>30</td><td rowspan="4">NV250-SV</td><td>125</td><td rowspan="4">NF250-SV</td><td>SC-N3</td><td>75</td><td>SC-N3</td></tr>
<tr><td>HF4324-037</td><td>37</td><td>150</td><td>SC-N4</td><td>100</td><td>SC-N4</td></tr>
<tr><td>HF4324-045</td><td>45</td><td>175</td><td>SC-N5</td><td rowspan="2">NV250-SV</td><td>125</td><td rowspan="2">NF250-SV</td><td>SC-N5</td></tr>
<tr><td>HF4324-055</td><td>55</td><td>200</td><td>SC-N7</td><td>150</td><td>SC-N6</td></tr>
</table>

・For LD/VLD rating

<table>
<tr><th rowspan="4">Model</th><th rowspan="4">Applicable Motor (kW)</th><th colspan="4">Without reactor (DCL or ACL)</th><th colspan="4">With reactor (DCL or ACL)</th></tr>
<tr><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th><th colspan="2">Earth-leakage breaker (ELB)</th><th>Circuit Breaker</th><th>Magnetic Contactor</th></tr>
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<tr><td>7.5</td><td>30</td></tr>
<tr><td>HF4324-7A5</td><td>11</td><td rowspan="2">NV63-SV</td><td>40</td><td rowspan="2">NF63-SV</td><td>SC-N1</td><td>30</td></tr>
<tr><td>HF4324-011</td><td>15</td><td>50</td><td>SC-N2</td><td rowspan="2">NV63-SV</td><td>40</td><td rowspan="2">NF63-SV</td><td>SC-N1</td></tr>
<tr><td>HF4324-015</td><td>18.5</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td rowspan="2">SC-N2S</td><td>50</td><td>SC-N2</td></tr>
<tr><td rowspan="2">HF4324-022</td><td>22</td><td>75</td><td rowspan="3">NV125-SV</td><td>60</td><td rowspan="3">NF125-SV</td><td rowspan="2">SC-N2S</td></tr>
<tr><td>30</td><td>100</td><td>SC-N3</td><td>75</td></tr>
<tr><td>HF4324-030</td><td>37</td><td rowspan="3">NV250-SV</td><td>125</td><td rowspan="3">NF250-SV</td><td>SC-N4</td><td>100</td><td>SC-N3</td></tr>
<tr><td>HF4324-037</td><td>45</td><td>150</td><td>SC-N5</td><td rowspan="3">NV250-SV</td><td>125</td><td rowspan="3">NF250-SV</td><td>SC-N4</td></tr>
<tr><td>HF4324-045</td><td>55</td><td>200</td><td>SC-N7</td><td>150</td><td>SC-N5</td></tr>
<tr><td>HF4324-055</td><td>75</td><td>NV400-CW</td><td>250</td><td>NF400-CW</td><td>SC-N8</td><td>200</td><td>SC-N7</td></tr>
</table>

* If export to the U.S. or Canada or compliance with UL/cUL standards is required, you need to use wires and breakers specified in the UL/cUL standards.
For details, see "1.7 Compliance with UL Standards".

* The models described in the table are examples of selection.
When using the device, choose a model that has appropriate breaking capacity and sensitive current by taking short circuit current and relevant laws and regulations into consideration based on the rated current shown in the table.

* The applicable motor capacity is a selection example when IE3 4-pole motor model of 60HZ 400VAC (400V class) is used.

* For the power line diameter, see the "Power line" column in the table shown in "7.5.4 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals".

・The electric durability ensured when the magnetic contactor is used in AC-1 class is 500,000 times, while emergency stop during motor operation is 25 times.

・If there is emergency stop during motor drive or commercial operation is performed, choose the magnetic contactor on the motor side in AC-3 class against the rated current of motor.

・If the rated capacity of inverter is larger than the motor capacity, choose instruments based on the inverter model.

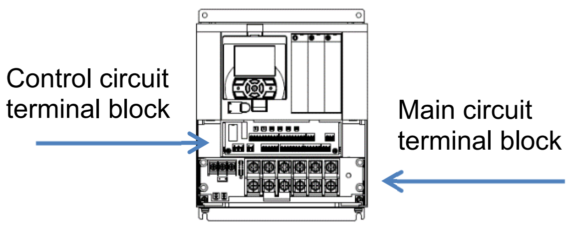
7.5.6 Wiring Locations

DANGER

- The charge lamp indicates input of power to R, S, and T.
  At the factory default setting, power is supplied to r1 and t1 via the J51 connector.
- When the J51 connector is removed and power is supplied to r1 and t1 from another source, the charge lamp does not indicate energization status of r1 and t1.
  Make sure that the power is shut off and safety is ensured before working.
- The charge lamp does not light up also when only 24V is supplied.

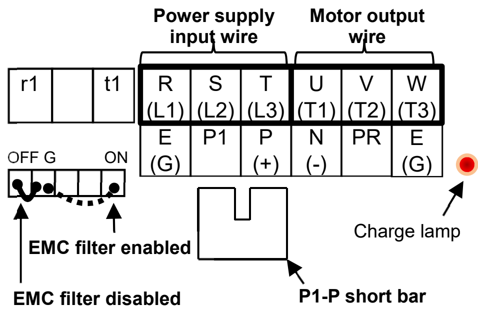
Model
200V class: HF4322-5A5 to HF4322-011（5.5～11kW）
400V class: HF4324-5A5 to HF4324-011（5.5～11kW）

Main Circuit Terminal



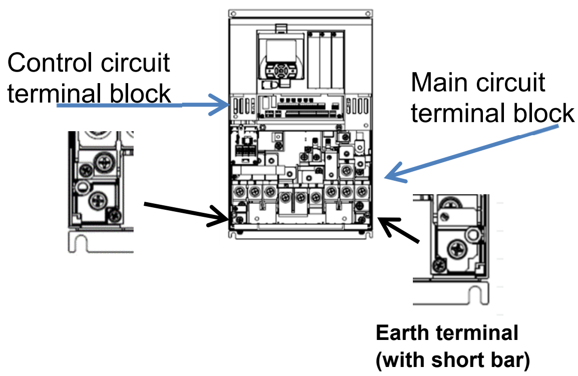
5.5、75kW
Screw size
r1, t1: M4
Earth terminal: M5
Others: M5

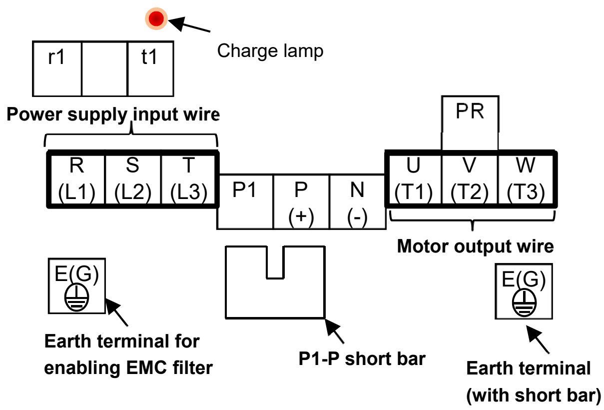
11kW
Screw size
r1, t1: M4
Earth terminal: M6
Others: M6



* The EMC filter is enabled/disabled by switching the short circuit connector.

Model
200V class: HF4322-015（15kW）and HF4322-022（22kW）

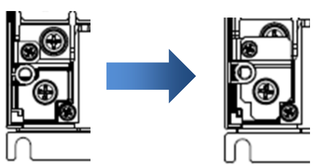




15kW
Screw size
r1, t1: M4
Earth terminal: M6
Others: M6

22kW
Screw size
r1, t1: M4
Earth terminal: M6
Others: M8

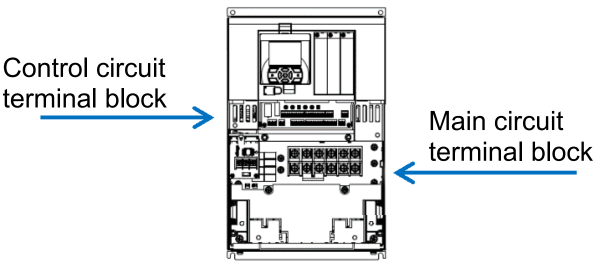
* The EMC filter is enabled by replacing the grounding screw equipped with short bar with the earth terminal for enabling the EMC filter.

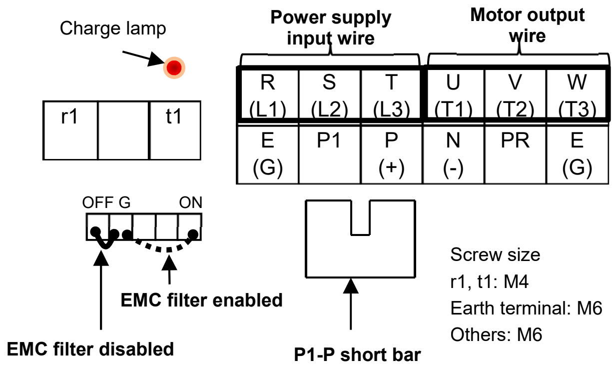


Fix the short bar with two screws.

Model
400V class: HF4324-015（15kW）and HF4324-022（22kW）

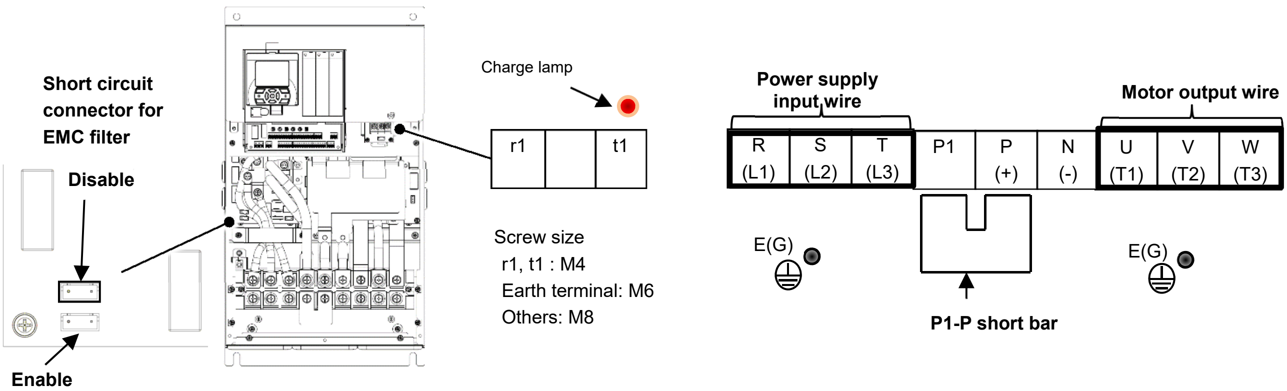
Main Circuit Terminal





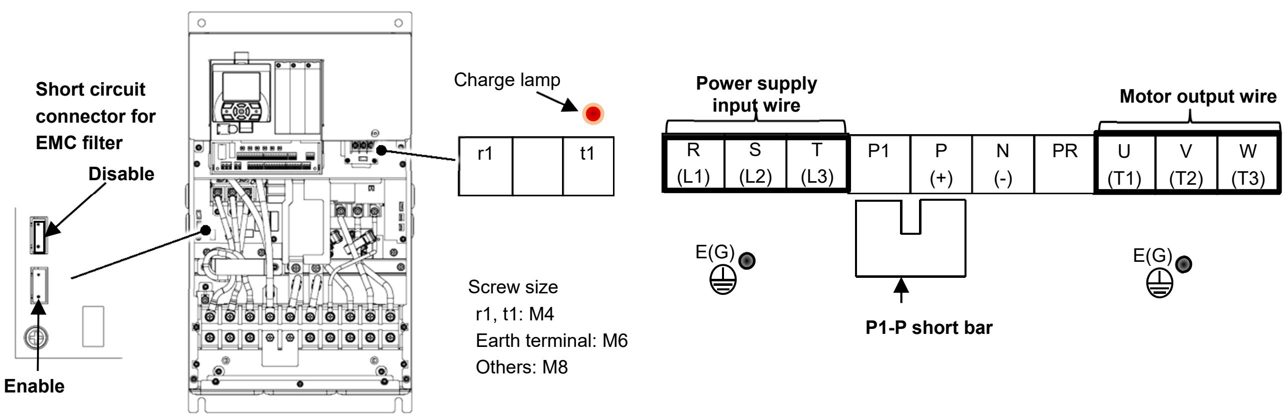
* The EMC filter is enabled/disabled by switching the short circuit connector.

Model
200V class: HF4322-030（30kW）



* The EMC filter is enabled/disabled by switching the short circuit connector.

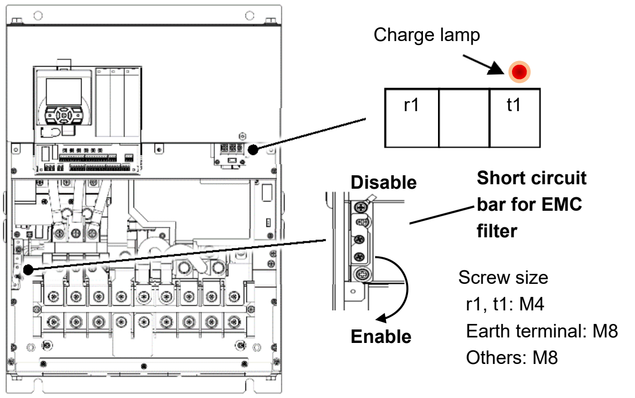
Model
400V class: HF4324-030（30kW）

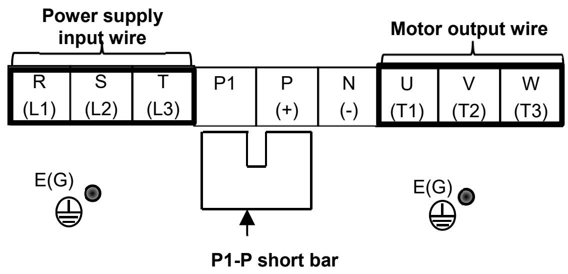


* The EMC filter is enabled/disabled by switching the short circuit connector.

Model
200V class: HF4322-037（37kW）

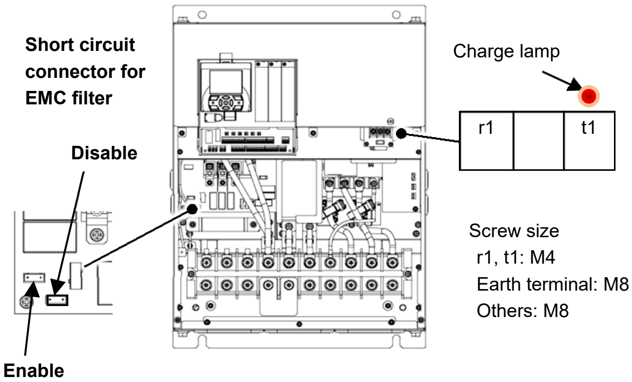
Main Circuit Terminal

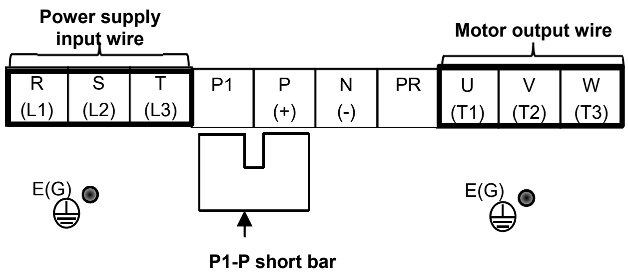




* For the switching method of EMC filter, see the lower section of this page.

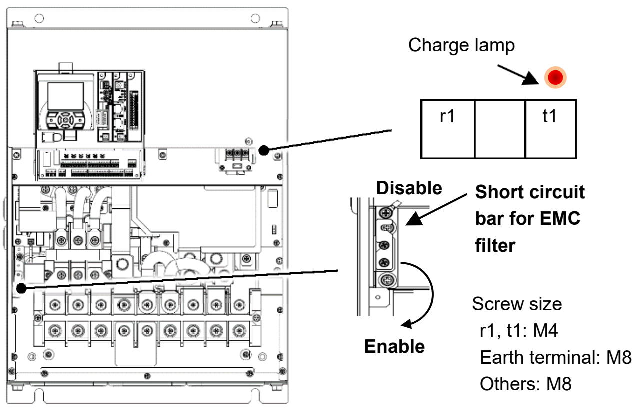
Model
400V class: HF4324-037（37kW）

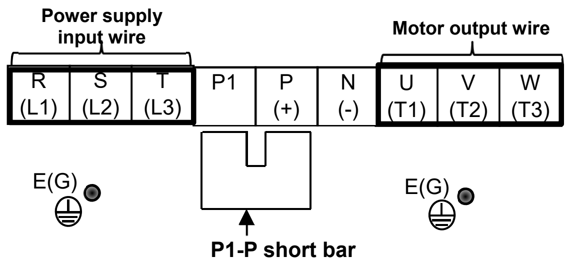




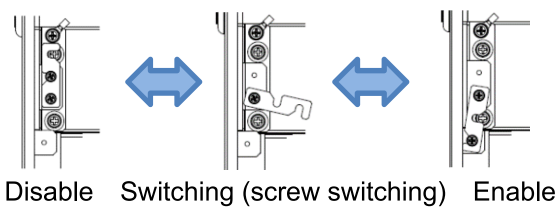
* The EMC filter is enabled/disabled by switching the short circuit connector.

Model
200V class: HF4324-045（45kW）



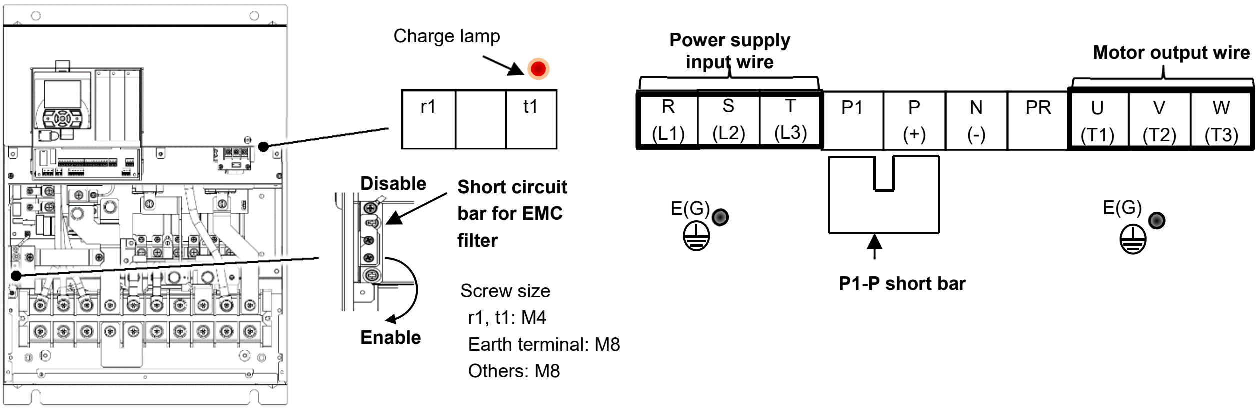


* The EMC filter is enabled/disabled by switching the short circuit bar.

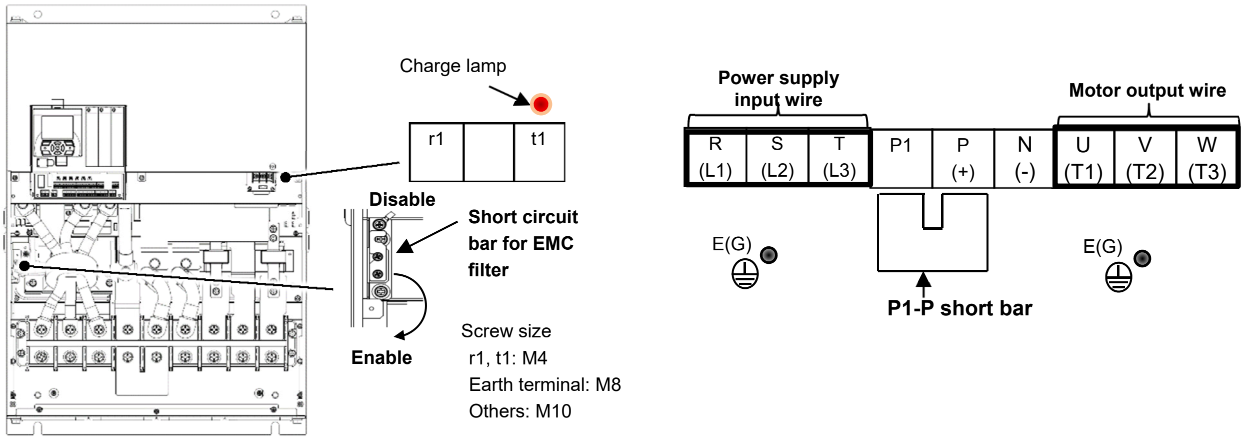


Model
400V class: HF4324-045（45kW）

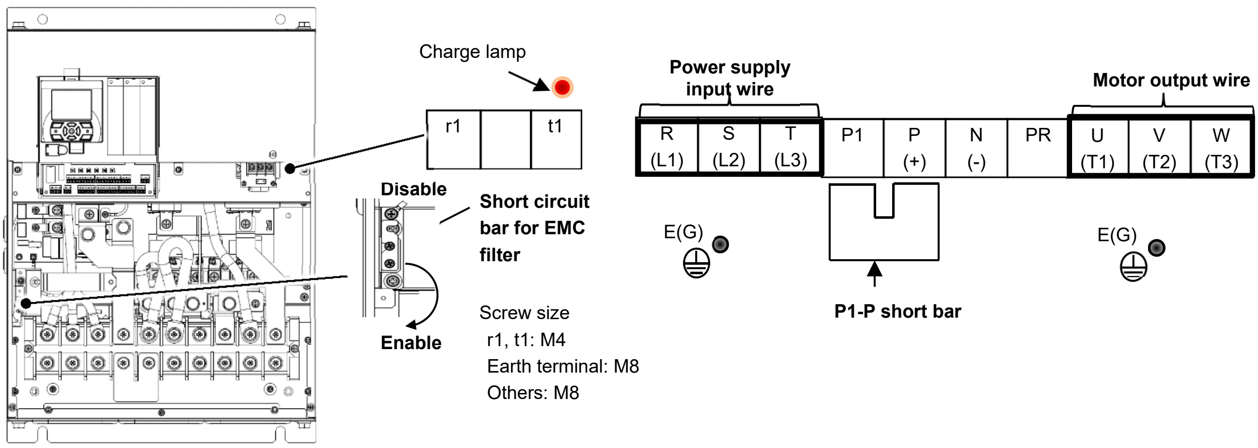
Main Circuit Terminal



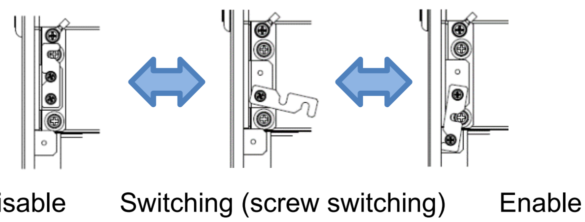
Model
200V class: HF4322-055（55kW）



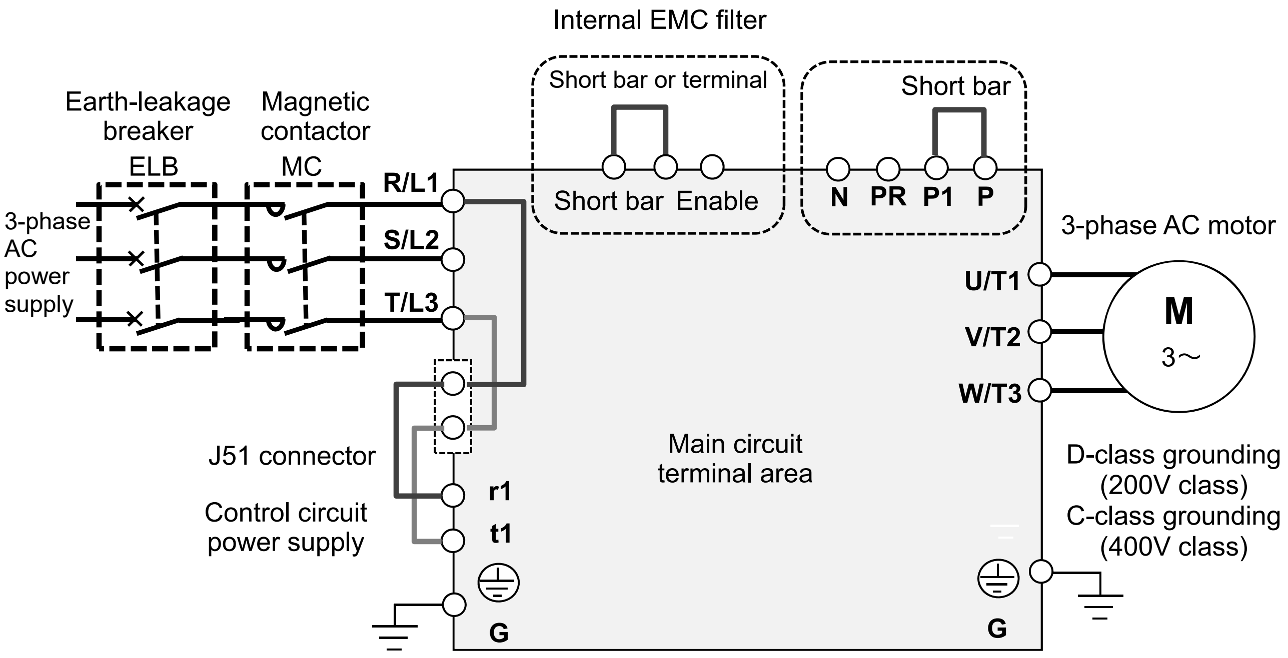
Model
400V class: HF4324-055（55kW）



・Switching method of EMC filter
The EMC filter is enabled/disabled by switching the short circuit bar.



7.5.7 Wiring to Power Supply and Motor



Do

· Use the input power supply within the range shown below.

Voltage class	Input range
200V class	200-240VAC (allowable variation range: +10%/-15%) Power supply frequency: 50Hz/60Hz (variation range: ±5%)
400V class	380-500VAC (allowable variation range: +10%/-15%) Power supply frequency: 50Hz/60Hz (variation range: ±5%)

DANGER

· Driving a 200V motor using a 400V-class inverter may burn the motor.

7.5.8 Wiring Separately to the Control Circuit Power Supply

- When the protection circuit of the inverter operates and shuts off the magnetic contactor on the input source of inverter, there will be no power supply that controls the inverter, and the alarm signal of the output terminal function [AL] cannot be retained.
  To retain the alarm signal, use the control circuit power supply r1 and t1.

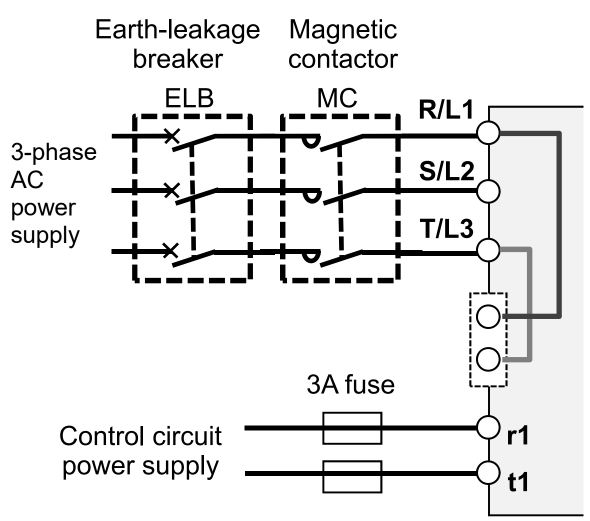
- By the following procedure, connect the terminals for control circuit power supply r1 and t1 to the primary side of the magnetic contactor.

(i) Loosen the screws and remove the wires connected to r1 and t1.
(ii) Remove the whole J51 connector.
(iii) Connect the control circuit power supply to r1 and t1.

> Do
> - For r1/t1 terminal wire (terminal screw size: M4), use a wire whose diameter is 1.25mm^2 or larger. The recommended tightening torque is 1.2Nm (maximum of 1.4Nm).
> - Connect a 3A fuse to the power line for the control circuit.

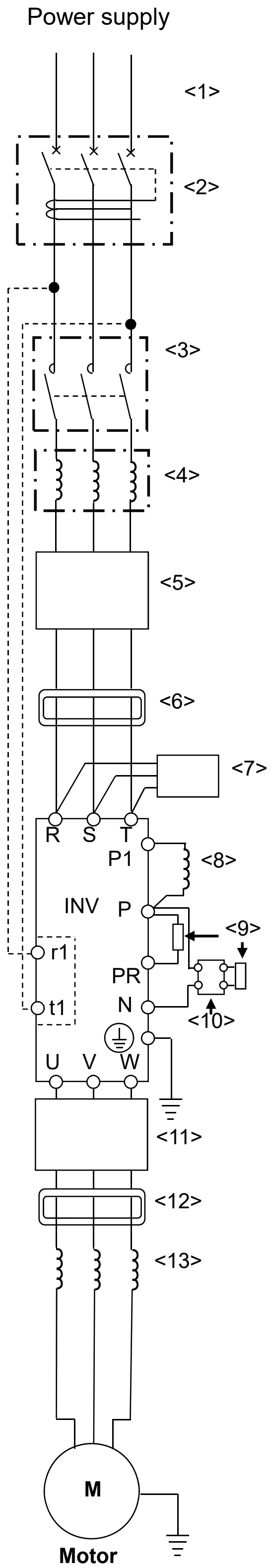
- To create a separate line for the control circuit power supply, remove the J51 connector and directly connect the power supply (two wires of the main circuit voltage). If there is abnormality on the main circuit area, you can change or read internal data while the main circuit area is turned off.
- By inputting 24V from an external source, you can change or read data only with the input of 24V power supply.

- If you turn on the control circuit power supply r1 and t1 in advance with the main circuit power supply R, S, and T, ground fault detection is performed upon main circuit power-on.
- When connecting a DC power supply to the control circuit power supply r1 and t1, select the NO(00) state by the output terminal [UPF] to [DHH] active state parameters ([CC-11] to [CC-17]). The signal output may chatter when DC power is shut off. Please be careful.



Specification of power receipt on the control circuit power supply
200V class: 200-240VAC (+10%, -15%) (50, 60Hz±5%) (282-339VDC)
400V class: 380-500VAC (+10%, -15%) (50, 60Hz±5%) (537-707VDC)

7.5.9 Outline of Applicable Peripheral Devices



Cautions

- The applicable devices shown in this chapter are those when standard 3-phase 4-pole cage motor is used.
- For the circuit breaker, choose an appropriate device by taking breaking capacity into consideration.
  (Use an inverter-compatible model.)
- To ensure safety, use an earth-leakage breaker (ELB).
- Use a 75°C copper wire (HIV wire).
- If the wiring length exceeds 20m, a thick power line needs to be used.
- Use an alarm output contact of 0.75 mm^2.
- Tighten the terminal screws at a specified torque. If they are not tightened enough, it may cause short circuit or fire. If they are tightened too much, it may damage the terminal block or inverter.
- Employ different sensitive currents for earth-leakage breaker (ELB) depending on the total wiring length between the inverter and power supply and between the inverter and motor.
  Also, use the inverter ready type earth-leakage breaker.
  High-speed type products may malfunction.
- If wiring is performed on a metal tube using CV wire, leak current is about 30mA/km.
- As relative permittivity of IV wire is high, the current increases by about 8 times. Therefore, use an item with 8 times sensitive current that is shown on the table below. If the total wiring length exceeds 100m, use a CV wire.

Total wiring length	Sensitive current (mA)
100m or shorter	50
300m or shorter	100

No.	Name	Function
<1>	Wire	See page 7-9 Recommended Wire Diameter, Wiring Tools, and Crimping Terminals.
<2>	Earth-leakage breaker (ELB) Magnetic circuit breaker (MCB)	
<3>	Magnetic contactor (MC)	
<4>	Input side reactor (for harmonic suppression, power coordination, and improvement of power factor)	This is applied as a countermeasure against harmonic suppression, or when imbalance of power supply voltage is 3% or above, or when power supply capacity is 500kVA or above. It is also used when a rapid change is made to power supply voltage. It is also effective in improving power factor.
<5>	Noise filter	This reduces the conductive noise that is generated from the inverter and transferred to the wire. Connect to the primary side (input side) of inverter.
<6>	Zero-phase reactor	When the inverter is used, noise may be generated on an adjacent radio or other devices through wiring on the power supply side. This is used for reducing the noise (reducing radiation noise).
<7>	Radio noise filter (capacitor filter)	This reduces the radiation noise that is emitted from the wire on the input side.
<8>	DC reactor	This suppresses harmonics generated from the inverter.
<9>	Braking resistor	This is used for increasing the braking torque of inverter, repeating power on and off at high interval, or reducing the speed of high load caused by moment of inertia.
<10>	Regenerative braking unit	
<11>	Output-side noise filter	This is installed between the inverter and motor to reduce the radiation noise that is emitted from the wire. It is used to reduce radio interference on radios or televisions or prevent malfunctioning of measurement instruments and sensors.
<12>	Zero-phase reactor	This is applied for reducing noise generated on the output side of inverter. (It can be used on both the input side and output side.)
<13>	Output-side AC reactor for reducing vibration/preventing malfunctioning of thermal relay	When a general-use motor is driven by the inverter, compared with when it is run by commercial power supply, larger vibration may be generated. By connecting this device between the inverter and motor, you can reduce the vibration of motor. Also, if the wiring length between the inverter and motor is long (10m or longer), by inserting a reactor, you can prevent malfunctioning of the thermal relay caused by harmonic attributable to switching of inverter. You can also use a current sensor instead of the thermal relay.

7.5.10 DC Reactor Connection Terminal (P1, P)

· These are terminals for connecting DC reactor DCL option used for improving power factor.
· By using the DCL option, you can reduce harmonic noise.

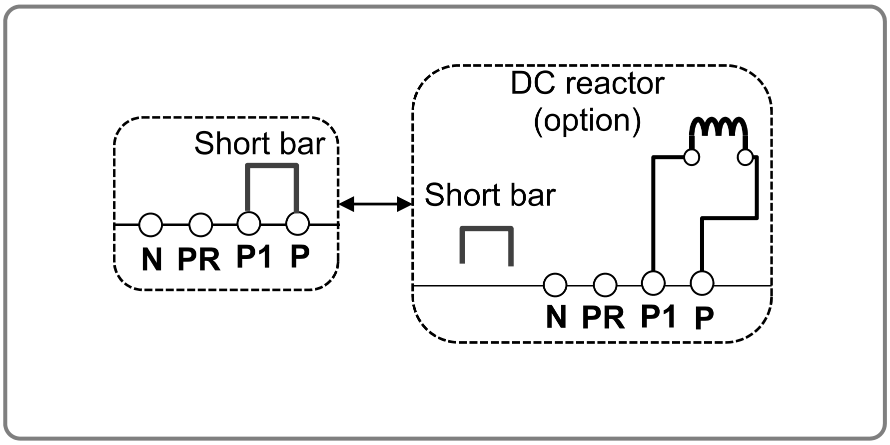
· When using the DC reactor DCL option, connect it after removing the short bar between the PD and P terminals.

Prohibited · When not using the DC reactor DCL option, do not remove the short bar between the P1 and P terminals.

Electric shock · If the short bar between P1 and P terminals is removed and the DC reactor DCL option is not connected, power is not supplied to the main circuit area of inverter, which disables operation.

Do · The wiring length to DC reactor DCL shall be within 5m. Otherwise, you may not be able to get the desired effects.

Caution · Please arrange the terminals so that heat generated from DCL does not affect the inverter.



7.5.11 Connection Terminals for External Braking Resistor (P, PR)

- In HF-430NEO, braking resistor circuit is included in the following models as standard.
  HF4322-5A5 to HF4322-022（200V class 5.5～22kW）
  HF4324-5A5 to HF4324-037（400V class 5.5～37kW）

- By attaching the optional braking resistor, you can use the device even at large regenerative load (lowering load or load applied at high-speed rotation).

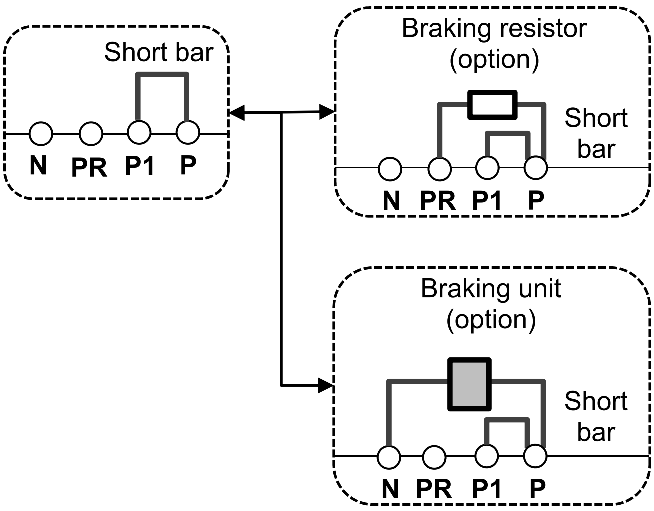
Prohibited / **Failure**

- Do not attach a resistor whose resistance is lower than the predefined value.
  Otherwise, the regenerative braking (BRD) circuit may be damaged.
- Do not connect items other than the braking resistor to the PR terminal and P terminal.
- Do not short the PR terminal and P terminal.

Caution

- Please arrange the terminals so that heat generated from braking resistor does not affect the inverter.

- With the braking resistor and regenerative braking unit, you can improve braking power and suppress overvoltage.
- To enhance braking power using an option, attach a braking resistor or braking unit.



7.5.12 Inverter Earth Terminal (G)

Do
Electric shock

- Make sure that the inverter and motor are grounded for use.
- Otherwise, you run the risk of electric shock.

Do
Electric shock

- In accordance with the electric installation engineering standards, connect 200V-class model to the earth electrode completing class-D ground work (equivalent to the third class grounding: 100Ω or less grounding resistance) and 400V-class model to the earth electrode completing class-C ground work (equivalent to the special third class grounding: 10Ω or less grounding resistance).

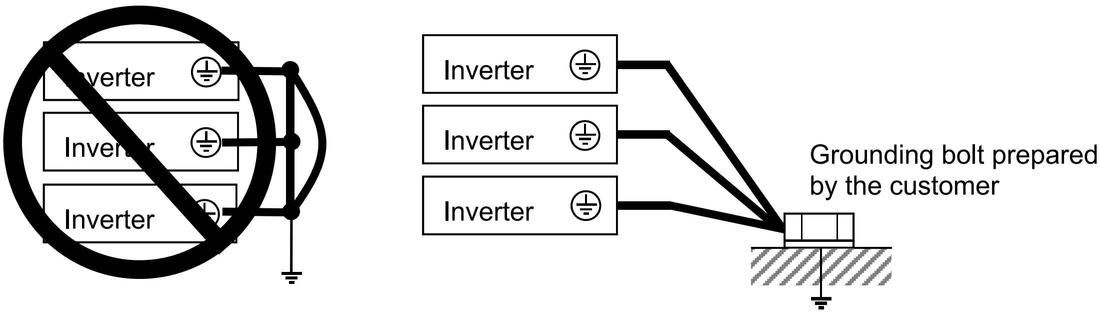
Do
Electric shock

- Use grounding wires whose thickness is not less than that of the applicable wires and make them short as much as possible.

Prohibited
Mal-functioning

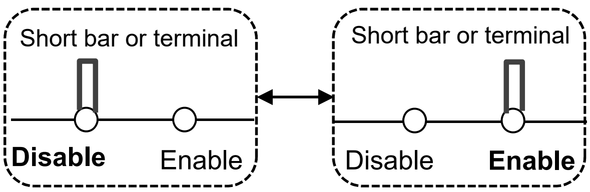
- When more than one inverters are used, connect them that the grounding route (condition) should not be cascaded or loops connection.

  Otherwise, the inverter or peripheral control devices may malfunction.



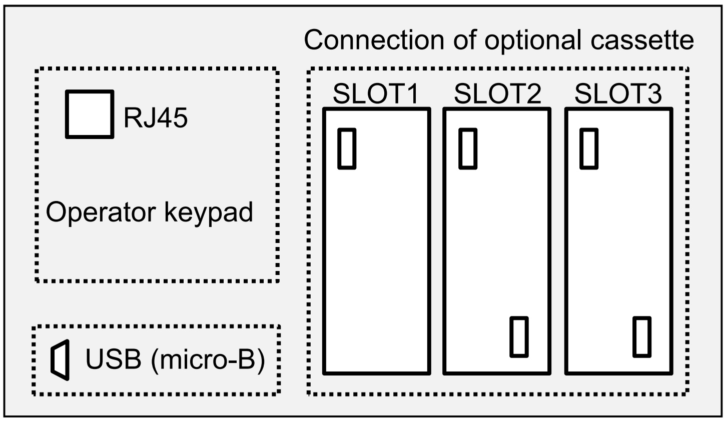
7.5.13 Enable the Internal EMC Filter

- To enable the EMC filter, move the short bar or terminal.
- For locations to be shorted, see the main circuit wiring diagram.



7.6 Operation and Optional Areas

7.6.1 Structure of Operation and Optional Areas



Operator keypad (factory default setting)

・The operator keypad is connected by default.

Option connection (factory default state)

・Optional slots are closed.

7.6.2 Description of Operation and Optional Areas

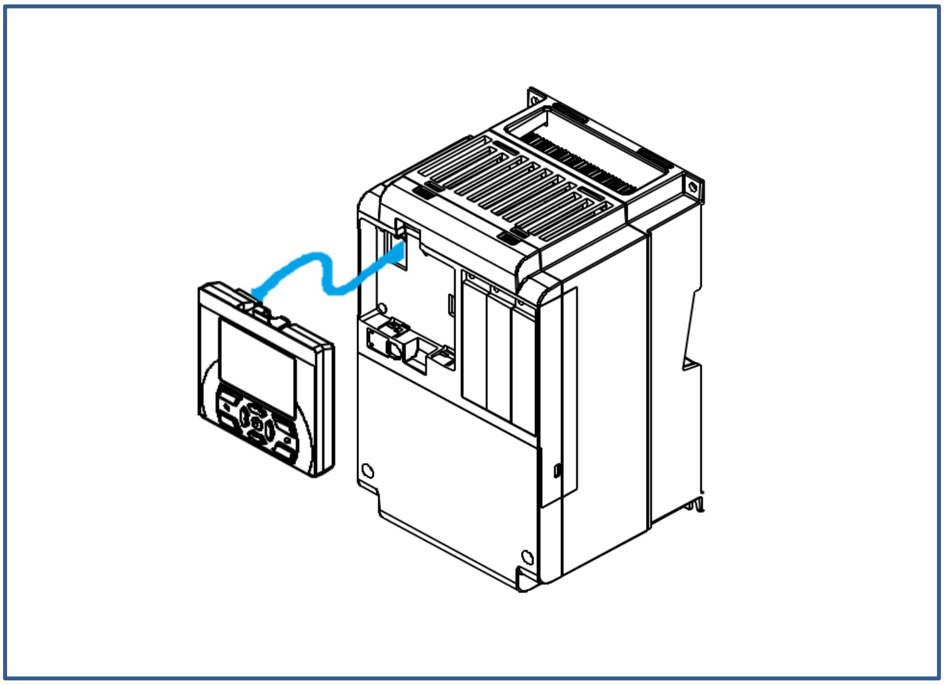
Connecting location	Name	Description
RJ45	Operator keypad	The operator keypad VOP is connected. The operator keypad can be taken out of the control panel with a straight LAN cable.
SLOT1	Optional cassette slot 1	Various optional cassettes can be connected.
SLOT2	Optional cassette slot 2	Various optional cassettes can be connected. The encoder feedback option (HF-FB) can only be connected to the slot 2.
SLOT3	Optional cassette slot 3	Various optional cassettes can be connected. The functional safety option (P1-FS) can only be connected to the slot 3.
USB (micro-B)	Connecting area for PC	By connecting with a PC, performs communication with a set up tool SAFS002.

・Before removing the operator keypad or disconnecting a USB device, be sure to turn off the power supply and wait until the POWER lamp goes off.
・When removing the operator keypad or disconnecting a USB device, hold the front cover. Otherwise, it may cause connection failure.

・Some extended options have predetermined connecting locations.
・Feedback option -> Slot 2
・Function safety option -> Slot 3

7.6.3 Take out the Operator Keypad on the Panel

- You can take out the operator keypad outside the panel for operation.
  When taking the operator keypad outside the panel, please contact the inverter technical communication center shown in the back cover.



- To remove the operator keypad from the inverter to use it, order a connector cable option ICS-1 (1m) or ICS-3 (3m).

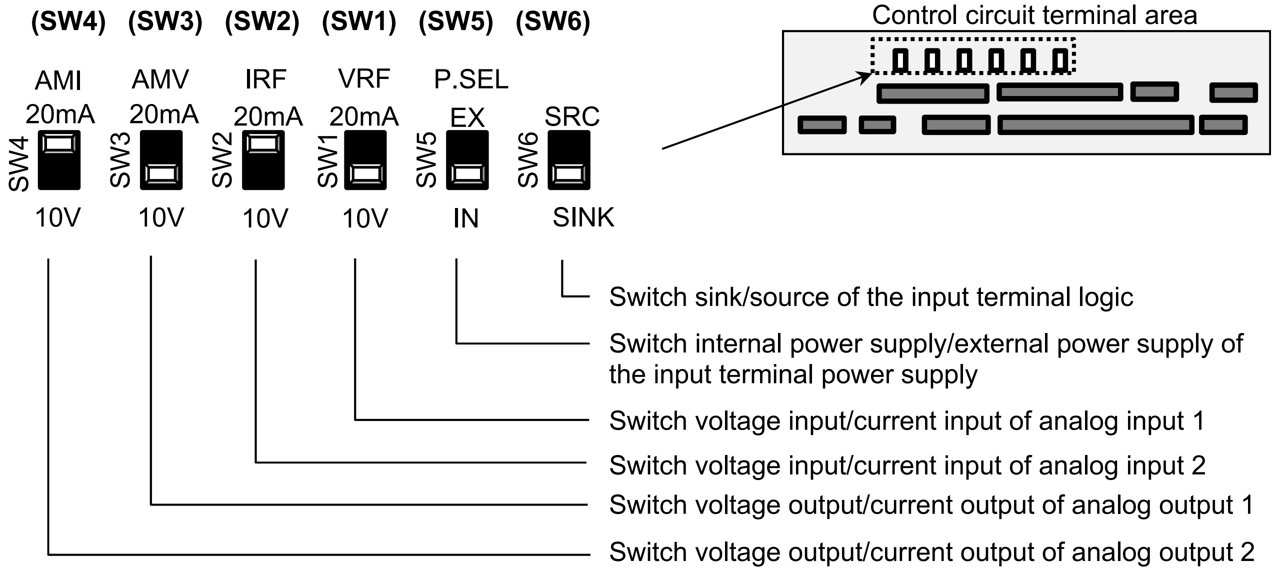
- If you prepare a cable by yourself, the following cables are recommended.
  TSUKO Cat5e cable with connectors at both ends (twisted wire)
  TSUNET-MC350E-MP 8C B 8-8
  Hitachi Metals, Ltd. Straight wire with connectors at both ends
  NETSTAR-C5E PC 24AWG × 4P

- Use a connector cable within 3m.
  If you use the connector exceeding 3m, it may cause malfunctioning.

- While power is supplied to the inverter, do not attach or remove the operator keypad.

7.7 Control Circuit Terminal Area

7.7.1 Switch Configuration



■Points to be noted on switches

Failure
・Using a switch under power-on condition may cause failure. Use the switch only after turning off the power and confirming that the POWER lamp on the operator keypad is off.

Do
・If the switch status does not match the actual input and output specifications, it may cause failure. Make sure to check that input and output to be used and switch characteristics are the same.

■Description of slide switches

Indication	SW name	Description
VRF (SW1)	Analog input 1 switch	Switches input specification of analog input 1 (VRF terminal). 10V: Voltage input is available. 20mA: Current input is available.
IRF (SW2)	Analog input 2 switch	Switches input specification of analog input 2 (IRF terminal). 10V: Voltage input is available. 20mA: Current input is available.
AMV (SW3)	Analog output 1 switch	Switches output specification of analog output 1 (AMV terminal). 10V: Output changes to voltage output. 20mA: Output changes to current output.
AMI (SW4)	Analog output 2 switch	Switches output specification of analog output 2 (AMI terminal). 10V: Output changes to voltage output. 20mA: Output changes to current output.
P.SEL (SW5)	Switching the method of power supply to the input terminals	Switches the method of power supply to the input terminals. IN: Drives the input terminals using the internal power supply. EX: Inputs an external power supply to drive input terminals. (In the case of EX, a power supply is required between the input terminals and COM.)
SRC/SINK (SW6)	Switch of sink/source for the input terminals	Switches the sink/source logic for input terminals. This switch is enabled when SW5 is IN. SINK: Enables sink logic. SRC: Enables source logic.

7.7.2 Wiring to the Control Circuit Terminal Block

■Points to be noted on wiring the control circuit terminals

Electric shock Failure / **Prohibited**

- COM, BC, and OM are common terminals for input and output signals, and they are insulated from one another. Do not make these common terminals shorted or grounded.
- Do not make them grounded via an external device.

Mal-functioning / **Do**

- Separate the wiring to the control circuit terminal block from that of the main circuit line (power line) or relay control circuit. If it is unavoidable to do so, make them positioned at right angles to each other. Otherwise, the inverter may malfunction.
- Although the control circuit terminal block has two lines, you can easily perform wiring by starting from the lower terminals. Make setting to perform wiring from the lower area.

Do / **Failure** / **Prohibited**

- When wiring between VRF and COM and between IRF and COM, make sure to check that the positions of the corresponding DIP switches SW1 and SW2 are at the desired input (voltage or current).
- Input of erroneous voltage or current caused by erroneous selection of switch or input of a value outside the specification range (using P24 terminal (24V) instead of H terminal (10V)), incorrect wiring (wires are installed in reverse orientation and input of voltage/current is reversed, short circuit occurs between H and L, wiring of a knob causes short circuit between H and L at 0Ω, etc.) may cause failure.

Mal-functioning / **Do**

- For wiring to the control circuit terminal block, use twisted shield wires, and connect the shield films to each common terminal.
- The wiring length to the control circuit terminal block shall be within 20m. If the connecting wire exceeds 20m, you may not be able to get sufficient characteristics due to effects of voltage drop.
  If it is unavoidable to set the length to more than 20m, use an analog insulation signal converter, and check that there is no problem with operation.
- After wiring, lightly pull the wires to check that wires are securely connected.

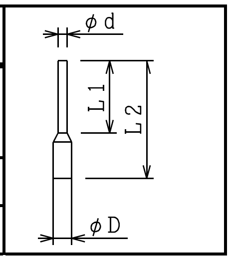
Do / **Failure**

- For output terminals and relay output terminals, install a diode for preventing counter-electromotive force.
- Otherwise, counter-electromotive force is applied, which may cause failure.

■Recommended terminals for wiring

- For the convenience of wiring and improvement of connection reliability, it is recommended to use rod terminals with the following specifications.
- For the control circuit terminal block, a spring clamp type terminal block is employed.

- Rod terminals with sleeve

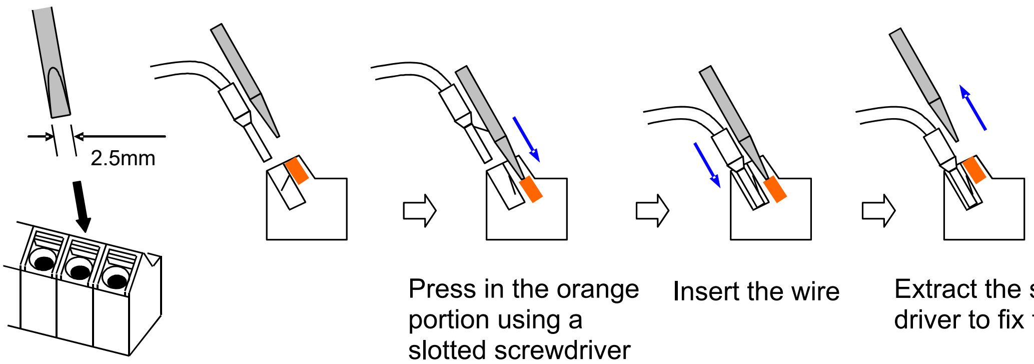
Wire size mm² (AWG)	**Rod terminal model *1**	**L1 [mm]**	**L2 [mm]**	**φd [mm]**	**φD [mm]**	
0.25 (24)	AI 0,25-8YE	8	12.5	0.8	2.0	
0.34 (22)	AI 0,34-8TQ					
0.5 (20)	AI 0,5-8WH		14	1.1	2.5	
0.75 (18)	AI 0,75-8GY			1.3	2.8	

*1) Manufacturer: Phoenix Contact
Caulking tool CRIMPFOX UD 6-4 or CRIMPFOX ZA 3

■Method of wiring/detaching wires

1. Press in the orange portion on the control circuit terminal block using a slotted screwdriver (2.5mm or less in width).
   (The wire insertion slot opens.)
2. While pressing the slotted screwdriver in the terminal block, insert the wire or rod terminal into the wire insertion slot (round hole).
3. Extract the slotted driver to fix the wire.

- Also when extracting the wire, extract it while the orange portion is pressed in with the slotted screwdriver (the wire insertion slot is open).



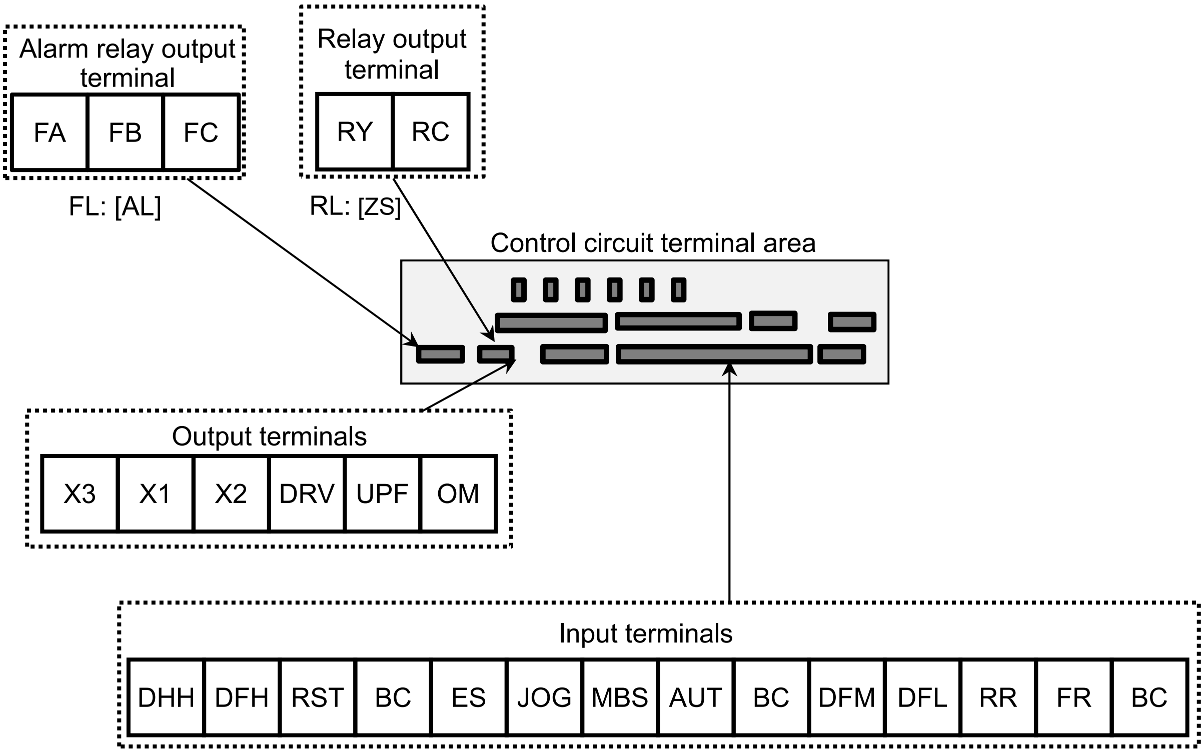
Press in the orange portion using a slotted screwdriver

Insert the wire

Extract the slotted driver to fix the wire

7.7.3 Wiring Portion Under Control Circuit

・ [ ] indicates the factory default setting.



Mal-functioning / **Do**

・When connecting contacts to control circuit terminals, use a relay that does not generate contact failure even at weak current or voltage emitted from cross-bar twin contacts.

Failure / **Do**

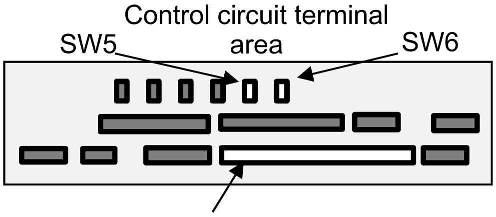
・When connecting a relay with output terminals, connect a diode for absorbing surge in parallel with the coil. Otherwise, internal elements may burn.
(See the chapter for output terminals)

Logic of input terminals

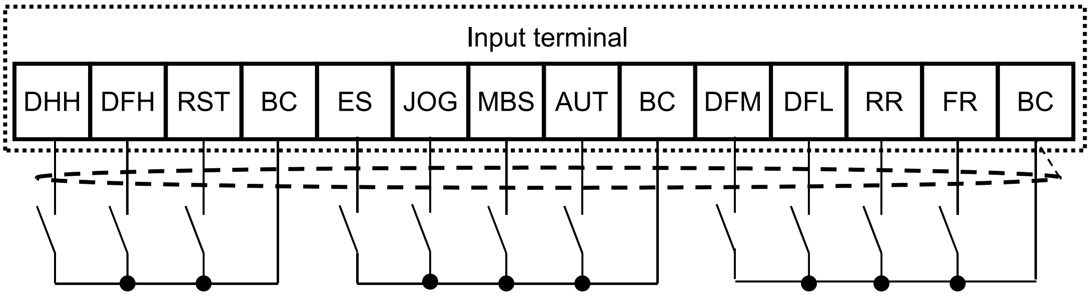
・Using SW6, switch the sink/source logic.

Input terminals

- All BC terminals are at the same potential.
- When connecting a power supply between FR-RST, DFH, DHH and BC, switch SW5 to the external power supply (EX).
- You can switch between the sink/source logic of input terminals by using SW6.



(Wiring example)



- [ ] indicates the factory default setting.

<table>
<tr><th colspan="4"></th><th>Terminal name</th><th>Description</th><th>Electrical characteristics</th></tr>
<tr><td rowspan="4">Input terminal</td><td rowspan="4">Digital input</td><td>Contact</td><td>FR,RR
DFL,DFM
AUT,MBS
JOG,ES
RST
DFH,DHH</td><td>Input terminal</td><td>Each terminal can select input terminal functions by parameter setting.
Switch the SINK / SRC of SW6 to select the sink logic and source logic.</td><td rowspan="3">• Max. allowable voltage DC27V
• Load current 5.6mA(at DC27V)
Voltage between each input and the BC terminal:
When using an external power supply:
• ON voltage Min.DC18V
• OFF voltage Max.DC3V
When using the internal power supply:
• ON voltage Max.DC3V
• OFF voltage Min.DC18V
• Maximum 32kpps pulse input
(When terminal DFH and DHH function Is pulse train input A/B)</td></tr>
<tr><td rowspan="2">Contact/pulse</td><td>DFH</td><td>Pulse input-A</td><td rowspan="2">When [CA-90] is set to 00, DFH and DHH terminals can be used as input terminals.
Each terminal can select input terminal functions by parameter setting.
When [CA-90] is not set to 00, they are used as terminals for pulse string input.
The maximum input pulse is 32kpps.</td></tr>
<tr><td>DHH</td><td>Pulse input-B</td></tr>
<tr><td>Com</td><td>BC</td><td>Common for input terminal</td><td>Common terminals for digital input terminals.
There are three BC terminals.</td><td></td></tr>
</table>

Initial terminal function

Terminal symbol	Description
[RST] Reset	Resets when trip occurs.
[AUT] Switch of frequency command	Switches between the main speed command [AA111] (OFF) and auxiliary speed command [AA112] (ON).
[JOG] Jogging	When operation command is input with [JOG] ON, operation is performed at the frequency set for [AG-22].
[USP] Prevention of power restoration restarting	When [USP] is ON, upon power-on, trip [E013] is issued if the operation command is issued.

Terminal symbol	Description
[MBS] Free-run stop	The motor performs free-run when [MBS] is ON.
[AD2] 2-stage acceleration deceleration	When [AD2] is ON, the acceleration/deceleration time 2[AC124] and [AC126] are enabled.
[ES] External trip	When [ES] is ON, trip [E012] is issued.

[FR] normal rotation and [RR] reverse rotation

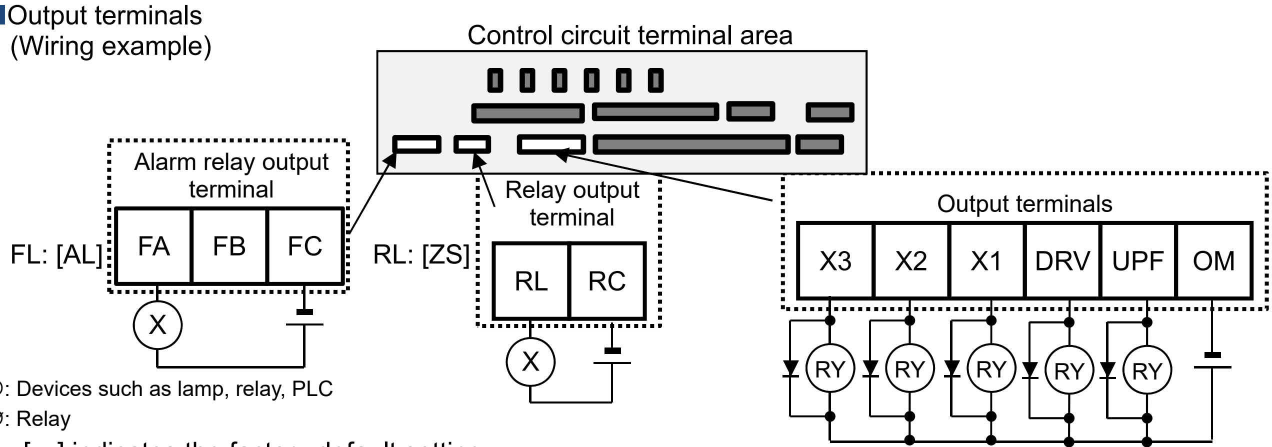
Normal rotation FR	Reverse rotation RR	Description
OFF	OFF	There is no command.
ON	OFF	Forward rotation command operation
OFF	ON	Reverse rotation command operation
ON	ON	There is no command (logic inconsistency).

[DFL] Multistage speed 1 and [DFM] multistage speed 2 commands

Multistage speed 1 DFL	Multistage speed 2 DFM	Description
OFF	OFF	The set frequency command is enabled
ON	OFF	[Ab-11] frequency command is enabled
OFF	ON	[Ab-12] frequency command is enabled
ON	ON	[Ab-13] frequency command is enabled

*) By configuring CF3 and 4, you can configure up to 15th speed.

■Output terminals
(Wiring example)



⊗: Devices such as lamp, relay, PLC
Ⓡ: Relay
・ [ ] indicates the factory default setting.
* Make sure to use diode. Otherwise, the internal circuit may be damaged.

			Terminal symbol	Terminal name	Description	Electrical characteristics
Output terminal	Digital output	Open collector	UPF DRV X1 X2 X3	Output terminal	You can select terminal functions using the parameter settings corresponding to each terminal. These terminals can be used both in sink logic or source logic.	Open collector output ・Between each terminal and OM ・Voltage drop at ON: 4V or below ・Maximum allowable voltage: 27V ・Maximum allowable current: 50mA
			OM	Common for output terminal	Common terminals for output terminals.	
		Relay	RL RC	1a relay terminal	A relay for contact a output.	Maximum capacity of contact ・AC250V, 2A (resistance) AC250V, 1A (induction) Minimum capacity of contact ・DC1V ,1mA
			FA FB FC	1c relay terminal	A relay for contact c output.	Maximum capacity of contact FB/FC： ・AC250V, 2A (resistance) AC250V, 0.2A (induction) FA/FC： ・AC250V, 1A (resistance) ・AC250V, 0.2A (induction) Minimum capacity of contact (common) ・AC100V, 10mA/DC5V ,100mA

■Initial terminal function

Terminal symbol	Description
[DRV: 001] During operation signal	Turns ON during operation (PWM output).
[UPF: 002] Frequency reached signal	Turns ON when the output frequency reaches the command frequency.
[X1:003] Frequency reached signal 2	Turns ON when the output frequency reaches the set frequency [CE-10]-[CE-13].

Terminal symbol	Description
[X2:007] Operation ready completion	Turns ON when operation is ready.
[X3:035] Overload advance notice	Turns ON when current exceeds the level of overload advance notice.
[ZS: 040] 0Hz detection signal	Turns ON when the output frequency goes below the 0Hz detection value level [CE-33].

About [AL] operation

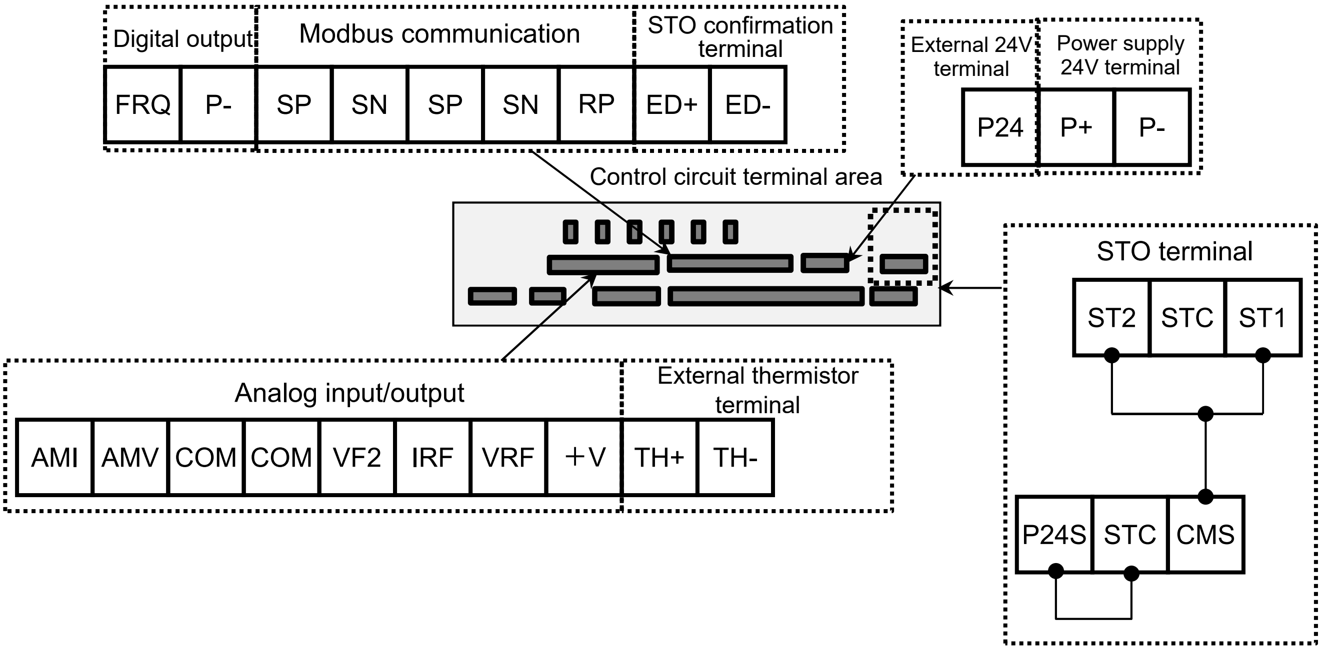
・When [CC-17] = 00

Power supply	Status	FC-FB	FC-FB
ON	Normal	Open	Close
ON	Trip	Close	Open
OFF	–	Open	Close

・When [CC-17] = 01

Power supply	Status	FC-FB	FC-FA
ON	Normal	Close	Open
ON	Trip	Open	Close
OFF	–	Open	Close

7.7.4 Wiring Portion above Control Circuit



Analog input terminal (factory default state)
The corresponding switches are as follows.
- VRF (voltage input): SW1
- IRF (current input): SW2

Analog output terminal (factory default state)
The corresponding switches are as follows.
- Ao1 (voltage output): SW3
- Ao2 (current output): SW4

Connection of STO terminal
When shipped from the factory, wiring is performed so that STO terminal is disabled.

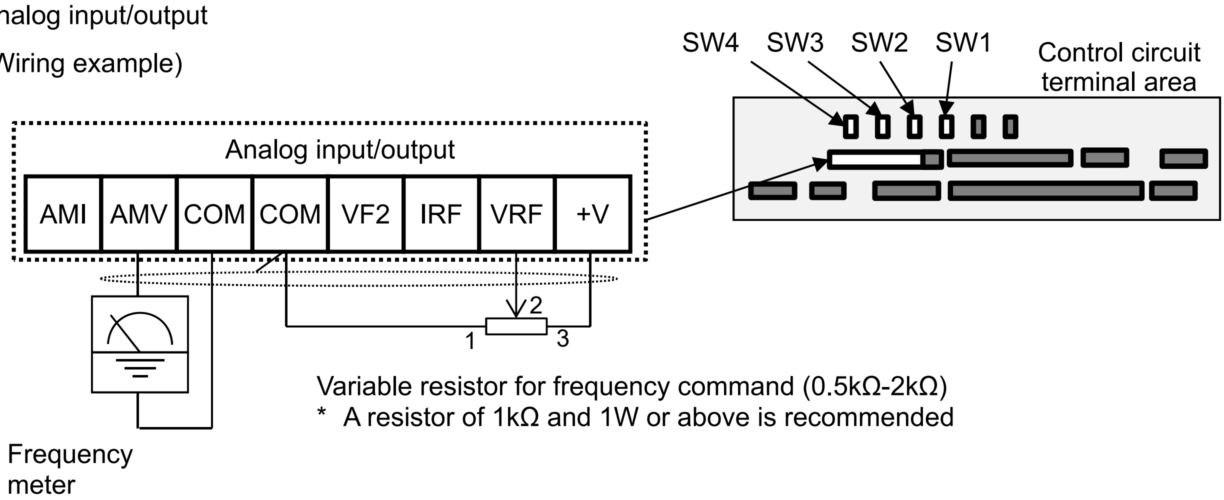
Failure

Prohibited

- Do not short between the analog power supply H and L terminals, power supply P+ and P- terminals, P24 and P- terminals, P+ and P- terminals, and P24 and P- terminals.
- Otherwise, the inverter may fail.

■Analog input/output

(Wiring example)

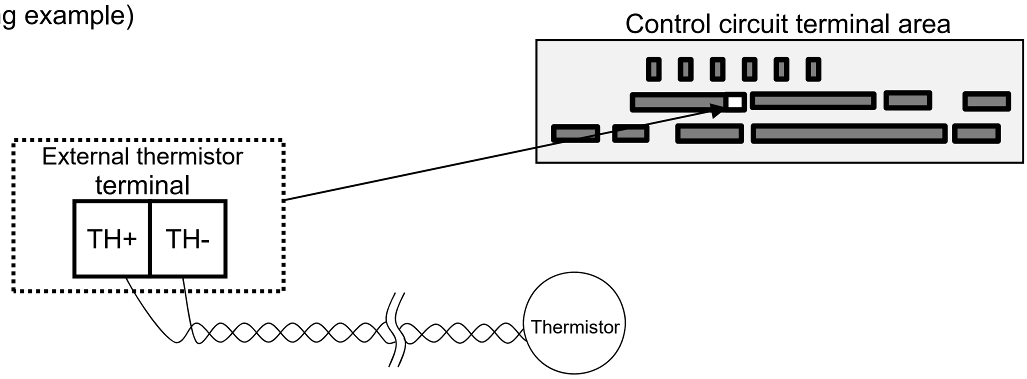


・In the example shown on the left, voltage is input when the variable resistor is used in +V-VRF-COM, therefore, set the SW1 of analog input 1 (VRF) to the voltage side.
・In the example shown on the left, if the frequency meter supports current measurement feature (4-20mA), set the SW3 of analog output 1 (AMV) to the current side of SW3.

		Terminal symbol	Terminal name	Description	Electrical characteristics
Analog input terminal for switching voltage and current	Power supply	COM	Analog power common	Common terminals for analog input terminals (VRF, IRF, VF2) and analog output terminals (AMV, AMI). There are two L terminals.	
		+V	Power supply for setting speed	This is a DC10V power supply. It is used when using analog input terminals (VRF, IRF, VF2) and variable resistor for inputting voltage.	Maximum allowable input current 20mA
	Analog input	VRF	Analog input terminal 1 (voltage/current switching SW1)	For VRF and IRF DC0-10V voltage input and 0-20mA current input can be switched using a switch for use. It can be used for input frequency command or feedback.	In the case of voltage input: ・Input impedance about 10kΩ ・Allowable input voltage DC-0.3V-12V In the case of current input: ・Input impedance about 100Ω ・Maximum allowable input current 24mA
		IRF	Analog input terminal 2 (voltage/current switching SW2)		
		VF2	Analog input terminal 3	DC-10V to 10V voltage input is available. It can be used for input frequency command or feedback.	Only voltage input: ・Input impedance about 10kΩ ・Allowable voltage input DC -12V to 12V
	Analog output	AMV	Analog output terminal 1 (voltage/current switching SW3)	For AMV and AMI, DC0-10V voltage output and 0-20mA current output can be switched using a switch as output of information monitor data of the inverter.	In the case of voltage output: ・Maximum allowable output current 2mA ・Output voltage accuracy ±10% (ambient temperature: 25°C±10°C) In the case of current input: ・Allowable load impedance 250Ω or below ・Output current accuracy: ±20% (ambient temperature: 25±10°C)
		AMI	Analog output terminal 2 (voltage/current switching SW4)		

■External thermistor

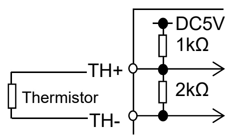
(Wiring example)



Mal-functioning

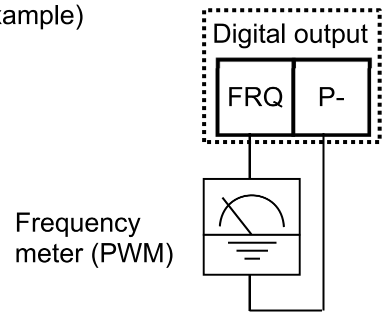
Do

- To prevent malfunctioning, note the following when performing wiring.
  - For connection to the TH terminal, twist only wires connecting to TH+ and TH-, and separate them from other wires.
  - Since the current flowing in the thermistor is very weak, separate the wires from main circuit line (power line).
  - The length of wiring to the thermistor shall be within 20m.

		Terminal symbol	Terminal name	Description	Electrical characteristics
Thermistor terminal	Analog input	TH+	External thermistor input	When an external thermistor is connected, and resistance abnormality occurs due to abnormal temperature, etc., trip the inverter. Connect the thermistor with TH+ and TH-. The level of detecting resistance abnormality can be adjusted from 0 to 10000Ω. [Recommended thermistor characteristics] Recommended product: SHIBAURA ELECTRONICS Co., Ltd. PB-41E Allowable rated power: 100mW or more Impedance at abnormal temperature: 3kΩ	DC0～5V [Input circuit] 
		TH-	Common for external thermistor		

■FRQ output terminal

(Wiring example)



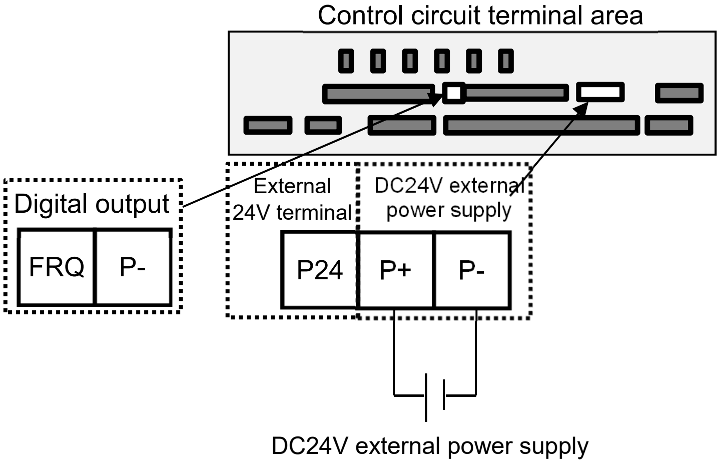
・For FRQ output, you can choose the PWM output method with 6.4ms fixed interval or pulse output method in which pulse frequency varies.

・You can control FRQ output by setting parameters.

			Terminal symbol	Terminal name	Description	Electrical characteristics
Digital	Output	Monitor output	FRQ	Digital monitor (voltage)	For digital monitor output, you can choose the PWM output method at 6.4ms interval or pulse output method with about 50% duty in which frequency varies.	Pulse string output DC0-10V ・Maximum allowable current 1.2mA ・Maximum frequency 3.60kHz
			P-	Common for digital monitor	The common terminal for digital monitor.	-

■Power input/output

(Wiring example)

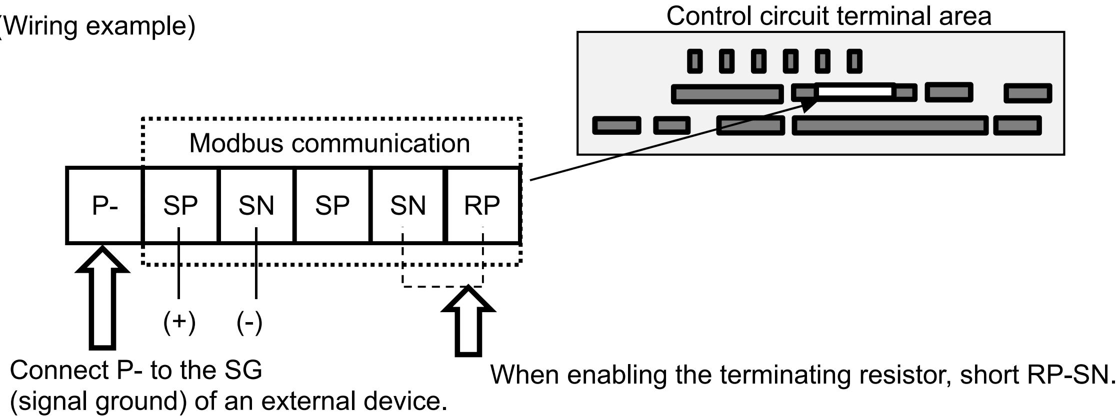


・When 24V power is supplied to P+ and P- from an external source, change of parameters and communication of optional devices are enabled even without main power supply.

		Terminal symbol	Terminal name	Description	Electrical characteristics
24V power supply	Power input	P24	24V output power terminal	DC24V power supply for contact signal. The common terminal is P-.	100mA output at maximum
		P+	External 24V input terminal (24V)	Input an external DC24V power to the inverter. With input of 24V power, you can change parameter settings or operate optional communication without using a control power supply.	Allowable input voltage DC24V±10% Maximum power consumption 1A
		P-	Terminal for P24/P+ (0 (zero) V)		

Serial communication

(Wiring example)

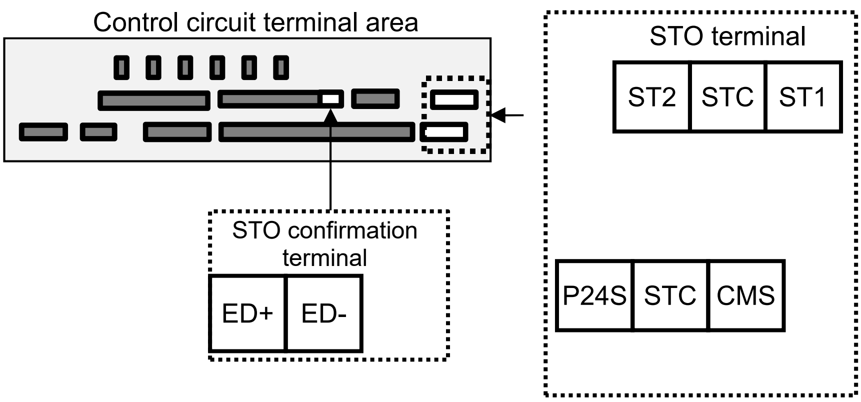


- SP and SN terminals with the same names are internally connected respectively, so they can be used for wiring multiple terminals.
- When using Modbus communication, see "Chapter 14 RS485 Communication".

		Terminal symbol	Terminal name	Description	Electrical characteristics
RS485 communication	Serial communication	SP SN RP (P-)	RS-485 terminal for Modbus communication	SP terminal: RS-485 differential (+) signal SN terminal: RS-485 differential (-) signal RP terminal: Connect to SP via the terminating resistor P- terminal: Connect with the signal ground of an external communication device. (also used by FRQ terminal) There are two SP terminals and SN terminals each, which are connected internally. Maximum baud rate is 115.2kbps.	Equipped with terminating resistor (120Ω) Enable: Short RP-SN Disable: Open RP-SN

STO terminal

- For the terminal function, see "21.4 STO Terminal Function".
- The section above describes only the function of STO terminal.



Terminal symbol	Terminal name
P24S	24V output power terminal
CMS	Common terminal for STO terminal
STC	Logic switching terminal
ST1	STO input 1
ST2	STO input 2
ED+	Monitoring output terminal
ED-	Monitoring output common

Chapter 8 Operation Check/Residual Risks

8

8.1 What This Chapter Explains

This chapter describes residual risks in operation and items to be checked concerning the risks.

The customer who use this product shall appropriately perform risk assessment before performing trial run or using the product, and appropriately protect their personnel and systems.

Although this chapter describes all the possible measures to make sure, it does not cover all the risks in your systems. Please note that we will bear no responsibility for damages resulting from causes described in this chapter. Make sure to perform risk assessment of the system equipped with this product.

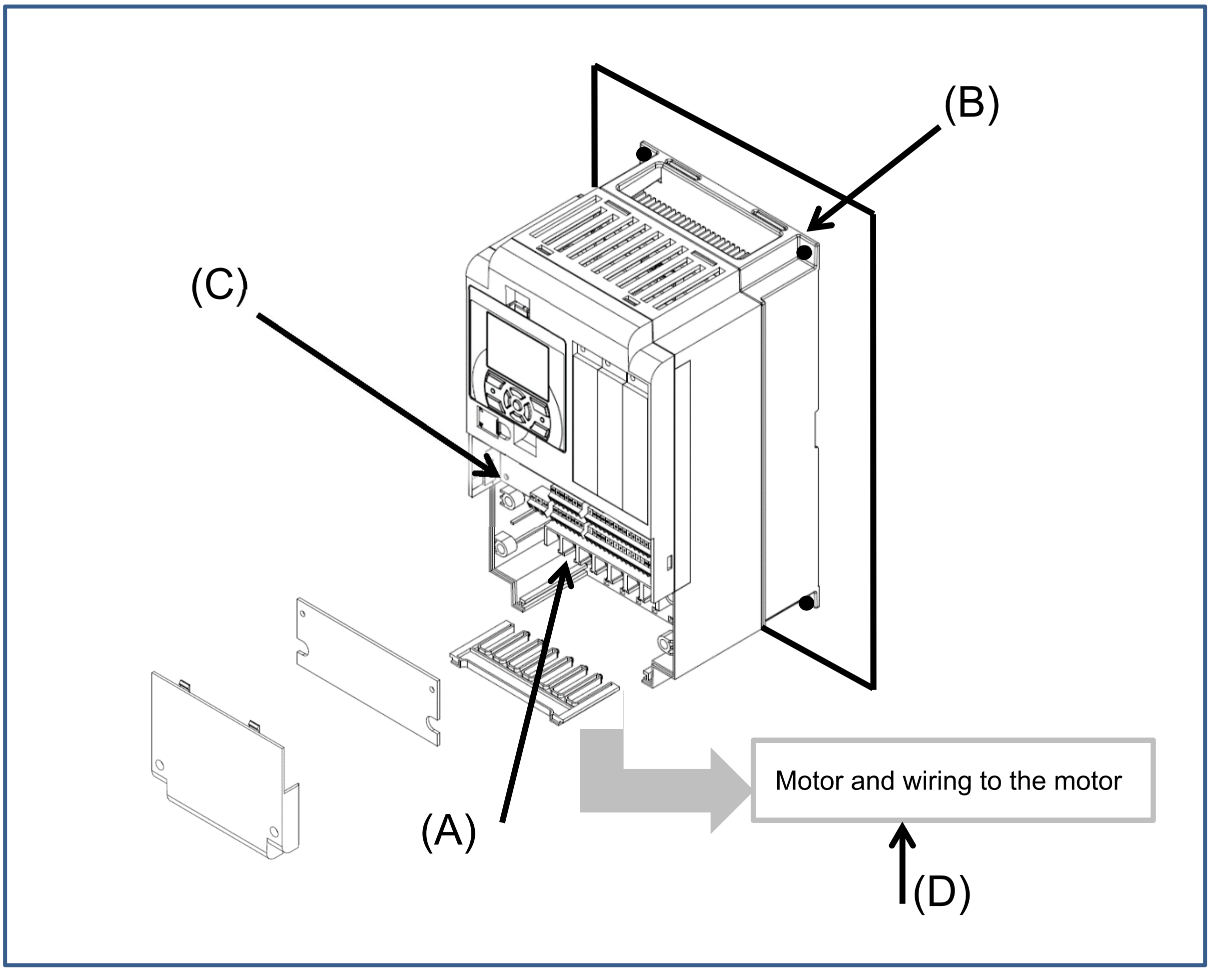
Also, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work

8.2 Content of the Checklist

The items in the checklist shown in the next section are classified in accordance with the following definitions in the same way as "Chapter 1 Safety Instructions/Risks".

⚠**DANGER** Indicates that incorrect handling may cause hazardous situations, which have a high chance of resulting in serious personal injury or death, and may result in major physical loss or damage.
⚠**WARNING** Indicates that incorrect handling may cause hazardous situations, which may result in serious personal injury or death, and may result in major physical loss or damage.
⚠**CAUTION** Indicates that incorrect handling may cause hazardous situations, which may result in moderate or slight personal injury or damage, and may result in physical loss or damage alone.

8.3 Sections with Residual Risks



■Residual risk checklist No.

No.	Section name	⚠ DANGER	⚠ WARNING	⚠ CAUTION
(A)	Main circuit terminal block	8, 10	-	-
(B)	Heat sink	4	-	1
(C)	I/O terminal block	11	-	-
(D)	Motor connected with the inverter and wiring to the motor	12, 13	-	-
-	Unknown section	9, 14, 15	-	2, 3, 5, 6, 7

8.4 Residual Risk Checklist

No.	Operation stage	Work	Target section	Residual risk	Details of harm	Protective measure	√
1	Installation	Installation	(B)	Caution	Damage caused by careless transport	Do not drop the product. Do not carry the inverter in a manner that applies force to the cover or operator keypad.	☐
2	Installation	Installation	-	Caution	Reduction of component life due to use in a location exposed to direct sunlight or at a temperature outside the specification range.	Check that ambient temperature is within the standard specification range in the whole year by means of cooling and ventilation.	☐
3	Installation	Installation	-	Caution	Failure due to short circuit caused by using in a location which humidity and condensation are out of standard range described in specification..	Check that ambient temperature is within the standard specification range in the whole year by means of cooling and ventilation. Otherwise, install the product in a location free from condensation.	☐
4	Installation	Installation	(B)	DANGER	The cooling fin that is heated to exceed 150°C sets fire to a flammable wall.	Install the inverter on an inflammable metal wall.	☐
5	Installation	Installation	-	Caution	Component failure due to entry of dust, corrosive gas, or other substances.	Install the inverter inside a totally enclosed panel.	☐
6	Installation	Installation	-	Caution	Reduction of a component life due to degradation of cooling capability by horizontal installation	Install it vertically.	☐
7	Installation	Installation	-	Caution	When the fin is installed outside the inverter, the cooling fan fails due to droplet, oil mist, etc.	When installing the fin outside the inverter, install it in a location free from droplet, oil mist, etc.	☐
8	Maintenance for installation	Electrical connections	(A)	DANGER	Arc flew out due to screws that are loosened by vibration, and set fire to the internal components.	Check screws are appropriately tightened on a regular basis.	☐
9	Maintenance for installation	Electrical connections	-	DANGER	Arc flew out due to screws that are loosened by vibration, and set fire to combustibles.	Check screws are appropriately tightened on a regular basis. Do not place flammable materials near the installed inverter.	☐
10	Maintenance before use	Wiring Inspection	(A)	DANGER	When the cover is removed, electric shock is caused in a high-voltage section.	Do not remove the cover when power is supplied. After power is turned off, wait 10 minutes or more to perform working.	☐
11	Maintenance before use	Wiring Inspection	(C)	DANGER	When the operator removes the cover, electric shock is caused when a tool touches a high-voltage section.	Do not remove the cover when power is supplied. After power is turned off, wait 10 minutes or more to perform working.	☐

* Installation, wiring, and setting work need to be performed by specialized technicians.

No.	Operation stage	Work	Target section	Residual risk	Details of harm	Protective measure	√
12 (a)	Installation	Electrical connections	(D)	DANGER	Due to long wiring length, insulation degraded by surge, which eventually burns the motor.	If the wiring length exceeds 20m, shorten the motor wiring length. Install the optional AC reactor.	☐
12 (b)					Since a motor with different voltage class is connected to the inverter, insulation degraded by surge, which eventually burns the motor.	Match the voltage class of inverter and that of motor.	☐
12 (c)					Due to unstable output caused by imbalance of power supply voltage, under voltage, extreme voltage drop, aging of motor, the motor burns, and eventually the inverter fails.	Check the receiving voltage of inverter, power receiving method, and power supply capacity are appropriate.	☐
12 (d)	Maintenance for use	Wiring Inspection			The short circuit failure caused by degradation of motor insulation, cracking of aged wires, etc., causes phase loss on inverter output, motor cable, and motor. Driving the inverter in such a condition burns the motor, and eventually the inverter fails.	Check there is no phase loss by inspection.	☐
12 (e)	Installation Use	Setting			By performing inappropriate parameter settings, high current flows in the motor, causing it to burn.	Set appropriate values for parameters related to motor electronic thermal function [bC110] to [bC225].	☐
13	Use	Operation			The stopped motor automatically starts running.	To restart the motor after stopping it by a function, define it in the system.	☐
14	General	General	-		Damage and injury caused by hidden risks.	Perform risk assessment on the system, and check that the failsafe function is incorporated into the system.	☐
15					Damage and injury caused by failure to obtain additional information concerning risks.	Obtain the latest version of User's Guide so that necessary information can be checked. Communicate information to the end users as necessary.	☐

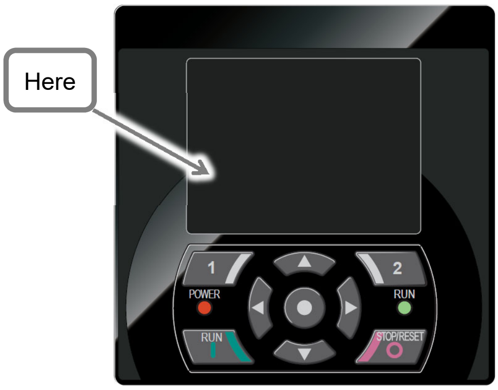
* Installation, wiring, and setting work need to be performed by specialized technicians.
When using the [SET] terminal function of input terminals, also check the second settings.

Chapter 9 Operating

9

9.1 What This Chapter Explains

The chapter provides explanations of the liquid crystal operation panel.
What can be done with the operator keypad and use methods are provided.
When using the inverter, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.
・The cancel function is assigned to the F1 key. Press the F1 key to go back.



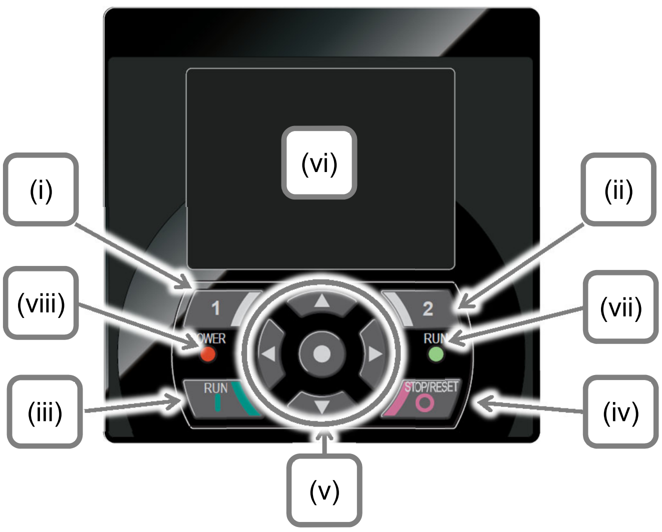
・For details, see the following sections.

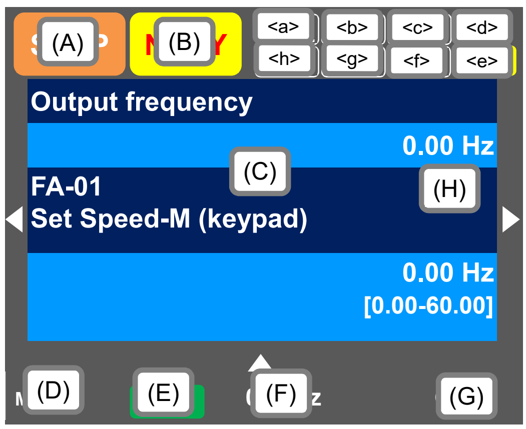
9.2 Start Operating the Inverter!

9.2.1 Operator Keypad and Icon Display

・The overview of the operator keypad is given below.
* The color of the screen image may be different from the actual color.

・About display screen (vi)



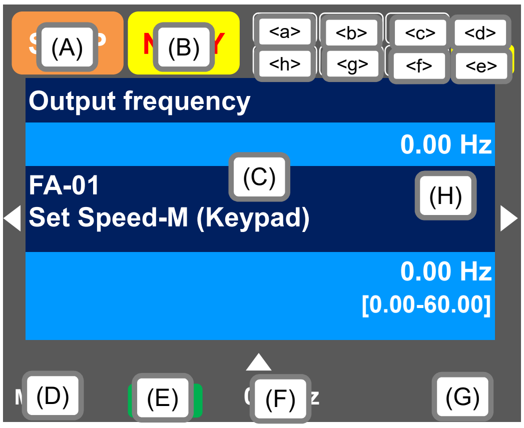


No.	Name	Setting
(i)	F1 key	Displays functions such as navigation to the home screen and cancellation at the bottom left of the screen.
(ii)	F2 key	Displays functions such as data storage at the bottom right of the screen.
(iii)	RUN key	The inverter runs when this key is enabled.
(iv)	STOP/RESET key	Performs deceleration stop and trip reset.
(v)	Arrow keys & SEL key (center)	Select data on the screen using arrow keys, and confirm by pressing the O key in the center.
(vi)	Display screen	Displays parameters and data.
(vii)	RUN lamp	Turns on when an operation command is sent.
(viii)	POWER lamp	Turns on when the operator keypad is ON. Turns on when R0 and T0 on the main circuit or P+ and P- on the terminal block are ON.

No.	Description
(A)	Displays the operation status.
(B)	Displays the warning status.
(C)	Displays data/parameters.
(D)	Displays details of the function assigned to the F1 key.
(E)	Displays the operation of RUN key on the operator keypad.
(F)	Displays frequency command, torque command, inverter name, clock, etc. The function to be displayed in this section can be selected using the F2 key (option) on the main screen.
(G)	Displays details of the function assigned to the F2 key.
(H)	When soft-lock function is enabled, the [LKS] mark is displayed.

No.	Name	Description
<a>	Power status	Displays the type of input power supply.
<b>	SET function	Displays which of the first setting or second setting is selected for SET terminal function.
<c>	Parameter	Displays the status of display restriction mode.
<d>	Screen No.	Displays the screen number.
<e>	STO function	Displays the STO command.
<f>	Control mode	Displays the command control mode.
<g>	-	Reserved
<h>	Special status	Displays the operation of special function.

・Sections of display screen on the operator keypad



Display (A) Main Operation status display

No.	Indication	Description
A1	RUN FR	Displayed during normal rotation operation. There is a parameter that cannot be changed during operation.
A2	RUN RR	Displayed during reverse rotation operation. There is a parameter that cannot be changed during operation.
A3	RUN 0Hz	Output is in process by 0Hz command. This is also displayed by DB, FOC, and SON functions. There is a parameter that cannot be changed during operation.
A4	TRIP	Displayed during trip after the occurrence of error. For errors that cannot be canceled, perform reset operation to cancel. -> 18.3.1 Checking Trip Information
A5	WARN	Displayed when setting inconsistency occurs. Resolve the inconsistency. -> 18.5.2 Checking setting inconsistencies
A6	STOP	This is displayed when the inverter is forcibly stopped by a function although an operation command is issued. ・The operation command is issued with frequency command at 0Hz. ・Although the operation command is not the operator keypad, the inverter is stopped by the STOP key of the operator keypad. ・Although the operation command is not the operator keypad, the inverter is stopped by terminal function [RST], [MBS], etc. ・The inverter is stopped by the instantaneous power failure non-stop function. At this time, the RUN lamp blinks.
A7	STOP	The operation command is suspended due to lack of operation command. ・If the operation command is issued from than the operator keypad, the operation is stopped when the breaking function is enabled.

・A6: When set to STOP (in red)

-> If Display (F): Frequency command is set to 0.00Hz, the frequency command is 0Hz.
Check if the frequency command is issued.

-> For example, while the inverter is running with the [FR] terminal, if it is stopped by the stop key, operation restarts when the [FR] terminal is turned on after turned off once.

Display (B) Warning status display

No.	Indication	Description
B1	LIM	This is displayed by the following functions. ・Under stall prevention ・Under torque limit ・Under overcurrent suppression ・Under overvoltage suppression ・Under upper/lower limit operation ・Under jump frequency operation ・Under minimum frequency limit Please refer [dC-37] for details.
B2	ALT	This is displayed by the following functions. ・Overload advance notice ・Motor thermal advance notice ・Inverter thermal advance notice ・Motor heating advance notice Please refer [dC-38] for details.
B3	RETRY	Displayed during retry standby or restart standby. Please refer [dC-39] for details.
B4	NRDY	Operation is not started even if the operation command is issued. ・Under insufficient voltage of the main power ・Under operation only by the 24V power supply ・Under reset operation ・Off when the [REN] terminal function is enabled Please refer [dC-39] for details.
B5	FAN	Displayed upon the fan life advance notice.
B6	C	Displayed upon the capacitor life advance notice on the circuit board.
B7	F/C	Displayed upon the fan life advance notice and capacitor life advance notice on the circuit board.
B8	(None)	A status other than above

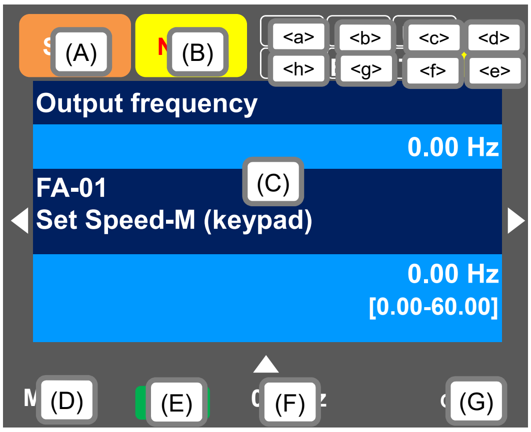
・B1: LIM and B2: ALT are displayed when current or internal voltage is rising.
If an error occurs, load or other element needs to be reconsidered.
・If it is determined that the life of cooling fan or capacitor on the circuit board is ending, the indication above is displayed.

Display (E) Display of RUN key function on the operator keypad

No.	Indication	Description
E1	oFR	Normal rotation by the RUN key on the operator keypad.
E2	oRR	Reverse rotation by the RUN key on the operator keypad.
E3	>FR	The RUN key is enabled by the [F-OP] terminal or the operator keypad function. (Normal rotation)
E4	>RR	The RUN key is enabled by the [F-OP] terminal or the operator keypad function. (Reverse rotation)
E5	(None)	The command other than the RUN key is selected.

・This section is displayed when the RUN key on the operator keypad is enabled.
・To run the inverter from the operator keypad while this item is not displayed, check [AA111] first.

・Sections of display screen on the operator keypad



<a> Power status display

No.	Indication	Description
a1	(None)	There is input to the main power supply/control power supply.
a2	CTRL	There is input to the control power supply.
a3	24V	The inverter runs with 24V input to P+/P-.

・Indicates the status of power input.
When CTRL or 24V is displayed, main power is not input, which makes operation impossible. Check the power supply.

<b> Display of [SET] input terminal function operation status

No.	Indication	Description
b1	M1	The [SET] terminal is not selected or the [SET] terminal is selected but the function is disabled. (common setting and first setting are enabled)
b2	M2	The [SET] terminal is selected and the function is enabled. (common setting and second setting are enabled)

・If the [SET] terminal is not used, M1 is displayed. If the center of parameter is “-” (common setting such as [AC-01]) or “1” (first setting such as [AA111]), the setting is enabled, and “2” (second setting such as [AA211]) is ignored.

<c> Selection of parameter display

No.	Indication	Description
c1	(None)	All-parameter display mode.
c2	UTL	Individual-function display mode.
c3	USR	User-setting display mode.
c4	CMP	Data-comparison display mode.
c5	MON	Monitor display mode.

・This section is displayed when the display limit function is working. If there is a hidden parameter, change the setting in [UA-10].

<d> Display of monitor screen No.

・Displays the screen number of each monitor. When making inquiries, please tell us the number of monitor displayed on your screen. The list of monitor screen numbers is shown in the next page.

<e> STO function display

・If the function is displayed, it means the current is shut off.
* For details of the STO function display, please contact us.

<f> Display of control command mode

No.	Indication	Description
f1	(None)	The speed control mode.
f2	TRQ	The torque control mode.
f3	POS	The position control mode.

・Indicates the mode of control operation.

<g> Reserved

<h> Display of special function status

No.	Indication	Description
h1	(None)	The inverter is not in the special status.
h2	AUT	The inverter is auto-tuning.
h3	SIM	The inverter is in the simulation mode.

・If the function is displayed, it means that the inverter is in the special state.

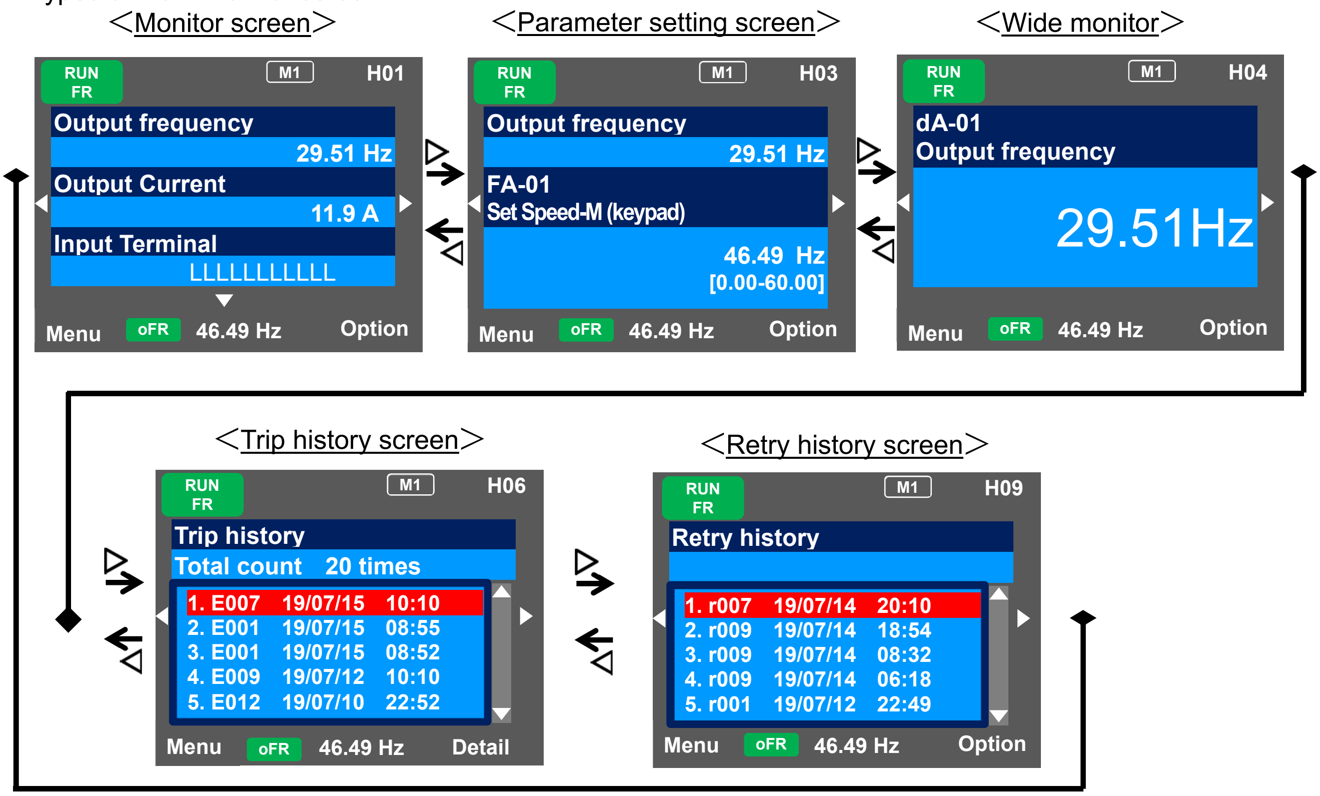
■List of monitor screen numbers

№	Name	Screen number
1	Monitor screen "Multi monitor"	H01
2	Setting screen for rotating direction of operator keypad	H02
3	Parameter setting screen	H03
4	Monitor with large characters "Wide monitor"	H04
5	Selection screen for parameter code	H05
6	Trip history screen	H06
7	Trip currently occurring	H07
8	Detailed trip history screen	H08
9	Retry history screen	H09
10	Detailed retry history screen	H10
11	Detailed screen for limitation status icon	H11
12	Home screen option	o01
13	Inverter name setting	o02
14	Selection of data displayed at the bottom center	o03
15	Menu screen	M01
16	R/W function screen	R01
17	Screen for selecting data uploaded using the R/W function	R02
18	Screen for selecting saving location for data uploaded using the R/W function	R03
19	Screen for displaying progress status of uploading using the R/W function	R04
20	Screen for selecting data downloaded using the R/W function	R05
21	Screen for selecting the location for reading data that is downloaded using the R/W function	R06
22	Screen for displaying progress status of downloading using the R/W function	R07
23	System settings screen	S01
24	Language selection screen	S02
25	Dimming setting screen	S03
26	Setting screen for automatic light off time	S04
27	Setting screen for dimming at light off	S05
28	Setting screen for automatic home transition time	S06
29	Monitor screen for basic inverter information	S07
30	Selection screen for operator initialization	S08
31	Operator version display screen	S09
32	Date and time screen	S11
33	Date and time setting screen	S12
34	Selection screen for date and time display format	S13
35	Setting screen for battery level warning	S14
36	Inverter model selection screen	S19
37	Read lock selection screen	S21
38	Selection screen for blinking at the time of trip	S22
39	Color setting screen	S23
40	Selection screen for self-check mode	S25~S35
41	Setting screen for automatic home screen	S36
42	Remote mode switching screen	S38
43	Scroll menu	L01
44	Scroll screen	L02
45	Message screen	∗

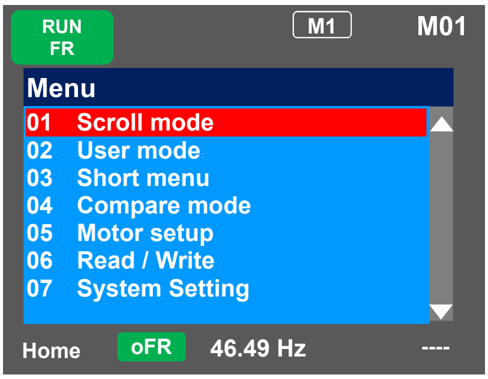
∗If a message is displayed, see "18.5.3 Checking display messages ".

9.2.2 Transition of Operator Keypad Screen

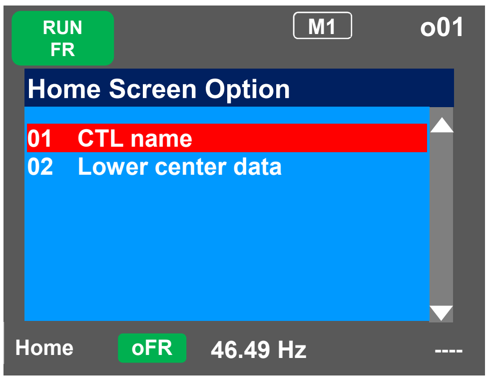
・Types of main monitor screen



<Menu screen>



<Home screen option>



・You can switch between the main screen and menu screen using the F1 (1) key.

・You can navigate to the home screen option from the main screen by using the F2 (2) key.
To return to the home screen, press F1 (1) key.

No.	Menu	Tips	Reference
01	Scroll mode	You can change parameters in the scroll mode.	9.3.1
02	User mode	The user mode will display user-registered parameters only.	9.6.1
03	Short mode	The short menu displays regularly used parameters for the inverter operation.	9.6.3
04	Compare mode	The compare mode will only display the parameters that have been modified from its initial settings.	9.6.3
05	Motor setup	The motor setup menu displays the parameters that are related to a basic motor setting.	9.6.4
06	Read/Write	With R/W function, you can read and write data.	9.6.5
07	System setting	On the System settings screen, you can use extended functions.	9.6.6

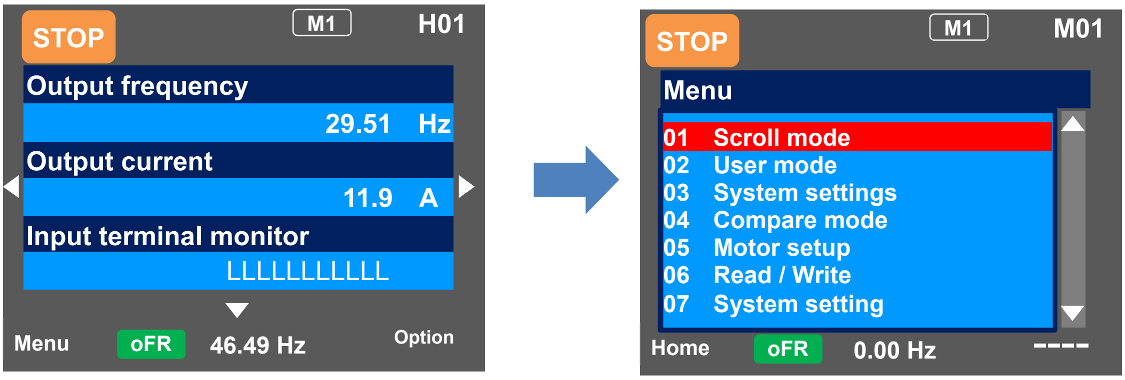
Home screen option		Tips
01 Controller (inverter) name		You can specify 8-digit string from alphanumeric letters and symbols.
02 Data displayed at the bottom center	00 Frequency command	The current frequency command is displayed.
	01 Torque command	The current torque command is displayed (during torque control).
	02 Time	The current time is displayed.
	03 Controller name	The specified controller (inverter) name is displayed.

9.3 Set up parameters!

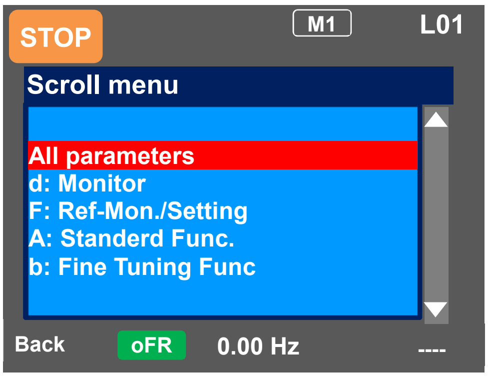
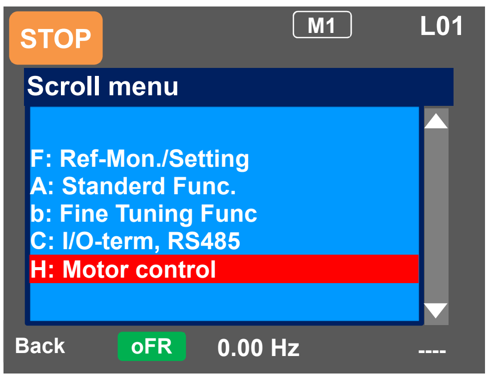
9.3.1 Scroll mode"

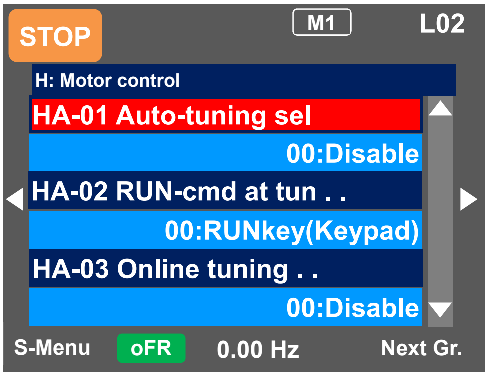
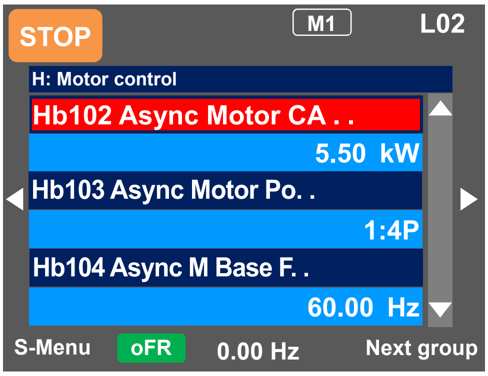
- Press F1 (Menu) key on the screen that is displayed upon power-on (Multi monitor in the example below) to move to the system settings screen (M01).

- When configuring basic settings of motor, base frequency, rated voltage of motor, input and output of terminals, as well as when configuring individual functions, change parameters in the scroll mode.
- You can check list of setting data of parameters in the scroll mode, therefore, it is also useful when checking the settings.
- In the system settings, if the scroll screen is set to the initial screen, dA-01, dA-02, and dA-03 of the d: Monitor are initially displayed.

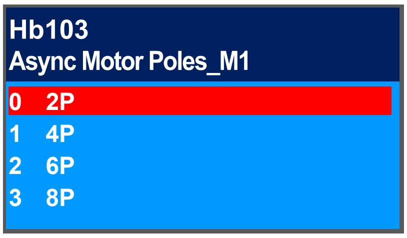


Scroll menu - Parameter selection screen

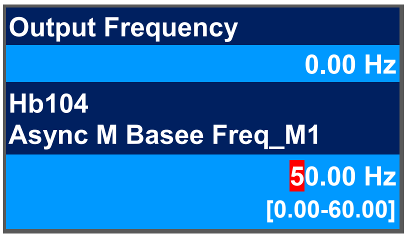
Set-up procedure	Action
① 	Choose the scroll mode on the system settings screen (M01) and press the SEL (O) key to show the scroll menu (L01).
② 	Choose a group you want to browse using the up and down (Δ∇) keys, and then press the SEL (O) key to move to the parameter list display. For example, select "H: Motor control". Example: In the example shown below, the Hb group, which is a basic parameter of induction motor, is checked, and a parameter is changed.

Set-up procedure	Action
③ 	Parameters of "H: Motor control" are displayed. Using the up and down (Δ∇) keys, you can check parameters. Pressing the F2 (2) key jumps to the top [Hb102] of the next group of [HA]. (Tips) You can jump to the top parameter of the sub-group in the group ([HA], [Hb], etc. in the case of group H) using the F2 (2) key (transition is performed in one direction). Example of group H: ···->HA->Hb->HC->Hd->HA->···
④ 	Using the up and down (Δ∇) keys, you can check parameters. Choose the parameter to change, and then press the SEL (O) key. Example1) [Hb103] The parameter to change the “Async. Motor number of poles setting, 1st-motor”. Example2) [Hb104] The parameter to change the “Async. Motor base frequency setting, 1st-motor”.

Example1) Change [Hb103] Async. Motor number of poles setting, 1st-motor

Set-up procedure	Action
① 	If the number of motor poles is 2, using the up and down (Δ∇) keys, adjust it to "00 2P", and then press the F2 (Save) key. (Tips) Data is saved when the F2 (2) key is pressed. It is saved even when the power is turned off because volatile memory is used. When configuring an item, the entire screen changes to the screen for setting the item. When not saving the setting after changing it, press the F1 (Back) key.The screen returns to the parameter list display.
② 	To confirm if the data is correctly changed, check the lower section of the parameter display. Press the F1 (1) key three times to return to the monitor.

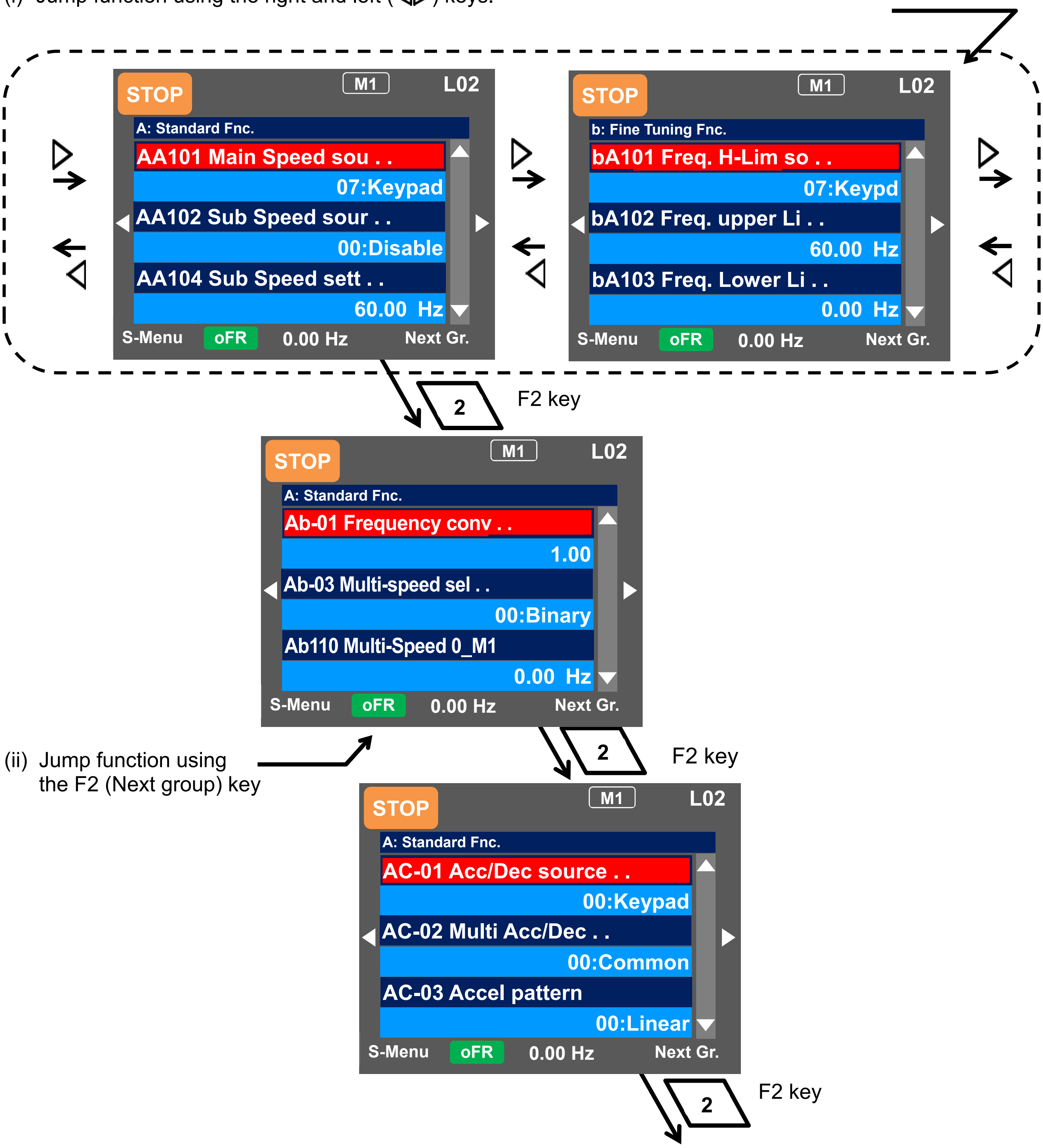
Example2) Change [Hb104] Async. Motor base frequency setting, 1st-motor.

Set-up procedure	Action
① 	You can change the Left-most digit of data area. Change the value using the arrow (△▽◁▷) keys, and then press the F2 (2) key. (Tips) In the figure on the right, base frequency is changed to 50.00Hz. Data is saved when the F2 (2) key is pressed. It is saved even when the power is turned off because volatile memory is used. You can make adjustments while performing monitoring. The monitor on the upper area shows the parameter selected in the Big monitor.
② 	To confirm if the data is correctly changed, check the lower section of the parameter display. Press the F1 (1) key three times to return to the monitor.

・In the scroll mode screen (L02), (i) you can jump to the parameter at the top of each group by using the right and left (◁▷) keys or (ii) jump to the parameter at the top of the sub-group (AA, Ab, etc.) of the group by using F2 (Next group) key.

(i) You can jump to the top parameter of each group by using the right and left (◁▷) keys.
(…<->All parameters<->d: Monitor<->F: Command monitor/setting<->…<->U: Initial setting, PDN<-> All parameters<->…)
(ii) You can jump to the top parameter of the sub-group in the group (AA, Ab, etc.) using the F2 (Next group) key (transition is performed in one direction (see below)).
・Example of group A: …->AA->Ab->AC->…->AJ->AA->…

(i) Jump function using the right and left (◁▷) keys.

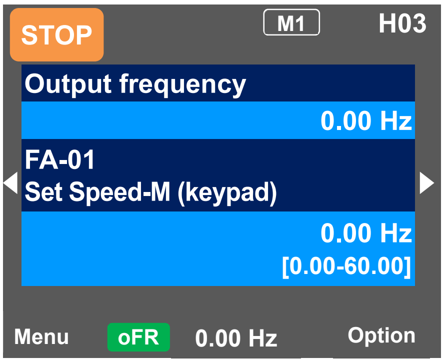


9.3.2 Changing a Parameter

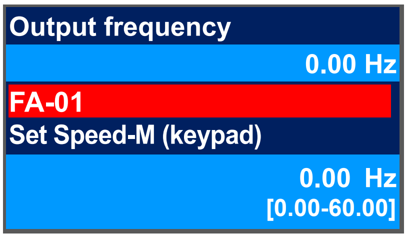
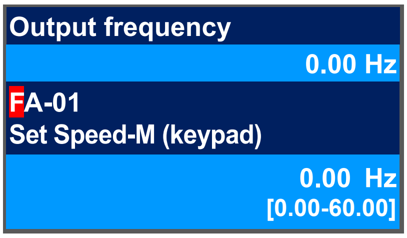
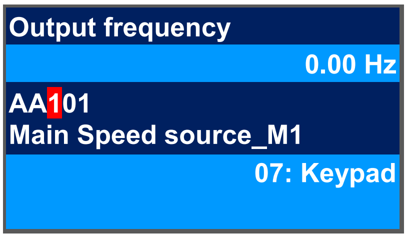
- On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to a setting screen "Concurrent monitor" (H03).

- When configuring settings such as frequency command and acceleration/deceleration time while watching the monitor during operation, you can change the settings on this monitor screen.
- On the parameter setting screen, you can change parameters while watching the monitor. For details of the monitor, see "9.4.2 Parameter setting screen.

- In the case of a parameter that requires selection of an item, the screen changes to the item selection screen.



Monitor screen - Parameter selection screen

Set-up procedure	Action
① 	Press the SEL (O) key to change the color of parameter field. (Tips) Using the up and down (Δ∇) keys, you can choose to change the parameter or change the monitor.
② 	When the SEL (O) key is pressed again, the left-most letter of the parameter can be changed.
③ 	Using the arrow (Δ∇◁▷) keys to change the parameter number that you want to change, and then press the SEL(O) key. Example1) When the frequency command destination [AA101]"Main speed input source selection, 1st-motor" is changed. Example2) When the frequency command value is controlled in [FA-01] while the frequency command destination is set to 07: Parameter setting.

Example1) Change the [AA101] “Main speed input source selection, 1st-motor” to [VRF] terminal.
* The [VRF] terminal is an analog input terminal (voltage/current).

	Set-up procedure	Action
①	Output frequency 0.00 Hz AA101 Main Speed source_M1 07: Keypad	Press the SEL (O) key while [AA101] is displayed. (Tips) The information currently selected is shown in the lower section. "07: keypad" is currently selected.
②	AA101 Main Speed source_M1 1 Term.[VRF] 2 Term.[IRF] 3 Term.[VF2]	Using the up and down (△▽) keys, select "1 Term. [VRF]", and then press the F2 (2) key. (Tips) Data is saved when the F2 (2) key is pressed. It is saved even when the power is turned off because volatile memory is used.When configuring an item, the entire screen changes to the screen for setting the item.
③	Output frequency 0.00 Hz AA101 Main Speed source_M1 01: Term.[VRF]	To confirm if the data is correctly changed, check the lower section. Press the F1 (1) key to return to the monitor. (Tips) The information currently selected is shown in the lower section. Currently, "1 Term. [VRF]" is selected.

Example2) Change frequency command in [FA-01]. (If the frequency command selection is "07: Keypad")

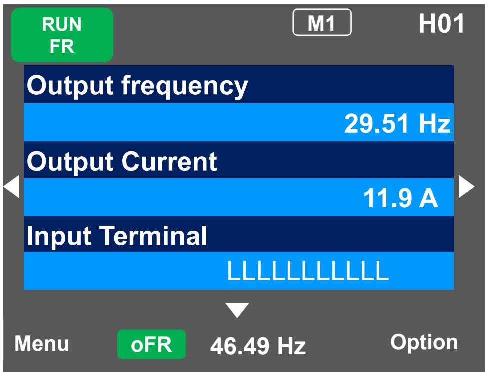
	Set-up procedure	Action
①	Output frequency 0.00 Hz FA-01 Set Speed-M (Keypad) 0.00 Hz [0.00-60.00]	Press the SEL (O) key while [FA-01] is displayed. (Tips) In [FA-01], the set value can be changed if the string inside () of main speed command indicates the operator keypad or multi-step speed. In other cases, it is set to the command monitor.
②	Output frequency 0.00 Hz FA-01 Set Speed-M (Keypad) 60.00 Hz [0.00-60.00]	You can change the left-most digit of data. Change the value using the arrow (△▽◁▷) keys, and then press the F2 (2) key. (Tips) In the figure on the right, base frequency is changed to 60.00Hz. Data is saved when the F2 (2) key is pressed. It is saved even when the power is turned off because volatile memory is used. You can make adjustments while performing monitoring.
③	Output frequency 0.00 Hz FA-01 Set Speed-M (Keypad) 60.00 Hz [0.00-60.00]	To confirm if the data is correctly changed, check the lower section. Press the F1 (1) key to return to the monitor. (Tips) The current frequency command is shown in the lower section. Currently, 60.00Hz is input as the command.

9.4 Monitor Inverter Information!

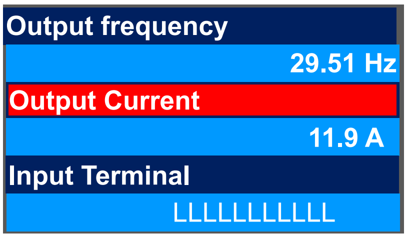
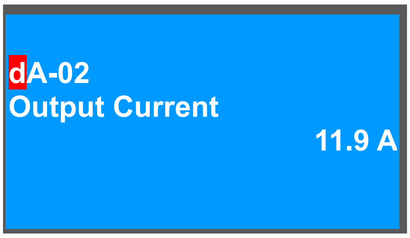
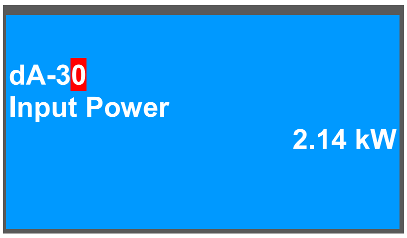
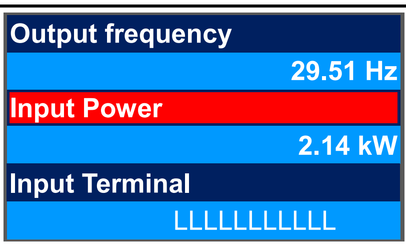
9.4.1 Monitor screen "Multi monitor".

- What is displayed on the first line of monitor screen "Multi monitor" (H01) is the same as that displayed on the upper area of the parameter setting screen (H03) and the screen with large characters, "Wide monitor" (H04).

- On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to "H01".
- In the three-line monitor screen, you can monitor three types of information at the same time. You can change and save the monitored data.

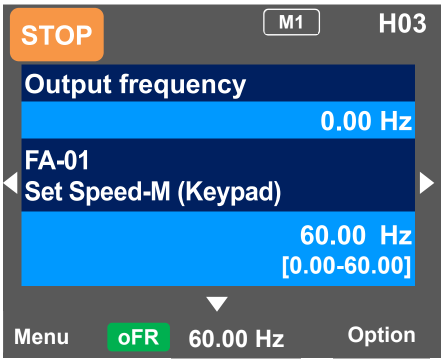


Example) Change the output current monitor to the input power monitor.

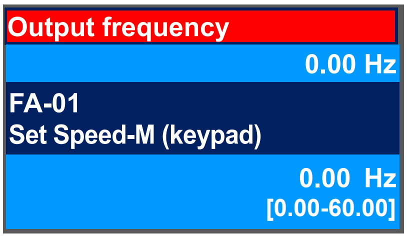
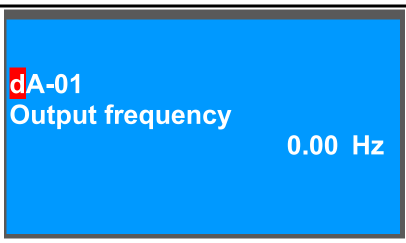
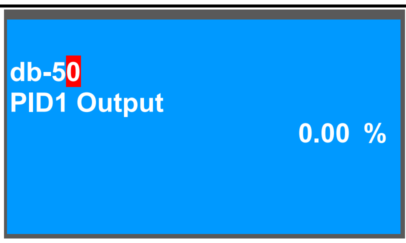
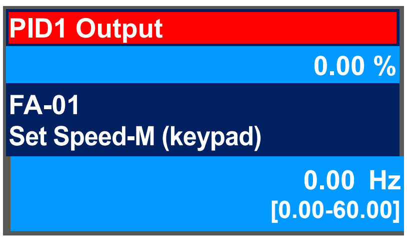
Set-up procedure	Action
①  Output frequency / 29.51 Hz / Output Current / 11.9 A / Input Terminal / LLLLLLLLLLL	Press the SEL (O) key to change the color of the field in upper section. Using the up and down (Δ∇) keys, navigate to the second line.
②  dA-02 / Output Current / 11.9 A	When the SEL (O) key is pressed, the left-most letter of the parameter can be changed.
③  dA-30 / Input Power / 2.14 kW	Using the arrow (Δ∇◁▷) keys, change [dA-02] to [dA-30].
④  Output frequency / 29.51 Hz / Input Power / 2.14 kW / Input Terminal / LLLLLLLLLLL	Press the SEL (O) key to confirm the monitoring target. Press the F1 (1) key to return to the monitor.

9.4.2 Parameter setting screen

- What is displayed on the upper monitor of the parameter setting screen (H03) is the same as that displayed on the first line of monitor screen "Multi monitor" (H01) and the screen with large characters, "Wide monitor" (H04).
- On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to "H03".
- On the setting screen, you can control parameter data while performing monitoring.
  To change the selected data, the screen changes to the setting screen that shows options.



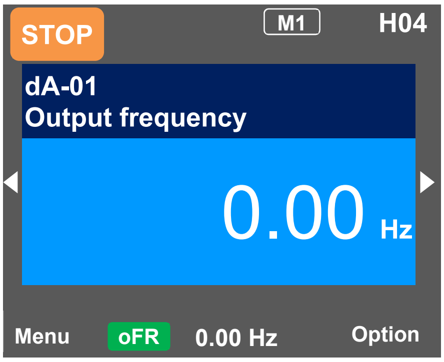
Example) Change the output frequency monitor to the PID1 output monitor.

	Set-up procedure	Action
①		Press the SEL (O) key to change the color of parameter field. Using the up and down (△▽) keys to select and navigate to the detail of monitoring.
②		When the SEL (O) key is pressed, the left-most letter of the parameter can be changed.
③		Using the arrow (△▽◁▷) keys, change [dA-01] to [db-50].
④		Press the SEL (O) key to confirm the monitoring target, which is then displayed in the upper section. Press the F1 (1) key to return to the monitor. You can also configure parameters using the up and down (△▽) keys.

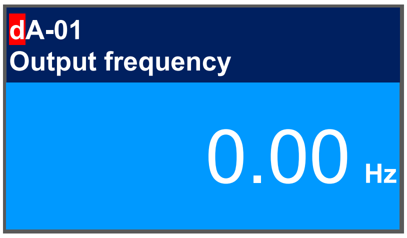
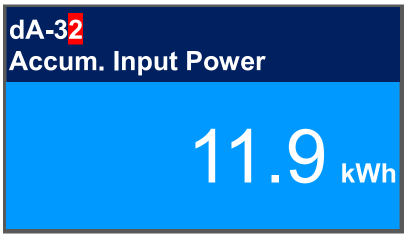
9.4.3 Wide monitor

- What is monitored on the screen with large characters, "Wide monitor" (H04) is the same as the upper monitor of the setting screen "Concurrent monitor" (H03) and the first line of monitor screen "Multi-monitor" (H01).

- On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to "H04".
- In the monitor screen with large characters, you can display a parameter in bigger size.



Example) Change the output frequency monitor to the integrated input power monitor.

Set-up procedure	Action
① 	When the SEL (O) key is pressed, the left-most letter of the parameter can be changed.
② 	Using the arrow (△▽◁▷) keys, change [dA-01] to [dA-32]. Press the SEL (O) key to confirm and return to the monitor.

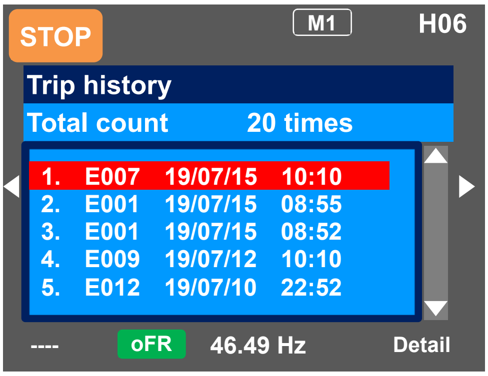
9.5 Check Error History!

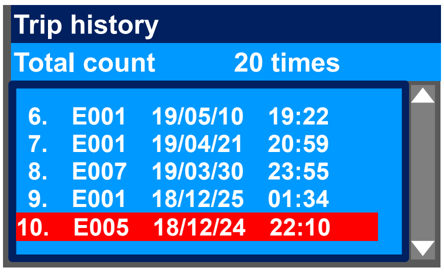
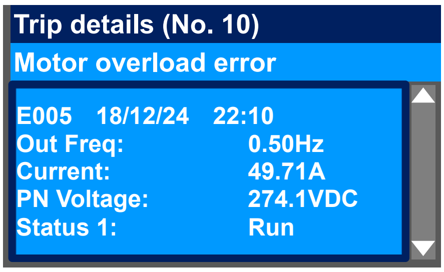
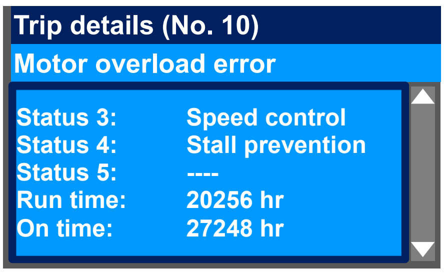
9.5.1 Trip history screen

- To display time in trip history, you need to configure clock settings.
- To use the clock function, you need an optional battery (CR2032) that is separately sold.

- On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to "H06".

- The trip history screen shows details of the errors that have occurred and the total number of times trip occurred.
- For details of errors, see “Chapter 18 Troubleshooting ".



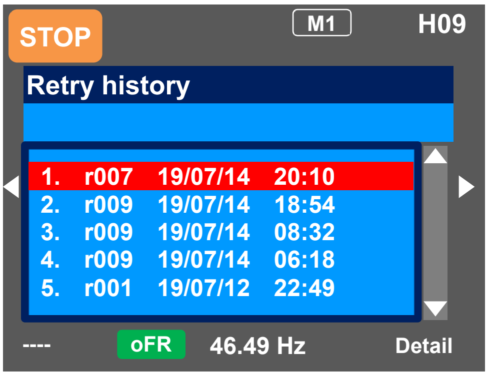
Set-up procedure	Action
① 	Using the up and down (Δ∇) keys, select history information you want to check.
② 	Press the SEL (O) key to show details of the selected history information.
③ 	Using the up and down (Δ∇) keys, you can check details. Press the F1 (1) key to return to the monitor.

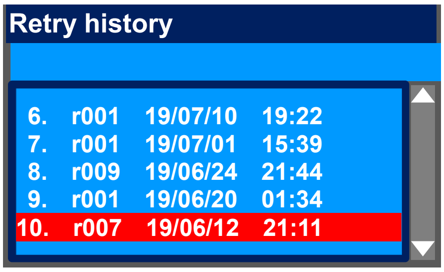
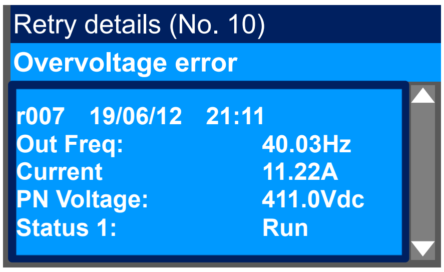
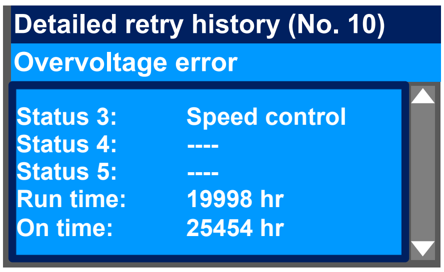
9.5.2 Retry history screen

・To display time in retry history, you need to configure clock settings.
・To use the clock function, you need an optional battery that is separately sold.

・On the screen that is displayed upon power-on, using the right and left (◁▷) keys, navigate to "H09".

・The retry history screen shows details of the errors that have occurred and the total number of times retry was performed.
・For details of errors, see "Chapter 18 Troubleshooting".



<table>
<tr><th>Set-up procedure</th><th>Action</th></tr>
<tr><td>① </td><td>Using the up and down (ΔΔ) keys, select history information you want to check.</td></tr>
<tr><td>② </td><td>Press the SEL (O) key to show details of the selected history information.</td></tr>
<tr><td>③ </td><td>Using the up and down (ΔΔ) keys, you can check details.
Press the F1 (1) key to return to the monitor.</td></tr>
</table>

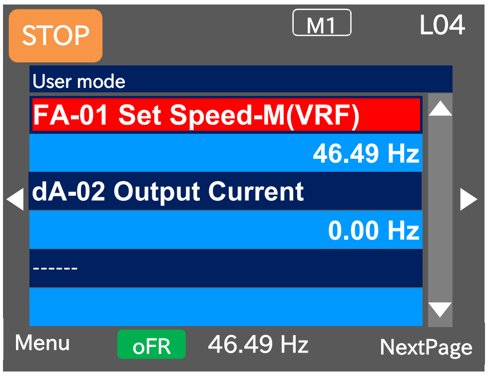
9.6 Menu Screen

The following menu screen is the explanation about the item besides the scroll mode（01）.

9.6.1 User mode（02）

・The user mode will display user-registered parameters only. This will allow to quickly access the parameters that are frequently used or are essential to the user.
・Select the "02 User mode" option from the menu screen, then press the SEL(O) to display the main user mode screen.

・This user mode screen displays the parameters that have been previously registered on the user parameters [UA-31] to [UA-62] in that order.
(「-----」will be displayed in case there is no registered parameter)

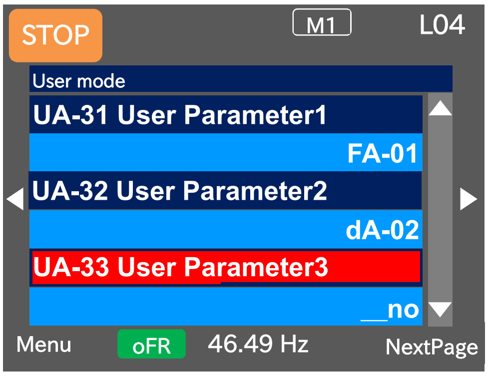


＜Main user mode screen＞

＜User mode parameter registration＞

・By pressing the RIGHT(▷)button, the screen will move to the parameter registration screen where the parameters UA-31 to UA-62 are displayed.

・Use the UP/DOWN(△▽)or the F2 key(Next page) to select the required user parameter then press the SEL(0) to display the parameter setting screen, then search and register the required parameter.
・Registering a non-existent parameter will release the registration in that user parameter(「___no」 will be shown instead).

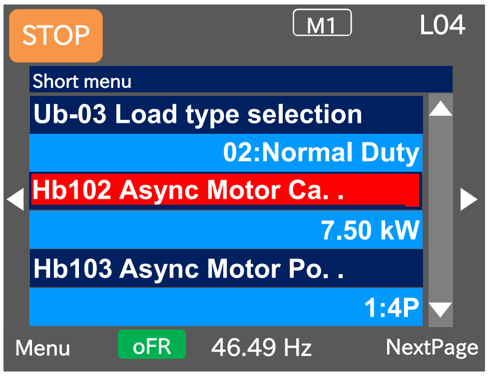


＜User mode screen (parameter registration screen)＞

9.6.2 Short Menu（03）

・The short menu displays regularly used parameters for the inverter operation allowing the user to configure the inverter more quickly and efficiently.
・Select the "03 Short menu" option from the menu screen, then press the SEL(O) to display the short menu screen.

・The short menu will display the parameters shown in the table below. (These are pre-defined parameters for the short menu.)



＜Short menu screen＞

＜Short menu pre-defined parameters＞

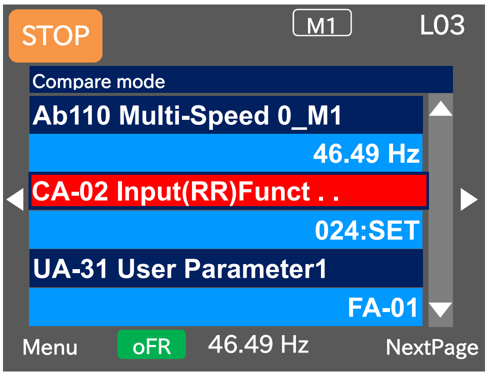
No.	Code	Name	No.	Code	Name
1	**Ub-03**	Load type selection	15	**AA115**	STOP mode selection, 1st-motor
2	**Hb102**	Async. Motor capacity setting, 1st-motor	16	**Ab110**	Multispeed-0 setting, 1st-motor
3	**Hb103**	Async. Motor number of poles setting, 1st-motor	17	**Ab-11**	Multispeed-1 setting
4	**Hb104**	Async. Motor base frequency setting, 1st-motor	18	**Ab-12**	Multispeed-2 setting
5	**Hb105**	Async. Motor maximum frequency setting, 1st-motor	19	**Ab-13**	Multispeed-3 setting
6	**Hb106**	Async. Motor rated voltage, 1st-motor	20	**bA101**	Upper frequency limit source selection, 1st-motor
7	**Hb108**	Async. Motor rated current, 1st-motor	21	**bA102**	Upper frequency limit, 1st-motor
8	**bC110**	Electronic thermal level setting,1st-motor	22	**bA103**	Lower frequency limit, 1st-motor
9	**AA121**	Control mode selection, 1st-motor	23	**Cb-40**	Thermistor type selection
10	**bb101**	Carrier frequency setting, 1st-motor	24	**CC-07**	Relay output terminal [FL] function
11	**AA101**	Main speed input source selection, 1st-motor	25	**CC-06**	Relay output terminal [AL] function
12	**AA111**	Run-command input source selection, 1st-motor	26	**bA-61**	Dynamic brake activation selection
13	**AC120**	Acceleration time setting 1, 1st-motor	27	**bA-60**	Dynamic brake use ratio
14	**AC122**	Deceleration time setting 1, 1st-motor	28	**bA-63**	Dynamic brake resistor value

＊The number in the No. column represents the short menu display order.

9.6.3 Compare Mode（04）

・The compare mode will only display the parameters that have been modified from its initial settings, allowing the user to quickly verify or modify the implemented changes.
・Select the "04 Compare mode" option from the menu screen, then press the SEL(O) to display the compare mode screen.

・The compare mode will not display the parameters that have not been modified from their initial settings.
Additionally this mode will not display any monitor parameters (Groups d and F).

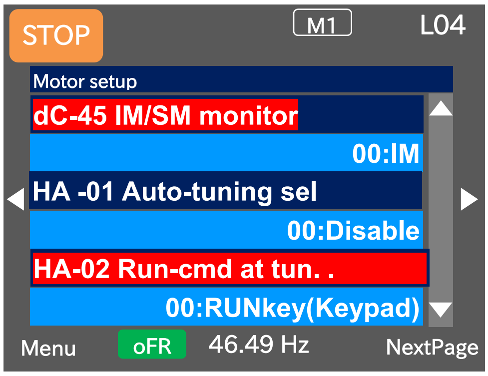


<Compare mode screen>

9.6.4 Motor Setup Menu（05）

・The motor setup menu displays the parameters that are related to a basic motor setting, allowing the user to quickly configure the inverter to operate a motor.
・Select the "05 Motor setup" option from the menu screen, then press the SEL(O) to display the motor setup screen.

・The motor setup menu will display the parameters shown in the table below.
(These are pre-defined parameters for the motor setup menu)



<Motor setup screen>

<Motor setup pre-defined parameters>

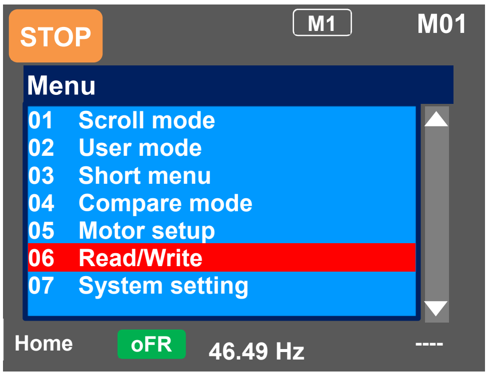
No.	Code	Name	No.	Code	Name
1	dC-45	IM/SM monitor	20	Hd103	Sync. Motor number of poles setting, 1st-motor
2	HA-01	Auto-tuning selection	21	Hd104	Sync. Motor base frequency setting, 1st-motor
3	HA-02	Auto-tuning RUN command source selection	22	Hd105	Sync. Motor maximum frequency setting, 1st-motor
4	HA-03	Online auto-tuning selection	23	Hd106	Sync. Motor rated voltage, 1st-motor
5	Hb102	Async. Motor capacity setting, 1st motor	24	Hd108	Sync. Motor rated current, 1st-motor
6	Hb103	Async. Motor number of poles setting, 1st-motor	25	Hd110	Sync. Motor constant R, 1st-motor
7	Hb104	Async. Motor base frequency setting, 1st-motor	26	Hd112	Sync. Motor constant Ld, 1st-motor
8	Hb105	Async. Motor maximum frequency setting, 1st-motor	27	Hd114	Sync. Motor constant Lq, 1st-motor
9	Hb106	Async. Motor rated voltage, 1st-motor	28	Hd116	Sync. Motor constant Ke, 1st-motor
10	Hb108	Async. Motor rated current, 1st-motor	29	Hd118	Sync. Motor constant J, 1st-motor
11	Hb110	Async. Motor constant R1, 1st-motor	30	Hd130	Minimum frequency adjustment for Sync.M, 1st-motor
12	Hb112	Async. Motor constant R2, 1st-motor	31	Hd131	No-Load current for Sync.M, 1st-motor
13	Hb114	Async. Motor constant L, 1st-motor	32	Hd132	Starting method for Sync. M., 1st-motor
14	Hb116	Async. Motor constant Io, 1st-motor	33	Hd133	IMPE 0V wait number for Sync. M., 1st-motor
15	Hb118	Async. Motor constant J, 1st-motor	34	Hd134	IMPE detect wait number for Sync. M., 1st-motor
16	HA110	Stabilization constant, 1st-motor	35	Hd135	IMPE detect number for Sync. M., 1st-motor
17	HA115	Speed response, 1st-motor	36	Hd136	IMPE 0V voltage gain for Sync. M., 1st-motor
18	Hb180	Ouput voltage gain, 1st-motor	37	Hd137	IMPE Mg-pole position offset, 1st-motor
19	Hd102	Sync. Motor capacity setting, 1st motor			

＊The number in the No. column represents the motor setup menu display order

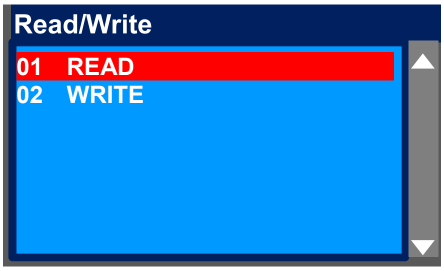
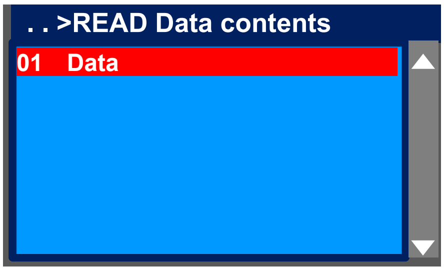
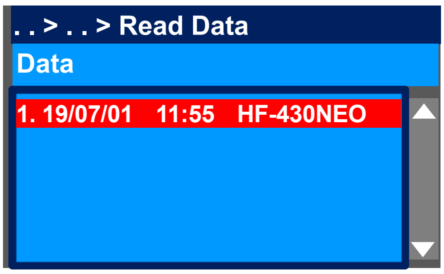
9.6.5 Read / Write Function

- On the screen that is displayed upon power-on, press the F1 (1) key to navigate to the menu screen "M01". Then, select the “06 Read/Write” by pressing the SEL (O) key.

- With R/W function, you can read and write data.
- Only a set of data can be saved.

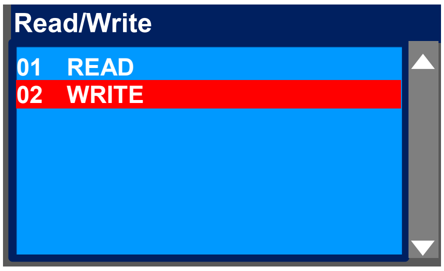
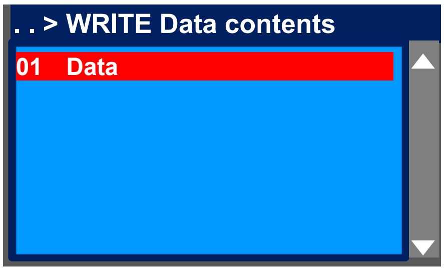
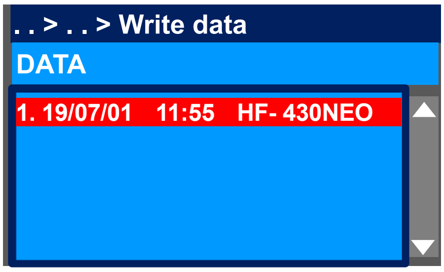


■Read function

Set-up procedure	Action
① 	Press the SEL (O) key to confirm the READ function.
② 	Select data to be read by using the up and down (Δ∇) keys. Then, confirm the function by pressing the SEL (O) key.
③ 	In accordance with the instruction shown on the screen, specify the location of data you to be saved, and press the F2 (2) key to navigate to the confirmation screen. Then, press the F2 (2) key to start reading the data. When the completion screen appears, the procedure is complete. <Display description> No. Date Time Inverter name: No. Data type ・Inverter name: No. is unique to HF-430NEO. ・Data type is 1: Only parameters ・To display date and time, you need to configure clock settings from System settings.

*＊If you cannot read data, see "9.11.1 Disabling Data R/W".

■Write function

<table>
<tr><th>Set-up procedure</th><th>Action</th></tr>
<tr><td>①

</td><td>Select the write function by using the up and down (Δ∇) keys.
Then, confirm by pressing the SEL (O) key.</td></tr>
<tr><td>②

</td><td>Select data to be written by using the up and down (Δ∇) keys.
Then, confirm the function by pressing the SEL (O) key.</td></tr>
<tr><td>③

</td><td>In accordance with the instruction shown on the screen, select data to be written to the inverter, and press the F2 (2) key to start writing. When the completion screen appears, the procedure is complete.

＜Display description＞
No. Date Time Inverter name: No. Data type
・Inverter name: No. is unique to HF-430NEO.
・Data type is 1: Only parameters.
・To display date and time, you need to configure clock settings from System settings.</td></tr>
</table>

＊If you cannot write data, see "9.11.1 Disabling Data R/W".

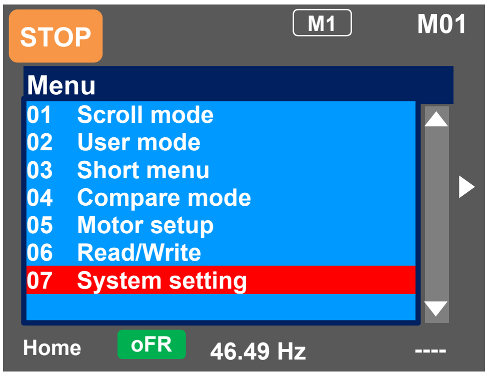
9.6.6 System setting

・On the screen that is displayed upon power-on, press the F1 (1) key to navigate to the menu screen "M01". Then, select the “07 System setting” by pressing the SEL (O) key.

No.	Name	Tips
01	Language selection	Changes the language setting.（02：English / 03：Japanese）
02	Dimming	Controls the brightness of operator keypad screen.
03	Automatic light off time*1)	Controls the time to automatically light off the screen.
04	Dimming at light off *1	Controls the brightness when the screen is automatically lit off.
05	Automatic home transition time	Sets the time to automatically return to the home screen.
06	Initial home screen selection	Sets the screen that is displayed upon power-on and automatic return to the home screen.
07	Read lock	Limits the reading of data.（00：OFF / 01：ON）
08	Blinking during trip	Sets whether blinking is performed or not during trip.（00：Disabled / 01：Enabled (blinking)）
09	Date and time*2)	Configures settings of time, display format, and battery level warning.（00：Setting / 01：Selection of display format ）
10	Battery level warning	Displays a warning message when the battery runs out.（00：Disabled / 01：Enabled）
11	Color setting	Sets the background color.(01：Blue / 02：Green / 03：Gray)
12	Basic inverter information monitor	Checks information of HF-430NEO.
13	Selection of connected model	Sets HF-430NEO.
14	Operator keypad version	Displays the version of the operator keypad.
15	Initialization of operator keypad	Initializes the operator keypad.（00：Yes / 01：No）
16	Self-check mode	Operates self-check mode. 01：Key, LED check / 02：TFT check / 03: RTC check / 04:Data Flash check 05:RS422 check / 06:Debug mode / 07:Version
17	Remote mode switching	If this setting is enabled, when the F1 key on the home screen is pressed for 1 second or more, you can switch the frequency command and operation command to commands issued from the operator keypad.（00：Disabled / 01：Enabled）
18	Reserve	Do not change the setting from OFF.（01：OFF）

*1) The light off function is disabled until trip is canceled after the occurrence of trip.
For details, see the User's Guide.
*2) To use the clock function, you need an optional battery that is separately sold.
Recommended product: CR2032, 3V
If no electricity is supplied to the inverter, battery replacement is required every two years.

・On the System settings screen, you can use extended functions.



・If there is an error in the memory area in the operator keypad, an error message is displayed on the operator keypad.
In such a case, initialize the operator keypad from the System settings, and confirm the settings.
If the error on the operator keypad is not solved, the internal memory may be damaged.
You need to replace the operator keypad.

■Battery replacement of the operator keypad

・The battery used for clock function is not included with this inverter. Prepare CR2032 as necessary.
・When battery is changed, the clock data is initialized, therefore, you need to configure the setting again.
・Even if the battery runs out, data in (read parameters) are retained.

■Disposal of battery of the operator keypad

・Disposal of the operator keypad or battery that is no longer needed subject to regulations of your municipalities.
Dispose of them in accordance with regulations of respective municipalities.
Insulate the battery using a tape or other materials when disposing of it.

Li-ion 「廢電池請回收」

・Care must be taken in export of an operator keypad equipped with a battery.
・When products equipped with lithium primary battery (including all manganese dioxide lithium coin batteries and heat-resistant manganese dioxide lithium coin batteries) are exported to or transferred via California in the U.S., it is obliged to mark the following sentences in the packaging case, individual packages, and instruction manuals.

Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

・When you export your products equipped with the operator keypad to California in the U.S., please mark the indications shown above on the packaging case such as external box and transportation box of your product.

・Follow the following steps to replace the battery.
(i) Check the inverter is turned off and the POWER lamp on the operator keypad is off.
(ii) Remove the operator keypad from the main unit. When removing the operator keypad, hold the front cover.
(iii) Open the cover of the operator keypad, which is on the back side, and then insert the battery. Make sure that you can see the + side when inserting the battery.
(iv) Close the cover, and install the operator keypad in the inverter again.

DANGER
・As batteries are subject to leakage, explosion, heat generation, and fire, do not short circuit + and - terminals, charge, disassemble, heat, expose to fire, or apply a strong impact.
・If a strong impact is accidentally applied to them (e.g., dropped on the floor), do not use the battery because they may have leakage.

Prohibited
・It is defined by the UL standard that battery replacement must be performed by a skilled technician. Please assign a skilled technician to perform the replacement work.

Do
・If you cannot see what is displayed on the operator keypad because the service life is near its end, replace the operator keypad.

9.7 Supplementary Information

■Back to the home monitor

・Press the F1 key repeatedly to go back to the home monitor. When home is shown above the F1 key, you can go back to the home monitor, and navigate through the home monitor using the right and left keys.

■Display (B) Details of warning status display

・When the up key is pressed while a monitor screen other than the trip history "Total monitor" is displayed, the screen changes to the monitor where you can check the current status. Press the SEL (O) key, down key, and F1 key to go back.

■Switch between normal/reverse rotations on the operator keypad

・By pressing the down key on the three-line monitor screen "Multi-monitor", you can specify F1 (normal rotation) or F2 (reverse rotation). To go back to the monitor, press the up key.

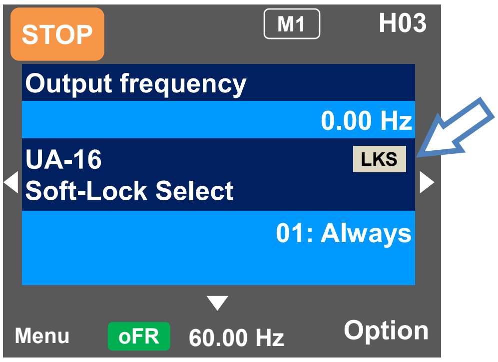
■I want to delete saved data that I read.

・By performing initialization of the operator keypad on the System settings screen, you can delete data that is saved using the read function. However, note that the settings of the operator keypad are also initialized.

9.8 Parameter Functions

9.8.1 Protecting Parameters (Prohibiting Change)

- By configuring the soft-lock function [UA-16] and [UA-17], you can prevent parameters from being changed.
- While soft-lock function is enabled, the LKS mark (LocK State mark) is shown on the right of parameters.
- By configuring the soft-lock function [UA-16] and [UA-17], you can prevent parameters from being changed.
- While soft-lock function is enabled, the LKS mark (LocK State mark) is shown on the right of parameters.



■Parameters

Item	Parameter	Data	Description
Soft-lock selection	[UA-16]	00	When the soft-lock terminal [SFT] is on, data set to [UA-17] other than [UA-16] are locked.
		01	After the setting is performed, data set by [UA-17] other than [UA-16] are locked.
Soft-lock target selection	[UA-17]	00	All data other than [UA-16] and [UA-17] cannot be changed.
		01	Data other than [UA-16] and [UA-17] and set frequency cannot be changed
Input terminal function	[CA-01]~[CA-11]	036	[SFT]: Used when the soft-lock function is used on terminals.

9.8.2 Limiting Displayed Parameters

- You can change the content of display on the operator keypad according to your purpose.
- To know which parameters are changed, you can check by setting [UA-10] to 03.
- If you do not want to display parameters for functions not in use, you can reduce them by setting [UA-10] to 01.

■Parameters

Item	Parameter	Data	Description
Display selection	[UA-10]	00	All parameters are displayed.
		01	Parameters are displayed by function. Disabled functions are not displayed with some exceptions.
		02	Display is performed in accordance with the settings configured by the user. Parameters set to [UA-31] to [UA-62] are displayed with some exceptions.
		03	Parameters that have been changed from the factory default settings and some other parameters are displayed.
		04	Monitor parameters and some other parameters are displayed.
Selection of second setting parameter display	[UA-21]	00	Hides parameters of second setting [**2**].
		01	Displays parameters of second setting [**2**].
Selection of whether to display option parameter	[UA-22]	00	Hides parameters that start with o.
		01	Displays parameters that start with o.
User parameter selection	[UA-31] ~ [UA-62]	-	No assignment
		*****	Choose the code you want to display. (Parameters other than [UA-31] to [UA-62] are subjected)

- If you are not using the input terminal function [SET] for switching to the second setting, by setting [UA-21] to 00, you can reduce a great number of displayed items.
- If you are not using option cassettes, by setting [UA-22] to 00, you can reduce indications for option cassettes.

(1) Function-specific display: [UA-10] =01

・If a function is not selected, parameters related to the function are hidden.

(i) IM control parameters

Display condition: AA121≤10 or AA221≤10

Parameter	Name
Hb*02	Async. Motor capacity setting, 1st / 2nd-motor
Hb*03	Async. Motor number of poles setting, 1st / 2nd -motor
Hb*04	Async. Motor base frequency setting, 1st / 2nd -motor
Hb*05	Async. Motor maximum frequency setting, 1st / 2nd -motor
Hb*06	Async. Motor rated voltage, 1st / 2nd -motor
Hb*08	Async. Motor rated current, 1st / 2nd -motor
Hb*10	Async. Motor constant R1, 1st / 2nd-motor
Hb*12	Async. Motor constant R2, 1st / 2nd-motor
Hb*14	Async. Motor constant L, 1st / 2nd-motor
Hb*16	Async. Motor constant Io, 1st / 2nd-motor
Hb*18	Async. Motor constant J, 1st / 2nd-motor
Hb*30	Minimum frequency adjustment, 1st / 2nd-motor
Hb*31	Reduced voltage start time setting, 1st / 2nd-motor
Hb*40	Manual torque boost operation mode selection, 1st / 2nd-motor
Hb*41	Manual torque boost value, 1st / 2nd-motor
Hb*42	Manual torque boost peak speed, 1st / 2nd-motor
Hb*45	Eco drive enable, 1st / 2nd-motor
Hb*46	Eco drive response adjustment, 1st / 2nd-motor
Hb*50	Free-V/f frequency 1 setting, 1st / 2nd-motor
Hb*51	Free-V/f voltage 1 setting, 1st / 2nd-motor
Hb*52	Free-V/f frequency 2 setting, 1st / 2nd-motor
Hb*53	Free-V/f voltage 2 setting, 1st / 2nd-motor
Hb*54	Free-V/f frequency 3 setting, 1st / 2nd-motor
Hb*55	Free-V/f voltage 3 setting, 1st / 2nd-motor
Hb*56	Free-V/f frequency 4 setting, 1st / 2nd-motor
Hb*57	Free-V/f voltage 4 setting, 1st / 2nd-motor
Hb*58	Free-V/f frequency 5 setting, 1st / 2nd-motor
Hb*59	Free-V/f voltage 5 setting, 1st / 2nd-motor
Hb*60	Free-V/f frequency 6 setting, 1st / 2nd-motor
Hb*61	Free-V/f voltage 6 setting, 1st / 2nd-motor
Hb*62	Free-V/f frequency 7 setting, 1st / 2nd-motor
Hb*63	Free-V/f voltage 7 setting, 1st / 2nd-motor
Hb*70	Slip compensation P-gain at V/f with encoder, 1st / 2nd-motor
Hb*71	Slip compensation I-gain at V/f with encoder, 1st / 2nd-motor
Hb*80	Output voltage gain, 1st / 2nd-motor
HC*01	Automatic torque boost voltage compensation gain, 1st / 2nd-motor
HC*02	Automatic torque boost slip compensation gain, 1st / 2nd-motor
HC*10	Zero speed range limit, 1st / 2nd-motor
HC*11	Boost value at start, 1st / 2nd-motor (IM-SLV,IM-CLV)
HC*12	Boost value at start, 1st / 2nd-motor (IM-0Hz-SLV)
HC*13	Secondary resistance (R2) correction, 1st / 2nd-motor
HC*14	Direction reversal protection, 1st / 2nd-motor
HC*20	Torque current reference filter time constant, 1st / 2nd-motor
HC*21	Speed feedforward compensation gain, 1st / 2nd-motor

(ii) SM (PMM) control parameters

Display condition: AA121>10 or AA221>10

Parameter	Name
Hd*02	Sync. Motor capacity setting, 1st / 2nd-motor
Hd*03	Sync. Motor number of poles setting, 1st / 2nd-motor
Hd*04	Sync. Base frequency setting, 1st / 2nd-motor
Hd*05	Sync. Maximum frequency setting, 1st / 2nd-motor
Hd*06	Sync. Motor rated voltage, 1st / 2nd-motor
Hd*08	Sync. Motor rated current, 1st / 2nd-motor
Hd*10	Sync. Motor constant R, 1st / 2nd-motor
Hd*12	Sync. Motor constant Ld, 1st / 2nd-motor
Hd*14	Sync. Motor constant Lq, 1st / 2nd-motor
Hd*16	Sync. Motor constant Ke, 1st / 2nd-motor
Hd*18	Sync. Motor constant J, 1st / 2nd-motor
Hd*30	Minimum frequency adjustment for Sync.M, 1st / 2nd-motor
Hd*31	No-Load current for Sync.M, 1st / 2nd-motor
Hd*32	Starting method for Sync.M, 1st / 2nd-motor
Hd*33	IMPE 0V wait number for Sync.M, 1st / 2nd-motor
Hd*34	IMPE detect wait number for Sync.M, 1st / 2nd-motor
Hd*35	IMPE detect number for Sync.M, 1st / 2nd-motor
Hd*36	IMPE voltage gain for Sync.M, 1st / 2nd-motor
Hd*37	IMPE Mg-pole position offset, 1st / 2nd-motor
Hd-41	IVMS carrier frequency
Hd-42	Filter gain of IVMS current detection
Hd-43	Open-phase voltage detection gain
Hd-44	Open-phase switching threshold compensation
Hd-45	SM(PMM)-IVMS speed control P gain
Hd-46	SM(PMM)-IVMS speed control I gain
Hd-47	SM(PMM)-IVMS wait time for open-phase switching,
Hd-48	SM(PMM)-IVMS restriction on the rotation-direction determination
Hd-49	SM (PMM)-IVMS open-phase voltage detection timing adjustment.
Hd-50	SM(PMM)-IVMS minimum pulse width adjustment
Hd-51	IVMS threshold current limit
Hd-52	IVMS threshold gain
Hd-58	IVMS carrier-frequency switching start/finish point

Hd-41 to 58 are reserved parameters.

・The * mark in the table is replaced by 1 or 2. (1 represents first and 2 represents second.)

(iii) Position control parameters
Display condition: AA123≠00 or AA223≠00

Parameter	Name
AE-01	Electronic gear setting point selection
AE-02	Electronic gear ratio numerator
AE-03	Electronic gear ratio denominator
AE-04	Positioning completed range setting
AE-05	Positioning completed delay time setting
AE-06	Position feedforward gain setting
AE-07	Position loop gain setting
AE-01	Electronic gear setting point selection

(iv) Orientation
Display condition: AA123=01 or AA223=01

Parameter	Name
AE-08	Position bias setting
AE-10	Stop position selection of home search function
AE-11	Stop position of home search function
AE-12	Speed reference of home search function
AE-13	Direction of home search function

(v) Absolute position control
Display condition: AA123>01 or AA223>01

Parameter	Name
AE-20 to 50	Position reference 0 to 15
AE-52	Position control range setting (forward)
AE-54	Position control range setting (reverse)
AE-56	Position control mode selection
AE-60	Teach-in function target selection
AE-61	Save current position at power off
AE-62	Pre-set position data
AE-64	Deceleration stop distance calculation gain
AE-65	Deceleration stop distance calculation bias
AE-66	Speed limit in APR control
AE-67	APR start speed
AE-70	Homing function selection
AE-71	Direction of homing function
AE-72	Low-speed homing speed setting
AE-73	High-speed homing speed setting

(vi) Normal acceleration/deceleration speed
Display condition: AC-02=00

Parameter	Name
AC*15	Accel/Decel change trigger, 1st /2nd-motor
AC*16	Accel1 to Accel2 frequency transition point, 1st / 2nd-motor
AC*17	Decel1 to Decel2 frequency transition point, 1st / 2nd-motor
AC*20	Acceleration time setting 1, 1st / 2nd-motor
AC*22	Deceleration time setting 1, 1st / 2nd-motor
AC*24	Acceleration time setting 2, 1st / 2nd-motor
AC*26	Deceleration time setting 2, 1st / 2nd-motor

(vii) Multi-stage acceleration/deceleration
Display condition: AC-02=01

Parameter	Name
AC-30	Accel. time for Multi-speed 1
AC-32	Decel. time for Multi-speed 1
AC-34	Accel. time for Multi-speed 2
AC-36	Decel. time for Multi-speed 2
AC-38	Accel. time for Multi-speed 3
AC-40	Decel. time for Multi-speed 3
AC-42	Accel. time for Multi-speed 4
AC-44	Decel. time for Multi-speed 4
AC-46	Accel. time for Multi-speed 5
AC-48	Decel. time for Multi-speed 5
AC-50	Accel. time for Multi-speed 6
AC-52	Decel. time for Multi-speed 6
AC-54	Accel. time for Multi-speed 7
AC-56	Decel. time for Multi-speed 7
AC-58	Accel. time for Multi-speed 8
AC-60	Decel. time for Multi-speed 8
AC-62	Accel. time for Multi-speed 9
AC-64	Decel. time for Multi-speed 9
AC-66	Accel. time for Multi-speed 10
AC-68	Decel. time for Multi-speed 10
AC-70	Accel. time for Multi-speed 11
AC-72	Decel. time for Multi-speed 11
AC-74	Accel. time for Multi-speed 12
AC-76	Decel. time for Multi-speed 12
AC-78	Accel. time for Multi-speed 13
AC-80	Decel. time for Multi-speed 13
AC-82	Accel. time for Multi-speed 14
AC-84	Decel. time for Multi-speed 14
AC-86	Accel. time for Multi-speed 15
AC-88	Decel. time for Multi-speed 15

(viii) Internal current braking
Display condition: AF*01=01, 02

Parameter	Name
AF*02	Braking type selection, 1st / 2nd-motor
AF*03	DC braking frequency, 1st / 2nd-motor
AF*04	DC braking delay time, 1st / 2nd-motor
AF*05	DC braking force setting, 1st / 2nd-motor
AF*06	DC braking active time at stop, 1st / 2nd-motor
AF*07	DC braking operation method selection, 1st / 2nd-motor
AF*08	DC braking force at start, 1st / 2nd-motor
AF*09	DC braking active time at start, 1st / 2nd-motor

(ix) Brake control 1 (common to forward/reverse)
Display condition: AF*30=01, 02

Parameter	Name
AF*31	Brake release wait time, 1st / 2nd-motor (Forward)
AF*32	Brake wait time for accel., 1st/2nd-motor (Forward)
AF*33	Brake wait time for stopping, 1st/2nd-motor (Forward)
AF*34	Brake confirmation signal wait time, 1st/2nd-motor (Forward)
AF*35	Brake release frequency setting, 1st/2nd-motor (Forward)
AF*36	Brake release current setting, 1st/2nd-motor (Forward)
AF*37	Braking frequency, 1st/2nd-motor (Forward)

(x) Brake control 1 (forward/reverse set individually)
Display condition: AF*30=02

Parameter	Name
AF*38	Brake release wait time, 1st/2nd-motor (Reverse)
AF*39	Brake wait time for accel., 1st/2nd-motor (Reverse)
AF*40	Brake wait time for stopping, 1st/2nd-motor (Reverse)
AF*41	Brake confirmation signal wait time, 1st/2nd-motor (Reverse)
AF*42	Brake release frequency setting, 1st/2nd-motor (Reverse)
AF*43	Brake release current setting, 1st/2nd-motor (Reverse)
AF*44	Braking frequency, 1st / 2nd-motor (Reverse)

(xi) Brake control 2
Display condition: AF*30=03

Parameter	Name
AF*50	Brake open delay time, 1st/2nd-motor
AF*51	Brake close delay time, 1st/2nd-motor
AF*52	Brake response check time, 1st/2nd-motor
AF*53	Servo lock/ DC injection time at start, 1st/2nd-motor
AF*54	Servo lock/ DC injection time at stop, 1st/2nd-motor

(xii) Free electronic thermal
Display condition: bc*11=02

Parameter	Name
bC*20	Free electronic thermal frequency-1, 1st/2nd-motor
bC*21	Free electronic thermal current-1, 1st/2nd-motor
bC*22	Free electronic thermal frequency-2, 1st/2nd-motor
bC*23	Free electronic thermal current-2, 1st/2nd-motor
bC*24	Free electronic thermal frequency-3, 1st/2nd-motor
bC*25	Free electronic thermal current-3, 1st/2nd-motor

(xiii) Gain mapping 1
Display condition: HA*20=00

Parameter	Name
HA*21	ASR gain switching time setting, 1st/2nd-motor
HA*27	ASR gain mapping P control P-gain 1, 1st/2nd-motor
HA*30	ASR gain mapping P control P-gain 2,1st/2nd-motor

(xiv) Gain mapping 2
Display condition: HA*20=01

Parameter	Name
HA*22	ASR gain mapping intermediate speed 1, 1st / 2nd-motor
HA*23	ASR gain mapping intermediate speed 2, 1st / 2nd-motor
HA*24	ASR gain mapping maximum speed, 1st / 2nd-motor
HA*31	ASR gain mapping P-gain 3, 1st / 2nd-motor
HA*32	ASR gain mapping I-gain 3, 1st / 2nd-motor
HA*33	ASR gain mapping P-gain 4, 1st / 2nd-motor
HA*34	ASR gain mapping I-gain 4, 1st / 2nd-motor

(xv) Instantaneous power failure non-stop
Display condition: bA-30≠00

Parameter	Name
bA-31	Instantaneous power failure non-stop function, start voltage level
bA-32	Instantaneous power failure non-stop function, target voltage level
bA-34	Instantaneous power failure non-stop function, deceleration time
bA-36	Instantaneous power failure non-stop function, start frequency decrement
bA-37	Instantaneous power failure non-stop function, DC bus voltage control P gain
bA-38	Instantaneous power failure non-stop function, DC bus voltage control I gain

(xvi) Overvoltage suppression
Display condition: bA*40≠00

Parameter	Name
bA*41	Overvoltage suppression active level, 1st / 2nd-motor
bA*42	Overvoltage suppression active time, 1st / 2nd-motor
bA*44	Constant DC bus voltage control P gain, 1st / 2nd-motor
bA*45	Constant DC bus voltage control I gain, 1st / 2nd-motor

(xvii) Over-magnetization
Display condition: bA*46≠00

Parameter	Name
bA*47	Over-magnetization function output filter time constant, 1st / 2nd_motor
bA*48	Over-magnetization function voltage gain, 1st / 2nd-motor
bA*49	Over-magnetization function level setting, 1st / 2nd-motor

(xviii) PID1
Display condition: AH-01=01, 02

Parameter	Name
db-30	PID1 feedback value 1 monitor
db-32	PID1 feedback value 2 monitor
db-34	PID1 feedback value 3 monitor
db-42	PID1 target value monitor
db-44	PID1 feedback value monitor
db-50	PID1 output monitor
db-51	PID1 deviation monitor
db-52	PID1 deviation 1 monitor
db-53	PID1 deviation 2 monitor
db-54	PID1 deviation 3 monitor
db-61	Current PID P-Gain monitor
db-62	Current PID I-Gain monitor
db-63	Current PID D-Gain monitor
db-64	PID feedforward monitor
FA-30	PID1 set-point 1 monitor
FA-32	PID1 set-point 2 monitor
FA-34	PID1 set-point 3 monitor
AH-02	PID1 deviation inversion
AH-03	Unit selection for PID1
AH-04	PID1 adjustment (0%)
AH-05	PID1 adjustment (100%)
AH-06	PID1 Adjustment (decimal point position)
AH-07	PID1 set-point 1 input source selection
AH-10	PID1 set-point-1 setting
AH-12	PID1 multistage set-point 1
AH-14	PID1 multistage set-point 2
AH-16	PID1 multistage set-point 3
AH-18	PID1 multistage set-point 4
AH-20	PID1 multistage set-point 5
AH-22	PID1 multistage set-point 6
AH-24	PID1 multistage set-point 7
AH-26	PID1 multistage set-point 8
AH-28	PID1 multistage set-point 9
AH-30	PID1 multistage set-point 10
AH-32	PID1 multistage set-point 11
AH-34	PID1 multistage set-point 12
AH-36	PID1 multistage set-point 13
AH-38	PID1 multistage set-point 14
AH-40	PID1 multistage set-point 15
AH-42	PID1 set-point 2 input source selection
AH-44	PID1 set-point 2 setting
AH-46	PID1 set-point 3 input source selection
AH-48	PID1 set-point 3 setting
AH-50	PID1 set-point calculation symbol selection
AH-51	PID1 feedback 1 input source selection
AH-52	PID1 feedback 2 input source selection
AH-53	PID1 feedback 3 input source selection
AH-54	PID1 feedback calculation symbol selection
AH-60	PID1 gain change method selection
AH-61	PID1 proportional gain 1
AH-62	PID1 integral time constant 1
AH-63	PID1 derivative gain 1
AH-64	PID1 proportional gain 2
AH-65	PID1 integral time constant 2
AH-66	PID1 derivative gain 2
AH-67	PID1 gain change time
AH-70	PID1 feed-forward input source selection
AH-71	PID1 output range
AH-72	PID1 over deviation level
AH-73	Turn-off level for the PID1 feedback compare signal
AH-74	Turn-on level for the PID1 feedback compare signal

(xix) PID2
Display condition: AJ-01=01, 02

Parameter	Name
db-36	PID2 feedback value monitor
db-55	PID2 output monitor
db-56	PID2 deviation monitor
FA-36	PID2 set-point monitor
AJ-02	PID2 deviation inversion
AJ-03	PID2 unit selection
AJ-04	PID2 scale adjustment (0%)
AJ-05	PID2 scale adjustment (100%)
AJ-06	PID2 scale adjustment (decimal point position)
AJ-07	PID2 set-point input source selection
AJ-10	PID2 set-point setting
AJ-12	PID2 feedback input source selection
AJ-13	PID2 proportional gain
AJ-14	PID2 integral time constant
AJ-15	PID2 derivative gain
AJ-16	PID2 output range
AJ-17	PID2 over deviation level
AJ-18	Turn-off level for the PID2 feedback compare signal
AJ-19	Turn-on level for the PID2 feedback compare signal

(xx) PID3

Display condition: AJ-21=01, 02

Parameter	Name
db-38	PID3 feedback value monitor
db-57	PID3 output monitor
db-58	PID3 deviation monitor
FA-38	PID3 set-point monitor
AJ-22	PID3 deviation inversion
AJ-23	PID3 unit selection
AJ-24	PID3 scale adjustment (0%)
AJ-25	PID3 scale adjustment (100%)
AJ-26	PID3 scale adjustment (decimal point position)
AJ-27	PID3 set-point input source selection
AJ-30	PID3 set-point setting
AJ-32	PID3 feedback input source selection
AJ-33	PID3 proportional gain
AJ-34	PID3 integral time constant
AJ-35	PID3 derivative gain
AJ-36	PID3 output variable
AJ-37	PID3 over deviation level
AJ-38	Turn-off level for the PID3 feedback compare signal
AJ-39	Turn-on level for the PID3 feedback compare signal

(xxi) PID4

Display condition: AJ-41=01, 02

Parameter	Name
db-40	PID4 feedback value monitor
db-59	PID4 output monitor
db-60	PID4 deviation monitor
FA-40	PID4 set-point monitor
AJ-42	PID4 deviation inversion
AJ-43	PID4 unit selection
AJ-44	PID4 scale adjustment (0%)
AJ-45	PID4 scale adjustment (100%)
AJ-46	PID4 scale adjustment (decimal point position)
AJ-47	PID4 set-point input source selection
AJ-50	PID4 set-point setting
AJ-52	PID4 feedback input source selection
AJ-53	PID4 proportional gain
AJ-54	PID4 integral time constant
AJ-55	PID4 derivative gain
AJ-56	PID4 output range
AJ-57	PID4 over deviation level
AJ-58	Turn-off level for the PID4 feedback compare signal
AJ-59	Turn-on level for the PID4 feedback compare signal

(xxii) PID in general

Display condition: AH-01=01, 02 or AJ-01=01, 02 or AJ-21=01, 02 or AJ-41=01, 02

Parameter	Name
AH-75	PID soft start function enable
AH-76	PID soft start target level
AH-78	Acceleration time setting for PID soft start function
AH-80	PID soft start time
AH-81	PID soft start error detection enable
AH-82	PID soft start error detection level
AH-85	PID sleep trigger selection
AH-86	PID sleep start level
AH-87	PID sleep active time
AH-88	Enable set-point boost before PID sleep
AH-89	Set-point boost time before PID sleep
AH-90	Set-point boost value before PID sleep
AH-91	Minimum RUN time before PID sleep
AH-92	Minimum active time of PID sleep
AH-93	PID wake trigger selection
AH-94	PID wake start level
AH-95	PID wake start time
AH-96	PID wake start deviation value

(xxiii) Simulation mode

Display condition: PA-20=01

Parameter	Name
PA-21	Error code selection for alarm test
PA-22	Simulation mode: Optional output selection for the output current monitor
PA-23	Optional output value setting for the output current monitor
PA-24	Simulation mode: Optional output selection for the DC bus voltage monitor
PA-25	Optional output value setting for the DC bus voltage monitor
PA-26	Simulation mode: Optional output selection for the output voltage monitor
PA-27	Optional output value setting for the output voltage monitor
PA-28	Simulation mode: Optional output selection for the output torque monitor
PA-29	Optional output value setting for the output torque monitor
PA-30	Simulation mode: Optional frequency matching start enable setting
PA-31	Optional frequency matching start setting value

(xxiv) Trace

Display condition: Ud-01=01

Parameter	Name
Ud-02	Trace start
Ud-03	Number of trace data setting
Ud-04	Number of trace signals setting
Ud-10~17	Trace data 0 to 7 selection
Ud-20	Trace signal 0 input/output selection
Ud-21	Trace signal 0 input terminal selection
Ud-22	Trace signal 0 output terminal selection
Ud-23	Trace signal 1 input/output selection
Ud-24	Trace signal 1 input terminal selection
Ud-25	Trace signal 1 output terminal selection
Ud-26	Trace signal 2 input/output selection
Ud-27	Trace signal 2 input terminal selection
Ud-28	Trace signal 2 output terminal selection
Ud-29	Trace signal 3 input/output selection
Ud-30	Trace signal 3 input terminal selection
Ud-31	Trace signal 3 output terminal selection
Ud-32	Trace signal 4 input/output selection
Ud-33	Trace signal 4 input terminal selection
Ud-34	Trace signal 4 output terminal selection
Ud-35	Trace signal 5 input/output selection
Ud-36	Trace signal 5 input terminal selection
Ud-37	Trace signal 5 output terminal selection
Ud-38	Trace signal 6 input/output selection
Ud-39	Trace signal 6 input terminal selection
Ud-40	Trace signal 6 output terminal selection
Ud-41	Trace signal 7 input/output selection
Ud-42	Trace signal 7 input terminal selection
Ud-43	Trace signal 7 output terminal selection
Ud-50	Trace trigger 1 selection
Ud-51	Trigger 1 activation selection at trace data trigger
Ud-52	Trigger 1 level setting at trace data trigger
Ud-53	Trigger 1 activation selection at trace signal trigger
Ud-54	Trace trigger 2 selection
Ud-55	Trigger 2 activation selection at trace data trigger
Ud-56	Trigger 2 level setting at trace data trigger
Ud-57	Trigger 2 activation selection at trace signal trigger
Ud-58	Trigger condition selection
Ud-59	Trigger point setting
Ud-60	Sampling time setting

(2) User setting: [UA-10] =02

- Parameters set to the user setting functions [UA-31] to [UA-62] are displayed.
  Main speed command [FA-01], output frequency monitor [dA-01], display selection [UA-10], and the password for display [UA-01] are always shown.

(3) Data-comparison display: [UA-10] =03

- Only parameters that have been changed from the factory default settings are displayed.
- All monitor displays [d****] and [F****], display selection [UA-10], and the password for display [UA-01] are always shown.

(4) Monitor display: [UA-10] =04

- All monitor displays [d****] are displayed.
- Display selection [UA-10], and the password for display [UA-01] are always shown.

- The initial value used for comparison is determined by the inverter model and the following settings.
  Initialize data selection [Ub-02]
  Load type selection [Ub-03]
- When base frequency is changed, the standard value of motor constant I0 is changed, which is regarded as change has been made. (The set value is retained.)
  When calling the initial value of Hitachi's induction motor (IM), by setting [Hb103] selection of the number of poles to another value (e.g., set 4 poles to 2 poles, and then to 4 poles again), you can set data corresponding with the base frequency after change to [Hb116] Motor constant I0

9.8.3 Saving Automatically Changed Parameters

- [UA-31] is the newest data, and [UA-62] is the oldest data.
- Only one value is saved for a parameter.
- If more than 32 parameters are changed, the oldest data of [UA-62] is deleted, and values are shifted by one parameter. Then, new data is saved in [UA-31].

- When selection of user parameter automatic setting [UA-30] is set to 01, parameters whose data has been changed are automatically saved in [UA-31] to [UA-62].
- Also, when you want to retrieve history of parameter changes, set selection of user parameter automatic setting [UA-30] to 01.
- Up to 32 changed parameters can be saved.

■Parameters

Item	Parameter	Data	Description
User parameter automatic setting selection	[UA-30]	00	Disable
		01	When a parameter is changed, the parameter is automatically set to [UA-31] to [UA-62].
User parameter selection	[UA-31] ~ [UA-62]	no	No assignment
		*****	When this function is enabled, automatically recorded parameters are displayed. (Parameters other than [UA-31] to [UA-62] are subjected)

9.8.4 Protecting Parameters by Password

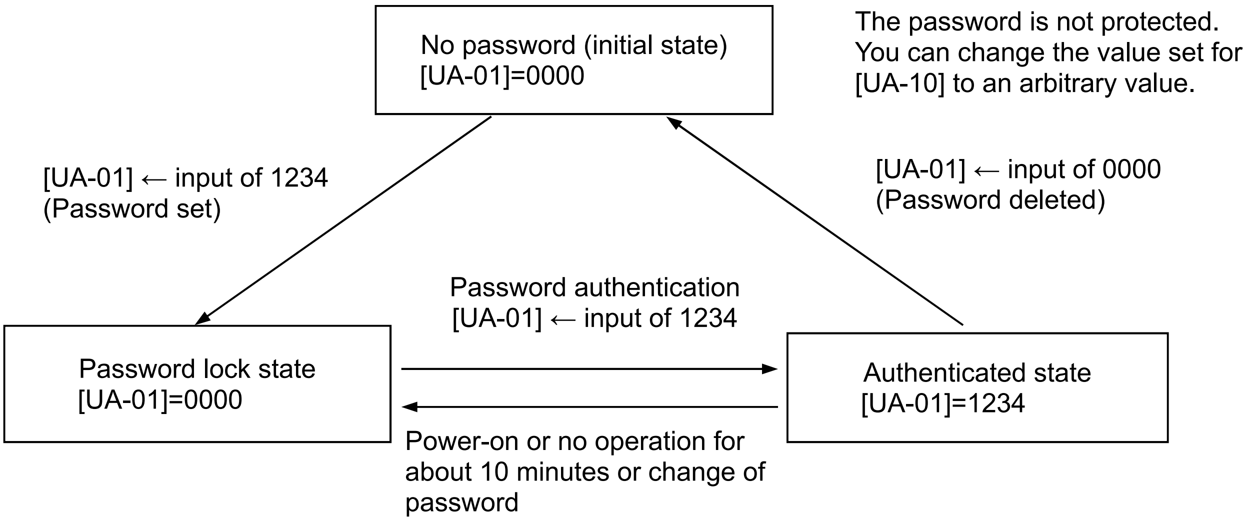
- By setting a password to the display selection function [UA-10] and soft-lock function [UA-16], you can prevent parameters from being displayed or changed.

- If you forget the set password, there is no way to unlock the password lock.
  Also, the password cannot be investigated by our plant or service station, therefore, care must be taken when setting a password.

■Parameters

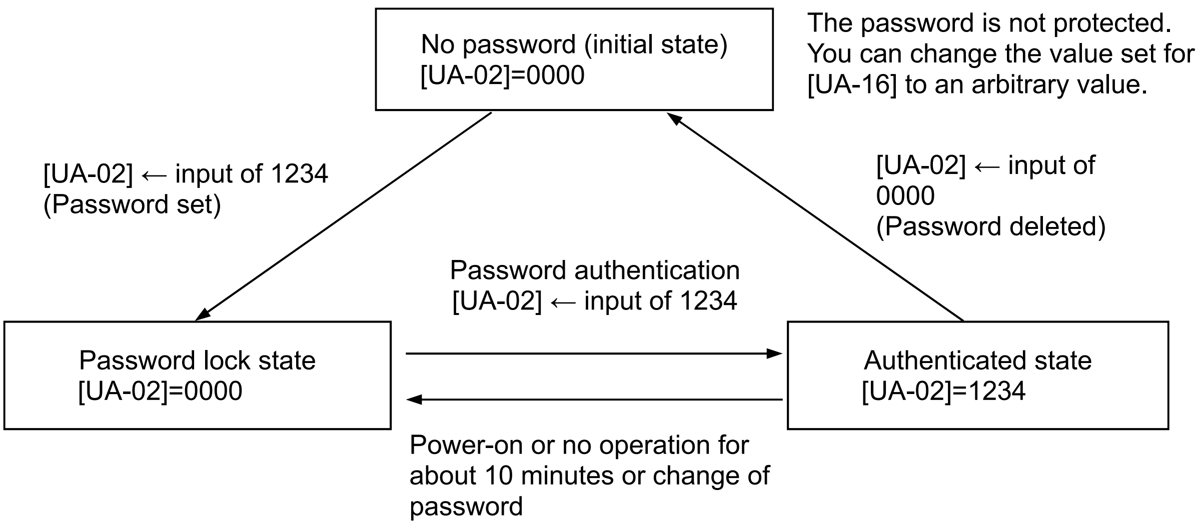
Item	Parameter	Data	Description
Password for display	[UA-01]	0000~FFFF	Lock/unlock the display selection function [UA-10].
Soft-lock password	[UA-02]		Lock/unlock the soft-lock function [UA-16].
Display selection	[UA-10]	00	All parameters are displayed.
		01	Parameters are displayed by functions. Disabled functions are not displayed with some exceptions.
		02	Display is performed in accordance with the settings configured by the user. Parameters set to [UA-31] to [UA-62] are displayed with some exceptions.
		03	Parameters that have been changed from the factory default settings and some other parameters are displayed.
		04	Monitor parameters and some other parameters are Minitor displayed.
Soft-lock selection	[UA-16]	00	When the soft-lock terminal [SFT] is on, changes of data set to [UA-17] other than [UA-16] are locked.
		01	After the setting is performed, changes of data set to [UA-17] other than [UA-16] are locked.
Input terminal function	[CA-01]~[CA-11]	036	[SFT]: Used when the soft-lock function is used on terminals.

■Outline of password function
(Example of password for limiting display)



The password is protected. You cannot change the value set for [UA-10].
The LKP icon is displayed in the parameter section.
After password authentication, although the password setting information is not deleted, you can change the value set for [UA-10]. If power is turned on again or 10 minutes pass without any operation, the password is automatically locked again.

■Outline of password function
(Example of a soft-lock password)



The password is protected. You cannot change the value set for [UA-16].
The LKP icon is displayed in the parameter section.
After password authentication, although the password setting information is not deleted, you can change the value set for [UA-16].
If power is turned on again or 10 minutes pass without any operation, the password is automatically locked again.

9.9 Display Fixation Function

9.9.1 Fixation of Display Using the DISP Terminal

- When the [DISP] function of the input terminal function is on, display of the operator keypad is fixed on the monitor screen.
- When the [DISP] function of the input terminal function is on, keys other than the RUN key and STOP/RESET keys are disabled.
- To disable the RUN key, set [AA111] to a value other than 02.

- The following shows operations when the [DISP] terminal is on.
  - When STOP key selection [AA-13] is 01, even if [AA111] is other than 02, you can stop the inverter or reset inverter trip by using the STOP/RESET key.
  - When STOP key selection [AA-13] is 02, even if [AA111] is other than 02, you can reset inverter trip by using the STOP/RESET key.
  - When STOP key selection [AA-13] is 00, if [AA111] is other than 02, the STOP/RESET key is also disabled, thus disabling all keys.

■Parameters

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	102	[DISP]: Used when the screen fixation function is used on terminals.
RUN command input source selection, 1st-motor	[AA111]	00	[FR]/[RR] terminals
		01	3 wire
		02	RUN key on the operator keypad
		03	RS485 setting
		04	Option 1
		05	Option 2
		06	Option 3
STOP key enable	[AA-13]	00	Disable
		01	Enable
		02	Enable at only trip reset

9.10 Error Operation on the Operator Keypad

9.10.1 Selection of Operation at Disconnection of Operator Keypad

- You can configure operation when the operator keypad is disconnected. When about 5 seconds have passed after communication with the operator keypad is disconnected, it is determined that disconnection occurred.
- For operation at disconnection, see the parameter table shown below.

■Parameter

Item	Parameter	Data	Description
Selection of operation at disconnection of operator keypad	[UA-20]	00	When disconnection occurs, the inverter trips due to [E040] Operator keypad communication error.
		01	When disconnection occurs, the inverter trips with [E040] Operator keypad communication error after deceleration stop.
		02	Ignores detection of disconnection.
		03	Performs the free-run stop when disconnection occurs. No error occurs.
		04	Performs the deceleration stop when disconnection occurs. No error occurs.

9.10.2 Display of Battery Level Warning

- The operator keypad is monitored on a regular basis, and when it is determined the time setting of operator keypad returns to the initial state, it is determined to be error.
- When [UA-19] is set to 01 and it is determined that abnormality occurs, the output terminal function 080[LBK] is turned on.
  When time is configured on the operator keypad, [LBK] is turned off.
- When [UA-19] is set to 02, when it is determined that abnormality occurs, an error is generated, and the inverter trips due to [E042] RTC error.
  The output terminal function 080 [LBK] is turned on at the same time the error occurs. When time on the operator keypad is configured, [LBK] is turned off.

- You can cancel trip of [E042] RTC error by performing the reset operation, however, if time is not configured, the error occurs again. In this case, the output terminal function 080 [LBK] is on.
- If [UA-19] is set to a value other than 00, insert the battery in the operator keypad, and set [UA-19] after configuring time.

■Parameter

Item	Parameter	Data	Description
Battery level warning selection	[UA-19]	00	Disable
		01	The output terminal function 080 [LBK] is turned on as a warning.
		02	Generates the [E042] RTC error and the inverter trips. Turns on the output terminal function 080 [LBK].

9.11 Preventing Read and Write of Unnecessary Data

9.11.1 Disabling Data R/W

- By setting [UA-18] Data R/W selection to 01, Read/Write access from VOP is disabled, and read and write of unnecessary data can be prevented.
- After the parameter is confirmed, if it is set to 01 after data is read for backup, unnecessary read and write can be prevented.

■Parameter

Item	Parameter	Data	Description
Data R/W selection	[UA-18]	00	R/W enabled. Read and write are possible.
		01	R/W disabled. Read and write are prohibited.

10

Chapter 10 Test Run

10.1 What This Chapter Explains

This chapter provides an operational flow to do a test run.
For method for using the operator keypad, see “Chapter 10.4.1 Operation Using the Operator Keypad” and “Chapter 9 Operating Instructions”.
Furthermore, to do a test run not via the operator keypad, configure the setting by referring to “Chapter 11 Examples of Settings by Operation Command Destination”.
Before conducting a test run, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

10.2 Let’s Check the Procedures Before Test Runs!

- To perform a test run, follow the procedures shown below.

Procedure ▸	Check Items ▸	For more details,
1. Safety check ⚠	• See the precautions required for handling the inverter.	• See Chapter 1 Safety Instructions/Risks.
2. Checking the inverter	• Confirm that there is no abnormality in items included in the package of inverter and the appearance of the inverter.	• See “Chapter 5 Included Items”.
3. Installation of the inverter	• Confirm that the inverter is installed in a proper environment and in a proper setting.	• See “Chapter 6 Installation”.
4. Wiring requirements	• Confirm that wires are properly connected to the inverter.	• See “Chapter 7 Wire Connection and Optional Devices”.
5. Setting up the operation method	• Check how to operate the operator keypad.	• See “Chapter 9 Operating Instructions”.
6. Setting up the running method	• Set up the inverter running method.	• See “Chapter 11 Examples of Settings by Operation Command Destination”.
7. Selecting a control mode and protective function according to a load	• Set up the inverter control method.	• See the Chapter 12 for descriptions of required items. The items required for running the inverter are provided in the following article.

Completed

10.3 Settings and Commands Required for Running the Inverter

- To turn the motor, configure the following settings:
- This article explains the settings for operation. Carefully read Safety Instructions before handling the inverter.

1. Basic setting for motor

- Set the following parameters in accordance with the plate of motor. Set the data indicating the basic characteristics of motor.

Item	Parameter	
	IM	SM(PMM)
Motor capacity selection	[Hb102]	[Hd102]
Selection of number of motor poles	[Hb103]	[Hd103]
Base frequency (frequency)	[Hb104]	[Hd104]
Maximum frequency (frequency)	[Hb105]	[Hd105]
Rated voltage of motor	[Hb106]	[Hd106]
Rated current of motor	[Hb108]	[Hd108]

∗See "12.3 Basic Settings for Motor" for details.

2. Setting for protection of motor

- The motor may be burned if a large current keeps on flowing in the motor; the setting therefore must be performed appropriately.

Item	Parameter
First electronic thermal level	[bC110]
First electronic thermal characteristics selection	[bC111]

∗See "12.7 Temperature Protection of Motor" for details.

3. Setting for activating the motor

- The voltage output of the inverter requires not only an operation command but also a frequency command. In the initial state, a main speed command is used as a frequency command.

Item	Parameter
First main speed command selection	[AA101]
First operation command selection	[AA111]
Main speed command	[FA-01]

∗For details, see "12.4 Select a Frequency Command", "12.5 Selecting a Operation Command" and "Chapter 11 Examples of Settings by Operation Command Destination".

4. Settings for motor control

- Set the motor control method.
- For changing to the mode of driving an SM (PMM), you need to change the control method.

Item	Parameter
First control mode	[AA121]

∗For details, see "12.9 Select motor control method in accordance with motor and load".

- When driving an SM (PMM) or using other motors than Hitachi's standard motors, or setting long wiring length, you need to set up the following motor constants:

- For induction motor IM

Item	Parameter
First IM motor constant R1	[Hb110]
First IM motor constant R2	[Hb112]
First motor constant L	[Hb114]
First IM motor constant I0	[Hb116]
First IM motor constant J	[Hb118]

- For synchronous motor (permanent magnetic motor) (SM (PMM))

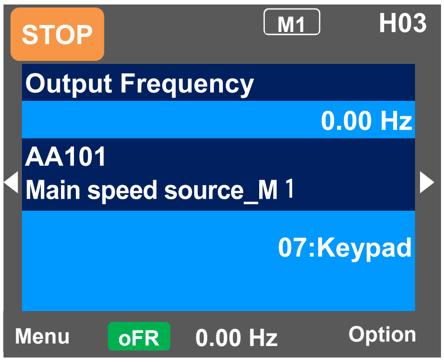
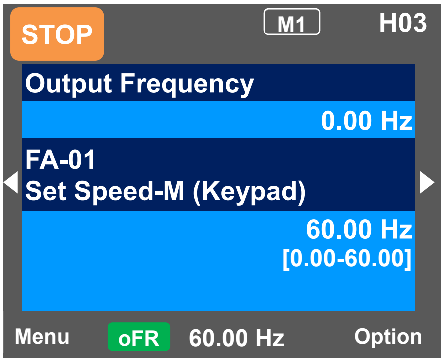
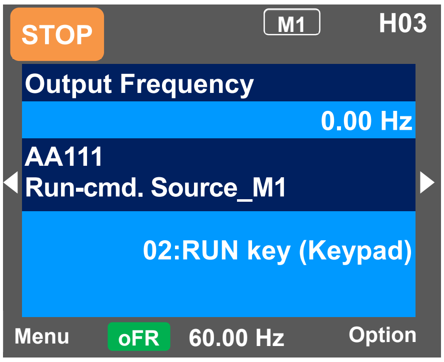
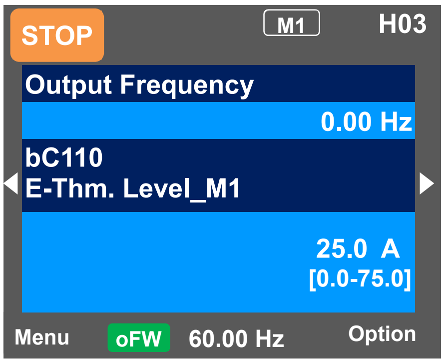
Item	Parameter
First SM (PMM) motor's constant R1	[Hd110]
First SM (PMM) motor's constant Ld	[Hd112]
First SM (PMM) motor's constant Lq	[Hd114]
First SM (PMM) motor's constant Ke	[Hd116]
First SM (PMM) motor's constant J	[Hd118]

10.4 Let’s Configure Settings for Test Runs!

10.4.1 To perform test runs via operator keypad

- From the initial screen displayed at power-on, move to “H03” with the LEFT/RIGHT (◁▷) keys.
- For procedure of changing parameters, see "9.3 Let’s Set Parameters”.
- To perform a test run only via operator keypad, set the following parameters from the initial value, or check the following parameters.

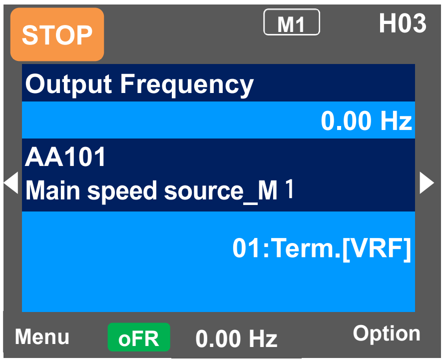
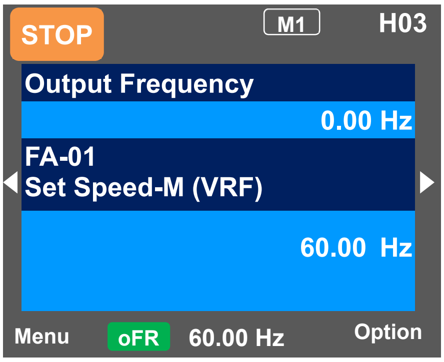
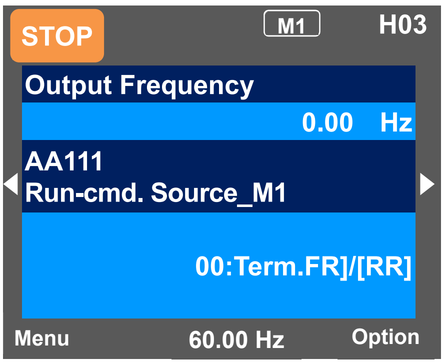
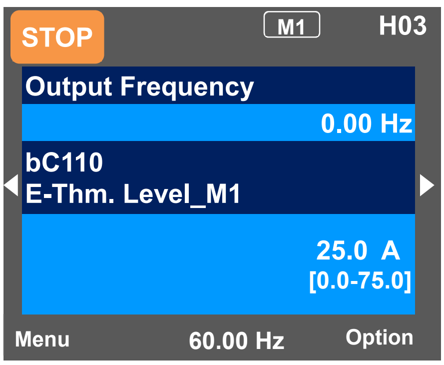
① Frequency command destination selection [AA101]
② Main speed command [FA-01]
③ Operation command destination selection [AA111]
④ Setting the electronic thermal level of motor [bC110]

Display description	Setting item
① 	＜Frequency command destination selection [AA101]＞ Set the frequency command destination to “07: Parameter set-up”.
② 	＜Main speed command [FA-01]＞ When the frequency command destination is set to “07: Parameter set-up”, “Main speed command (Operator keypad)” will be shown. If a frequency command is set in this state, the value will be shown at the bottom command monitor area.
③ 	＜Operation command destination selection [AA111]＞ When the operation command destination is set to “02: RUN key on operator keypad”, “oFR” will be shown on operator keypad at the bottom in the area for displaying function of RUN key. ＊When the destination is set to reverse, “oRR” will be shown.
④ 	＜Setting the electronic thermal level of motor [bc110]＞ Set the level so that it does not exceed the rated current of motor. ⚠ Note that the motor may be burned if the electronic thermal level is not appropriately set. ＊The electronic thermal for protecting the inverter works automatically.

10.4.2 Running by attaching a variable resistor to the terminal block [FR] input, ＋V, VRF, and COM

- From the initial screen displayed at power-on, move to “H03” with the LEFT/RIGHT arrow (◁ ▷) keys.
- For procedure of changing parameters, see "9.3 Let’s Set Parameters”.
- To perform a test run using analogue input VRF, set the following parameters from the initial value, or check the following parameters.

① Frequency command destination selection [AA101]
② Main speed command [FA-01]
③ Operation command destination selection [AA111]
④ Setting the electronic thermal level of motor [bC110]

Display description	Setting item
① 	＜Frequency command destination selection [AA101]＞ Set the frequency command destination to “01:VRF input”.
② 	＜Checking the main speed command [FA-01]＞ When the operation command destination is set to “01:VRF input”, “Main speed command (VRF)” will be shown. If a frequency command is set in this state, the value will be shown at the bottom command monitor area.
③ 	＜Operation command destination selection [AA111]＞ When the operation command destination is set to “00:[FR]/[RR] terminal”, the display will disappear from the area for displaying function of RUN key on operator keypad at the bottom. ＊Normal/reverse rotation can be set at [FR]/[RR] terminal.
④ 	＜Setting the electronic thermal level of motor [bc110]＞ Set the level so that it does not exceed the rated current of motor. ⚠ Note that the motor may be burned if the electronic thermal level is not appropriately set. ＊The electronic thermal for protecting the inverter works automatically.

Do

- To connect a cable between VRF and COM, or between IRF and COM, make sure to check that a desired input (voltage or current) is provided to the corresponding positions of DIP switch SW1 and SW2.

Failure

Prohibited

- A damage may be caused by inputting a wrong voltage or current for reasons such as wrong selection of switches, input beyond the specification range (P24 terminal of 24V is used instead of ＋V terminal of 10V), and wrong wiring (voltage/current being input reversely because the wire is connected in the wrong way; a cable between ＋V and COM is short-circuited at 0 Ω during wiring of a tab; and so on).

10.4.3 Supplement

- Check the setting of the motor capacity, the number of motor poles, frequency, voltage, and current in order to conduct motor control.

- In the initial state, the motor is in the V/f control mode, in which voltage is output proportional to the frequency for induction motor control.
  For control modes, see “12.9 Selecting the Motor Control Mode according to Motor and Load".

- IM: Induction motor

General motor items	Code	Setting range (unit)
Capacity	[Hb102]	0.01~75.00 (kW)
Number of motor poles	[Hb103]	2 to 48 (poles)
Frequency	[Hb104]	10.00~590.00 (Hz)
	[Hb105]	
Voltage	[Hb106]	1~1000 (V)
Current	[Hb108]	0.01~10000.00 (A)

- SM (PMM): Synchronous (permanent magnet) motor

General motor items	Code	Setting range (unit)
Capacity	[Hd102]	0.01~75.00 (kW)
Number of motor poles	[Hd103]	2 to 48 (poles)
Frequency	[Hd104]	10.00~590.00 (Hz)
	[Hd105]	
Voltage	[Hd106]	1~1000 (V)
Current	[Hd108]	0.01~10000.00 (A)

- See "12.3 Basic Settings for Motor” for details.

10.5 Checking in the simulation mode

- If the simulation mode [PA-20] is set to 01 and the power is turned on again, the inverter enters the simulation mode and does not output to the motor.
- To cancel the simulation mode, set [PA-20] to 00 and then turn on the power again.
- Because the inverter behaves just like a normal operation except that it cannot output to the motor, you can check terminals and communication operations.
- It will be possible to change the internal data on a real-time basis by assigning a parameter or analog input to the internal data.
- Operation checks can be performed in the condition that the control power supply is input or 24-V power supply is used.
- If the error code selection [PA-21] is set during the simulation mode, a trip is issued as soon as the setting is made. To cancel a trip, reset the inverter (turn ON the [RST] terminal or press RESET key) as usual. When the inverter is reset, [PA-21] will be automatically set to 00.

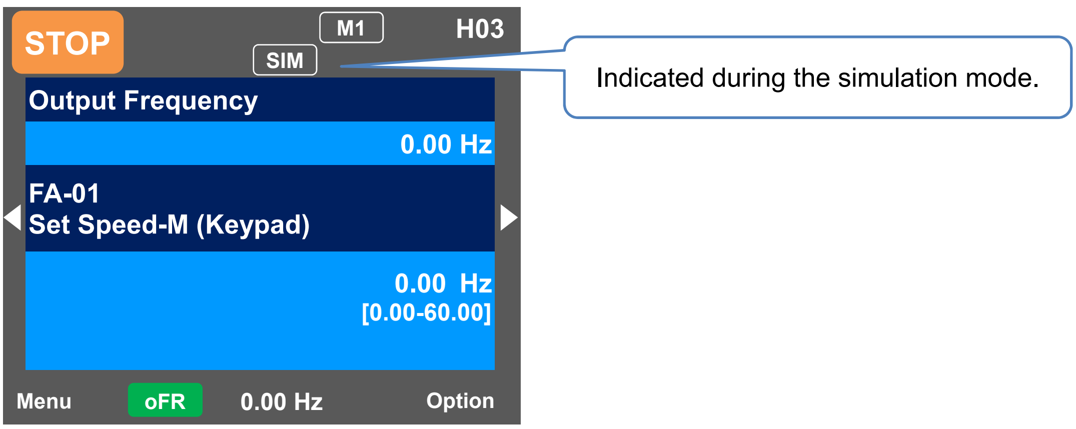
- The motor cannot be driven in the simulation mode.
- To check the actual motor behavior, set the simulation mode [PA-20] to “00: Disable” and then turn on the power again.
- To activate the simulation mode, activate it in the condition that 24-V power supply is input for 24-V power supply; that control power supply is input for control power supply terminals (r1, t1) inputs; and that R, S, and T terminals are input for main power supply inputs R, S, and T. Then turn off the power to end the simulation mode.
- Because the simulation mode is for simulating terminals’ behaviors, the function activated by a motor control operation does not work.
- In the simulation mode, if an error not listed in the selection of error code for alarm test [PA-21] is entered, the error will not be generated.
- In the simulation mode, if a serious fault error is entered to the selection of error code for alarm test [PA-21], the power needs to be turned on again. (Serious fault errors: E010, E011, E014, E019, E020)

＜Entering the simulation mode＞

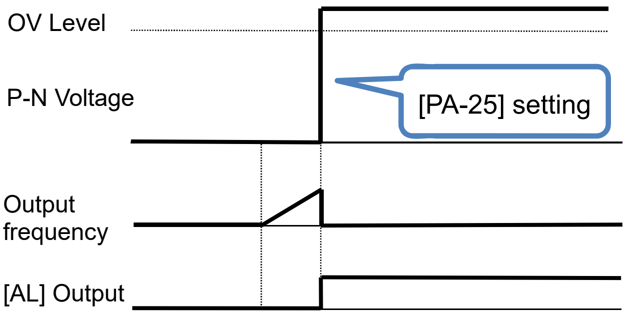
1. Set the simulation mode [PA-20] to 01.
2. Turn off the power, and then turn it on again.
3. The simulation mode becomes active.

＜Canceling the simulation mode＞

1. Set the simulation mode [PA-20] to 00.
2. Turn off the power, and then turn it on again.
3. The simulation mode is canceled.

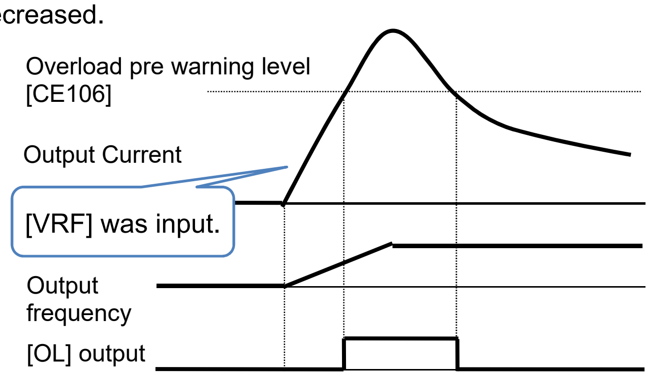


(Example: usage 1)
Checking the behavior while the alarm [AL] is on.
- The operation was started.
- P-N voltage monitor optional selection [PA-24] was set to 01, and P-N voltage monitor optional setting value [PA-25] was set to the maximum value.



- An overvoltage error [E007] occurred and [AL] was ON.

(Example: usage 2)
Checking the signal output of overload pre warning level [OL].
- The overload pre warning level [CE106] was set, and the operation was started.
- Output current monitor optional output selection [PA-22] was set to 02, and [Ai1] was increased and decreased.



- [OL] was turned ON because the output current exceeded the overload pre warning level [CE106].

■Parameters

Item	Parameter	Data	Description
Simulation mode	[PA-20]	00	Disable
		01	Enable
Selection of error code for alarm test	[PA-21]	000~255	Issues a set error. Errors not listed in the selection do not occur.
Output current monitor optional output selection P-N voltage monitor optional output selection Output voltage monitor optional output selection Output torque monitor optional output selection Frequency adjustment frequency optional output selection	[PA-22] [PA-24] [PA-26] [PA-28] [PA-30]	00	Disable
		01	Enable (Parameter setting)
		02	Enable (Setting by [VRF])
		03	Enable (Setting by [IRF])
		04	Enable (Setting by [VF2])
		05	Enable (Setting by [Ai4])
		06	Enable (Setting by [Ai5])
		07	Enable (Setting by [Ai6])
Output current monitor optional setting value	[PA-23]	0.0 to 3.0 × Inverter rated current (A)	Treats the set values as internal output values.
P-N voltage monitor optional setting value	[PA-25]	200V class: 0.0 to 450.0 (Vdc) 400V class: 0.0 to 900.0 (Vdc)	Treats the set values as internal output values.
Output voltage monitor optional setting value	[PA-27]	200V class: 0.0-300.0(V) 400V class: 0.0-600.0(V)	Treats the set values as internal output values.
Output torque monitor optional setting value	[PA-29]	-500.0~500.0 (%)	Treats the set values as internal output values.
Frequency matching frequency optional setting value	[PA-31]	0.00~590.00 (Hz)	Treats the set values as internal output values.

Chapter 11 Examples of Settings by Operation Command

11

11.1 What This Chapter Explains

This chapter provides examples of settings by connection at a frequency command and operation command. In respective settings, an operation command and frequency command are to be set separately; hence it is possible to set according to working environments by combining each command.
Make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

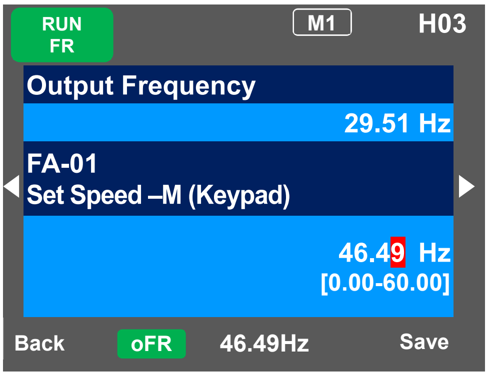
11.2 Frequency and operation commands

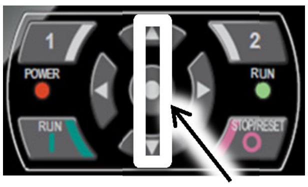
The inverter does not output until both a frequency command (e.g. 60Hz) and an operation command (forward rotation command) are entered.

11.2.1 Setting the operator keypad

- On the parameter setting screen, select [AA101] = 07 frequency command.
- Frequency command can be changed using (1) parameter [FA-01] (if the operator keypad is used); or (2) parameter setting [Ab110].

(Example) For [FA-01]





■Frequency command
- Frequency command can be changed by using UP/DOWN keys to set the main speed command [FA-01] to a desired setting.

■Parameters

Parameter	Setting function	Set value
[AA101]	Frequency setting by setting on the operator keypad	07
[FA-01]∗	Main speed command	0.00Hz
[Ab110]∗	0th speed of the 1st multi-step speed	

∗If [AA101] is set to 07, a change made to either [FA-01] or [Ab110] parameter will be reflected to the other parameter. If [FA-01] cannot be changed or a change is not reflected, it means that the command hasn’t been the operator keypad due to terminal functions or setting of [AA101].
You need to set the frequency value other than 0.00.

11.2.2 Operating on operator keypad

- On the parameter setting screen, select 02 for [AA111].

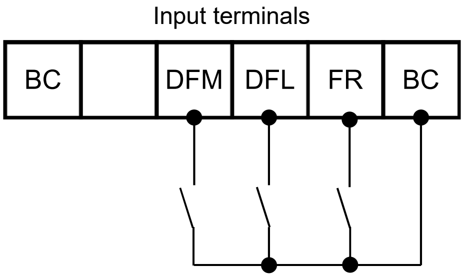
■Operation and stop commands
You can operate or stop by pressing RUN key or STOP key on the operator keypad.

■Parameter

Parameter	Setting function	Set value
[AA111]	Operates with RUN key on the operator keypad.	02

11.2.3 Commanding by the multi-speed terminal

- Where a multi-speed command hasn’t been entered, the command complies with [AA101].
- Where zero speed is used, select 07 for [AA101].



■Frequency command
- Switch the frequency command by ON/OFF inputs of the multi-speed terminals [DFL] and [DFM].

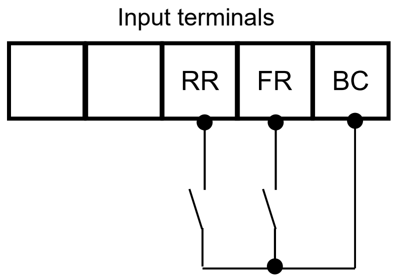
■Parameters

Parameter	Setting function	Set value
[AA101]	Frequency setting by setting on the operator keypad	07
[FA-01]*1)	Main speed command	0.00Hz
[Ab110]*1)	0th speed of the 1st multi-step speed ([DFL]OFF/[DFM]OFF)	
[Ab-11]*2)	1st speed of the multi-step speed ([DFL]ON/[DFM]OFF)	
[Ab-12] *2)	2nd speed of the multi-step speed ([DFL]OFF/[DFM]ON)	
[Ab-13] *2)	3rd speed of the multi-step speed ([DFL]ON/[DFM]ON)	
[CA-06]	Terminal No. 6 is for [DFL].	001
[CA-07]	Terminal No. 7 is for [DFM].	002

*1) If [AA101] is set to 07, a change made to either [FA-01] or [Ab110] parameter will be automatically reflected to the other parameter. If [FA-01] cannot be changed or a change is not reflected, it means that the command hasn’t been the operator keypad due to terminal functions or setting of [AA101].
*2) Set the frequency command used at the multi-step speed command.

11.2.4 Operating using FR/RR terminal

- Select 00 [FR] /[RR] terminal for [AA111] on the parameter setting screen.



■Operation and stop commands

You can operate or stop by ON/OFF inputs of either the [FR] terminal or [RR] terminal.

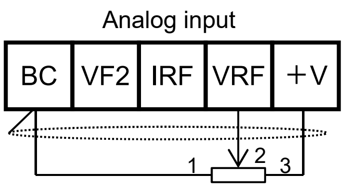
■Parameters

Parameter	Setting function	Set value
[AA111]	Operation by [FR]/[RV] terminal	00
[CA-01]	Terminal No. 1 is for [FR].	001
[CA-02]	Terminal No. 2 is for [RR].	002

11.2.5 Commanding by using a frequency setter

- Select 01 for [AA101] on the parameter setting screen.

※ The switch for VRF on the control circuit board needs to be voltage.



Variable resistor for frequency command
(1kΩ~2kΩ)

■Frequency command

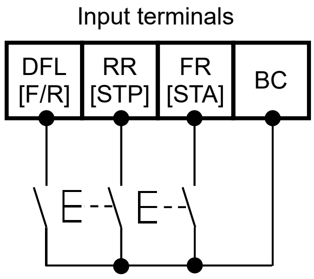
- Switch the frequency command by adjusting the tab position of frequency setter.

■Parameter

Parameter	Setting function	Set value
[AA101]	Gives a frequency command with VRF terminal input.	01

11.2.6 Operation on 3 wire terminals

- On the parameter setting screen, select 01 for [AA111]. In this paragraph, the 3-wire function is assigned to the input terminal function.



*) Terminal FR [CA-01] =016, RR [CA-02] =017, DFL [CA-03] =018

■Operation and stop commands

- To start operation, turn ON the [STA] terminal; to stop, turn ON the [STP] terminal. Select the rotation direction using the [F/R] terminal.

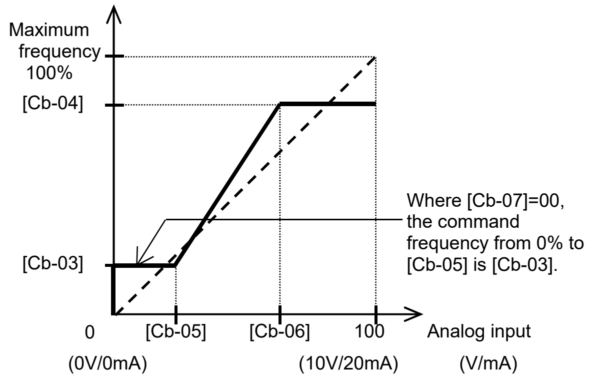
■Parameters

Parameter	Setting function	Set value
[AA111]	Gives a frequency command using the 3 wire function.	01
[CA-01]	Terminal FR is for [STA].	016
[CA-02]	Terminal RR is for [STP].	017
[CA-03]	Terminal DFL is for [F/R].	018

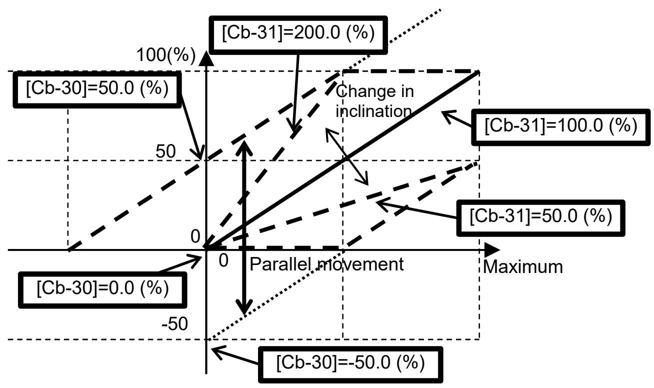
11.2.7 Adjusting analog inputs (VRF/IRF)

(Example) Adjusting the operation (example for VRF)

- You can limit the operation range of command frequency by setting the ratio to the input. (where a frequency is given via terminal input)



(Example) Making fine adjustment (example for VRF)



■Parameters

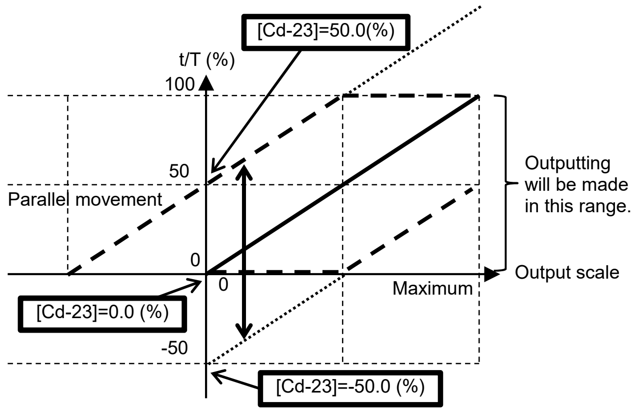
Parameter		Setting function
VRF	IRF	
[Cb-03]	[Cb-13]	Sets a frequency command ratio to a start ratio for analog input.
[Cb-04]	[Cb-14]	Sets a frequency command ratio to an end ratio for analog input.
[Cb-05]	[Cb-15]	Sets a start ratio for analog input for 0 to 10 V/0 to 20 mA.
[Cb-06]	[Cb-16]	Sets the end ratio for analog input for 0 to 10 V/0 to 20 mA.
[Cb-30]	[Cb-32]	Adjusts the zero point of reference line to voltage input 10 V / current input 20 mA and the maximum frequency.
[Cb-31]	[Cb-33]	Adjusts the inclination of reference line of voltage input 10 V / current input 20 mA.

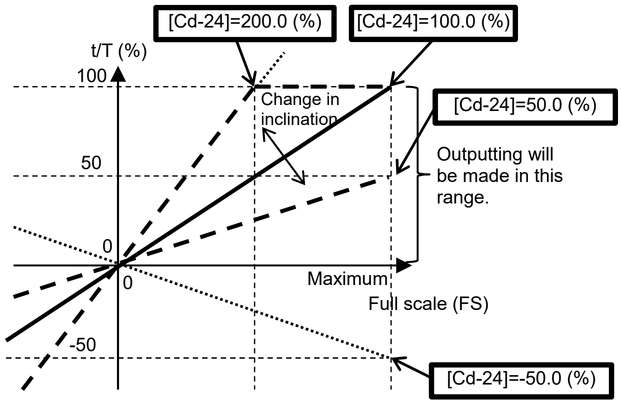
- IRF can be adjusted by substituting VRF parameter of the example with IRF parameter. Voltage and current inputs can be switched using the switch on the board.

11.2.8 Adjusting analog outputs (AMV/AMI/FRQ)

(Example) Adjusting the operation (example for AMV)

- Firstly, set a value equivalent to 0% output.
- Secondly, adjust a value equivalent to 100% output.



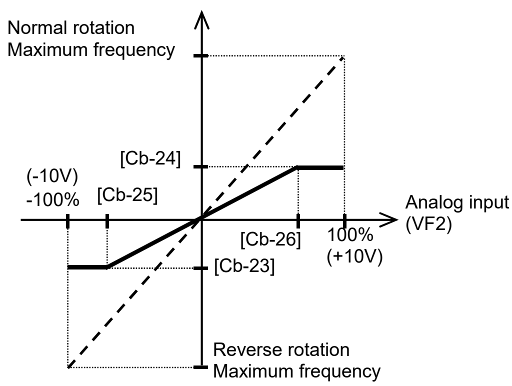


■Parameters

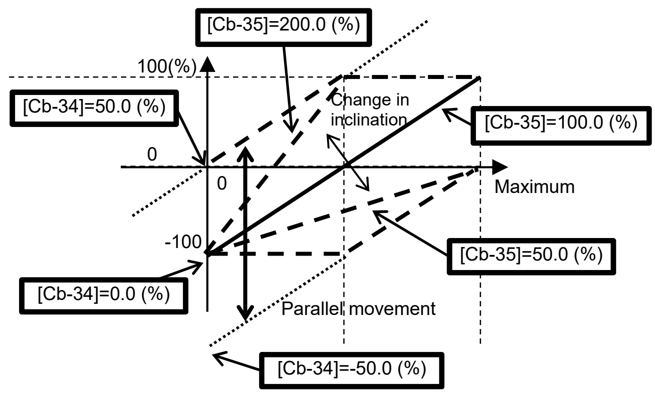
Parameter			Setting function
AMV	AMI	FRQ	
[Cd-23]	[Cd-33]	-	Adjusts the zero point of reference line to voltage output 10 V / current output 20 mA and data at 100%.
[Cd-24]	[Cd-34]	-	Adjusts the inclination of voltage output 10 V / current output 20 mA and data at 100%.
-	-	[Cd-13]	Adjusts the zero point of reference line to output 100% duty ratio and data at 100%.
-	-	[Cd-14]	Adjusts the inclination of output 100% duty ratio and data at 100%.

11.2.9 Adjusting analog input (VF2)

(Example) Adjusting the operation (example for VF2)



(Example) Making fine adjustment

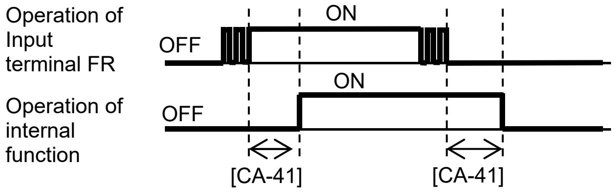


■Parameters

Parameter	Setting function
VF2	
[Cb-23]	Sets a frequency command ratio to a start ratio for analog input.
[Cb-24]	Sets a frequency command ratio to an end ratio for analog input.
[Cb-25]	Sets a start ratio for analog input for -10 to 10V.
[Cb-26]	Sets an end ratio for analog input for -10V to 10V.
[Cb-34]	Adjusts -10V of the reference line to -10V/10V and frequency.
[Cb-35]	Adjusts the inclination of reference line.

11.2.10 Prevention of malfunction of input terminals

- Malfunctions due to noises or other factors can be prevented by setting responses of input terminals.

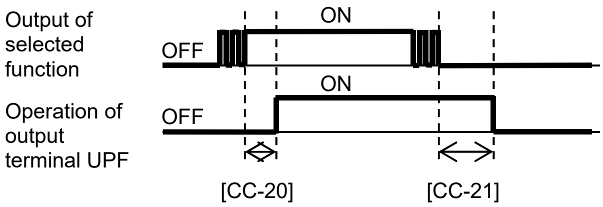


■Parameters

Input terminals	Response time	Input terminals	Response time
FR	[CA-41]	JOG	[CA-47]
RR	[CA-42]	ES	[CA-48]
DFL	[CA-43]	RST	[CA-49]
DFM	[CA-44]	DFH	[CA-50]
AUT	[CA-45]	DHH	[CA-51]
MBS	[CA-46]		

11.2.11 Stabilization of output terminals

- Excess sensitive reactions of internal functions can be stabilized by setting delays of output terminals.



■Parameters

Output terminal	On-delay time	Off-delay time
UPF	[CC-20]	[CC-21]
DRV	[CC-22]	[CC-23]
X1	[CC-24]	[CC-25]
X2	[CC-26]	[CC-27]
X3	[CC-28]	[CC-29]
RL	[CC-30]	[CC-31]
FL	[CC-32]	[CC-33]

12

Chapter 12 Inverter Functions

12.1 What This Chapter Explains

This chapter describes various functions of the inverter. Select a function that you want to use and configure it. Make sure to carefully read "Chapter 1 Safety Instructions/Risks" for safety work.

Caution

Do

- Wrong parameter setting could cause unexpected operation and result in a dangerous situation.
- Check and carefully read "Chapter 1 Safety Instructions/Risks" again before setting parameters. Carefully read a note for each parameter.

■Search a function to use.

• Show the content of this chapter.

12.2 Basic Setting of Inverter

12.2.1 Change duty rating of inverter

- The duty rating mode of the inverter can be chosen from Normal Duty (ND), Low Duty (LD), and Very Low Duty (VLD). See “Difference in duty rating modes” in the following.
- The rated current, excess duty endurance, and rated temperature of the inverter could change depending on the duty rating mode.
- A change of the inverter duty rating mode is reflected immediately after the duty type [Ub-03] is changed.

- When [Ub-03] is changed, the parameter set for the electric current is automatically adjusted at the ratio of the changed rated current and the set value is changed accordingly.
- Another check is necessary if the electric current is set by using the stall prevention function, DC braking function, electronic thermal function, excess duty warning function, or low current detection function.
- When VLD is selected and the control mode is selected out of the VLD specification range with the control type [AA121], the control mode is automatically set to the V/f control. Another check is necessary when the control type setting is changed.

■Parameters

Item	Parameters	Data	Description
Duty Type	[Ub-03]	00	VLD (Very Low Duty)
		01	LD (Low Duty)
		02	ND (Normal Duty)

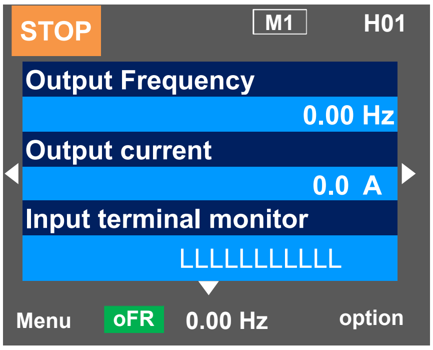
■Difference in duty rating modes

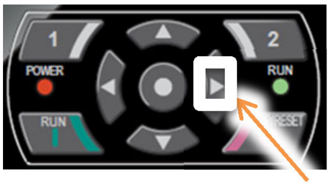
Duty rating	ND (Normal Duty)	LD (Low Duty)	VLD (Very Low Duty)
Excess duty endurance	150% (1 min.) 200% (3 sec.)	120% (1 min.) 150% (3 sec.)	110% (1 min.) 120% (3 sec.)
Temperature characteristics	50 °C (with derating)	45°C (with derating)	40°C (with derating)
Corresponding control type ∗	Induction motor IM • V/f control • V/f control with sensor • SLV (sensor less vector) control • 0 Hz-range SLV control • Vector control with sensor Synchronous motor SM • SLV control	Induction motor IM • V/f control • V/f control with sensor • SLV (sensor less vector) control Synchronous motor SM • SLV control	Induction motor IM • V/f control • V/f control with sensor • SLV (sensor less vector) control Synchronous motor SM • SLV control
Major applications	Lifts, agitator, cranes, etc. Conveyors, transportation machines, etc.		Fans, pumps

∗ Feedback option of the optional cassette is necessary for the vector control with sensor

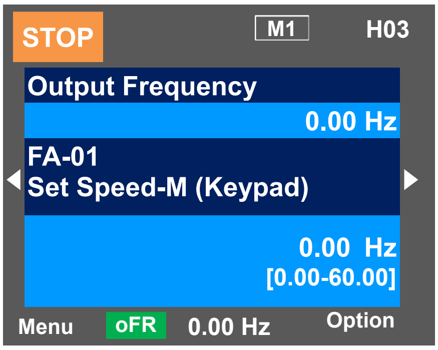
- The inverter rating is changed.

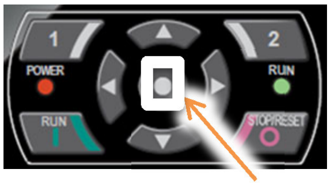
1 Press right (▶) key on the display screen.



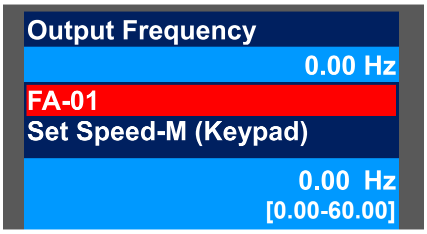


2 Press SEL(o) key twice on the parameter setting display screen and the parameter area begins blinking.

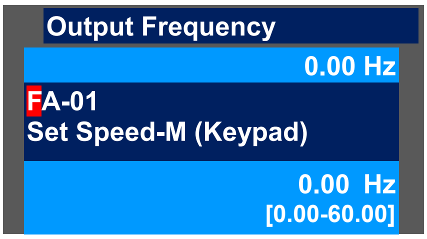




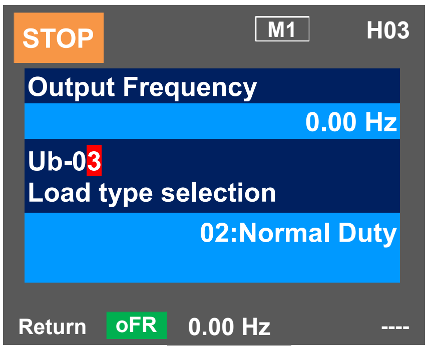
1

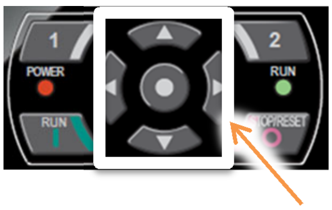


2

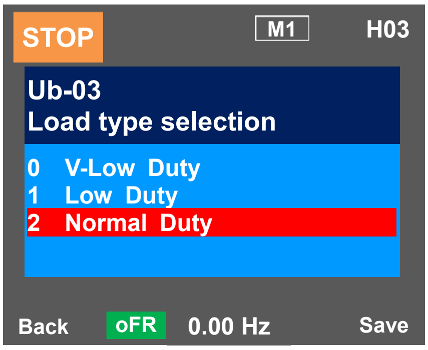


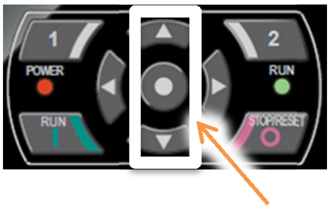
3 Use up, down, right, and left keys to choose a parameter and SEL(o) key to set it.

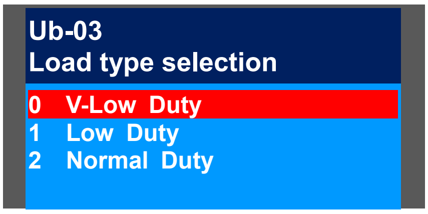


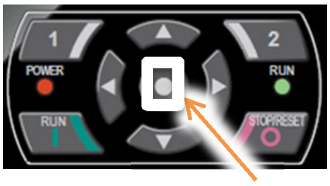


4 Use up and down keys to choose a mode and SEL(o) key to set it.



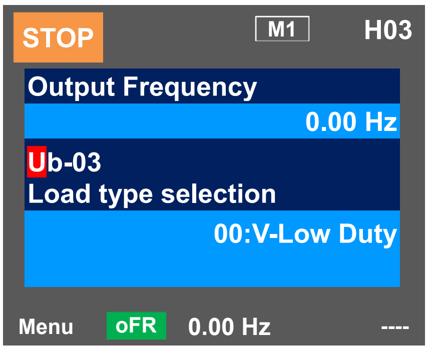






*The change is applied and SEL(o) key is used to proceed.

5 Check the content on the previous screen.
If the content is changed, the change is supposed to be stored in the storage element and the mode is switched.



12.2.2 Initialization of inverter

- When the initialization target [Ub-01] is chosen and [Ub-05] Start Initialization is set to 01, the designated data can be initialized to the factory setting.
- Only the trip history can be cleared without initialization of the stored parameter values.

- Duty type selection (Ub-03) is not initialized.
- The initialization sets the parameters to initial values. If the data before the initialization are necessary, read the data using the R/W function (Read) on the operator keypad or use PC software to save the data on a PC.

- Initial values to be stored after the initialization can be changed by changing the initial value selection [Ub-02], for details of the modes, see a list of the parameters attached to this document.

■Parameters

Item	Parameters	Data	Description
Selection of initialization	[Ub-01]	00	The initialization is disabled.
		01	The trip history and retry history are cleared.
		02	All the parameters are all initialized.
		03	The trip history, retry history, and all parameters are initialized.
		04	The trip history, retry history, all parameters are initialized.
		05	Parameters other than those of I/O terminal function are initialized.
		06	Parameters other than the communication function parameters are initialized.
		07	Parameters other than those of I/O terminal function and communication function are initialized.
		08	Reserved
Selection of initial values	[Ub-02]	00	Mode 0
		01	Mode 1
		02	Mode 2
		03	Mode 3
Initialization start	[Ub-05]	00	Function disabled
		01	Initialization start

■Content of [Ub-01] parameters chosen for initialization

Item	Parameter range	Description
Classification of I/O terminal functions	[CA-01]~[CA-11]	Input terminal selection
	[CA-21]~[CA-31]	a/b contact selection
	[CA-41]~[CA-51]	Input terminal response
	[Cb-40]	Thermistor selection
	[CC-01]~[CC-07]	Output terminal selection
	[CC-11]~[CC-17]	a/b contact selection
	[CC-20]~[CC-33]	Output delay
	[CC-40]~[CC-60]	Logical operation function

Item	Parameter range	Description
Classification of communication functions	[CF-01]~[CF-10]	Setting of RS485 communication
	[CF-20]~[CF-38]	Setting of EzCOM communication

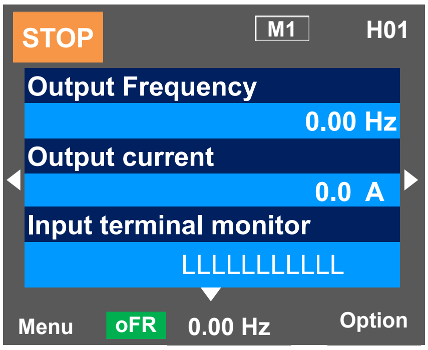
■Table of initialization targets

[Ub-01] Selection of initialization : Initialization targets are indicated by ○.

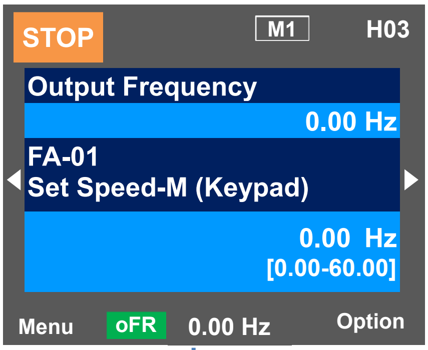
[Ub-01]	(1) History data	(2) Setting of I/O terminal	(3) Communication function	(4) Other than parameters (2) and (3)
00	-	-	-	-
01	○	-	-	-
02	-	○	○	○
03	○	○	○	○
04	○	○	○	○
05	-	-	○	○
06	-	○	-	○
07	-	-	-	○

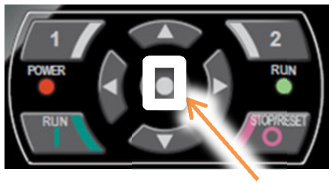
- Example of initialization of the trip history, all the parameters

1 Press right (▶) key on the display screen.

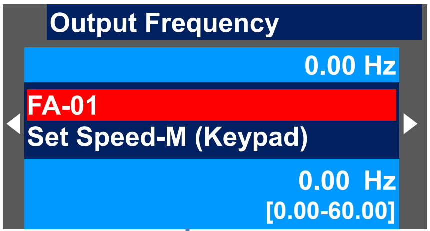


2 Press SEL(o) key twice on the parameter setting display screen and the parameter area begins blinking.

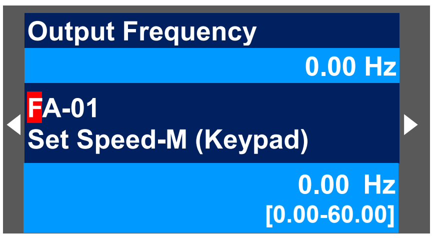




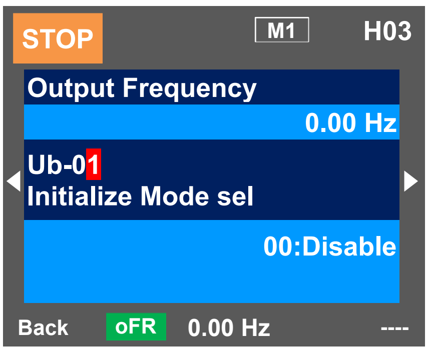
1

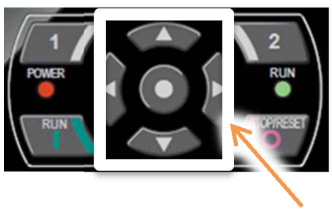


2

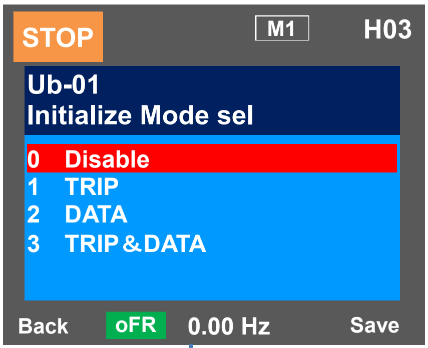


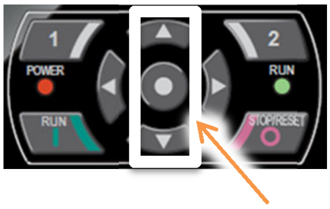
3 Use up, down, right, and left keys to choose a parameter and SEL(o) key to set it.

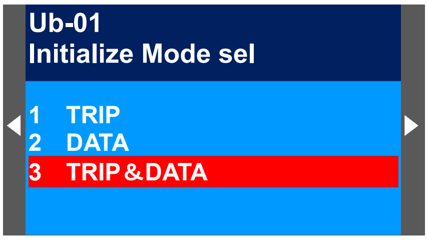


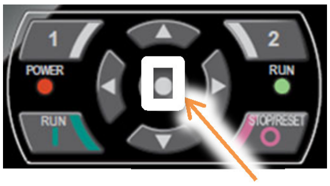


4 Use up and down keys to choose a mode and SEL(o) key to set it.

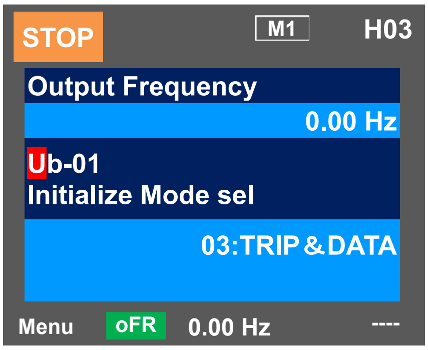




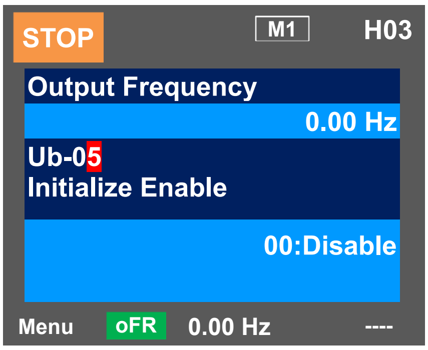




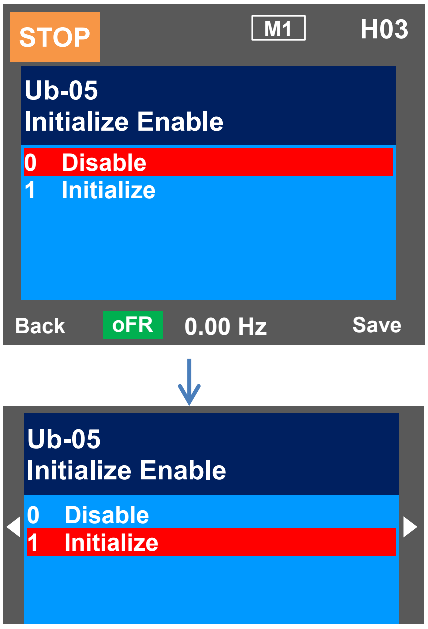
5 Check the content on the previous screen.
The initialization is not done yet.



6 Next, use up, down, right, and left keys to choose [Ub-05] and SEL(o) key to set it.



7 Choose Enabled and press SEL(o) key and **initialization** begins.



8 Initialization is on-going.

9 Initialization is end.

12.3 Basic Setting of Motor

12.3.1 Parameter setting of motor rating data

- Basic parameters to control and protect the motor are set.
- The following basic parameters need to be set for any control type.
- The motor operation could be stabilized if the motor items are set to the inverter.
- The induction motor (IM) and synchronous motor (SM) / permanent magnet motor (PMM) are set separately.

■About induction motor (IM)

Items of Induction motor	Parameters of inverter		Setting range (unit)	Description
Capacity	[Hb102]	Selection of motor capacity	0.01~75.00 (kW)	Sets the motor capacity.
Number of motor poles	[Hb103]	Selection of number of motor poles	2-48 (poles)	Sets the number of motor poles.
Frequency	[Hb104]	Base frequency	10.00~590.00 (Hz)	Sets the base frequency of motor.
	[Hb105]	Max. frequency		Sets the max. frequency of motor.
Voltage	[Hb106]	Rated voltage of motor	1~1000 (V)	Sets the rated voltage of motor.
Current	[Hb108]	Rated current of motor	0.01~10000.00 (A)	Sets the rated current of motor.

■About synchronous motor (SM) / permanent magnetic motor (PMM)

Items of PM motor	Parameters of inverter		Setting range (unit)	Description
Capacity	[Hd102]	Selection of motor capacity	0.01~75.00 (kW)	Sets the motor capacity.
Number of poles	[Hd103]	Selection of number of poles	2-48 (poles)	Sets the number of poles.
Frequency	[Hd104]	Base frequency	10.00~590.00 (Hz)	Sets the base frequency of motor.
	[Hd105]	Max. frequency		Sets the max. frequency of motor.
Voltage	[Hd106]	Rated voltage of motor	1~1000 (V)	Sets the rated voltage of motor.
Current	[Hd108]	Rated current of motor	0.01~10000.00 (A)	Sets the rated current of motor.

Caution
Burnout

The motor could burn if the base frequency is set smaller than the motor frequency.
(Smaller than 50 Hz in case of standard induction motor)

The motor could burn if the max. frequency and rated voltage are set out of the range specified in the motor specifications.

After initialization, the motor protection function needs to be configured again. Otherwise, the motor could burn.

Do

For setting the max. frequency larger than 60 Hz, contact the motor manufacturer about allowed max. frequency.

■Capacity and number of poles
- The inverter reads out preset standard motor data if the capacity and number of poles are changed.
- The motor disturbance could be suppressed and the motor operation could be stabilized if the capacity and number of poles are correctly set.

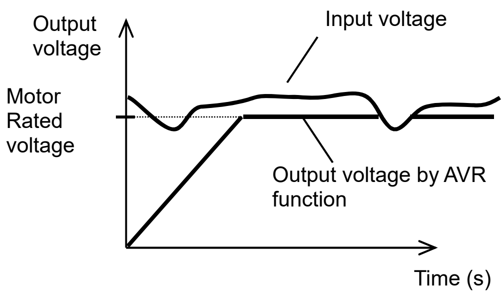
■Base frequency
- Set the base frequency according to the motor specifications.
- The induction motor should be regarded as a special one if used at higher than 60 Hz. In this case, the inverter capacity may need to be made larger as the maximum capacity of the inverter motor is incorrect.

■Max. frequency
- Sets the max. frequency of motor to use.

■Rated voltage
- Set the rated voltage of motor according to the motor specifications.
- Expected characteristics may not be obtained if the motor rated voltage is set higher than receiving voltage or inverter rated voltage.

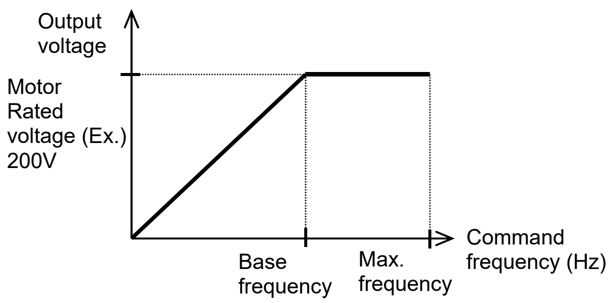
■Rated current
- Set the rated current of motor according to the motor specifications. Inappropriate setting could disturb the motor protection.
- The motor control could become unstable unless the motor rated current is correctly set.
- Expected characteristics may not be obtained if the motor rated current is set higher than the inverter rated current. In some cases, the inverter protection works first.

■Automatic voltage regulation function (AVR function)
- The inverter automatically operates the automatic voltage regulation function (AVR function). This function outputs voltage to the motor correctly even with variation in the input voltage to the inverter.
- Output of a voltage larger than the input voltage is not allowed even using this function.



- To use operation with conventional AVR function being set OFF, make the setting in [bA146] over-excitation function selection.
- [bA146] =02 for AVR OFF during deceleration.
- [bA146] =01 for AVR OFF all time.

■Relation between frequency and voltage under general V/f control (IM)
- General V/f control command is given in the following with the base frequency and rated voltage being set.
- At the frequency in the range from the base to max. frequency, the output voltage reaches a max. of the rated voltage of motor.



■Control of general synchronous motor
- Basically the synchronous motor needs current calculation control and the motor parameters need to be set. The parameters in this item and motor constants in the next item need to be set.

12.3.2 Motor constant setting

- Note that the motor constants will be overwritten if any of the following actions is taken.
  This applies to both IM and SM (PMM).
  - The motor capacity or number of motor poles is changed.
  - The auto-tuning is performed.
  - The initialization is performed.

  Please be advised to save the constants using the R/W function on the operator keypad.
- For details of adjustment, see “12.9.1 Control mode selection”.

- The motor operation could be stabilized if the following operations are made.
- In particular, the motor constants need to be set according to the motor specifications when the automatic boost function, automatic boost function with sensor, sensor less vector control function, 0 Hz-range sensor less vector control function, or vector control function with sensor is used.
- The motor constants of standard motor are automatically set to the followings when the motor capacity or number of motor poles is changed.
- Some of the motor constants in the followings are automatically set to acquire constant data when the auto-tuning function is used. For details, see the next section.
- The motor constants can be chosen from the motor constant selection or manually changed or adjusted.
- IE3 motor constants are used as initial values of the induction motor (IM) constants.

■IM motor constant parameters

Item	Parameters	Data	Description
Motor constant R1	[Hb110]	0.000001~1000.000000(Ω)	Sets the primary resistance of IM.
Motor constant R2	[Hb112]		Sets the secondary resistance of IM.
Motor constant L	[Hb114]	0.000001~1000.000000(mH)	Sets the leakage inductance of IM.
Motor constant I0	[Hb116]	0.01~10000.00(A)	Sets the no-load current of IM.
Motor constant J	[Hb118]	0.00001~10000.00000(kgm^2)	Sets the moment of inertia of the system.

・When base frequency is changed, standard value of motor constant I0 is also changed and regarded as there is a changed value.
Correct value is to be obtained by auto-tuning, or to read out the Induction Motor (IM) as initial value, [Hb103] pole number selection is to be set other value for example, 4 poles are to be set to 2 poles and then 4 poles again and then proper value is set for [Hb116] motor constant I0 for changed base frequency.

■SM/PMM motor constant parameters

Item	Parameters	Data	Description
Motor constant R	[Hd110]	0.000001~1000.000000(Ω)	Sets the resistance of SM/PMM.
Motor constant Ld	[Hd112]	0.000001~1000.000000(mH)	Sets the d-axis inductance of SM/PMM.
Motor constant Lq	[Hd114]		Sets the q-axis inductance of SM/PMM.
Motor constant Ke	[Hd116]	0.1~100000.0(mVs/rad)	Sets the calculated value of induced voltage of SM/PMM.
Motor constant J	[Hd118]	0.00001~10000.00000(kgm^2)	Sets the moment of inertia of the system.

- The base (max.) frequency can be calculated from the rated number of revolutions of the motor (min^{-1}) and the number of poles in the following formula.
  Base (max.) frequency (Hz) = rated number of revolutions (min^{-1}) × number of poles (pole)/120
- The motor constant Ke is the peak value of the phase inducted voltage (mV) per electrical angular speed (rad/s).

12.3.3 Auto-tuning of motor

- The auto-tuning is a function that measures and automatically sets the motor constants necessary for the motor control.
- There are two types of auto-tuning functions: Offline auto-tuning where the auto-tuning function finishes after a single measurement and online auto-tuning where the auto-tuning function measures a change in the constants due to motor temperature increase every time the motor is started or stopped.

- Use the offline auto-tuning to measure the motor constants if you use a motor whose constants are unknown.
- The online auto-tuning can stabilize the motor behavior by correcting the temperature increase of the motor during operation.

Warning Injury Failure / Do

- When 02 (revolving) is chosen in the auto-tuning selection [HA-01], the motor automatically begins rotating when the tuning starts.
  Make sure of the followings.
  - No problem shall occur even with the rotation at a frequency close to 80% of the base frequency.
  - The motor shall not be driven from external.
  - The braking shall be in the open state.

Warning Injury / Do

-The torque is not high enough during the auto-tuning.
Lift or other machine could have unexpected slipping.
Remove the motor from the loading machine and perform the auto-tuning to the independent motor.
(In this case, the moment of inertia J is that of the independent motor and hence the moment of inertia of the loading machine should be converted to the value about the motor axis and added to J.)

Warning Failure / Do

-For a machine with limited motor axis rotation (lift, ball screw, etc.), 01 (non-revolving) should be chosen in [HA-01] since rotation higher than the allowed one could occur causing a damage to the machine.

■Parameters

Item	Parameters	Data	Description
Auto-tuning selection	[HA-01]	00	Function disabled
		01	Non-revolving auto-tuning is performed. After this parameter is set, an operation command starts the tuning.
		02	Revolving auto-tuning is performed. After this parameter is set, an operation command starts the tuning.
		03	The tuning for the IVMS control type is performed. After this parameter is set, an operation command starts the tuning.
Operation command for auto-tuning	[HA-02]	00	RUN key on the operator keypad
		01	Command is sent from the designated operation commander.
Online tuning selection	[HA-03]	00	Function disabled
		01	The online tuning is performed. The online tuning is automatically performed after the deceleration stops in ordinary operations.

- The constants of induction motor (IE3 motor) are used as default in the factory setting.
  If you use standard induction motor, expected characteristics will be achieved without offline auto-tuning in most cases.
- Smooth tuning could be done if the offline auto-tuning is first performed for the factory-set parameters.

- If you use a synchronous motor SM (or permanent magnet motor PMM), perform the tuning after the control type [AA121] is set to 11 (SM/PMM: Synchronous activation) or 12 (SM/PMM: IVMS activation).
- If expected characteristics cannot be achieved, adjust the parameters and motor constants.
- Perform the offline auto-tuning before using the online auto-tuning function.

- The motor constants are for a single phase of Y-connection.
- The offline auto-tuning is performed only when the operation can be made.

- If no-load current is not known, check the current in the operation at the base frequency with the V/f control by using an electric current monitor and enter the value to [Hb116] before the auto-tuning.
- Even if 01 (non-revolving) is chosen for [HA-01], the motor could rotate slightly.
- The offline auto-tuning automatically overwrites the parameters with acquired data. The online auto-tuning does not overwrite the parameters with the data as it corrects internal data.

■Parameter data
overwritten in the offline auto-tuning

Selection of IM/SM	Parameters to be overwritten	
	Non-revolving tuning [HA-01]=01	**Revolving tuning [HA-01]=02**
Induction motor (IM) control [AA121]=00~10	[Hb110] Motor constant R1 [Hb112] Motor constant R2 [Hb114] Motor constant L	[Hb110] Motor constant R1 [Hb112] Motor constant R2 [Hb114] Motor constant L [Hb116] Motor constant I0 [Hb118] Motor constant J
Control of synchronous motor (permanent magnetic motor) (SM (PMM)) [AA121]=11~12	[Hd110] Motor constant R [Hd112] Motor constant Ld [Hd114] Motor constant Lq	-

*The above table shows the case where [SET] terminal is OFF or not selected. If [SET] terminal is made ON and the secondary setting is used, the parameters of [H*21*] ([Hb210], [Hd210], etc.) are effective and overwritten according to the selection of the control type [AA221].

■IVMS auto-tuning
- If a high torque is necessary for activation, Hitachi’s original IVMS control is used. If 03 is chosen for the auto-tuning selection [HA-01], it can be detected whether the target motor can be driven with the IVMS control, although combination check should be made in advance. Contact our sales personnel.

- The tuning with the IVMS control should be performed on an independent motor with the control type [AA121] set to 12 (SM/PMM: IVMS activation).
- In case of failure of the auto-tuning with the IVMS control, data necessary for the IVMS control cannot be obtained from the motor and the control type [AA121] should be set to 11 (SM/PMM: Synchronous activation) to drive the motor.

<Offline auto-tuning>

1. Check the control type [AA121].

For the induction motor (IM), make sure that the control type [AA121] is set to the one for IM.
For the synchronous motor (SM) or permanent magnetic motor (PMM), make sure that the control type [AA121] is set to the one for PMM.

2. Set the auto-tuning selection [HA-01].

In the auto-tuning selection [HA-01], 01: Non-revolving or 02: Revolving is set.
The tuning does not begin at this stage.
Only "non-revolving" can be chosen for synchronous motor (SM) / permanent magnetic motor (PMM).

3. Set a start command for tuning.

Pressing OPERATION button on the operator keypad starts the tuning, Pressing STOP button terminates the tuning, and however tuning data are not saved.

4. The inverter automatically operates.

Output of a preset pattern is given to the motor.
If the auto-tuning selection [HA-01] is set to 01: Non-revolving, non-revolving output of three different patterns is given.
If the auto-tuning selection [HA-01] is set to 02: Revolving, acceleration and deceleration are repeated twice in addition to the above output.
The frequency increases up to 80% of the base frequency.
After the above operation finishes, the output with no revolution is checked as final check.

5. The tuning finished.

When the tuning End display appears, the tuning finishes. Use STOP key to cancel the End display.

<Online auto-tuning>

1. Perform the offline auto-tuning.

The online auto-tuning works with the designated motor constants and the offline auto-tuning described on the left is performed.

2. The online tuning selection [HA-03] is set.

Set the online tuning selection [HA-03] to 01: Enabled.

3. Check the online auto-tuning.

The online tuning operates for up to 5 s when every operation stops. Use the online tuning after making sure that the operation and stop can be made correctly by your operation command.

- In case of termination due to trip or erroneous tuning, correct data cannot be acquired.
  See the next section.
- The result of the online tuning is automatically reflected in up to 5 s after the stop.
  It is not reflected if the operation is restarted during the tuning.
- The online tuning is not performed if the servo-on function [SON] or forcing function [FOC] is working.
- In the factory setting, the offline auto-tuning can be started by the operation key on the operator keypad.
  It can be changed to a designated operation command by changing the operation command [HA-02] of the auto-tuning.

■Tuning failure during auto-tuning.

Expected causes▸	Examples of measures
• The control type is not suitable for the motor.	• Since the tuning type changes depending on the control type [AA121], IM control or SM/PMM control, set the type in accordance with the motor.
• The base frequency, motor rated voltage, or motor rated current is not suitable for the motor specifications.	• Since wrong basic parameters of the motor could cause excess current or trip, check the basic parameters and set them appropriately.
• STOP key was pressed.	• Pressing the STOP key on the operator keypad interrupts the auto-tuning. Check the setting of the auto-tuning again before starting the tuning.
• External factors such as braking caused a trip.	• Factors that cause the trip need to be removed.
• The input terminal function worked.	• The tuning could be disturbed if the input terminal function works during the auto-tuning.
• The motor capacity is too small compared to the one set for the inverter.	• If the tuning does not finish correctly, the motor constants need to be set manually.

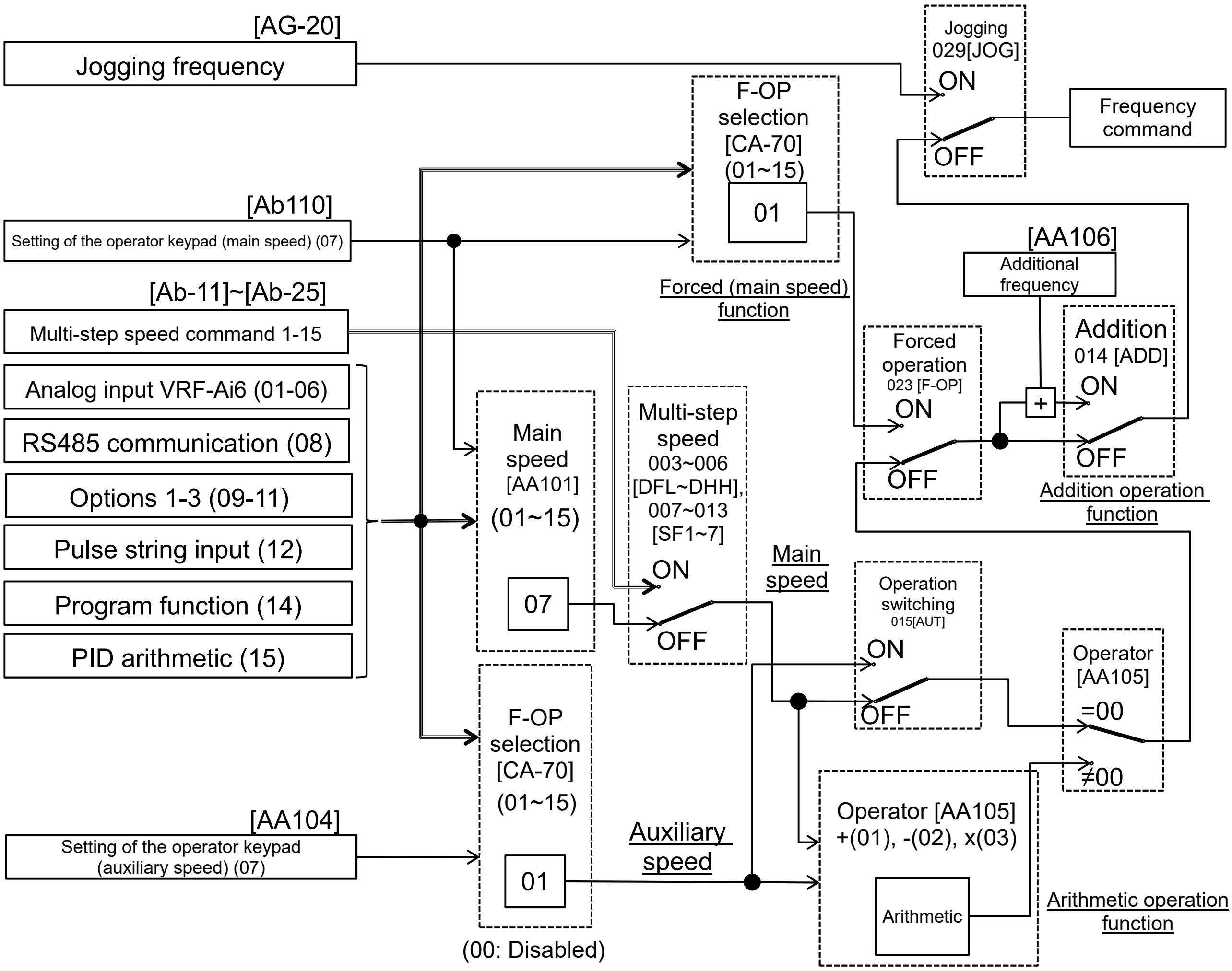
- In case of failure of the auto-tuning, the motor constant data are not updated and the motor works in the untuned state.

12.4 Frequency Command Selection

12.4.1 Type of frequency command

- The frequency command selected in each function is enabled.
- For details, see the next and subsequent sections.
- The value of the enabled frequency command is shown in [FA-01]. If the frequency command can be modified on the operator keypad, the modification is made by changing [FA-01] when, for example, [AA101] =07 is effective. ([Ab110] is overwritten when [FA-01] is changed.)

- The operation of the inverter requires not only a frequency command but also an operation command.
- To use the second setting switching [SET] of the input terminal function, replace 1 of the third digit of the parameter with 2. Ex.: [AA101] -> [AA201]. If the third digit is "-", the parameter is shared for the first and second settings.



- In the above example, [AA101] =07 (operator keypad) is enabled.
  For details, see the following explanation.
- Other command destinations can be chosen even when RS485 (Modbus communication, EzCOM function) is being used.

- If an operation command is given from the operation screen of PC software SAFS001, [AA101] =07 and [AA111] =03 are forcedly overwritten when the operation screen opens.
  When the operation screen closes, the values returned to the ones used before the screen opened.
- Functions not assigned to the input terminal functions [CA-01]-[CA-11] become OFF.

12.4.2 Operation on operator keypad

- The operator keypad is used to give a frequency command.
- For operation using the operator's keypad, the operation direction can be changed by setting RUN key direction selection [AA-12].

- The output of the inverter (operation of the motor) requires not only a frequency command but also an operation command.
- The main and auxiliary speeds can be selected and calculated by using the input terminal function [AUT] and the operator selection. For details, see "12.4.9 Selecting and calculating two commands to make a command"
- If not using the operator keypad, you need to make FR/RR direction switching from each command.

■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	07	The frequency set from the operator keypad is for main speed In this case the setting is made for [Ab110].
Auxiliary speed command selection	[AA102]		Auxiliary speed to use switching and arithmetic functions is set from the operator keypad. For auxiliary speed, the setting is made for [AA104].
0th speed of the 1st multi-step speed	[Ab110]	0.00~590.00(Hz)	Frequency setting of the main speed on the operator keypad. Shared for the 0th speed of the multi-step speed function.
Auxiliary speed setting	[AA104]		Frequency setting of the auxiliary speed on the operator keypad.
RUN key direction selection	[AA-12]	00	Forward rotation operation
		01	Reverse rotation operation
Output terminal function	[CC-01] ~[CC-07]	010	[FREF] ON when a frequency command can be given from the operator keypad.

12.4.3 Operation with analogue signal from terminal block

■Enabling frequency command from terminal block

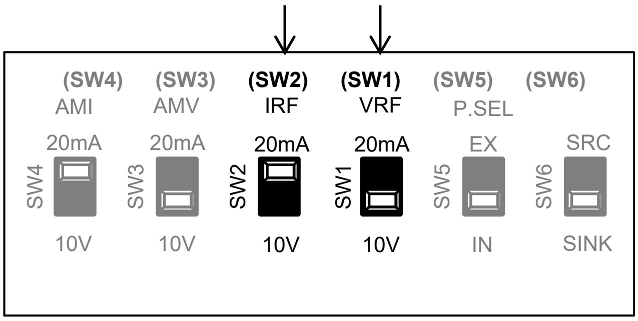
- A frequency command is given by input from the terminal block.
- The inverter has three kinds of external analogue input.

Terminal connection	Input range	Switching method
VRF-COM	0-10 V/0-20 mA switchable	SW1 on the board is switched.
IRF-COM		SW2 on the board is switched.
VF2-COM	-10~10V	-

- For each input, relation between the input signal and the frequency command can be set independently. See “12.24 Things that can be done with external signal input.”
- To add/subtract a command, the auxiliary speed command [AA102] and operator [AA105] should also be set. [VF2] can be added to [VRF] and [IRF] without choosing an operator in the [Cb-22] [VF2] terminal selection. For details, see “12.24 Things that can be done with external signal input.”

- The output of the inverter requires not only a frequency command but also an operation command.
- Note that the voltage input and the current input are switched from each other by the terminal block switch.
- For adjustment of the analogue input, see “12.24 Things that can be done with external signal input.”

- First, the voltage SW and current SW are switched when the wiring is made.



- Next, a command destination for the parameter [AA101] is set.

■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	01	Input between VRF and L enabled.
		02	Input between IRF and L enabled.
		03	Input between VF2 and L enabled.
		04	Input between Ai4 and L enabled. *1)
		05	Input between Ai5 and L enabled. *1)
		06	Input between Ai6 and L enabled. *1)

*1) Optional P1-AG is necessary.

12.4.4 Command from RS485 communication

- RS485 communication is used to give a frequency command.
- For details, see “Chapter 14 RS485 Communication”.

■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	08	Command from RS485 communication

12.4.5 Command from optional cassette

- Optional device is used to give a frequency command.
- An option from which a command is received is chosen from multiple options.
- For the frequency commands, refer to the instruction manual provided together with each optional cassette.

■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	09	Frequency commands from optional cassette in slot 1 enabled.
		10	Frequency commands from optional cassette in slot 2 enabled.
		11	Frequency commands from optional cassette in slot 3 enabled.

12.4.6 Making command from pulse string input

■Input terminals [DFH] and [DHH] of the main body are used.

- To use the input terminals [DFH] and [DHH] of the main body as a pulse string input frequency command, set [CA-90] to be 01: command.
- A pulse string given as input to the input terminals [DFH] and [DHH] of the inverter is used.
- A pulse string given as input to the input terminals [DFH] and [DHH] can be used as a frequency command / PID feedback value in each control mode.
- Set an input pulse frequency that corresponds to the maximum frequency to the pulse string frequency scale [CA-92].
- The pulse string input values to the input terminals [DFH] and [DHH] can be monitored with [dA-70].

To give a pulse string input frequency command, there are two methods. One is to use the main terminals and the other is to use the optional HF-FB.

- Start/End function of analogue input cannot be used. To limit the pulse string input frequency, use the pulse string frequency bias size [CA-94], the pulse string frequency upper detection limit [CA-95], and the pulse string frequency lower detection limit [CA-96]
- When the pulse input frequency is below the pulse string frequency lower detection limit [CA-96], it is regarded as 0 Hz in the processing.
- Slow start if the pulse string frequency lower detection limit [CA-96] is set to a high value.

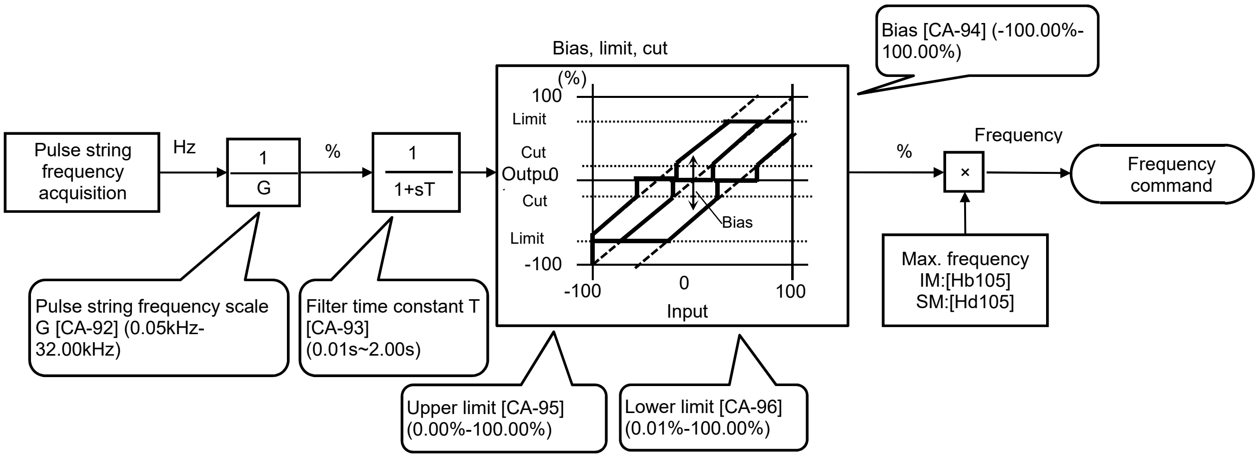
■Parameters (main body)

Item	Parameters	Data	Description
Main speed command selection	[AA101]	12	Frequency command from pulse string input (input terminals [DFH] and [DHH])
Pulse string input (main body) detection target selection	[CA-90]	01	Used for frequency command
Pulse string input (main body) mode selection	[CA-91]	00	Mode 0: 90° phase difference pulse string
		01	Mode 1: Forward/Reverse rotation command and rotation direction
		02	Mode 2: Forward rotation pulse string and reverse rotation pulse string
Pulse string frequency (main body) scale	[CA-92]	0.05~32.00 (kHz)	Input a pulse string frequency that corresponds to the maximum frequency.
Pulse string frequency (main body) filter time constant	[CA-93]	0.01~2.00 (sec)	A filter is applied to the input of the pulse string frequency.
Pulse string frequency (main body) bias size	[CA-94]	-100.0~100.0(%)	A bias is applied to the input of the pulse string frequency.
Pulse string frequency (main body) upper detection limit	[CA-95]	0.0~100.0 (%)	The output of the pulse string frequency input is limited.
Pulse string frequency (main body) lower detection limit	[CA-96]		In outputting the pulse string frequency input, pulses with the frequency lower than the limit is set to 0.0%.

■Monitor (main body)

Item	Parameters	Data	Description
Pulse string input monitor (main body)	[dA-70]	-100.00~100.00(%)	The frequency command from the pulse string input (input terminals DFH/DHH) is displayed.

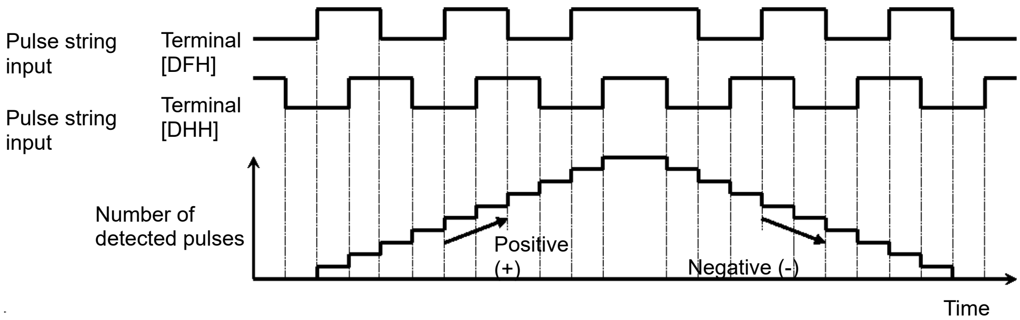
■Internal arithmetic block diagram
Internal processing is schematically drawn.



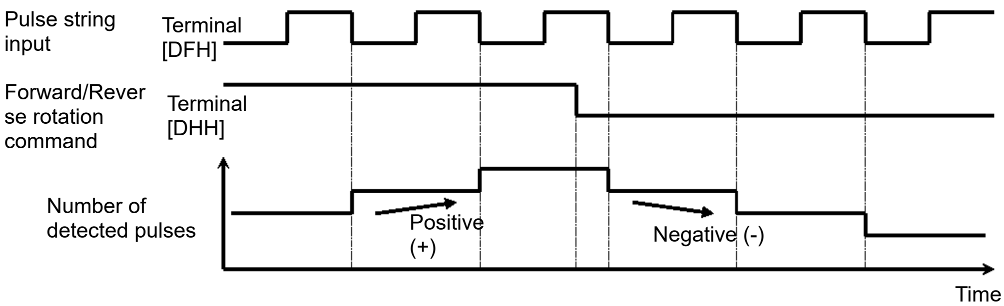
Pulse string frequency processing block

■For details of the pulse string input mode, see below.
Command frequency is determined by the frequency of the pulse string input.
The sign of the command frequency is determined in the following way.

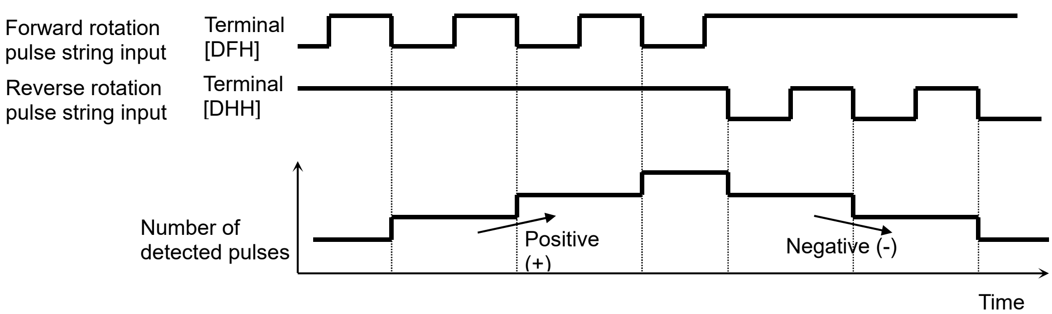
(1) Mode 0: [CA-91]=00 90° phase difference pulse string



(2) Mode 1: [CA-91]=01 forward and reverse rotation commands + pulse string



(3) Mode 2: [CA-91]=02 Forward rotation pulse string + reverse rotation pulse string



■Use of optional cassette HF-FB

- The pulse string given in [SAP] [SBP] [SAN] [SBN] of the optional cassette HF-FB (feedback option) is used.
- A pulse string given as input to HF-FB can be used as a frequency command / PID feedback value in each control mode.
- Set an input pulse frequency that corresponds to the maximum frequency to the pulse string frequency scale [ob-12].
- The pulse string input values to HF-FB can be monitored with [dA-71].

- Start/End function of analogue input cannot be used. To limit the pulse string input frequency, use the pulse string frequency bias size [ob-14], the pulse string frequency upper detection limit [ob-15], and the pulse string frequency lower detection limit [ob-16]
- When the pulse input frequency is below the pulse string frequency lower detection limit [ob-16], it is regarded as 0 Hz in the processing.
- Slow start if the pulse string frequency lower detection limit [ob-16] is set to a high value.

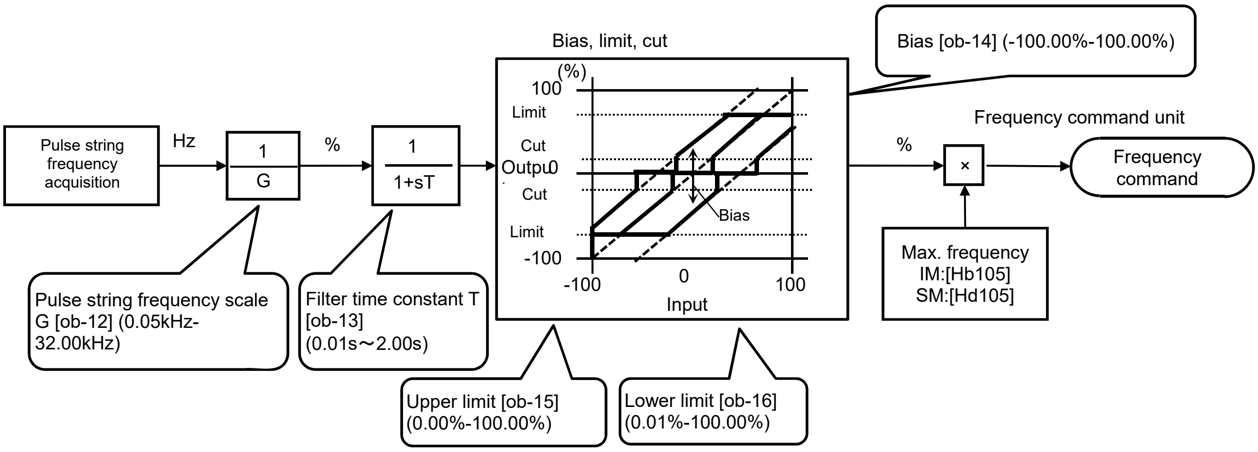
■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	13	Frequency command from optional HF-FB enabled.
Pulse string input (option) detection target selection	[ob-10]	01	Used for frequency command
Pulse string input (option) mode selection	[ob-11]	00	Mode 0: 90° phase difference pulse string
		01	Mode 1: Forward/Reverse rotation command and rotation direction
		02	Mode 2: Forward rotation pulse string and reverse rotation pulse string
Pulse string frequency (option) scale	[ob-12]	0.05~200.0 (kHz)	A pulse string frequency equivalent to the maximum frequency is given.
Pulse string frequency (option) filter time constant	[ob-13]	0.01~2.00 (sec)	A filter is applied to the input of the pulse string frequency.
Pulse string frequency (option) bias size	[ob-14]	-100.0~100.0(%)	A bias is applied to the input of the pulse string frequency.
Pulse string frequency (option) upper detection limit	[ob-15]	0.0~100.0 (%)	The output of the pulse string frequency input is limited.
Pulse string frequency (option) lower detection limit	[ob-16]		In outputting the pulse string frequency input, pulses with the frequency lower than the limit is set to 0.0%.

■Monitor (main body)

Item	Parameters	Data	Description
Pulse string input monitor (option)	[dA-71]	-100.00~100.00(%)	Frequency command from pulse string input (option input A phase / B phase)

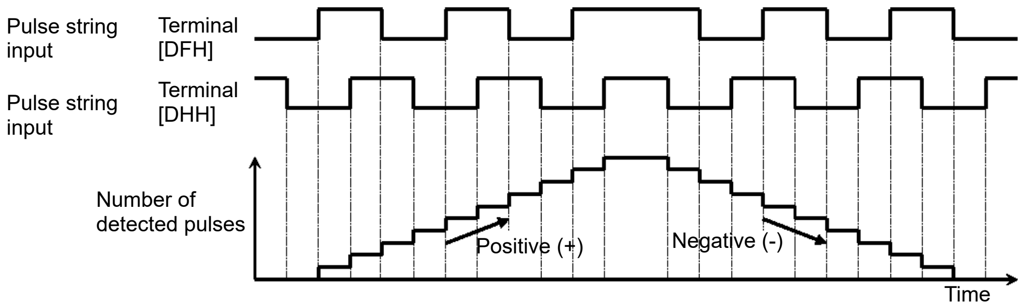
■Internal arithmetic block diagram
Internal processing is schematically drawn.



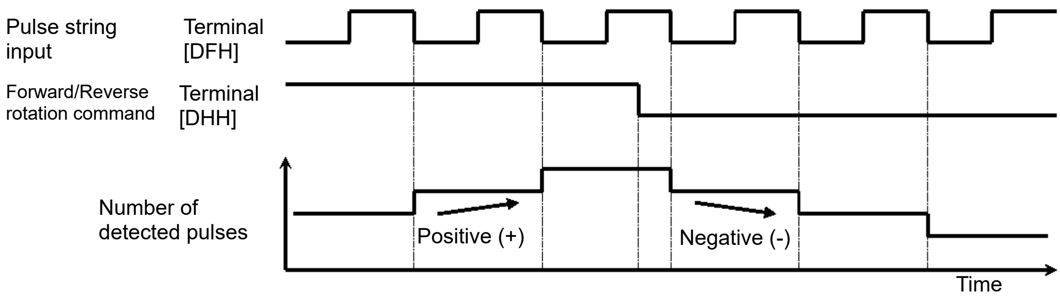
Pulse string frequency processing block

■For details of the pulse string input mode, see below.
Command frequency is determined by the frequency of the pulse string input.
The sign of the command frequency is determined in the following way.

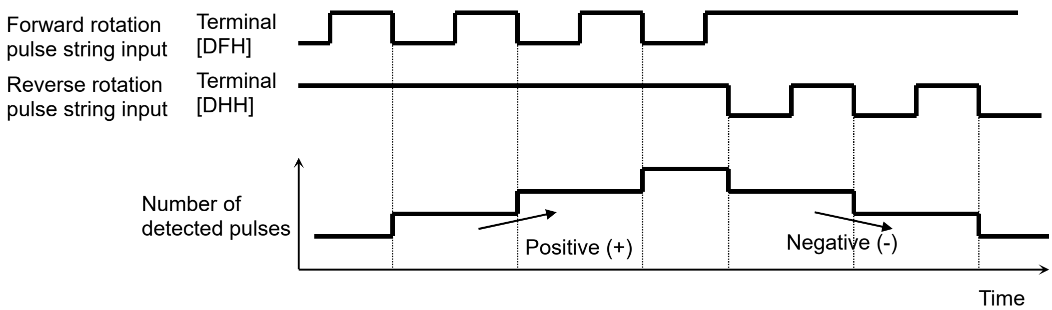
(1) Mode 0: [ob-11]=00 90°phase difference pulse string



(2) Mode1:[ob-11]=01 Forward and reverse commands + pulse string



(3) Mode 2: [ob-11]=02 Forward rotation pulse string + reverse rotation pulse string



12.4.7 Command by PID control

- To use the PID control for motor control, PID arithmetic is set in the frequency command selection after the PID function is set.
- To give a command from the PID control, parameters of the PID control function need to be set. For details, see “12.10 Process control in accordance with system.”

■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	15	An arithmetic result of the PID control is output.

12.4.8 Selecting and calculating two commands to make a command

- By selecting an operator, one can either switch between main speed and auxiliary speed ([AUT] switching with [AA105] =00) or make a command (arithmetic frequency) ([AA105] not equal to 00) on the basis of addition, subtraction, or multiplication of the two speeds.

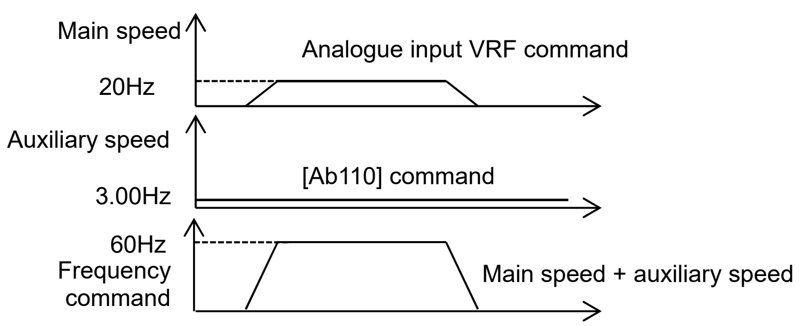
■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	01~15	01: VF-COM input 02: IRF-COM input, 03: VF2-COM input 07: parameter setting 08: RS485 communication 12: pulse string input (main body) 14: Reserved 15: PID arithmetic 00: disabled (only for auxiliary speed)
Main speed command selection	[AA102]		
Operator selection	[AA105]	00	The arithmetic function is disabled and can be switched by using the [AUT] terminal.
		01	(Main speed) + (auxiliary speed) is used for the command.
		02	(Main speed) - (auxiliary speed) is used for the command.
		03	(Main speed) x (auxiliary speed) is used for the command.
Input terminal function	[CA-01]~[CA-11]	015	[AUT] Main speed and auxiliary speed are switched from each other for the operation. OFF: Main speed is effective ON: Auxiliary speed is effective. *) The operator needs to be [AA105] =00.

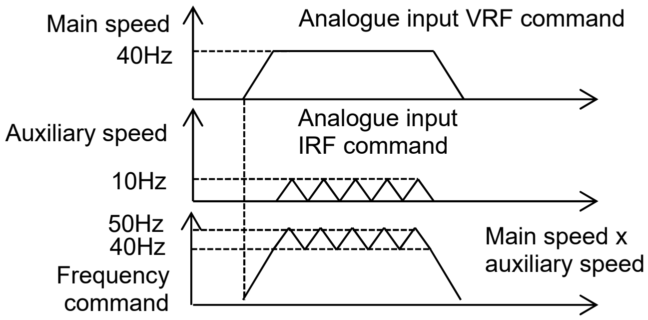
■Operating two commands

(Ex. 1) Gain is multiplied.

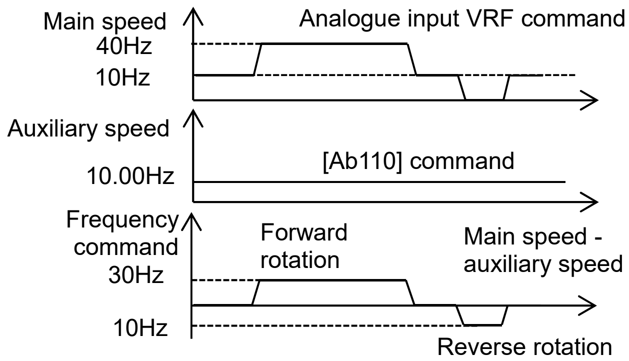
[AA101]=01 (VRF command)
[AA102]=07 (set [Ab110])
[AA105]=03 (multiplication)
[Ab110]=3.00(Hz)



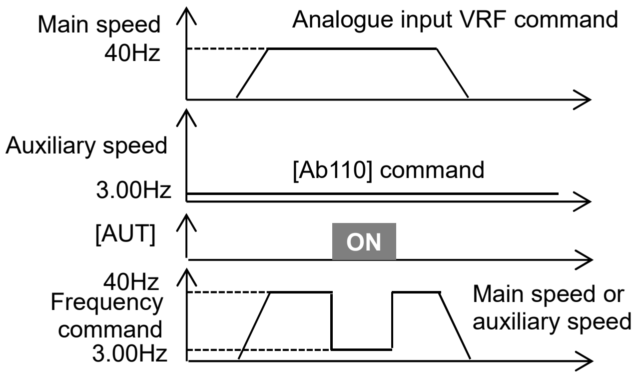
(Ex. 2) Command by addition
[AA101]=01 (VRF command)
[AA102]=02 (set [Ab110])
[AA105]=01 (addition)



(Ex. 3) Forward rotation at a high speed and reverse rotation at a low speed are made by a command.
[AA101]=01 (VRF command)
[AA102]=07 (set [Ab110])
[AA105]=02 (disabled)
[Ab110]=10.00(Hz)



■Switching of two commands
[AA101]=01 (VRF command)
[AA102]=07 (set [Ab110])
[AA105]=00 (disabled)
[Ab110]=3.00(Hz)



- The same setting can be used for both [AA101] and [AA102], square can be calculated multiplication.
- The input terminal [UP] [DWN] functions are effective for commands where the main speed can be set (with the operator keypad setting, multi-speed setting, and analogue holding function [AHD]).
- The output frequency of the inverter accelerates/decelerates toward the frequency command, following the setting of the acceleration/deceleration time.

12.4.9 Multi-step switching of frequency commands.

- A frequency command is controlled with a signal pattern by setting multiple command frequencies in advance.
- In the multi-step speed command, one can either give a binary combination of 0 (OFF) and 1 (ON) or give a priority on certain terminals (bit operation).
- In the binary operation, a frequency at max. 16th speed with four terminals can be set. In the bit operation, a frequency at max. 8th speed with seven terminals can be set.

- If the operator keypad [AA101] =07 is chosen in the frequency command selection, rewriting of the main speed command [FA-01] automatically rewrites [Ab110], frequency setting of the 0th speed.
- The frequency setting for the 1st to 15th speeds should be made in the 1st-15th speeds of the multi-step speed function ([Ab-11]-[Ab-25]).
- With the multi-step speed function, one can set the acceleration/deceleration time individually for the frequency switching in the multi-step speed command.
  For details, see “12.8.3 Setting acceleration/deceleration time in multi-step speed”
- The multi-step speed function is effective only for the main speed command. Not applied to the auxiliary speed command
- If [SET] terminal is made ON and the secondary setting function is used, [Ab210] instead of [Ab110] becomes effective.

■Parameters

Item	Parameters	Data	Description
Main speed command monitor	[FA-01]	Data change depending on the frequency command selection.	The frequency command value is shown.
Multi-step speed selection	[Ab-03]	00	Binary operation, max. 16 speed modes
		01	Bit operation, max. 8 speed modes
0th speed of the multi-step speed	[Ab110]	0.00/Min. frequency -max. frequency (Hz)	0th speed of the multi-step speed
1st-15th speeds of the multi-step speed	[Ab-11]~[Ab-25]		1st-15th speeds of the multi-step speed
Multi-step input determination time	[CA-55]	0~2000(ms)	This is the time to fix the frequency in switching the multi-step speed.

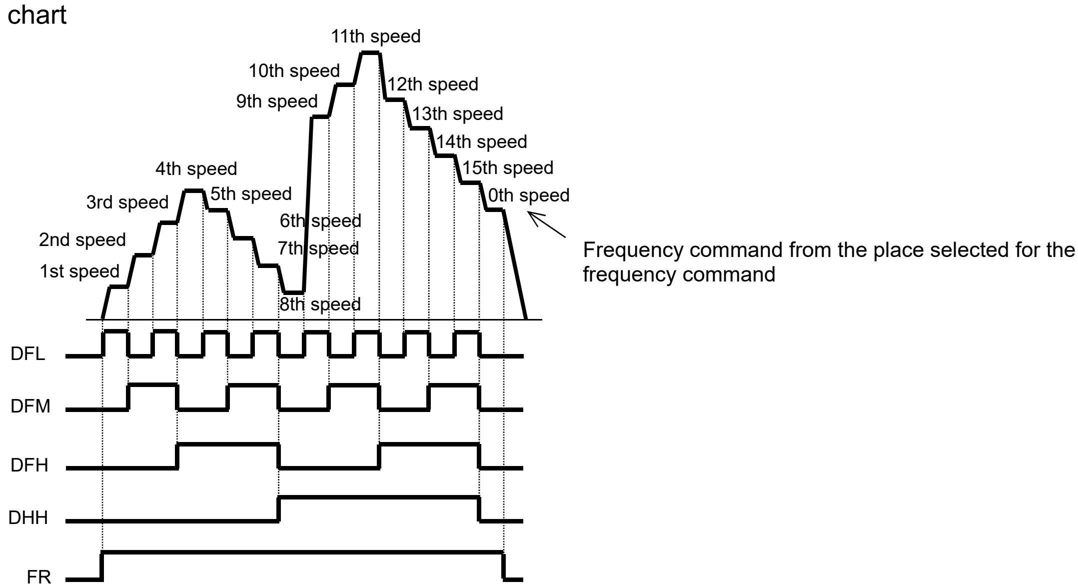
■(1) Binary operation (max. 16-speed command: [Ab-03] =00)

- Multi-step speeds of 0th to 15th speeds can be chosen by assigning 003-006 ([DFL]-[DHH]) to the input terminals FR-RST, DFH, and DHH [CA-01]-[CA-11].

■Action table

Multi-step speed	DHH	DFM	DFM	DFL	Parameters
0th speed	OFF	OFF	OFF	OFF	Ab110
1st speed	OFF	OFF	OFF	ON	Ab-11
2nd speed	OFF	OFF	ON	OFF	Ab-12
3rd speed	OFF	OFF	ON	ON	Ab-13
4th speed	OFF	ON	OFF	OFF	Ab-14
5th speed	OFF	ON	OFF	ON	Ab-15
6th speed	OFF	ON	ON	OFF	Ab-16
7th speed	OFF	ON	ON	ON	Ab-17
8th speed	ON	OFF	OFF	OFF	Ab-18
9th speed	ON	OFF	OFF	ON	Ab-19
10th speed	ON	OFF	ON	OFF	Ab-20
11th speed	ON	OFF	ON	ON	Ab-21
12th speed	ON	ON	OFF	OFF	Ab-22
13th speed	ON	ON	OFF	ON	Ab-23
14th speed	ON	ON	ON	OFF	Ab-24
15th speed	ON	ON	ON	ON	Ab-25

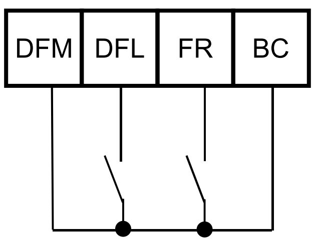
■Action chart



- For the binary operation, idling time to wait for a terminal input to be given can be set in the multi-step input determination time [CA-55]. This can prevent transition during terminal switching.
- Data are fixed after the time specified in [CA-55] passes with no change in the input.
  Input response would be slow if the determination time is set to be large.
- For the command frequency of the 0th speed, the command designated in the main speed selection [AA101] is used. The left table is for [AA101] =07.

Ex.) 2nd speed is effective.
In this case we have [CA-03] =003 (DFL) and [CA-04] =004 (DFM).
Assignment is made for [CA-10] =005 (DFH) and [CA-11] =006 (DHH).
Only the input terminal DFM is ON.

Input terminal



Multi-step speed	DHH	DFM	DFM	DFL
1st speed	OFF	OFF	OFF	ON
2nd speed	OFF	OFF	ON	OFF
3rd speed	OFF	OFF	ON	ON

■(2) Bit operation (max. 8-speed command: [Ab-03] =01)

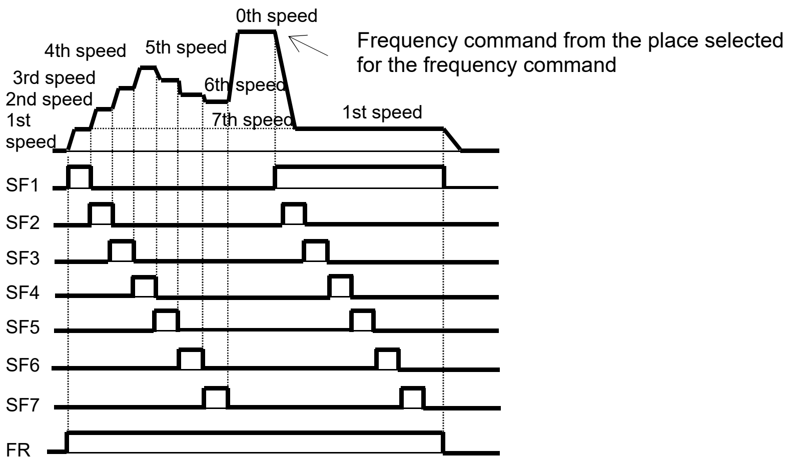
- Multi-step speeds of 0th to 7th speeds can be chosen by assigning 007-013 ([SF1]-[SF7]) to the input terminals FR-RST, DFH, and DHH [CA-01]-[CA-11].
- The frequency setting of [SF1]-[SF7] should be made to the multi-step speeds of 1st to 7th speeds ([Ab-11]-[Ab-17]).

- If multiple terminals are made ON simultaneously, the one with smaller number has priority. "-" in the table indicates that a frequency is chosen independently from ON/OFF state of the terminals.
- For the command frequency of the 0th speed, the command designated in the main speed selection [AA101] is used. The following table is for [AA101] =07.

■Action table

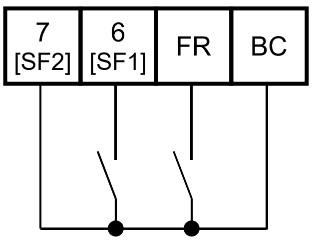
Multi-step speed	SF7	SF6	SF5	SF4	SF3	SF2	SF1	Parameters
0th speed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	**Ab110**
1st speed	-	-	-	-	-	-	ON	**Ab-11**
2nd speed	-	-	-	-	-	ON	OFF	**Ab-12**
3rd speed	-	-	-	-	ON	OFF	OFF	**Ab-13**
4th speed	-	-	-	ON	OFF	OFF	OFF	**Ab-14**
5th speed	-	-	ON	OFF	OFF	OFF	OFF	**Ab-15**
6th speed	-	ON	OFF	OFF	OFF	OFF	OFF	**Ab-16**
7th speed	ON	OFF	OFF	OFF	OFF	OFF	OFF	**Ab-17**

■Action chart



Ex.) 2nd speed is effective.
In this case we have [CA-06] =007 (SF1) and [CA-07] =008 (SF2).
No assignment is made for 009 (SF3) and 013 (SF7).
Only the input terminal No. 7 (SF2) is ON.

Input terminal



Multi-step speed	SF4	SF3	SF2	SF1
1st speed	-	-	-	-
2nd speed	-	-	ON	OFF
3rd speed	-	ON	OFF	OFF

If SF1 becomes ON in this state, the 1st speed becomes effective.

12.4.10 Temporal addition of frequency command

- Only when the input terminal function 014 [ADD] signal is given, the designated frequency is added or subtracted.
- Addition or subtraction is chosen on the basis of the designated sign of the frequency.

- The frequency addition of the input terminal function 014 [ADD] is made within the limited frequency range. If the frequency is not within the range between the upper and lower limits or exceeds the maximum frequency, the frequency command is restricted.
- If the sign of the frequency command changes ((-) to (+) or (+) to (-)) as a result of the arithmetic, the rotation direction is reversed.
- This function is also effective for PID target value.

■Parameters

Item	Parameters	Data	Description
Additional frequency setting	[AA106]	-590.00~590.00(Hz)	Sets the frequency to add.
Input terminal selection	[CA-01]~[CA-11]	014	[ADD] The designated frequency is added.

12.4.11 Remote operation of frequency

■UP/DOWN function

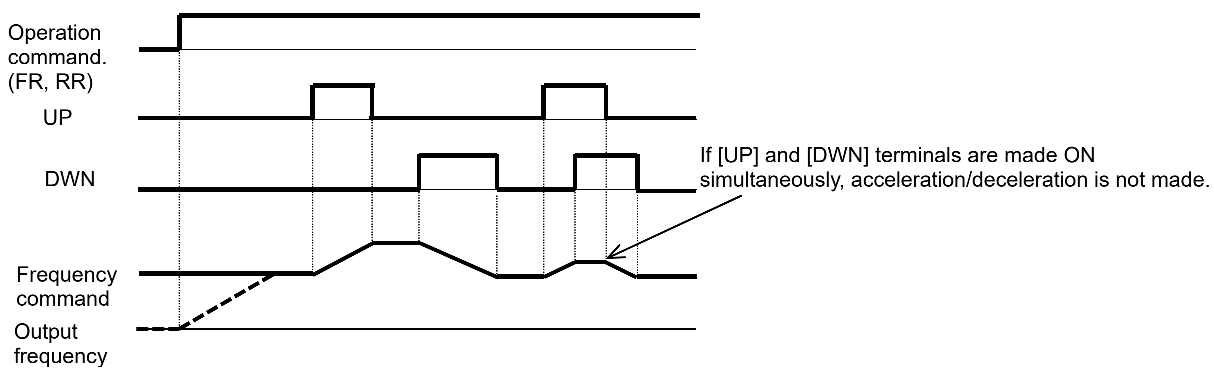
- The frequency command of the inverter can be changed by a signal input if 020 [UP terminal and 021 [DWN] terminal are assigned in the input terminal function.
- This function works following the selected frequency command when the frequency command selection [AA101] is 07 (parameter effective) or when a multi-step speed command is given.
- The command operation time with the terminals 020[UP]/021[DWN] being ON follows the acceleration time [CA-64] to increase or the deceleration time [CA-66] to decrease.

- When 020 [UP] terminal / 021 [DWN] terminal is made ON/OFF immediately after the power shutdown, data may not be able to be correctly saved.
- Cannot be used to set the frequency of the input terminal function 029 [JOG] jogging operation.

- Even when 024 [SET] function is used to switch to the second control, the operation time follows the acceleration time [CA-64] to increase or the deceleration time [CA-66] to decrease.
- If 01 (save) is chosen in [CA-61], the frequency value adjusted by the 020 [UP] terminal / 021 [DWN] function can be saved. To clear the saved frequency value, assign 022[UDC] to the input terminal and change the [UDC] terminal from ON to OFF. Clearance by [UDC] follows the designated value of [CA-62].

■Action chart

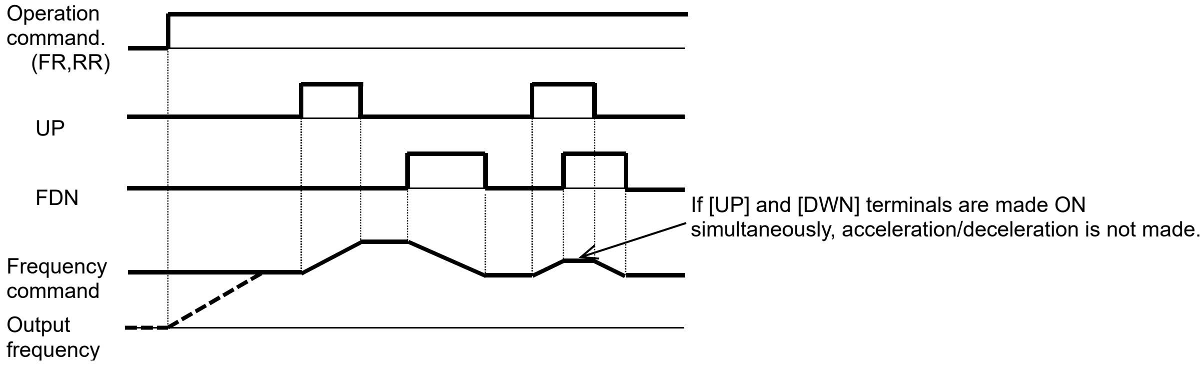
For the case where the frequency command comes with the parameter setting and multi-step speed function



■Analogue command holding function (analogue holding function)
- If the main speed command [AA101] is an analogue input command (01-03), this function is effective even when data are held by the analogue command holding [AHD] function.
- If 019[AHD] function is effective, the held data can be moved up/down by using [UP]/ [DWN] function.

- The input terminal function 019 [AHD] analogue command holding function (analogue holding function) holds the command of the analogue input when the function becomes ON. When the function becomes OFF, the command returns to the analogue command. Namely, data changes with the [UP] [DWN] function are not saved.

■Action chart
A frequency command uses [AHD] in the analogue input.



■Parameters

Item	Parameters	Data	Description
Main speed command selection	[AA101]	01~15	01: VRF-COM input 02: IRF-COM input 03: VF2-COM input 07: parameter setting 08: RS485 communication 12: pulse string input (main body) 14: Reserved 15: PID arithmetic
Input terminal function selection	[CA-01]~[CA-11]	019	AHD: Analogue command holding
		020	UP: Remote operation acceleration
		021	DWN: Remote operation deceleration
		022	UDC: Remote operation data clearance
UP/DWN overwriting target selection	[CA-60]	00	Overwrites the frequency command.
		01	PID target value is overwritten.
UP/DWN memory selection	[CA-61]	00	The command is not saved in case of power shutdown.
		01	The command is saved in case of power shutdown.
UP/DWN UDC terminal mode selection	[CA-62]	00	Cleared to 0 Hz.
		01	Cleared to the saved command.
Acceleration time for UP/DWN functions	[CA-64]	0.00~3600.00(s)	Sets acceleration time for UP/DWN functions.
Deceleration time for UP/DWN functions	[CA-66]		Sets deceleration time for UP/DWN functions.

12.4.12 Temporary change of frequency command destination

-When 023 [F-OP] terminal is ON, the command destination of [CA-70] is employed in a priority to the frequency command destination given in [AA101].

- When 023 [F-OP] terminal is ON, the operation command destination also employs the operation command selection designated in [CA-71].

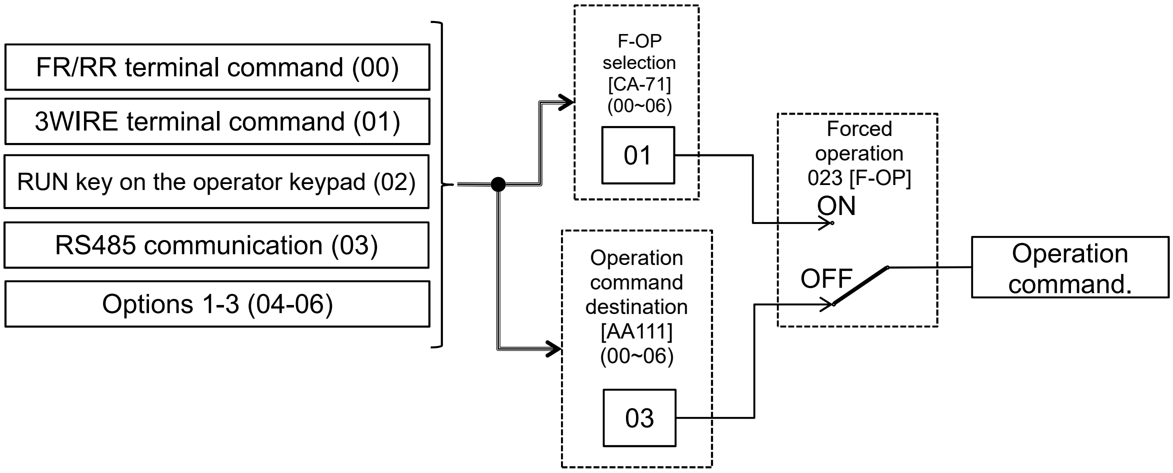
■Parameters

Item	Parameters	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	023	[F-OP]: Gives a forced command.
Frequency command selection with [F-OP] enabled.	[CA-70]	01~15	01: VRF-COM input 02: IRF-COM input 03: VF2-COM input 04: Ai4-COM input 05: Ai5-COM input 06: Ai6-COM input 07: parameter setting 08: RS485 communication 09:option 1 10: option 2 11: option 3 12: pulse string input (main body) 13: pulse string input (option) 14: Reserved 15: PID arithmetic
Operation command selection with [F-OP] enabled.	[CA-71]	00~03	00: [FR]/[RR] terminal 01: 3 wire 02: RUN key on operator keypad 03: RS485 communication 04: option 1 05: option 2 06: option 3

12-5 Operation Command Selection

12.5.1 Types of operation commands

- The operation command (operation modes) selected in a function is enabled.
- For details, see the description in the next and subsequent sections.
- The operation of the inverter requires not only an operation command but also a frequency command.



- The above shows an example of operation with [AA111] =02 (RUN key on the operator keypad).
- Functions not assigned to the input terminal functions [CA-01]-[CA-11] become OFF.

12.5.2 Operation on operator keypad

- The operator keypad is used to give a frequency command.
- Use "Operation key" and "Stop key" to make and stop operation, respectively.
- For operation using the operator keypad, the operation direction can be changed by setting RUN key direction selection [AA-12].

- The output of the inverter requires not only an operation command but also a frequency command.
- If the forced operation 023 [F-OP] of the terminal function is enabled, the command destination specified in the [F-OP] function becomes effective irrespective of the present setting.

■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	02	Operation command from "Operation key"/"Stop key" on the operator keypad.
RUN key direction selection	[AA-12]	00	Forward rotation command from the operator keypad.
		01	Reverse rotation command from the operator keypad.
Output terminal function	[CC-01]~[CC-07]	011	[REF] ON when an operation command can be given from the operator keypad.

12.5.3 Operation with forward/reverse rotation terminal

- A forward rotation command can be given from [FR] terminal and a reverse one from [RR] terminal.
- Operation can be started/stopped by making the [FR] or [RR] terminal function ON/OFF on the control circuit terminal block of the inverter.
- In the factory setting, the [FR] and [RR] terminals are assigned to the terminal Nos. 9 and 8, respectively. This assignment can be changed by setting [CA-01]-[CA-11] in the input terminal setting selection.
- a/b contact of each terminal can be switched by changing the corresponding setting item of [CA-21]-[CA-31].

- The output of the inverter requires not only an operation command but also a frequency command.
- The input terminal function 023 [F-OP] is enabled, the command destination specified in the [F-OP] function becomes effective irrespective of the present setting.

- Simultaneous input of a forward and reverse rotation commands is equivalent to stop command.
- The relation between [FR] and [RR] terminals is given below.

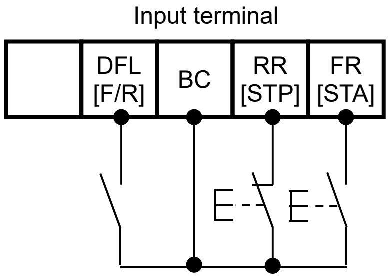
FW terminal	RV terminal	Operation command.
OFF	OFF	Stop command
ON	OFF	Forward rotation command.
OFF	ON	Reverse rotation command.
ON	ON	Stop command

■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	00	Run/Stop from the control circuit terminal block. ([FR], [RR] terminals)
Input terminal function selection	[CA-01]~[CA-11]	01	[FR] terminal function
		02	[RR] terminal function
Input terminal a/b (NO/NC) selection	[CA-21]~[CA-31]	00	a contact (NO)
		01	b contact (NC)

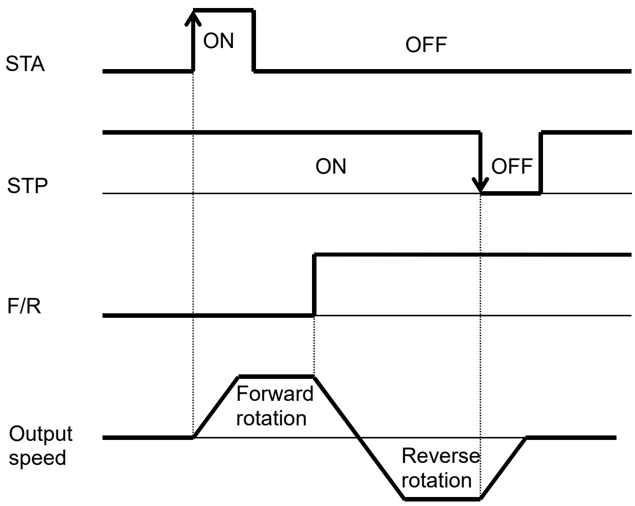
12.5.4 Operation with 3 wire function of terminal block

- Operation start command can be given from [STA] terminal and stop command from [STP] terminal.
- To use the 3 wire function, the setting of the operation command selection [AA111] and the input terminal setting selection [CA-01]-[CA-11] needs to be changed.
- Select [AA111] =01 3 wire function. In this example, the 3 wire function is assigned to the input terminal function in the following way.
  *) Set the terminals as the terminal FR [CA-01] =016, RR [CA-02] =017, DFL [CA-03]=018.



- The output of the inverter requires not only an operation command but also a frequency command.
- The terminal 023 [F-OP] is enabled, the command destination specified in the [F-OP] function becomes effective irrespective of the present setting.

- Operation can be started/stopped by making the 016 [STA]/017 [STP] terminal function ON/OFF on the control circuit terminal block of the inverter.
- 018 [F/R] terminal function switches forward and reverse rotations by the contact.
- The terminal action is made in the following way.



■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	01	Run/Stop from the control circuit terminal block. ([STA], [STP] terminals)
Input terminal function selection	[CA-01]~[CA-11]	016	[STA] terminal function
		017	[STP] terminal function
		018	[F/R] terminal function

12.5.5 Operation with RS485 communication

- RS485 coil is used to give an operation start/stop command.
- The output of the inverter requires not only an operation command but also a frequency command.
- The terminal 023 [F-OP] is enabled, the command destination specified in the [F-OP] function becomes effective irrespective of the present setting.

■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	03	Start/Stop by RS485 communication command.

12.5.6 Operation from optional board

- Optional communication command is used to give an operation start/stop command.
- The output of the inverter requires not only an operation command but also a frequency command.
- The terminal 023 [F-OP] is enabled, the command destination specified in the [F-OP] function becomes effective irrespective of the present setting.

■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	04	Frequency command from option 1 enabled.
		05	Frequency command from option 2 enabled.
		06	Frequency command from option 3 enabled.

12.5.7 Disabling the keys on operator keypad

- When a terminal command or communication command is given, the operation cannot be stopped from the operator keypad by setting [AA-13] =01.
- Set [AA-13] =02 to disable the Stop key and use the resetting function in case of a trip.
- Set [AA-13] to 00: Disabled if a stop command is given from the operator keypad of the inverter in case of emergency.
- Usually, operation under an operation command from other than the operator keypad can be stopped by using the Stop/Reset key on the operator keypad.
- When the operation under an external command is stopped from the operator keypad, the operation stops for safety. To restart the operation, turn off the external command and on it again.

- When 102 [DISP] terminal function is ON, the operator keypad screen is fixed to home screen.

■Parameters

Item	Parameters	Data	Description
Operation command selection	[AA111]	00	Run/Stop from the control circuit terminal block. ([FR], [RR] terminals)
		01	Run/Stop from the control circuit terminal block. ([STA], [STP] terminals)
		02	Start/Stop by RS485 communication command.
STOP key selection	[AA-13]	00	Function disabled Always recognizes stop/reset key operation.
		01	Function enabled The stop/reset key no longer works.
		02	Only inverter trips can be reset by the stop/reset key.
Input terminal function selection	[CA-01]~[CA-11]	102	[DISP] terminal function

- [AA-13] STOP key selection is enabled when the operation command [AA111] is set to a value other than the value of the operator keypad (02).

12.5.8 Temporary change of operation command destination

- When 023 [F-OP] terminal is ON, the command destination of [CA-71] is employed in a priority to the operation command destination given in [AA111].

- When 023 [F-OP] terminal is ON, the frequency command destination also employs the frequency command selection designated in [CA-70].
- If [AA111] and [CA-71] are set differently from each other, the operation is interrupted when the [F-OP] terminal is made ON or OFF.
  The selected operation command is enabled when it is made OFF and then ON.

■Parameters

Item	Parameters	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	023	[F-OP]: Gives a forced command.
Frequency command selection with [F-OP] enabled.	[CA-70]	01~15	01: VRF-COM input 02: IRF-COM input 03: VF2-COM input 04: Ai4-COM input 05: Ai5-COM input 06: Ai6-COM input 07: parameter setting 08: RS485 communication 09:option 1 10: option 2 11: option 3 12: pulse string input (main body) 13: pulse string input (optional) 14: Reserved 15: PID arithmetic 16: Reserved
Operation command selection with [F-OP] enabled.	[CA-71]	00~06	00: [FR]/[RR] terminal, 01: 3 wire, 02: RUN key on operator keypad 03: RS485 communication 04: option 1 05: option 2, 06: option 3

12.6 Limit Frequency and Operation Command

12.6.1 Limit frequency and operation commands.

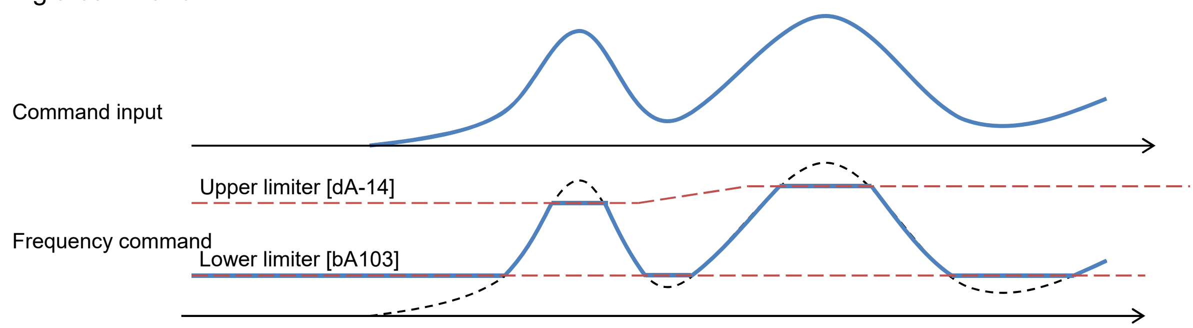
- A limiter of the upper and lower limits of the frequency command can be set.
  The upper limiter can be set from analogue input by setting [bA101].
- This function limits a frequency command even if a frequency command value outside the range between the upper and lower limiters is set.
- When [bA102] is 0.00 Hz and [bA103] is 0.00 Hz, the corresponding data do not work.

- The upper and lower limiters should be set lower than the max. frequency. Otherwise, warning of the inconsistency will arises.
- To set the limiters, set the upper limiter [bA102] first. Make sure that it is larger than the lower limiter value [bA103].
- Under the restriction by the upper and lower limiters and the minimum frequency, a LIM icon appears.
- To enable the upper limiter, set [bA101]. When [bA101] =07, the upper limiter is enabled by setting [bA102] to a value other than 0.00.

■Parameters

Item	Parameters	Data	Description
Max. frequency	For IM [Hb105] For SM (PMM) [Hd105]	10.00~590.00(Hz)	Sets the max. frequency. IM: Induction motor [AA121]=00-10 SM(PMM): Synchronous motor (permanent magnet motor) [AA121]=11, 12
Min. frequency	[Hb130]	0.00~10.00(Hz)	Sets the min. frequency to start output. Disabled when [AA121]=09, 10.
Selection of upper limit of frequency	[bA101]	00~13	00 (disabling) 01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input) 07 (parameter setting) 08 (RS485) 09 (option 1) 10 (option 2) 11 (option 3) 12 (pulse string input (main body)) 13 (pulse string input HF-FB)
Frequency upper limiter	[bA102]	0.00, lower limiter of frequency - max. frequency (Hz)	Sets the upper limit of the frequency command. Disabled when 0.00 is set (for [bA101]=07).
Frequency lower limiter	[bA103]	0.00, start frequency -upper limiter of frequency (Hz)	Sets the lower limit of the frequency command. Disabled when 0.00 is set.
Frequency upper limit monitor	[dA-14]	0.00~590.00(Hz)	The employed upper limit of the frequency is shown.

■Limiting a command



12.6.2 Limit operation command direction.

- Output in the allowed rotation direction can be obtained by setting the operation direction limit selection [AA114] to limit the direction of the operation.
- Set the operation direction limit selection if reverse operation output could adversely affect connected machines with no external force applied.

- Even if this function works, you may have output of reverse operation as a result of the control other than V/f control. In this case, enable the reverse operation prevention function.
  See “12.6.3 Limiting output direction.”
- Even if this function is used, the motor may rotate in the reverse direction under an external force applied in that direction. If you use this function to limit the operation direction, use the function for a system that does not receive an external force applied in the reverse direction.

- The reverse rotation direction command due to a negative value of the frequency is also restricted.
- Output stops when the direction is being limited.

■Parameters

Item	Parameters	Data	Description
Operation direction limit selection	[AA114]	00	Both forward and reverse rotations enabled
		01	Only forward rotation enabled
		02	Only reverse rotation enabled

12.6.3 Limit output direction.

- Under some control, output at a low speed in the direction opposite to the one specified in the operation command may occur.
  The output can be restricted in the direction specified in the operation command if the reverse rotation prevention function selection [HC114] is used.
- Enable the reverse rotation prevention function selection if the reverse rotation of the motor could give damage to the connected machine.

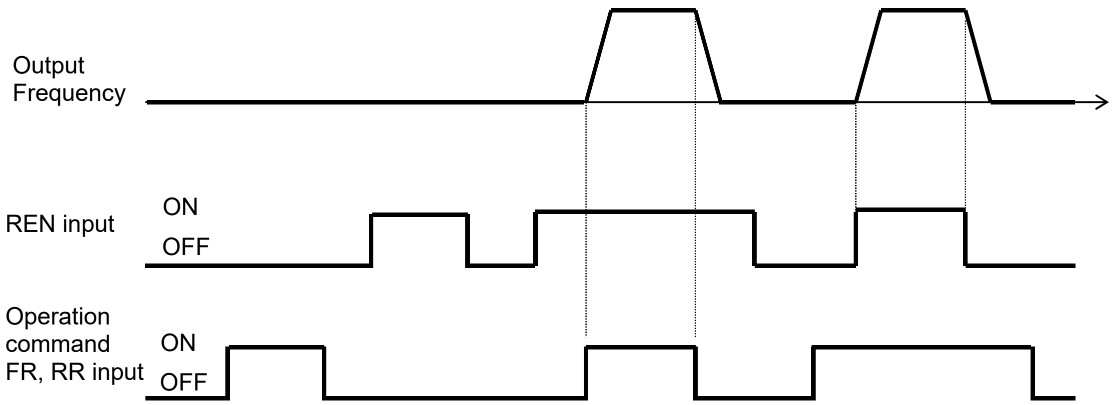
- This function is enabled when the control method [AA121] is set to 08 (sensor less vector control), 09 (sensor less vector control in zero speed range), or 10 (vector control with sensor).
- Even if this function is used, the motor may rotate in the reverse direction under a high-load external force applied in that direction. If you use this function to limit the operation direction, make sure that the motor would not make reverse rotation.

Item	Parameters	Data	Description
Control method selection	[AA121]	08	Sensor less vector control
		09	Sensor less vector control in zero speed range
		10	Vector control with sensor
Selection of reverse rotation prevention function	[HC114]	00	Disabled
		01	Enabled

12.6.4 No output until operation permission

- The system is configured in such a way that the operation can be stopped for safety irrespective of the operation command until the system allows the operation.
- If 101[REN] is assigned in the input terminal function, the inverter is not allows to make output until the terminal [REN] becomes ON.

- This function becomes enabled when 101[REN] is set to any of the input terminal selections [CA-01]-[CA-11].
- The operation does not start if [REN] is set to OFF. To make output from the inverter based on an operation command in a trial operation, [REN] needs to be set to 000[no] temporarily.



■Parameters

Item	Parameters	Data	Description
Input terminal function	[CA-01]~[CA-11]	101	[REN]: Controls Permitted/Not permitted using operation permission signal. ON: Allowed OFF: Not allowed

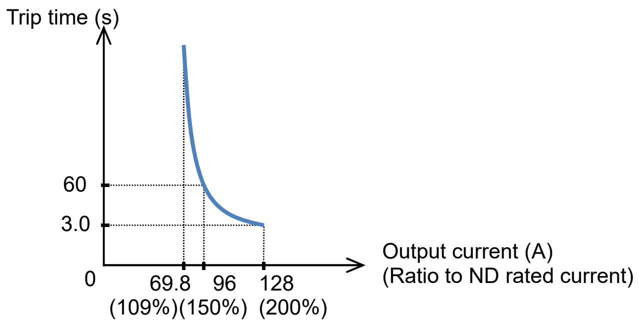
12.7 Thermal Protection of Motor

12.7.1 Electronic thermal setting of motor

■Change of electronic thermal level of motor

- Setting in accordance with the motor rated current protects continuous flow of current in the motor.
  To make the protection earlier, the protection level should be set lower than the motor rated current.

(Ex. 1) Motor rated current 64A ([bC110]=64.0A)
Setting range:12.8A(20%)~204.0A(300%)
When driven at a base frequency



- Make the setting correctly as this is necessary to protect the motor.
- When the thermal protection begins, [E005] motor electronic thermal error occurs.
- Irrespective of the thermal setting of the motor, the inverter electronic thermal protection works independently to protect the inverter.
- When the current grows rapidly, [E001] excessive current error could occur before [E005] motor electronic thermal error.
- Even electronic thermal level is set high, electronic thermal for inverter itself works separately, at frequency decreased from 5Hz and 80% at 0Hz.

- The electronic thermal time-limited characteristics is shown in (Ex. 1) when the first electronic thermal level [bC110] is 64A
- Example 1 shows the case of reduction ratio x1. (For example, the case of the motor driven at a base frequency for [bC111] =01.)
- The magnification ratio and hence the time to a trip could change depending on the choice of the electronic thermal characteristic.
- A trip occurs in 60 s when an electric current of 150% of the electronic thermal level x1 flows continuously.

■Parameters

Item	Parameters	Data	Description
First electronic thermal level	[bC110]	In range of 20-300% of the inverter rated current (unit: A) *1)	Sets the protection current of motor.
First electronic thermal characteristics selection	[bC111]	00	Reduced torque characteristics: Pattern for cooling function deterioration at a low speed
		01	Constant torque characteristics: Pattern for constant output
		02	Free setting: Multiple patterns are available according to the motor characteristics.

*1) The inverter rated current is switched by the load type selection [Ub-03]. Even if [bC110] is set to be high, [E001] excessive current error occurs when the current exceeds the excess current level.

■Change of electronic thermal characteristics

- Optimal protection characteristics can be achieved with the deterioration of the cooling ability of the motor at a low speed taken account of. ([bC111] =00)
- Frequency-dependent characteristics can be set in the selection of the electronic thermal characteristics. ([bC111] =02)

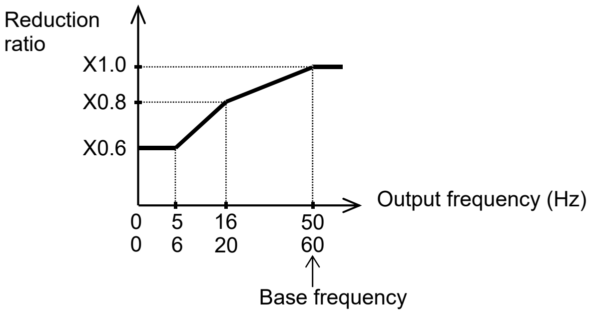
- Auto cooling motor needs to be used with reduced load (current) since the cooling function of the auto cooling fan becomes less effective when the motor rotation frequency decreases.
- The reduced torque characteristics are in accordance with the heat generation of the auto cooling motor.

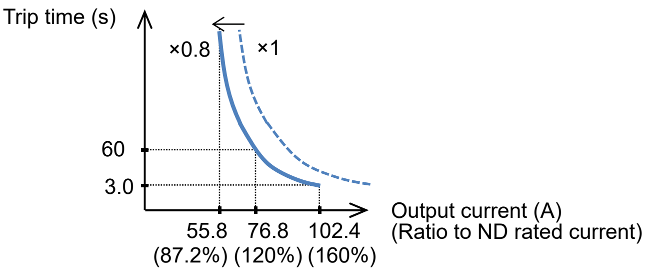
■Parameters

Item	Parameters	Data	Description
First electronic thermal characteristics selection	[bC111]	00	Reduced torque characteristics: Pattern for cooling function deterioration at a low speed
		01	Constant torque characteristics: Pattern for constant output
		02	Free setting: Multiple patterns are available according to the motor characteristics.

■ Reduced torque electronic thermal [bC111]=00

(Ex. 2) Induction motor rated current 64A, [bC110] =64 (A)
For base frequency [Hb104] =60Hz,
output frequency=20 Hz

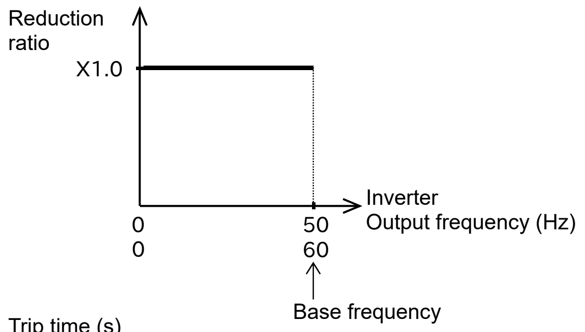


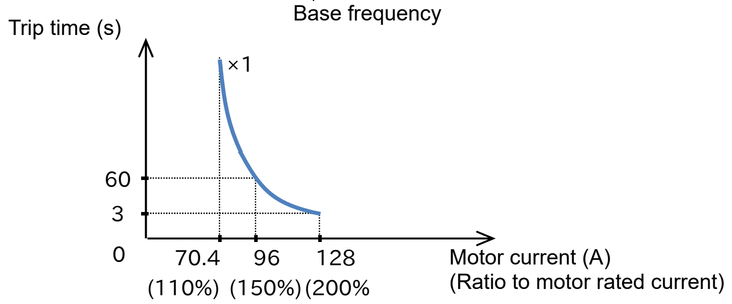


- Can be used for load reduction in accordance with the cooling performance at a low speed.
- When the first electronic thermal level [bC110] is 64 A, the reduction ratio is ×0.8 for operations at a base frequency of 60 Hz and output frequency of 20 Hz and the electronic thermal time-limited characteristics are given in the lower part of Example 2.
- Since Example 1 shows the case of the reduction ratio ×1, a trip occurs in 60 s when an electric current of 150% ×1 of the ND rated current flows continuously. However in Example 2, a trip occurs in 60 s when an electric current of 150%×0.8=120% of the ND rated current flows continuously.

■Constant torque electronic thermal
- Use this setting to use the constant-torque motor

(Ex. 3) For induction motor rated current: 64A, [bC110] =64(A)
Base frequency [Hb104] =50Hz, output frequency =5Hz





- When the first electronic thermal level [bC110] is 64 A, the reduction ratio is ×0.9 for operations at a base frequency of 60 Hz and output frequency of 2.5 Hz and the electronic thermal time-limited characteristics are given in the lower part of Example 3.
- Since Example 1 shows the case of the reduction ratio ×1, a trip occurs in 60 s when an electric current of 150% ×1 of the ND rated current flows continuously. However in Example 3, a trip occurs in 60 s when an electric current of 150%×0.9=135% of the ND rated current flows continuously.

■Free electronic thermal characteristics
- To protect the motor, the electronic thermal characteristics can be freely set in accordance with the load.

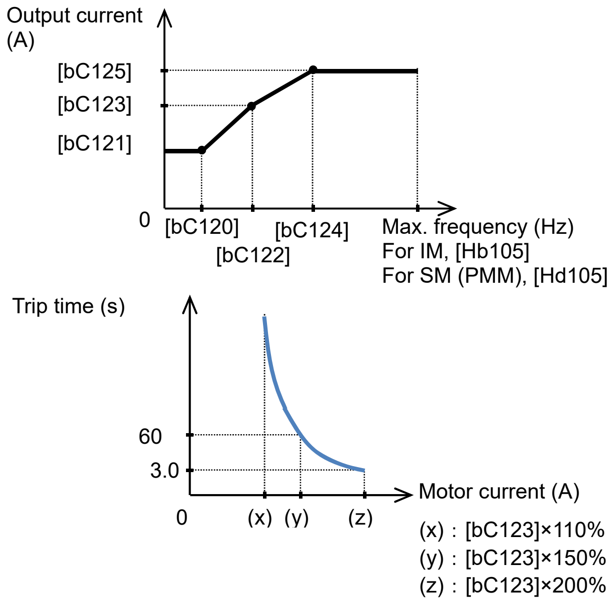
■Parameters

Item	Parameters	Data	Description
Free electronic thermal frequency 1	[bC120]	0.00~[bC122](Hz)	Frequency corresponding to free electronic thermal current 1
Free electronic thermal current 1	[bC121]	Inverter rated current x 0-300% (A) *1)	Current corresponding to free electronic thermal frequency 1
Free electronic thermal frequency 2	[bC122]	[bC120]~[bC124](Hz)	Frequency corresponding to free electronic thermal current 2
Free electronic thermal current 2	[bC123]	Inverter rated current x 0-300% (A) *1)	Current corresponding to free electronic thermal frequency 2
Free electronic thermal frequency 3	[bC124]	[bC122]~590.00(Hz)	Frequency corresponding to free electronic thermal current 3
Free electronic thermal current 3	[bC125]	Inverter rated current x 0-300% (A) *1)	Current corresponding to free electronic thermal frequency 3

*1) The inverter rated current is switched by the load type selection [Ub-03].

■Free electronic thermal characteristics (continued)

(Ex. 4) For output frequency of [bC122]

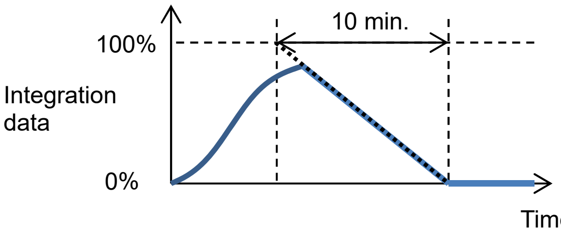


- When the output frequency coincides with the first free-electronic thermal frequency 2 [bC122], the electronic thermal time-limited characteristics are given in the lower part of Example 4.
- In Example 4, a trip occurs in 60 s when an electric current of 150% of the designated first free-electronic thermal current 2 [bC123] flows continuously.
- When [bC121][bC123][bC125] are set as default (0.00) and [bC111] electronic thermal is set as 02, E005 is generated.
- Be sure to set [bC125][bC123] and [bC121] in this sequence when to set free electronic thermal.

■Change of heat emission characteristics of electronic thermal

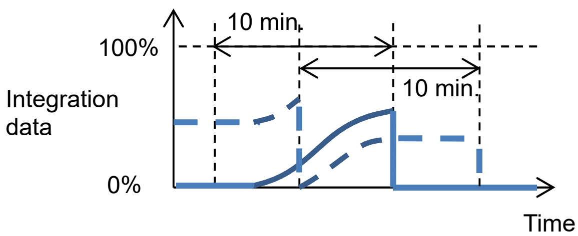
- When the current is below the electronic thermal level, the temperature integration data can be reduced according to the heat emission from the motor. ([bC112] =01)

Ex. 1) Subtraction mode (for [bC112] =01, [bC113] =600 s (10 min.))



- The electronic thermal of the inverter works independently even when the electronic thermal subtraction time is made shorter.
- Appropriate setting should be made for the motor that you use.
- In case of [bC112] =00, resetting cannot be made in 10 s after occurrence of an error.

Ex. 2) Constant period mode (for [bC112] =00)



*) In the constant period mode, a trip occurs when either of the duplicated counters reaches 100%.
In the constant period mode, data are cleared with a constant period of 10 minutes.

■Parameters

Item	Parameters	Data	Description
First electronic thermal subtraction function selection	[bC112]	00	Constant period mode: The temperature integration data are cleared with a constant period of 10 minutes.
		01	Subtraction mode: The temperature integration data are subtracted in accordance with the heat emission of the motor.
First electronic thermal subtraction time	[bC113]	1s~1000s	Should be set in accordance with the heat emission time of the motor. Sets the time for the integration data to change form 100% to 0%.

■Maintaining electronic thermal after power termination or resetting

- The temperature integration data of the motor are saved even after power termination or inverter trip resetting. When the motor current increases again when the power is made on or the system is reset, the system is restarted with the saved temperature integration data.

- When the data-holding function is used, the integration data are held even if the inverter is powered off for a long period of time, and a risk of occurrence of an error would increase.
  After it is powered on, a short-time operation could cause an error.

Item	Parameters	Data	Description
First electronic thermal data holding selection	[bC-14]	00	Not holding: The temperature integration data are cleared by the power shut-off and resetting.
		01	Holding: The temperature integration data are not cleared and subtracted only in the subtraction mode.

■Related functions

- The integration state can be monitored from [dA-42] electronic thermal load rate monitor (motor).
- If you want a warning signal when the electronic thermal exceeds a certain level, set the output signal function 026 [THM] and [CE-30] electronic thermal warning level (motor). For details, see “12.19.8 Output of warning before thermal protection of motor.”

- The integration state can be monitored from [dA-43] electronic thermal load rate monitor (controller).
- If you want a warning signal when the electronic thermal exceeds a certain level, set the output signal function 027 [THC] and [CE-31] electronic thermal warning level (controller). For details, see “12.19.9 Output of warning before thermal protection of inverter.”

12.7.2 Monitoring of motor temperature

- The temperature protection of an external device can be made by connecting a thermistor installed in the motor or other external device to the inverter and setting the function of the thermistor.
- The external thermistor should be wired between the control terminals TH+ and TH-.
- Set the thermistor selection [Cb-40] and the resistance level to cause an error [bb-70] in accordance with the thermistor's specifications.
- [E035] thermistor error occurs when the thermistor resistance reaches the thermistor error level [bb-70] depending on the motor temperature.
- When [Cb-40] is set to 02, [dA-38] motor temperature monitor indicates the detected temperature of the motor.

- When an external thermistor is not connected, a trip occurs if the thermistor selection [Cb-40] is set to 01.
- To use this function, the wiring distance between the motor and the inverter has to be 20 m or shorter. Since the current flowing in the thermistor is very weak, a measure such as wiring separation should be taken to prevent noise from the motor current.
- When [Cb-40] is set to a value other than 02, [dA-38] motor temperature monitor indicates 0 °C.

■Parameters

Item	Parameters	Data	Description
Thermistor error level	[bb-70]	0~10000.(Ω)	Set the resistance for the temperature at which a trip Occurs in accordance with the thermistor resistance specifications. Effective when [Cb-40]=01, 02
Thermistor selection	[Cb-40]	00	Disabled
		01	Enabled Positive temperature coefficient resistor (PTC)
		02	Enabled Negative temperature coefficient resistor (NTC)
Thermistor adjustment	[Cb-41]	0.0~1000.	Use as gain adjustment.
Motor temperature monitor	[dA-38]	-20.0~200.0(C°)	Indicates the detected motor temperature.

12.8 Function of Accelerating and Decelerating Motor Speed

12.8.1 Change acceleration time and deceleration time

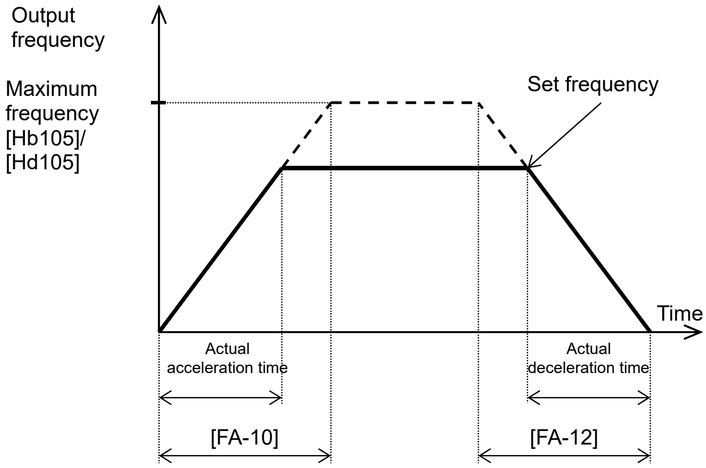
- Set up the acceleration time and the deceleration time of the motor. Set a longer time for slower acceleration or deceleration; set a shorter time for faster acceleration or deceleration.
- Set, as the acceleration time, the time that it takes to rise from 0 Hz to the maximum frequency; set as the deceleration time, the time that it takes to fall from the maximum frequency to 0 Hz.
- In the initial state, the acceleration time 1 [AC120] and the deceleration time 1 [AC122] are enabled.
- The currently enabled acceleration time and deceleration time can be monitored with [FA-10] and [FA-12], respectively; in the initial state, [FA-10] = [AC120] acceleration time 1 and [FA-12] = [AC122] deceleration time 1

- When the function of acceleration or deceleration action cancellation 071 [LAC] is selected as the Input terminal function and the signal is turned ON, the set acceleration or deceleration time will become re-set at 0 s and the output frequency will be made instantaneously to follow the frequency command.
- The target of command for the acceleration or deceleration time can be selected with [AC-01].
- The acceleration or deceleration time may be changed in response to the command given by the multi-speed function. For details, see Chap. 12.4.9: Switching the frequency in multiple speeds.

■Parameters

Item	Parameter	Data	Description
Maximum frequency	For IM, [Hb105] For SM (PMM), [Hd105]	10.00~590.00(Hz)	Set the maximum value for the frequency.
Acceleration time 1	[AC120]	0.00~3600.00(s)	Set, as the acceleration time, the time that it takes to rise from 0 Hz to the maximum frequency.
Deceleration time 1	[AC122]		Set, as the deceleration time, the time that it takes to fall from the maximum frequency to 0 Hz.
Acceleration or deceleration input type	[AC-01]	00~04	00: Parameter set-up 04: Reserved
Input terminal selection	[CA-01]~[CA-11]	071	Acceleration or deceleration cancellation function [LAC] OFF: Function disabled. ON: Ignore the acceleration or deceleration time, and follow the command.
Acceleration time (Monitor + Setting)	[FA-10]	0.00~3600.00(s)	Display the currently-enabled acceleration time.
Deceleration time (Monitor + Setting)	[FA-12]		Display the currently-enabled deceleration time.

■An actual example of setting up the acceleration or deceleration time



Acceleration time t_s

$$t_S = \frac{(J_L + J_M) \times N_M}{9.55 \times (T_S - T_L)}$$

Deceleration time t_B

$$t_B = \frac{(J_L + J_M) \times N_M}{9.55 \times (T_B + T_L)}$$

J_L : Moment of inertia J ($kg \cdot m^2$) of the load converted into that of the motor shaft.
J_M: Moment of inertia J ($kg \cdot m^2$) of the motor.
N_M: Revolution speed of the motor (r/min)
T_s : Maximum acceleration torque ($N \cdot m$) of the motor driven by the inverter.
T_B : Maximum deceleration torque ($N \cdot m$) of the motor driven by the inverter.
T_L : required operating torque ($N \cdot m$)

- However short the acceleration or deceleration time is set, the actual acceleration or deceleration of the motor cannot be shorter than the minimum acceleration or deceleration time that is determined by the moment of inertia J of the mechanical system and the motor torque.
  An act of acceleration or deceleration in a shorter time than the minimum acceleration or deceleration time may cause an over current or over voltage trip to happen.

12.8.2 Switch acceleration time and deceleration time in two stages

- Setting this function allows you to change the acceleration or deceleration time while driving in response to the terminal command, the frequency command, or the direction command.
- When [AC115] = 00, setting 031 [AD2] in any of the [CA-01] to [CA-11] and turning OFF/ON the target Input terminal allows you to switch the acceleration or deceleration time. ⇒ (Example 1)

- When the input terminal is used for switching, operation should be performed by assigning 031 [AD2] to any of [CA-01] to [CA-11].

- When [AC115] = 01, the frequency command and the relationship between the set values [AC116] and [AC117] can be used to switch the acceleration or deceleration time.
⇒ (Example 2)
- When [AC115] = 02, the acceleration or deceleration time can be switched between that for the forward revolution and that for the backward revolution.
⇒ (Example 3)

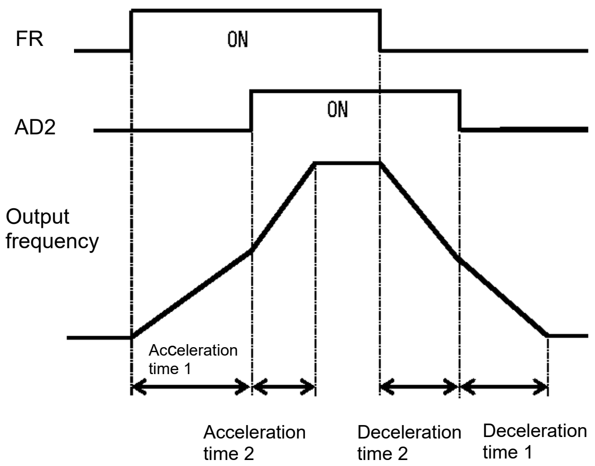
■Parameters

<table>
<tr><th>Item</th><th>Parameter</th><th>Data</th><th>Description</th></tr>
<tr><td>Maximum frequency</td><td>For IM, [Hb105]
For SM (PMM), [Hd105]</td><td>10.00~590.00(Hz)</td><td>Set the maximum value for the frequency.</td></tr>
<tr><td>Acceleration time 1</td><td>[AC120]</td><td rowspan="4">0.00~3600.00(s)</td><td>Set, as the acceleration time, the time that it takes to rise from 0 Hz to the maximum frequency.</td></tr>
<tr><td>Deceleration time 1</td><td>[AC122]</td><td>Set, as the deceleration time, the time that it takes to fall from the maximum frequency to 0 Hz.</td></tr>
<tr><td>Acceleration time 2</td><td>[AC124]</td><td>Set, as the acceleration time, the time that it takes to rise from 0 Hz to the maximum frequency.</td></tr>
<tr><td>Deceleration time 2</td><td>[AC126]</td><td>Set, as the deceleration time, the time that it takes to fall from the maximum frequency to 0 Hz.</td></tr>
<tr><td rowspan="3">2-stage acceleration or deceleration selection</td><td rowspan="3">[AC115]</td><td>00</td><td>Switching by [AD2] terminal (Example 1)</td></tr>
<tr><td>01</td><td>Switching by 2-stage acceleration or deceleration frequency (Example 2)</td></tr>
<tr><td>02</td><td>Enabled only when the revolution is switched between the forward and the backward directions (Example 3)</td></tr>
<tr><td>2-stage acceleration frequency</td><td>[AC116]</td><td rowspan="2">0.00~590.00(Hz)</td><td>Enabled when 2-stage acceleration or deceleration selection [AC115] is 01.</td></tr>
<tr><td>2-stage deceleration frequency</td><td>[AC117]</td><td>Enabled when 2-stage acceleration or deceleration selection [AC115] is 01.</td></tr>
<tr><td>Acceleration or deceleration input type selection</td><td>[AC-01]</td><td>00</td><td>Use the "Setting" of the operator keypad to input the type.</td></tr>
<tr><td>Input terminal function selection</td><td>[CA-01]~[CA-11]</td><td>031</td><td>2-stage acceleration or deceleration function [AD2].
When [AC115] = 00,
OFF: The set acceleration or deceleration command is enabled.
ON: [AC124]/[AC126] is forcefully enabled.</td></tr>
</table>

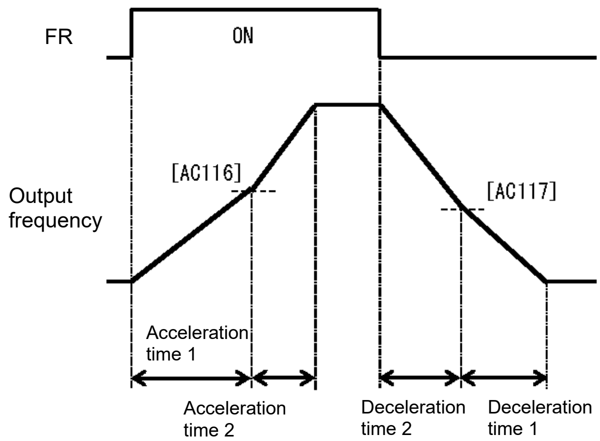
- You can use [AC115] to select one of the following three methods of switching the acceleration or deceleration time:
  - Switching by the Input terminal function [AD2];
  - Automatically switching by any given frequency; and
  - Automatically switching only at the time of switching between the forward revolution and the backward revolution.
- Described below is an exemplar case of switching between the acceleration or deceleration time 1 and the acceleration or deceleration time 2.

- Set, as the acceleration time, the time that it takes to rise from 0 Hz to the maximum frequency; and set as the deceleration time, the time that it takes to fall from the maximum frequency to 0 Hz.
  Each of the set times is the corresponding one of the following values.
  Acceleration time 1: Calculated value from [AC120];
  Deceleration time 1: Calculated value from [AC122];
  Acceleration time 2: Calculated value from [AC124]; and
  Deceleration time 2: Calculated value from [AC126].

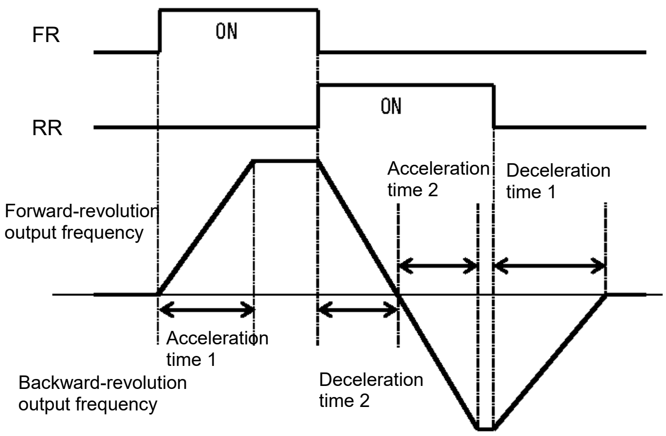
(Example 1) In the case of setting [AC115] = 00



(Example 2) In the case of setting [AC115] = 01



(Example 3) In the case of setting [AC115] = 02



12.8.3 Switch the acceleration or deceleration time in multiple stages.

- Setting up this function allows the acceleration or deceleration time to be changed in response to the multi-speed terminal command.

- When using the input terminal function to switch the multiple speeds, operation should be performed by assigning 003 [DFL] to 006 [DFH] or 007 [SF1] to 013 [SF7] to any of [CA-01] to [CA-11].
- When [AC-02] multi-stage acceleration or deceleration selection is 01, the 2-stage acceleration or deceleration function is disabled.

■Parameters

Item	Parameter	Data	Description
Multi-stage acceleration or deceleration selection	[AC-02]	00	The acceleration or deceleration time follows [AC120] [AC122] or [AC124] [AC126] (when 2-stage acceleration or deceleration function is enabled).
		01	The acceleration or deceleration time will be switched in accordance with the multi-speed command.
Multi-speed command	[Ab-11]~[Ab-25]	0.00~590.00 (Hz)	Set the multi-speed command with 1st speed [Ab-11] to 15th speed [Ab-25].
Acceleration time set-up for the multi-speed 1st to 15th speeds	[AC-30] [AC-34] [AC-38] [AC-42] [AC-46] [AC-50] [AC-54] [AC-58] [AC-62] [AC-66] [AC-70] [AC-74] [AC-78] [AC-82] [AC-86]	0.00~ 3600.00(s)	Set an acceleration time ranging from 0 Hz to the maximum frequency for each of the multi-speed commands.
Deceleration time set-up for the multi-speed 1st to 15th speeds	[AC-32] [AC-36] [AC-40] [AC-44] [AC-48] [AC-52] [AC-56] [AC-60] [AC-64] [AC-68] [AC-72] [AC-76] [AC-80] [AC-84] [AC-88]		Set a deceleration time ranging from the maximum frequency to 0 Hz for each of the multi-speed commands.
Multi-speed selection	[Ab-03]	00	Corresponding to 16-speed binary operation. 003[DFL]~006[DHH]
		01	Corresponding to 8-speed bit operation. 007[SF1]~013[SF7]
Input terminal function selection	[CA-01]~[CA-11]	003~006/ 007~013	Implementing the multi-speed command. 003[DFL]~006[DHH]/ 007[SF1]~013[SF7]

- Shown below are the multi-speed table for binary operation (when [Ab-03] = 00) and that for bit operation (when [Ab-03] = 01).

■Table for binary operation：[Ab-03]=00　Input terminal function 003 [DFL] to 006 [DHH]

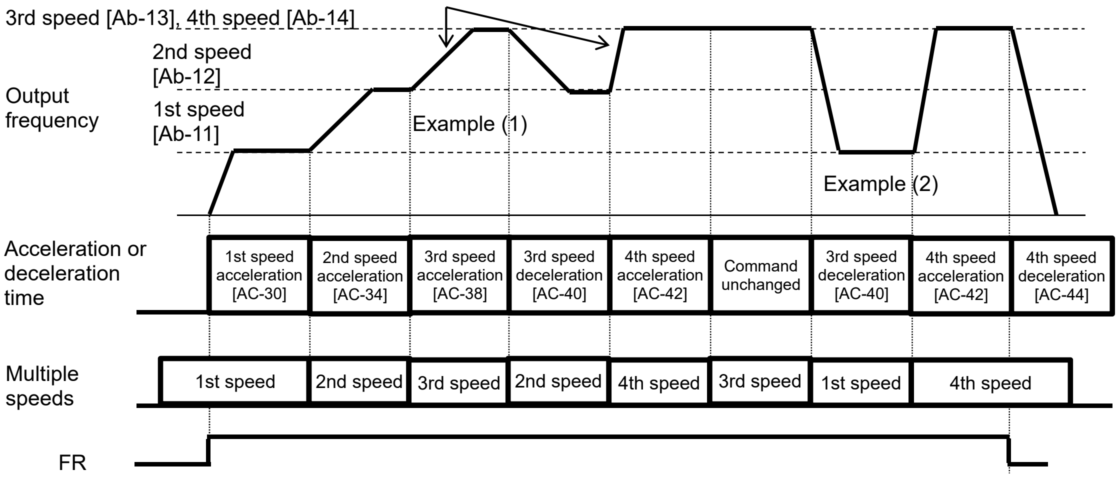
Multiple speeds	DHH	DFH	DFM	DFL
0th speed	OFF	OFF	OFF	OFF
1st speed	OFF	OFF	OFF	ON
2nd speed	OFF	OFF	ON	OFF
3rd speed	OFF	OFF	ON	ON
4th speed	OFF	ON	OFF	OFF
5th speed	OFF	ON	OFF	ON
6th speed	OFF	ON	ON	OFF
7th speed	OFF	ON	ON	ON
8th speed	ON	OFF	OFF	OFF
9th speed	ON	OFF	OFF	ON
10th speed	ON	OFF	ON	OFF
11th speed	ON	OFF	ON	ON
12th speed	ON	ON	OFF	OFF
13th speed	ON	ON	OFF	ON
14th speed	ON	ON	ON	OFF
15th speed	ON	ON	ON	ON

■Table for bit operation：[Ab-03] = 01　Input terminal function 007 [SF1] to 013 [SF7]

Multiple speeds	SF7	SF6	SF5	SF4	SF3	SF2	SF1
0th speed	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1st speed	-	-	-	-	-	-	ON
2nd speed	-	-	-	-	-	ON	OFF
3rd speed	-	-	-	-	ON	OFF	OFF
4th speed	-	-	-	ON	OFF	OFF	OFF
5th speed	-	-	ON	OFF	OFF	OFF	OFF
6th speed	-	ON	OFF	OFF	OFF	OFF	OFF
7th speed	ON	OFF	OFF	OFF	OFF	OFF	OFF

■Exemplar operation

If the set frequency is the same, only the acceleration or deceleration time can be changed.

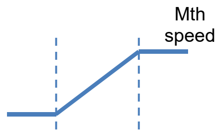
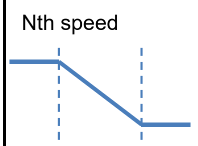


Example (1) If the multi-speed 3rd speed is engaged and the revolution is accelerating, the enabled acceleration time is the multi-speed 3rd speed acceleration time [AC-38].

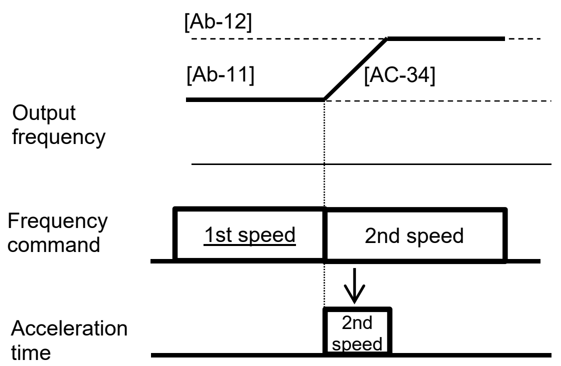
Example (2) If the multi-speed 1st speed is engaged and the revolution is decelerating, the enabled deceleration time is the multi-speed 3rd speed deceleration time [AC-40] for the multi-speed 3rd speed that has been engaged until the multi-speed 1st speed is engaged.

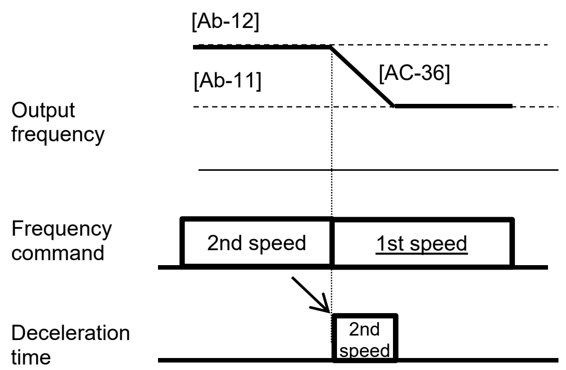
■Acceleration or deceleration time table

- The following table shows the multi-speed commands and their corresponding acceleration or deceleration times.

Setting state	Multi-speed command	Command state	Acceleration or deceleration time to be used
The frequency after a speed is ON will be higher than the speed before that. To the accelerating state  Acceleration time for multi-speed Mth speed	1st speed ON	Multi-speed 1st speed [Ab-11] > Frequency before 1st speed is ON	Acceleration time for multi-speed 1st speed [AC-30]
	2nd speed ON	Multi-speed 2nd speed [Ab-12] > Frequency before 2nd speed is ON	Acceleration time for multi-speed 2nd speed [AC-34]
	3rd speed ON	Multi-speed 3rd speed [Ab-13] > Frequency before 3rd speed is ON	Acceleration time for multi-speed 3rd speed [AC-38]
	4th speed ON	Multi-speed 4th speed [Ab-14] > Frequency before 4th speed is ON	Acceleration time for multi-speed 4th speed [AC-42]
	5th speed ON	Multi-speed 5th speed [Ab-15] > Frequency before 5th speed is ON	Acceleration time for multi-speed 5th speed [AC-46]
	6th speed ON	Multi-speed 6th speed [Ab-16] > Frequency before 6th speed is ON	Acceleration time for multi-speed 6th speed [AC-50]
	7th speed ON	Multi-speed 7th speed [Ab-17] > Frequency before 7th speed is ON	Acceleration time for multi-speed 7th speed [AC-54]
	8th speed ON	Multi-speed 8th speed [Ab-18] > Frequency before 8th speed is ON	Acceleration time for multi-speed 8th speed [AC-58]
	9th speed ON	Multi-speed 9th speed [Ab-19] > Frequency before 9th speed is ON	Acceleration time for multi-speed 9th speed [AC-62]
	10th speed ON	Multi-speed 10th speed [Ab-20] > Frequency before 10th speed is ON	Acceleration time for multi-speed 10th speed [AC-66]
	11th speed ON	Multi-speed 11th speed [Ab-21] > Frequency before 11th speed is ON	Acceleration time for multi-speed 11th speed [AC-70]
	12th speed ON	Multi-speed 12th speed [Ab-22] > Frequency before 12th speed is ON	Acceleration time for multi-speed 12th speed [AC-74]
	13th speed ON	Multi-speed 13th speed [Ab-23] > Frequency before 13th speed is ON	Acceleration time for multi-speed 13th speed [AC-78]
	14th speed ON	Multi-speed 14th speed [Ab-24] > Frequency before 14th speed is ON	Acceleration time for multi-speed 14th speed [AC-82]
	15th speed ON	Multi-speed 15th speed [Ab-25] > Frequency before 15th speed is ON	Acceleration time for multi-speed 15th speed [AC-86]
	No multi-speed	Other than those above	Acceleration time [AC120]
The frequency after a speed is OFF will be lower than the speed before that. To the decelerating state  Deceleration time for multi-speed Nth speed	1st speed OFF	Multi-speed 1st speed [Ab-11] > Frequency after 1st speed is OFF	Deceleration time for multi-speed 1st speed [AC-32]
	2nd speed OFF	Multi-speed 2nd speed [Ab-12] > Frequency after 2nd speed is OFF	Deceleration time for multi-speed 2nd speed [AC-36]
	3rd speed OFF	Multi-speed 3rd speed [Ab-13] > Frequency after 3rd speed is OFF	Deceleration time for multi-speed 3rd speed [AC-40]
	4th speed OFF	Multi-speed 4th speed [Ab-14] > Frequency after 4th speed is OFF	Deceleration time for multi-speed 4th speed [AC-44]
	5th speed OFF	Multi-speed 5th speed [Ab-15] > Frequency after 5th speed is OFF	Deceleration time for multi-speed 5th speed [AC-48]
	6th speed OFF	Multi-speed 6th speed [Ab-16] > Frequency after 6th speed is OFF	Deceleration time for multi-speed 6th speed [AC-52]
	7th speed OFF	Multi-speed 7th speed [Ab-17] > Frequency after 7th speed is OFF	Deceleration time for multi-speed 7th speed [AC-56]
	8th speed OFF	Multi-speed 8th speed [Ab-18] > Frequency after 8th speed is OFF	Deceleration time for multi-speed 8th speed [AC-60]
	9th speed OFF	Multi-speed 9th speed [Ab-19] > Frequency after 9th speed is OFF	Deceleration time for multi-speed 9th speed [AC-64]
	10th speed OFF	Multi-speed 10th speed [Ab-20] > Frequency after 10th speed is OFF	Deceleration time for multi-speed 10th speed [AC-68]
	11th speed OFF	Multi-speed 11th speed [Ab-21] > Frequency after 11th speed is OFF	Deceleration time for multi-speed 11th speed [AC-72]
	12th speed OFF	Multi-speed 12th speed [Ab-22] > Frequency after 12th speed is OFF	Deceleration time for multi-speed 12th speed [AC-76]
	13th speed OFF	Multi-speed 13th speed [Ab-23] > Frequency after 13th speed is OFF	Deceleration time for multi-speed 13th speed [AC-80]
	14th speed OFF	Multi-speed 14th speed [Ab-24] > Frequency after 14th speed is OFF	Deceleration time for multi-speed 14th speed [AC-84]
	15th speed OFF	Multi-speed 15th speed [Ab-25] > Frequency after 15th speed is OFF	Deceleration time for multi-speed 15th speed [AC-88]
	No multi-speed	Other than those above	Deceleration time [AC122]

- The switching timing of frequency command by multi-speed terminal command is different from that of the deceleration time.

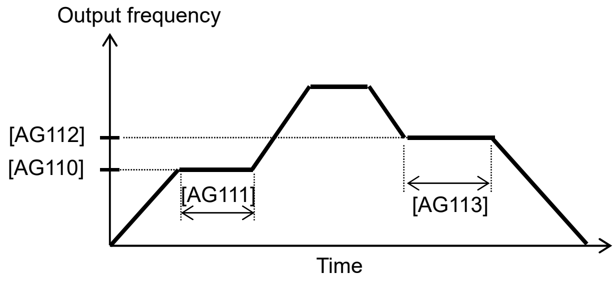




12.8.4 Stagnate the acceleration or deceleration in the middle of its progress

- Use the hold function, which is more effective for a mechanical system that has a larger moment of inertia.
- The acceleration-hold function is to withhold further acceleration until the motor that is starting its revolution achieves a small enough slip. Use this function when an over current trip happens at the start of the motor revolution.
- The deceleration-hold function is to withhold further deceleration until the motor achieves a small enough slip. Use this function when an over voltage trip happens during deceleration.

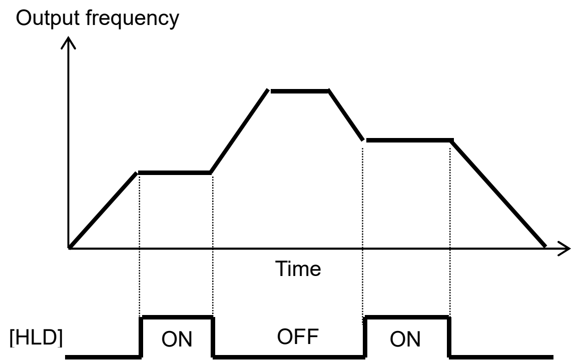
■Hold the frequency at any value for a set length of time.



- The working of this function depends on none of the content of the acceleration pattern selection [AC-03] and that of the deceleration pattern selection [AC-04]. This function works for all the patterns.

- There are two methods of stopping the acceleration or deceleration, and they can be used together.
  - Stopping automatically at any frequency for any length of hold time.
  - Stopping by means of the Input terminal function.

■To hold the frequency by means of the input terminal 100 [HLD] terminal function.



■Parameters

Item	Parameter	Data	Description
Acceleration-hold frequency	[AG110]	0.00~590.00(Hz)	Setting the frequency at which the acceleration is withheld. A setting of 0.00 is not valid.
Acceleration-hold time	[AG111]	0.00~60.00(s)	Setting the length of time for which the acceleration is withheld.
Deceleration-hold frequency	[AG112]	0.00~590.00(Hz)	Setting the frequency at which the deceleration is withheld. A setting of 0.00 is not valid.
Deceleration-hold time	[AG113]	0.00~60.00(s)	Setting the length of time for which the deceleration is withheld.
Input terminal function selection	[CA-01]~[CA-11]	100	Using the acceleration- or deceleration-hold [HLD] function.

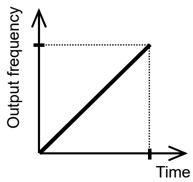
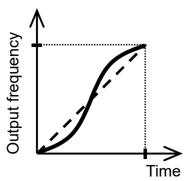
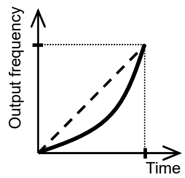
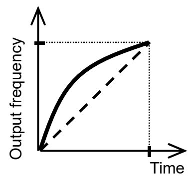
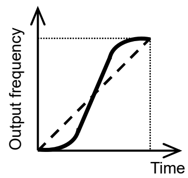
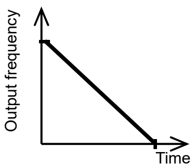
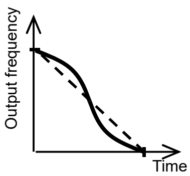
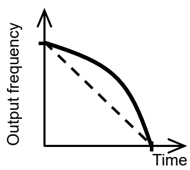
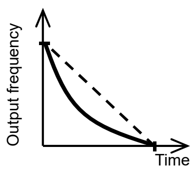
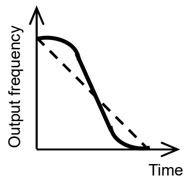
12.8.5 Change the acceleration or deceleration pattern

- Setting a(n) acceleration or deceleration pattern is possible that suit each system.
- Setting the acceleration pattern selection and the deceleration pattern selection can be done independently of each other by means of [AC-03] and [AC-04], respectively.
- To use a(n) acceleration or deceleration pattern other than the linear one (00), a stable operation can be achieved by an command that can fix the target of the frequency command by means of the operator-keypad command and/or the multi-speed command.
- Even if a(n) acceleration or deceleration pattern is set, the acceleration time should be set at the time that it takes to rise from 0 Hz to the maximum frequency and the deceleration time should be set at the time it takes to fall from the maximum frequency to 0 Hz.

- Changing the acceleration or deceleration pattern from one to another will create a sector with a(n) acceleration or deceleration time having a steep gradient. If the occurrence of an over current/over voltage is predictable, it will be prevented by adjusting from happening, the acceleration or deceleration time has to be adjusted to prevent such an occurrence.
- When any other acceleration or deceleration pattern than the linear one (00) is set, a change of command value during the acceleration or deceleration may cause a recalculation of the acceleration or deceleration pattern, which may result in a shock.
- When any other acceleration or deceleration pattern than the linear one (00) is set, use any other command than the analog input one. An unsteady command value may cause a recalculation of the acceleration or deceleration pattern, which may prolong the actual acceleration or deceleration time.

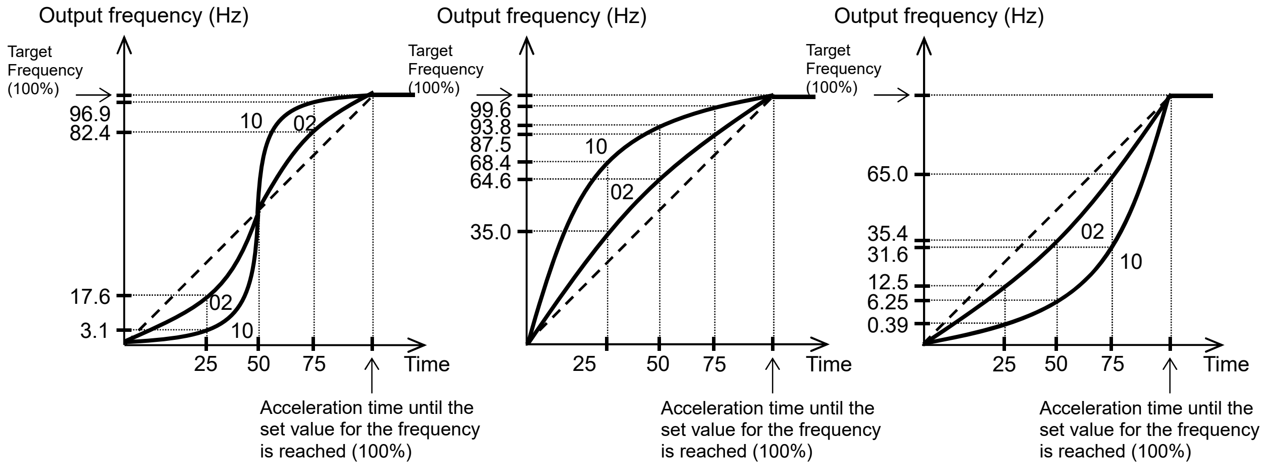
■Pattern selection

Select a pattern for each of the acceleration and the deceleration patterns by referring to the following table.

Set value	00	01	02	03	04
Curve	Linear	S-shaped	U-shaped	Inverse-U- shaped	EL-S-shaped
[AC-03] (Acceleration)					
[AC-04] (Deceleration)					
Description	Providing a linear acceleration up or deceleration down to the set frequency value.	Effective in the prevention of load collapse in lifts or on conveyors, for example.	Effective when a winder or the like needs to control of the tension and/or prevent the object to be wound from being cut. Usable for 1-shot winding/feeding.		Providing a shockless start/stop as in the case of the S-shaped curve, but providing a linear middle sector.

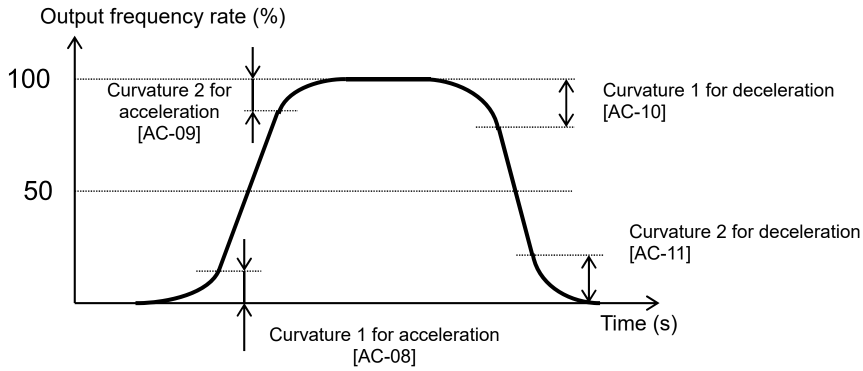
■Curve constant (degree of bulging) of pattern

- Determine the bulging degree by referring to the following figure.



■EL-S-shaped curve's curvature

- Use of an EL-S-shaped curve allows the curvature settings [AC-08] to [AC-11] for acceleration/deceleration.



- Setting all the curvatures at 50 (%) makes the EL-S-shaped curve equivalent to an S-shaped curve.
- When setting the pair of [AC-08] and [AC-09] or that of [AC-10] and [AC-11], divide 100(%) into 2 segments, and assign one of which to the former of the pair and the other to the latter thereof (i.e., the two segments, if summed up, render a value up to 100%).
- A setting where [AC-08] = 100 and [AC-09] = 0 makes the acceleration curve a U-shaped acceleration curve.

■ Parameters

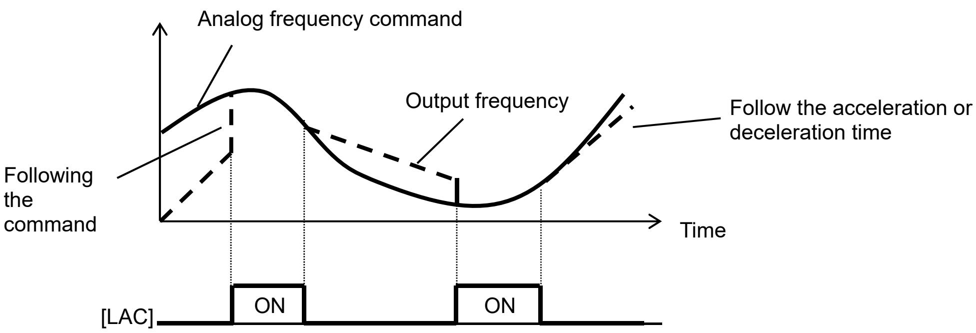
Item	Parameter	Data	Description
Acceleration pattern selection Deceleration pattern selection	[AC-03] [AC-04]	00	Linear acceleration/deceleration
		01	S-shaped acceleration/deceleration
		02	U-shaped acceleration/deceleration
		03	Inverse-U-shaped acceleration/deceleration
		04	EL-S-shaped acceleration/deceleration
Acceleration curve constant Deceleration curve constant	[AC-05] [AC-06]	1~10	1 (small bulging) ⇕ 10 (large bulging)
Curvature 1 for EL-S-shaped acceleration	[AC-08]	0~100(%)	Designate the curvature of the curved sector when an EL-S-shaped pattern is used. (For acceleration)
Curvature 2 for EL-S-shaped acceleration	[AC-09]		
Curvature 1 for EL-S-shaped deceleration	[AC-10]		Designate the curvature of the curved sector when an EL-S-shaped pattern is used. (For deceleration)
Curvature 2 for EL-S-shaped deceleration	[AC-11]		

12.8.6 Make the frequency follow the command instantaneously

- If the acceleration or deceleration cancel [LAC] function is selected as the input terminal function selection and the signal is turned ON, the acceleration or deceleration time becomes ignored and the output frequency is made instantaneously to follow the set frequency.

- As the use of the acceleration or deceleration cancellation function makes the output follow the command, a large amount of increase/decrease in the frequency demanded by the command may cause a trip.
- [LAC] function is valid for any frequency command such as one from parameter set-up, one from the communication, and so on.

Item	Parameter	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	071	Acceleration or deceleration cancellation function [LAC] is selected. Canceling the acceleration or deceleration and making the output follow the command.



12.9 Motor Control Method

12.9.1 Selection of control mode

- Select an appropriate motor control mode for the motor to be driven and the control method.
- Set [AA121] = 11 or 12 to drive a synchronous motor (SM)/permanent magnet motor (PMM).
- The characteristics of the control operation may be improved by automatic tuning.
- Whether the currently-selected mode is the control mode for induction motors or that for synchronous motors (SMs)/permanent magnet motors (PMMs) can be checked by [dC-45] IM/SM(PMM) monitor.

- To conduct high-torque control of conveyors or the like without using encoder feedback.
- To conduct high-torque control of cranes and lifts from 0 Hz without using encoder feedback.
- To control the torque in order to conduct hit-and-stop control as well as tension control.

- As improper settings for a given motor result in performance below its potential characteristics, be sure to set up appropriately.
- See "12.3 Basic Settings for Motor" for checking.
- To drive multiple induction motors (IMs) by a single inverter, it is recommendable to use it with V/f control's constant torque characteristics.
- An exemplar selection of control mode will be shown in the following section.
  Some of your systems may have more suitable modes than what is selected as the example.

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	00	V/f control-constant torque characteristics (IM)
		01	V/f control-reducing torque characteristics (IM)
		02	V/f control-free V/f (IM)
		03	Automatic torque boost (IM)
		04	V/f control-constant torque characteristics (IM) with sensor
		05	V/f control-reducing torque characteristics (IM) with sensor
		06	V/f control with sensor-free V/f (IM)
		07	Automatic torque boost (IM) with sensor
		08	Sensor less vector control (IM)
		09	Zero-Hz range sensor less vector control (IM)
		10	Vector control (IM) with sensor
		11	Synchronous-start type sensor less vector control (SM (PMM))
		12	IVMS-start type sensor less vector control (SM (PMM))
IM/SM(PMM) monitor	[dC-45]	00	Induction motor IM being selected.
		01	Synchronous motor SM (permanent magnet motor PMM) being selected.

* IM : Induction motor
SM (PMM) : Synchronous motor (permanent magnet motor)

1 Check the motor type.

- Use an induction motor (IM). (PMM). **Proceed to #2**
- To use a synchronous motor (SM)/permanent magnet motor **Proceed to "12.9.12 Drive synchronous motor (permanent magnet motor)."**

2 Select a control mode.

- No feedback is to be used.
  - To use in applications, such as lifts and cranes, that require a high torque from the start. **Proceed to "12.9.10 Use zero-speed range (zero-Hz range) sensor less vector control."**
  - To use in applications, such as conveyors and machine tools, that carry heavy loads and require a high torque. **Proceed to "12.9.9 Use sensor less vector control."**
  - To use in applications where the frequency-voltage characteristics of a high-speed motor/special motor need to be changed freely as intended. **Proceed to "12.9.4 Drive with free V/f control."**
  - To use in applications that require a certain torque at the start though the load is light. **Proceed to "12.9.6 Manually adjust torque." or Proceed to "12.9.7 Automatically adjust torque."**
  - To save energy with V/f control appropriately to a fan/pump. **Proceed to "12.9.3 Drive with V/f control (reducing torque characteristics)."**
  - To use with generic characteristics of V/f control. **Proceed to "12.9.2 Drive with V/f control (constant torque characteristics)**

- To use in applications that require feedback from encoders, sensors, etc.
  - To use in applications: that carry a heavy load; that require control needing a high torque; and that require position control **Proceed to "12.9.11 Drive with vector control with sensor."**
  - To use in applications where a motor with an encoder is driven and the frequency-voltage characteristics of the motor need to be changed freely as intended. **Proceed to "12.9.15 Drive with free V/f control with sensor."**
  - To use in applications: where a motor with an encoder is driven; that require a certain torque the start; and where the motor revolution speed needs to be equal to the command speed. **Proceed to "12.9.16 Use automatic boost function with sensor."**
  - To use in applications where a fan/pump with an encoder is driven and where the motor revolution speed needs to be equal to the command speed while the energy consumption needs to be reduced. **Proceed to "12.9.14 Drive with V/f control with sensor (reducing torque characteristics)."**
  - To use in applications where a motor with an encoder is driven and where the motor needs to be used with generic characteristics of V/f control. **Proceed to "12.9.13 Drive with V/f control with sensor (constant torque characteristics)."**

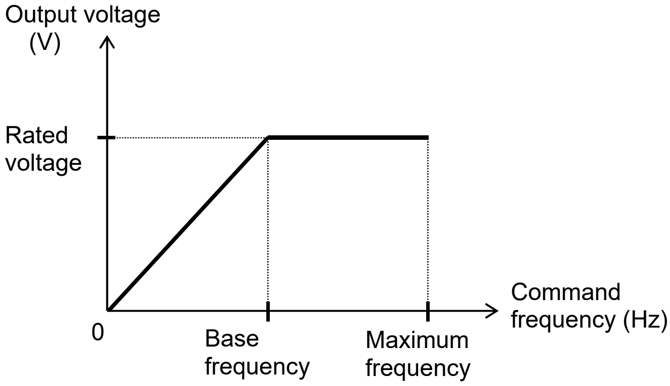
- To conduct encoder feedback, see also "12.9.17 Use encoder."

12.9.2 Drive with V/f control (constant torque characteristics)

■V/f control (constant torque characteristics)

- With constant torque characteristics, the output voltage is outputted proportionally to a given command frequency along the straight line drawn from the point 0 Hz/0 V to the intersection of the base frequency and the rated voltage.
- The output voltage corresponding to a frequency range from 0 Hz to the base frequency is determined proportionally to the given frequency, but the output voltage corresponding to a frequency range from the base frequency to the maximum frequency is constant irrespective of the frequency.
- Use of the manual boost function renders the output voltage higher than that on the basic proportional line by the boost voltage.
  The manual boost function is effective in the case of low speeds and insufficient torque.

- When a motor is hunting and vibrating, an adjustment of the stability constant [HA110] may improve the state of the motor.
- When a single inverter runs multiple motors and the motors are vibrating, a downward adjustment of the stability constant [HA110] may stabilize the state of the motors.



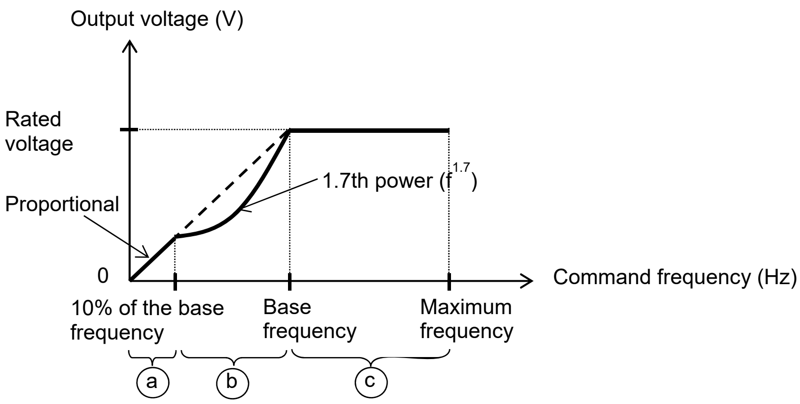
■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	00	To be used with the V/f control and the constant torque characteristics (IM).
Stability constant	[HA110]	0~1000(%)	To adjust the control for reducing the hunting of motors.
Base frequency	[Hb104]	10.00 to the maximum frequency (Hz)	To set the base frequency of motors.
Maximum frequency	[Hb105]	Base frequency to 590.00 (Hz)	To set the maximum frequency of motors.
Motor's rated voltage	[Hb106]	1~1000 (V)	Set the rated voltage of motors.

12.9.3 Drive with V/f control (reducing torque characteristics)

■V/f control (reducing torque characteristics)

- Suitable for applications, such as a fan/pump, that require no large torque at a low-speed range.



- When a motor is hunting and vibrating, an adjustment of the stability constant [HA110] may improve the state of the motor.

- As the output voltage is low at a low-speed range, improved efficiency, lower noise, and less vibration can be expected.

Period a: Constant torque characteristics are employed for a period from 0 Hz to the frequency that is 10% of the base frequency. (e.g.) A 60-Hz base frequency yields constant torque characteristics for a range from 0 to 6 Hz.

Period b: Reducing torque characteristics are employed for a period from the frequency that is 10% of the base frequency to the base frequency. For a given frequency, the voltage on the curve of the 1.7th power to the given frequency is outputted.

Period c: The voltage has constant-output characteristics for a range from the base frequency to the maximum frequency.

■Parameters

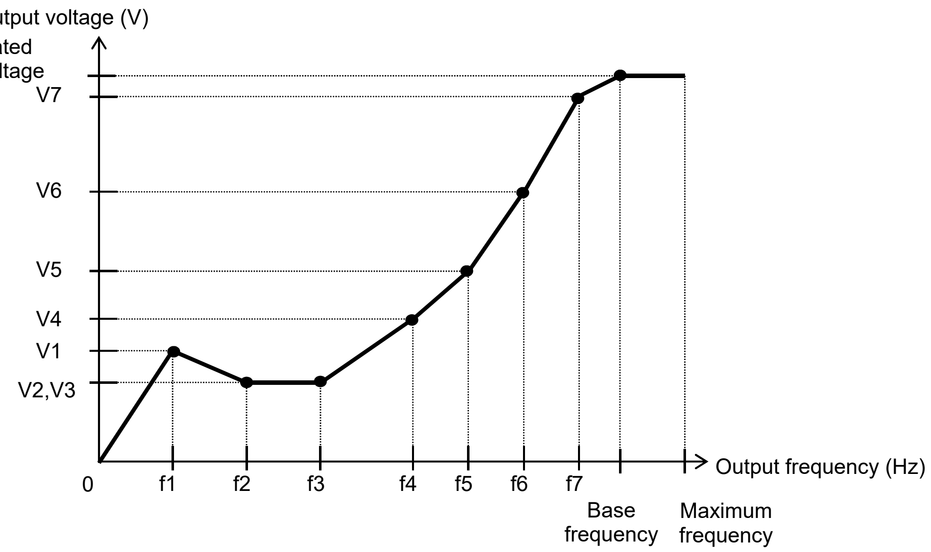
Item	Parameter	Data	Description
Control mode	[AA121]	01	To be used with the V/f control and the reducing torque characteristics (IM).
Stability constant	[HA110]	0~1000(%)	To adjust the control for reducing the hunting of motors.
Base frequency	[Hb104]	10.00 to the maximum frequency (Hz)	To set the base frequency of motors.
Maximum frequency	[Hb105]	Base frequency to 590.00 (Hz)	To set the maximum frequency of motors.
Motor's rated voltage	[Hb106]	1~1000 (V)	Set the rated voltage of motors.

12.9.4 Run with V/f control (free V/f)

■V/f control (free V/f)

- In the free V/f set-up, any intended V/f characteristics can be set by setting the voltage and the frequency at 7 points.

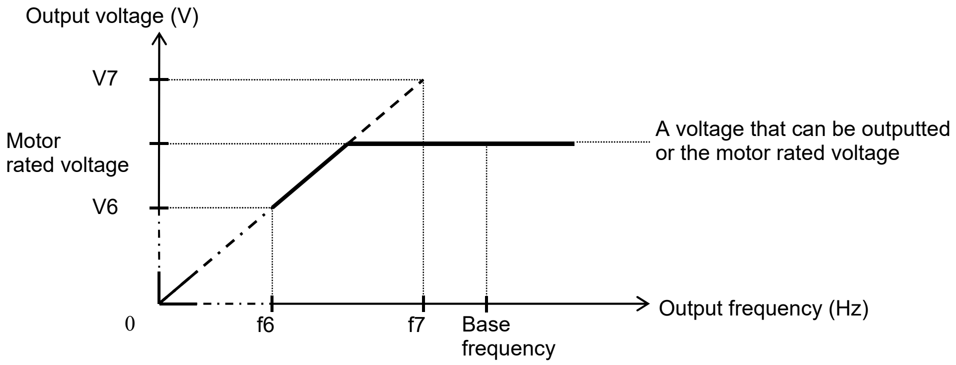
- When a motor is hunting and vibrating, an adjustment of the stability constant [HA110] may improve the state of the motor.
- The frequencies set by free V/f set-up have to always meet the following requirement: f1 ≤ f2 ≤ f3 ≤ f4 ≤ f5 ≤ f6 ≤ f7 ≤ base frequency.
  The initial value for each of the frequencies set by the free V/f set-up is 0 Hz.
  Set the maximum frequency and the base frequency first, and then set the frequencies f7, f6, f5, f4, f3, f2, and f1 in this order by the free V/f set-up.
- Setting the [AA121] at 02 (free V/f set-up) disables the manual torque boost operation mode [Hb140].



■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	02: Free V/f (IM)	To use the free V/f (IM)
Stability constant	[HA110]	0~1000(%)	To adjust the control for reducing the hunting of motors.
Base frequency	[Hb104]	10.00 to the maximum frequency (Hz)	To set the base frequency of motors.
Maximum frequency	[Hb105]	Base frequency to 590.00 (Hz)	To set the maximum frequency of motors.
Motor's rated voltage	[Hb106]	1~1000 (V)	Set the rated voltage of motors.
Free V/f frequency 7	[Hb162]	[Hb160] to the base frequency (Hz)	Set the frequency at each break point.
Free V/f frequency 6	[Hb160]	[Hb158]~[Hb162] (Hz)	
Free V/f frequency 5	[Hb158]	[Hb156]~[Hb160] (Hz)	
Free V/f frequency 4	[Hb156]	[Hb154]~[Hb158] (Hz)	
Free V/f frequency 3	[Hb154]	[Hb152]~[Hb156] (Hz)	
Free V/f frequency 2	[Hb152]	[Hb150]~[Hb154] (Hz)	
Free V/f frequency 1	[Hb150]	0.00~[H152](Hz)	
Free V/f voltage 7	[Hb163]	0.0~1000.0(V)	Set the output voltage at each break point.
Free V/f voltage 6	[Hb161]		
Free V/f voltage 5	[Hb159]		
Free V/f voltage 4	[Hb157]		
Free V/f voltage 3	[Hb155]		
Free V/f voltage 2	[Hb153]		
Free V/f voltage 1	[Hb151]		

- Even the setting of 1000 V for all of the free V/f voltages 1 to 7 will not enable the inverter to output a voltage that is higher than the input voltage or the motor's voltage selection.
- Set the characteristics very carefully because inappropriate characteristic settings may cause over current to happen during the acceleration or deceleration and/or may cause machine vibration.



12.9.5 Run in the energy-saving mode

- Set automatic adjustment so as to achieve the minimum output power of the inverter during constant-speed operation. Suitable for the load corresponding to the reducing torque characteristics of a fan/pump.
- Running with this function needs a setting of 01 for the energy-saving operation selection [Hb145]. The response and the accuracy can be adjusted by the energy-saving response/accuracy adjustment [Hb146].
- Because this function is implemented by relatively slow control, a rapid change in load, such as an impact load, may stall the motor and cause an over current trip
- This function acts when either the V/f control (constant torque characteristics) or the V/f control (Reducing torque characteristics) is selected.

■Parameters

<table>
<tr><th>Item</th><th>Parameter</th><th>Data</th><th colspan="3">Description</th></tr>
<tr><td>Energy-saving operation selection</td><td>[Hb145]</td><td>00: disabled
01: enabled</td><td colspan="3">Select whether or not to conduct the energy-saving operation.</td></tr>
<tr><td rowspan="2">Energy-saving response/accuracy adjustment</td><td rowspan="2">[Hb146]</td><td rowspan="2">0~100(%)</td><td>Setting</td><td>Response</td><td>Accuracy</td></tr>
<tr><td>0
⇕
100</td><td>Slow
⇕
Fast</td><td>High
⇕
Low</td></tr>
</table>

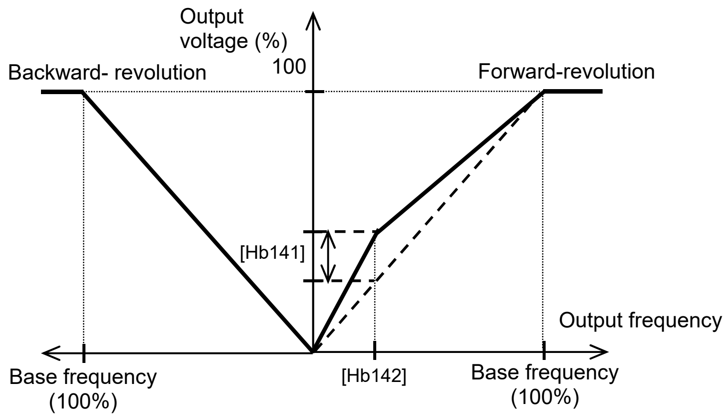
12.9.6 Manually adjust torque

- Raise the output voltage by adding an extra voltage in order to achieve a higher torque at low speeds than otherwise.
- In the V/f control, no special correction is conducted to control the motor. Accordingly, at low output voltages, the resistance component and/or the wiring in the motor will cause the voltage drop, which in turn lowers the voltage applied to the motor. Manual boost corrects the voltage and thereby improves the lowering of the torque at the low-speed range.

- Be sure not to cause an over excitation of the motor when raising the set value for the manual torque boost. Boosting increases the flow of the current, which may burn the motor.
- The target of the torque boost is the V/f control of induction motors. (except the free V/f)

- As the amount of manual torque boost [Hb141], set the proportion thereof to the motor rated voltage [Hb106] (= 100 %). The set value is the maximum amount to be added at manual torque boost break point [Hb142].
- As the manual torque boost break point [Hb142], set the proportion of the frequency at that point to the base frequency [Hb104] (= 100%).

e.g.) When [Hb140] = 02, the boost works only for the forward revolution of the motor.



■Parameters

Item	Parameter	Data	Description
Torque boost operation mode selection	[Hb140]	00	Disabled
		01	Always enabled
		02	Enabled only for forward revolution
		03	Enabled only for backward revolution
Amount of manual torque boost	[Hb141]	0.0~20.0(%)	Setting the maximum amount of torque boost for the motor's rated voltage [Hb106] at the time of setting the manual torque boost break point.
Manual torque boost break point	[Hb142]	0.0~50.0(%)	Set, as the break point, the proportion of the boost amount to the base frequency [Hb104]

12.9.7 Automatically torque boost

- Automatically adjust the frequency and the output voltage so as to achieve a higher torque.
- The automatic boost corrects the frequency and the output in order to control the motor.
  Accordingly, it requires the acquisition of the motor constant by means of auto-tuning or the like.

- When a motor is hunting and vibrating, an adjustment of the stability constant [HA110] may improve the state of the motor.
- In the automatic torque boost, set the motor capacity appropriately, the number of motor poles, the base frequency, the rated voltage, and the rated current in order to conduct motor control.
- When the motor performs below its potential characteristics, conduct the auto-tuning and make adjustment by referring to the next section.

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	03	To use the automatic torque boost (IM).
Stability constant	[HA110]	0~1000(%)	To adjust the control for reducing the hunting of motors.
Base frequency	[Hb104]	10.00 to the maximum frequency (Hz)	To set the base frequency of motors.
Maximum frequency	[Hb105]	Base frequency to 590.00 (Hz)	To set the maximum frequency of motors.
Motor rated voltage	[Hb106]	1~1000 (V)	Set the rated voltage of motors.
Automatic torque boost voltage compensation gain	[HC101]	0~255	To adjust the amount of the voltage added by the automatic torque boost.
Automatic torque boost Slip compensation gain	[HC102]		To adjust the amount of the frequency added by the automatic torque boost.

Phenomenon▶	Estimated cause(s)▶	Exemplar measures to be taken
Slower motor revolution at low speeds than what is expected.	• Insufficient output voltage, which in turn renders the torque insufficient.	• Make an adjustment by incrementing the automatic torque boost voltage compensation gain [HC101] by approximately 5% each time.
	• Insufficient frequency correction, which in turn renders the torque insufficient.	• Make an adjustment by incrementing the automatic torque boost slip compensation gain [HC102] by approximately 5% each time.
A heavy load lowers the revolution frequency of the motor.	• Insufficient frequency correction, which in turn renders the torque insufficient.	• Make an adjustment by incrementing the automatic torque boost slip compensation gain [HC102] by approximately 5% each time.
A heavy load raises the revolution frequency of the motor.	• An excessive frequency correction raises the frequency.	• Make an adjustment by decrementing the automatic torque boost slip compensation gain [HC102] by approximately 5% each time.
With a heavy load, an acceleration causes an over current.	• An excessive voltage correction increases the current.	• Make an adjustment by decrementing the automatic torque boost voltage compensation gain [HC101] by approximately 5% each time.
	• An excessive frequency correction raises the frequency.	• Make an adjustment by decrementing the automatic torque boost slip compensation gain [HC102] by approximately 5% each time.

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like.
  When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change automatically change the frequencies for the stall prevention function, the momentary-stop non-stop function, the over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.8 Stabilize motor revolution

- This is a function to adjust the motor that is hunting to achieve a stable state. Search a set range for a point where the hunting stops, and make an adjustment accordingly.
- When a single inverter drives multiple motors, setting the stability constant at 0 may improve the state.
- When a load with large inertia such as a fan is rotated, decrementing the stability constant [HA110] by 10% each time may improve the state.
- When the motor capacity is smaller than the rated capacity of the inverter, incrementing the set value by 10% each time may improve the state. In contrast, when the motor capacity is larger than the rated capacity of the inverter, decrementing the set value by 10% each time may improve the state.

- If the motor is hunting and vibrating, check if appropriate settings are provided for the motor capacity, the number of motor poles, the base frequency, the rated voltage, and the rated current.
- Then conduct the auto-tuning to check if the hunting ends, and adjust the stability constant.
- Exemplar methods of reducing the hunting include the following methods:
    1. Adjust the carrier frequency [bb101] by gradually decrementing it down to 2 kHz.
    2. Adjust the output voltage gain [Hb180] by gradually decrementing it down to 80%.

  If no effect can be observed, restore the original values.

Caution

- Do not conduct a steady operation with a setting for the output voltage gain [Hb180] that exceeds 100%. The motor may be burned.

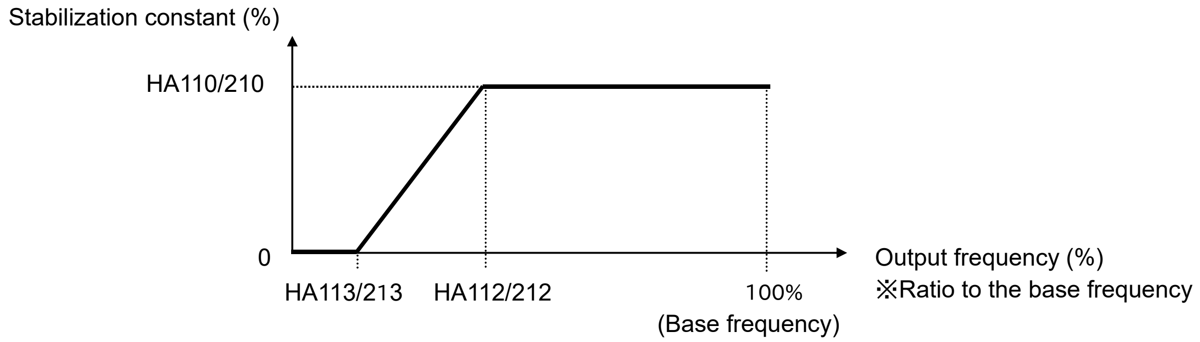
■Parameters

Item	Parameter	Data	Description
Stability constant	[HA110]	0~1000(%)	To adjust the control for reducing the hunting of motors.
Output voltage gain	[Hb180]	0~255(%)	Decrease it if the motor is hunting. A lower setting decreases the output voltage.
Carrier frequency	[bb101]	0.5~16.0(kHz) ∗	Change the carrier frequency of the PWM output. If the motor is hunting, lower the setting.
Stabilization ramp function end ratio, 1st-motor	[HA112]	0~100(%)	These adjust the stabilization constant- output frequency characteristic curve.
Stabilization ramp function end ratio, 2nd-motor	[HA212]		
Stabilization ramp function start ratio, 1st-motor	[HA113]		
Stabilization ramp function start ratio, 2nd-motor	[HA213]		
Flux settling level, 1st-motor	[HC137]	0.0~100.0(%)	These adjust the magnetic flux settling level at the start of the operation.
Flux settling level, 2nd-motor	[HC237]		
Forcing level, 1st-motor	[HC140]	0~1000(%)	These adjust the output current when the forcing function is active.
Forcing level, 2nd-motor	[HC240]		
Modulation threshold 1, 1st-motor	[HC141]	0~133(%)	These adjust the upper limit of the output voltage.
Modulation threshold 1, 2nd-motor	[HC241]		
Modulation threshold 2, 1st-motor	[HC142]		
Modulation threshold 2, 2nd-motor	[HC242]		

∗ Some settings may limit the carrier frequency. For details, see "12.12 Adjust motor sound, noise, and heat production of inverter."

■Stabilization ramp function start ratio [HA113/213], end ratio [HA112/212]

・These parameters are used to adjust the stabilization constant - output frequency characteristic curve. When the output frequency is below the start ratio the stabilization constant is 0%, and when it exceeds the end ratio the stabilization constant becomes the [HA110/210] set value. Between the start and end ratio the stabilization constant increases from 0 to [HA110/210] proportionally to the output frequency. See the figure below.



Note) Make sure that the start ratio value is lower than the end ratio value when adjusting these parameters. In case the end ratio is lower than the start ratio, the end ratio setting will be ignored and the start ratio value will be assigned to both the start and end ratio values.

■Flux settling level [HC137/237]

・These parameters are used to adjust the magnetic flux settling level at the start of the operation. Since the acceleration begins when the magnetic flux has reached the level set by these parameters at the start of the operation, the waiting time until the acceleration begins is decreased by setting a smaller value to these parameters. However, changing the setting of these parameters can destabilize the start of the operation.
These parameter settings are effective only when the control mode selection [AA121/221] is set to either 08: Sensor-less vector control (IM), 09: Zero-Hz-range sensor-less vector control (IM), or 10: Vector control with encoder (IM).

■Forcing level [HC140/240]

・These parameters are used to adjust the output current level while the forcing function is active. These parameter settings are effective only when the control mode selection [AA121/221] is set to either 08: Sensor-less vector control (IM), 09: Zero-Hz-range sensor-less vector control (IM), or 10: Vector control with encoder (IM). And the basis of these parameters [HC140/240] is applied by the parameters shown in the following table.

Control mode	basis of [HC140/240]
Sensor-less vector control (IM), Vector control with encoder (IM)	[Hb116/216] Async. Motor constant I0
Zero-Hz-range sensor-less vector control	[HC110/210] Zero speed range limit (IM -0Hz-SLV)

In the case the Zero-Hz-range sensor-less vector control is being used, and the forcing current is high, the forcing current can be reduced by setting these parameters small.

■Modulation threshold 1, 2 [HC141/241], [HC142/242]

・These parameters are used to adjust the upper limit of the inverter output voltage. By increasing these parameter values the output current can be reduced. However by applying these settings, the operation can become unstable. Additionally, always make sure that the [HC141] and [HC142] are set to the same value in case these parameter settings need to be changed (same for the 2nd motor parameters [HC241] and [HC242]).

・These parameter settings are effective only when the control mode selection [AA121/221] is set to either 08: Sensor-less vector control (IM), 09: Zero-Hz-range sensor-less vector control (IM), or 10: Vector control with encoder (IM).

12.9.9 Use sensor-less vector control

- Automatically adjust the frequency and the output voltage so as to achieve responsively a higher torque even at slow speeds.
- In the sensorless vector control, to control the motor, the frequency and the output voltage are corrected and the response is adjusted with respect to the load inertia.
- Even in the case of standard motors, a large load inertia and/or a long wiring may require the auto-tuning.
- Use of other motors than standard motors requires the setting-up of the motor constant and the load inertia by, for example conducting the auto-tuning.

- In the sensor less vector control, set appropriately the motor capacity, the number of motor poles, the base frequency, the rated voltage, and the rated current in order to conduct motor control.
- When the motor performs below its potential characteristics, conduct the auto-tuning and make adjustment by referring to the next section.
- In the case of a long wiring (approximately longer than 20 m) and in the case of controlling motors other than out company's, the performance may be below what are expected from the characteristics.
- As the capacity becomes farther away from the maximum applicable motor capacity, sufficient operation characteristics becomes more difficult to get.
- In the sensorless vector control, adjustment of the response is possible. The sensorless vector control can be used in applications that require a better follow-up performance of the frequency to the command.
- When a motor is hunting and vibrating, an adjustment of the speed response [HA115] may improve the state of the motor.
- To limit the output direction by enabling the reversal prevention function [HC114].
- To correct the slip change caused by temperature changes by enabling the selection of the secondary resistance correction [HC113]. Connection is needed between a thermistor for measuring the temperature of the motor and the TH terminal.

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	08	To use the sensor less vector control (IM).
Speed response	[HA115]	0~1000(%)	To adjust the responsiveness of the control. A larger value enhances the responsiveness.
Amount of boost at the start(sensor less vector)	[HC111]	0~50(%)	To adjust the current command at the start when the starting torque is not sufficient.
Selection of whether a secondary-resistance correction is to be conducted.	[HC113]	00	Disabled
		01	Enabled Requiring a temperature thermistor.
Selection of reversal prevention	[HC114]	00	Disabled
		01	Enabled Limit the output to prevent the output in the reverse direction.
Time constant for torque current command filter	[HC120]	0~100(ms)	To adjust the filter for the torque current.
Speed feed forward compensation adjustment gain	[HC121]	0~1000(%)	To adjust the feed forward control of the speed controller.

Phenomenon▶	Estimated cause(s) ▶	Exemplar measures to be taken
Socks occur during the revolutions at the start.	• The control system has a speed response that is too high.	• Make an adjustment by decrementing the response adjustment [HA115] by 5% each time. • Make an adjustment by decrementing the IM motor constant J [Hb118] by 5% each time. • Make an adjustment by decrementing the boost amount at the start [HC111] by 5% each time.
Unsteady revolutions at low speeds, resulting in fluctuating revolutions.	• The control system has a speed response that is too low.	• Make an adjustment by incrementing the response adjustment [HA115] by 5% each time. • Make an adjustment by incrementing the IM motor constant J [Hb118] by 5% each time.
The motor is hunting.	• The control system has a speed response that is too low.	• Make an adjustment by decrementing the response adjustment [HA115] by 5% each time. • Make an adjustment by decrementing the IM motor constant J [Hb118] by 5% each time.
When a load in the motor-stopping direction is applied to the motor, the revolution frequency becomes lower.	• The motor constant R2 is set at too small a value.	• Make an adjustment by incrementing the IM motor constant R2 [Hb112] by 5% of the current value each time.
When a load in the motor-stopping direction is applied to the motor, the revolution frequency becomes higher.	• The motor constant R2 is set at too large a value.	• Make an adjustment by decrementing the IM motor constant R2 [Hb112] by 5% of the current value each time.
When a load in the motor-stopping direction is applied to the motor, the revolution frequency becomes higher.	• Insufficient regenerative torque at low speeds.	• Make an adjustment by incrementing the IM motor constant R1 [Hb110] by 5% of the current value each time. • Make an adjustment by incrementing the IM motor constant I0 [Hb116] by 5% of the current value each time.
Revolution in the opposite direction to the command direction occurs for an instant.	• A command demanding the revolution in the opposite direction is dispatched over the control system for an instant.	• Enable the reversal prevention selection [HC114].

- Set the carrier frequency [bb101] at a value of 2.0 kHz or higher.
  A set frequency of 1.9 kHz or lower may cause hunting.
- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like.
  When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change automatically change the frequencies for the stall prevention function, the momentary-stop non-stop function, the over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.10 Use zero-speed range (zero-Hz range) sensor less vector control

- Automatically adjust the frequency and the output voltage so as to achieve responsively a higher torque even at slow speeds.
- In the zero-speed range sensorless vector control, the sensorless vector control is supplemented with an output that can achieve an intended torque from at extremely low speeds such as those in the zero-speed range.
- Even in the case of standard motors, a large load inertia and/or a long wiring may require the auto-tuning.
- Use of other motors than Hitachi's standard motors requires the setting-up of the motor constant and the load inertia by, for example conducting the auto-tuning.
- As in the case of the sensorless vector control, acquire the motor constant by means of auto-tuning or the like.

- In the zero-speed range sensor less vector control, as in the case of the sensor less vector control, set appropriately the motor capacity, the number of motor poles, the base frequency, the rated voltage, and the rated current in order to conduct motor control.
- When the motor performs below its potential characteristics, conduct the auto-tuning and make adjustment by referring to the next section.
- In the case of a long wiring (approximately longer than 20 m) and in the case of controlling motors other than out company's, the performance may be below what are expected from the characteristics.
- As the capacity becomes farther away from the maximum applicable motor capacity, sufficient operation characteristics becomes more difficult to get.

- In the zero-speed range sensorless vector control, as in the case of the sensorless vector control, adjustment of the response is possible. In addition to the adjustment of the response, it is possible to set the torque boost for the current at the start.
- When a motor is hunting and vibrating, an adjustment of the speed response [HA115] may improve the state of the motor.

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	09	To use the zero-speed range sensor less vector control (IM) function.
Speed response	[HA115]	0~1000(%)	To adjust the responsiveness of the control. A larger value enhances the responsiveness.
Zero-speed range limiter	[HC110]	0~100(%)	To limit the current at the start so as not to allow the rising of the current to rise too high.
Amount of boost at the start (zero-speed range sensor less vector)	[HC112]	0~50(%)	To adjust the current command at the start when the starting torque is not sufficient.
Time constant for torque current command filter	[HC120]	0~100(ms)	To adjust the filter for the torque current.
Speed feed forward compensation adjustment gain	[HC121]	0~1000(%)	To adjust the feed forward control of the speed controller.

- In addition to the adjustment of the sensor less vector control, refer to the following description.

Phenomenon▶	Estimated cause(s)▶	Exemplar measures to be taken
Socks occur during the revolutions at the start. Over current occurs at the start	• Boost amount is too large.	• Make an adjustment by decrementing the zero-speed range limiter [HC110] by 5% each time. • Make an adjustment by decrementing the zero-speed range boost at the start [HC112] by 5% each time.
The motor cannot provide enough torque for the load is too high for the motor to at the start. Acceleration is not possible.	• Boost amount is too small.	• Make an adjustment by incrementing the zero-speed range boost at the start [HC112] by 5% each time.

- Set the carrier frequency [bb101] at a value of 2.0 kHz or higher. A set frequency of 1.9 kHz or lower may cause hunting.
- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like. When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change automatically change the frequencies for the stall prevention function, the momentary-stop non-stop function, the over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.11 Use vector control with sensor

- The feedback of the encoder signal from the motor allows highly accurate frequency control from the low-speed range.
- In the vector control with sensor, to control the motor, the frequency and the output voltage are corrected and the response is adjusted with respect to the load inertia.
  Accordingly, it requires the acquisition of the motor constant and the load inertia by means of auto-tuning or the like.
- In the vector control with sensor, adjustment of the response is possible.
  The vector control with sensor can be used in applications that require a better follow-up performance of the speed to the command.
- In the vector control with sensor, the position control mode can be used.
- Even in the case of standard motors, a large load inertia and/or a long wiring may require the auto-tuning.
- Use of other motors than standard motors requires the setting-up of the motor constant and the load inertia by, for example conducting the auto-tuning.
- When a motor is hunting and vibrating, an adjustment of the speed response [HA115] may improve the state of the motor.

- Conducting the vector control with sensor requires the encoder feedback from the motor.
- When [CA-90] = 02, Input terminals [DFH] and [DHH] are switched to the terminals for feedback control.
  When [CA-90] ≠ 02, terminals [EAP], [EBP], [EAN], and [EBN] of the feedback option HF-FB are enabled.
  See "12.9.17 Use encoder."
- In the vector control with sensor, set appropriately the motor capacity, the number of motor poles, the base frequency, the rated voltage, and the rated current in order to conduct motor control.
- As the motor's frame number becomes smaller and smaller from the one of the maximum applicable motor, sufficient operation characteristics becomes more difficult to get.
- In the case of a long wiring (approximately longer than 20 m) and in the case of controlling motors other than out company's, the performance may be below what are expected from the characteristics.
- As the motor's frame number becomes smaller and smaller from the one of the maximum applicable motor, sufficient operation characteristics becomes more difficult to get.

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	10	To use the vector control with sensor (IM).
Speed response	[HA115]	0~1000(%)	To adjust the responsiveness of the control. A larger value enhances the responsiveness.
Vector control mode selection	[AA123]	00	Operation is possible by switching between the speed control and the torque control.
		01	Activate the pulse train position control mode.
		02	Activate the absolute position control mode.
		03	Activate the high-resolution absolute position control mode.

Phenomenon▸	Estimated cause(s)▸	Exemplar measures to be taken
The performance is not sufficient for what the motor control characteristics predict.	• An improper motor constant is being used.	• The performance may be improved by automatic tuning. Check "12.3.3 Auto-tune motor."
Socks occur during the revolutions at the start. The motor is hunting.	• The control system has a frequency response that is too high.	• Make an adjustment by decrementing the response adjustment [HA115] by 5% each time. • Make an adjustment by decrementing the IM motor constant J [Hb118] by 5% each time.
Unsteady revolutions at low speeds, resulting in fluctuating revolutions.	• The control system has a frequency response that is too low.	• Make an adjustment by incrementing the response adjustment [HA115] by 5% each time. • Make an adjustment by incrementing the IM motor constant J [Hb118] by 5% each time.
Normal acceleration is impossible and the protection against the over load works.	• An improper motor constant is being used.	• The performance may be improved by automatic tuning. Check "12.3.3 Auto-tune motor."
	• An improper phase sequence is being used.	• Set V/f control (00) in [AA121], and check the frequency detection value monitor [dA-08]. The wiring is correct if the forward operation [FW] has a positive (+) value and if the reversal operation [RV] has a negative (-) value. If the forward and negative operations have incorrect values, rearrange the phase sequence in the encoder or check again, "12.9.17 Use encoder."

- Set the carrier frequency [bb101] at a value of 2.0 kHz or higher. A set frequency of 1.9 kHz or lower may cause an incorrect operation.
- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like.
  When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change automatically change the frequencies for the stall prevention function, the momentary-stop non-stop function, the over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.12 Control synchronous motor (permanent magnet motor).

- Controlling a synchronous motor (permanent magnet motor) requires the setting-up of the motor constant. See, "12.3 Basic Settings for Motor." The motor constant is data corresponding to one phase of Y-connection (including wiring).

■Things to be noted when conducting the synchronous motor (permanent magnet motor) control

- Set an appropriate over current level of the inverter [bb160]. Do not drive a motor whose maximum current (demagnetization level) is below the 150% of [bb160].
  * Be aware of the root-mean-square value and the peak value. The rated output current listed in the specification table is the root-mean-square value.

- This is the control mode for the reducing torque applications where the motor that has the same frame number as the inverter's rating needs a torque at the start that is 50% or smaller. If a certain starting torque is necessary, contact the sales officer of our company.

- This mode can be used neither in applications that require a constant torque from low speeds nor in applications that involve rapid acceleration or deceleration and that require a large torque from low speeds. Never use this mode for applications involving a gravity load, such as lifts.

- Synchronous motors (permanent magnet motors) cannot be operated by a direct input from the commercial power supply.

- Multiple synchronous motors (permanent magnet motors) cannot be driven by a single inverter.

- Synchronous motors (permanent magnet motors) are more likely to cause over voltage errors than non-synchronous motors (induction motors). If the rapid deceleration and/or the direct-current braking function need to be used, consider the use of an optional braking resistor, a regenerative braking unit, a regenerative power converter.

- When a hold brake is used, release the brake before the motor starts operation. Otherwise, the motor may lose its synchronism.

- The motor may move in the reverse direction at the start of its revolution. When a malfunction is caused by the reverse revolution, use the initial-position estimation function [Hd132].

- Set the carrier frequency [bb101] at a value of 8.0kHz or higher. Some low carrier frequencies may make the motor generate a lot of heat.

- The tolerable load moment of inertia is 50 times as large as the motor's moment of inertia or smaller. Some applications whose loads moment of inertia exceed the above mentioned range may result in a performance that is below the desired one.

- In the case of a long wiring (approximately longer than 20 m) and in the case of controlling motors other than out company's, the performance may be below what are expected from the characteristics.

- In the case of a long wiring (approximately longer than 20 m), frequency-synchronized re-start may cause an over current error.

- Driving a motor whose rated current [Hd108] exceeds the inverter's rated current or a motor whose frame number is smaller than the maximum applicable motor by 2 or more may result in a performance that is below the desirable one.

- Set not only the motor's rated current [Hd108] but also the electronic thermal level [bC110].

- If the initial position estimation is enabled in the starting method [Hd132], a shrill sound caused by the position detection action may be heard, but this sound has nothing to do with any abnormality.

- If the initial position estimation is enabled in the starting method [Hd132], start the operation from the state in which the motor stopped. Failure to acquire the correct position may occur, which may result in unintended revolution, over current, or loss of synchronization.

■Disabled functions

- The following functions cannot be used when the synchronous motor (permanent magnet motor) control is conducted.
- Even when they are enabled by parameters of setting, they are actually disabled.

- In the following table, only the common settings (parameter center "-") and the first settings (parameter center "1") are listed, but it is not possible either to use the second settings (parameter center "2") that correspond to the first settings in the following table.

Item	Parameter	Description
Functions associated with torque control	[FA-15] [FA-16] [dA-15] and [dA-16]	Torque command monitoring function
	[Ad-01] to [Ad-04], and [Ad-40] to [Ad-43] Input terminal 067 [ATR]	Torque controlling function
	[Ad-11] to [Ad-14], Input terminal 068 [TBS]	Torque biasing function
	[bA110] to [bA116], and [bA210] to [bA216] Input terminals 060 [TL], 061 [TRQ1], and 062 [TRQ2] Output terminal 022 [TRQ]	Torque limiting function
	[CE120] to [CE123], Output terminal 019 [OTQ]	Over torque signal
Over current restraining function	[bA120] and [bA121]	Over current restraining function
Functions associated with induction motor control	[HA110]	Stabilization adjustment gain
	[Hb130] [Hb131] [Hb140] to [Hb142] [Hb145] [Hb146] [Hb150] to [Hb163] [Hb170] [Hb171] and [Hb180]	Functions associated with V/f control
	[HC101] and [HC102]	Functions associated with automatic boost
	[HC110] to [HC114], [HC120], and [HC121]	Sensor less vector control, Zero-speed range sensor less vector control
Part of gain mapping function	[HA126] [HA129]	Constant for I control
Part of auto-tuning	[HA-01]=02	Rotating system tuning
	[HA-03]	Online auto-tuning
Commercial power supply switching function	Input terminal 035 [CS]	Switching to commercial power supply
Acceleration or deceleration cancellation function	Input terminal 071 [LAC]	Acceleration or deceleration cancellation function
Jogging Operation	[AG-20] [AG-21] Input Terminals029[JOG]	Jogging Operation Function

■Control operation in synchronous start mode

- In this control mode, operations of magnetic-pole position estimation, synchronous start control, and sensor less vector control are started in this order.
- In the magnetic-pole position estimation, it is possible to select whether the motor is started after the motor's magnetic-pole positions are estimated by use of the initial-position estimation function or the magnetic-pole positions are synchronized by use of the DC braking function.
- In the case of starting after the magnetic-pole position estimation, estimation operation is conducted at the start by setting the start method [Hd132] at 01.
- In the case of the start method [Hd132] being set at 00, the motor is started as its magnetic poles are synchronized with the output phases. In the case where the magnetic poles and the output phases are unsynchronized by a great amount, or in the case that require a certain starting torque, use the starting-time DB to synchronize the magnetic-pole positions and the output phases before the acceleration.

- Use [AF108] to adjust the current during a synchronous starting. Adjustment is possible even when [AF101] = 00. When a larger torque is needed than what is needed in the synchronous starting mode, use of IVMS start mode may improve the situation. Please contact the sales officer of our company.
- The frequency [Hd130] at which the synchronous start control is switched to the sensorless vector control is adjusted at the lowest frequency (switching).
- When a motor is hunting and vibrating, an adjustment of the speed response [HA115] and/or the no-load current [Hd131] may improve the state of the motor.
- When the starting-time DB function is used at the start, see "12.14.2 Start after applying DC braking."

■Parameters for synchronous starting mode

Item	Parameter	Data	Description
Control mode	[AA121]	11	To use synchronous-start type sensor less vector control (SM/PMM)
Speed response	[HA115]	0~1000(%)	To adjust the responsiveness of the control. A larger value enhances the responsiveness.
SM(PMM) lowest frequency (switch)	[Hd130]	0~50(%)	The frequency at which the sensor less vector control is started. Set the ratio to the base frequency [Hd104].
SM(PMM) no-load current	[Hd131]	0~100(%)	Set the ratio of the no-load current to the rated current during the sensor less vector control.
SM(PMM) start method	[Hd132]	00	Initial position estimation is disabled.
		01	Initial position estimation is enabled.
SM(PMM) initial position estimation zero-V stand-by times	[Hd133]	0~255	This is a stand-by adjustment value to stabilize the reference value for the initial position estimation detection.
SM(PMM) initial position estimation detection stand-by times	[Hd134]		This is an adjustment value to stabilize the current rise of the initial position estimation operation.
SM(PMM) initial position estimation detection times	[Hd135]		This is a detection-operation adjustment value of the initial position estimation operation.
SM(PMM) initial position estimation voltage gain	[Hd136]	0~200(%)	This is the output-voltage adjustment gain of the initial position estimation operation.
SM(PMM) initial position estimation magnetic-pole position offset	[Hd137]	0~359°	To conduct corrections in a case where the initial position estimation operation has a certain error.
DC braking selection	[AF101]	01	Internal DC braking: enabled
DC braking force at the start	[AF108]	0~100(%)	To adjust the DC braking force. Setting of 100% will provide maximum braking force.
DC braking time at the start	[AF109]	0.0~60.0(s)	Enabled during the internal DC braking. When the operation command is turned ON, DC braking is started.
Over current detection level	[bb160]	Depend on the inverter model	To Set the level at which the over current is detected.

Phenomenon▶	Estimated cause(s) ▶	Exemplar measures to be taken
At the start, rotating temporarily in the opposite direction to the intended one.	• Misalignment of the output phases and the motor's magnetic-pole positions	• Enable the initial-position estimation function. [Hd132]=01 In the cases of a slight opposite-direction movement even in the initial-position estimation function, make an adjustment by incrementing [Hd137] by 5° at a time.
Over current occurs at the start At the start, the motor loses synchronization and no acceleration is observed.	• Insufficient starting torque • Misalignment of the output phases and the motor's magnetic-pole positions	• Enable the initial-position estimation function. [Hd132]=01 • Set the DC braking at the start [AF101] = 01, and after the start, the time needed for the motor to be stabilized is set in [AF109]. In addition, make an adjustment by incrementing the braking force at the start [AF108] by 5% each time.
A long starting time is required.	• A long phase-synchronization time is required.	• When the magnetic-pole positions are synchronized in the DC braking at the starting, enable the initial-position estimation function instead of the DC braking at the start. [Hd132]=01
Fluctuating revolutions occur at low speeds (at the lowest frequency(switch) or even lower).	• Insufficient starting torque	• Make an adjustment by incrementing the braking force at the start [AF108] by 5% each time.
Hunting occurs at low speeds (at the lowest frequency (switch) or even lower).	• There is a motor constant error.	• Decrement the motor constant R [Hd110] little by little until it reaches a value = set value × 0.7. • Increment little by little each of the motor constant Ld [Hd112] and the motor constant Lq [Hd112] until they reach their respective values = set values × 1.4. Note, however that Ld ≤ Lq.
Shock or over current occurs at about the lowest frequency (switch).	• The speed response is too low.	• Make an adjustment by incrementing the speed response [HA115] by 5% each time.
	• Load fluctuation occurs at around the switch.	• Adjust the lowest frequency (switch) [Hd130].
Hunting occurs at higher speeds (at the lowest frequency (switch) or higher).	• Unsynchronized speed response.	• Make an adjustment by incrementing/decrementing the speed response [HA115] by 5% each time.
	• Distorted wave form of the radio wave.	• Make an adjustment by incrementing the no-load current [Hd131] by 5% each time.
A long initial position estimation time is required.	• Set value for the estimation is too large.	• Lower the values [Hd133] to [Hd135] by the same ratio. * Too low a value may result in an operation in the opposite direction.
A movement in the opposite direction occurs while the initial position estimation is being used.	• The estimation is improperly conducted.	• Raise the values [Hd133] to [Hd135] by the same ratio, or raise the voltage gain [Hd136] by 5% each time.
While the initial position estimation is being used, over current errors may occur.	• Voltage gain is too high.	• Decrement the voltage gain [Hd136] by 5% each time.
Frequency-synchronized re-start may cause errors.	• Too high revolution speeds and too large offset of the phases.	• Make an adjustment by incrementing the speed response [HA115] by 5% each time. Waiting a longer time for the re-start may improve the situation.

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like. When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change automatically change the frequencies for the stall prevention function, the momentary-stop non-stop function, the over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

■Control operation in IVMS start mode

- IVMS start mode is a start mode where larger torque is provided than in the synchronous starting mode.
- When the synchronous starting mode provides an insufficient torque, use of the IVMS start mode may improve the performance.
- Use of the IVMS start mode requires an SM (PMM) constant that is set by the sensor less vector control and an adjustment dedicated for IVMS start mode.
- Before the motor drive, conduct an IVMS auto-tuning and a test run with the load removed.

- Some SM (PMM) may be unable to start in the IVMS start mode.
- IVMS start mode is a control mode that requires a strict adjustment.
  Please contact the sales officer of our company if you're motor cannot start.
- IVMS start mode requires a re-adjustment when the inverter is replaced.
  When a malfunctioning inverter needs to be restored immediately by replacing the malfunctioning inverter with a new one, the synchronous starting mode should be used.
- As the IVMS start mode is a very special control, which may make a unique operation sound as the starting sound.

■Parameters for IVMS start mode（Reserved）

<table>
<tr><th>Item</th><th>Parameter</th><th>Data</th><th>Description</th></tr>
<tr><td>IVMS carrier frequency</td><td>[Hd-41]</td><td>0.5~16.0(kHz)</td><td>Set the carrier frequency during the IVMS drive.</td></tr>
<tr><td>Filter gain of IVMS detection current</td><td>[Hd-42]</td><td>0~1000</td><td>The filter adjustment gain applied to the detection current during the IVMS drive.</td></tr>
<tr><td>Open-phase voltage detection gain selection.</td><td>[Hd-43]</td><td>00~04</td><td>The adjustment gain applied to the detection voltage during the IVMS drivel.</td></tr>
<tr><td rowspan="2">Selection of open-phase switch threshold correction.</td><td rowspan="2">[Hd-44]</td><td>00</td><td>IVMS correction: Disabled (no correction)</td></tr>
<tr><td>01</td><td>IVMS correction: Enabled
(correction to be conducted)</td></tr>
<tr><td>Speed control P gain</td><td>[Hd-45]</td><td>0~1000</td><td>Speed control P gain during the IVMS drive A larger value enhances the responsiveness of the speed control.</td></tr>
<tr><td>Speed control I gain</td><td>[Hd-46]</td><td>0~10000</td><td>Speed control I gain during the IVMS drive A larger value enhances the responsiveness of the speed control.</td></tr>
<tr><td>Waiting time for open-phase switching</td><td>[Hd-47]</td><td>0~1000</td><td>Waiting time for the open-phase switching during the IVMS drive. A larger value enhances the stability.</td></tr>
<tr><td rowspan="2">Restriction on the rotation-direction determination</td><td rowspan="2">[Hd-48]</td><td>00</td><td>Rotation-direction determination: Disabled
(no restriction)</td></tr>
<tr><td>01</td><td>Rotation-direction determination: Enabled (restricted to the operation-command direction)</td></tr>
<tr><td>Adjustment of the timing for detecting the open-phase voltage</td><td>[Hd-49]</td><td rowspan="2">0~1000</td><td>Adjustment value of the IVMS detection timing.</td></tr>
<tr><td>Minimum pulse-width adjustment</td><td>[Hd-50]</td><td>To adjust the width of the voltage pulse during the IVMS drive.
A larger value renders the pulse width wider.</td></tr>
<tr><td>Current limit of IVMS threshold</td><td>[Hd-51]</td><td rowspan="2">0~255</td><td>Set a limit on each of the upper and the lower limits of the detection current during the IVMS drive.
Enabled when [Hd-44] = 01 (enabled).</td></tr>
<tr><td>IVMS threshold gain</td><td>[Hd-52]</td><td>To adjust the IVMS auto-tuning value.</td></tr>
<tr><td>IVMS carrier-frequency switching start/finish point</td><td>[Hd-58]</td><td>0~50(%)</td><td>To adjust the point where the carrier frequency is switched in the IVMS start mode.</td></tr>
</table>

- In this control mode, operations of magnetic-pole position estimation, IVMS start control, and sensor less vector control are started in this order.
- In this control mode, only the parameters set by the first set-up are enabled. Terminal [SET] cannot be used.
- In the magnetic-pole position estimation, it is possible to select whether the motor is started after the motor's magnetic-pole positions are estimated by use of the initial-position estimation function or the magnetic-pole positions are synchronized by use of the DC braking function.

- In the case of starting after the magnetic-pole position estimation, estimation operation is conducted at the start by setting the start method [Hd132] at 01.
- In the case of the start method [Hd132] being set at 00, the magnetic poles are positioned to the output phases at the start. As a large offset between the magnetic poles and the output phases may fail the starting, use the starting-time DB to synchronize the magnetic-pole positions and the output phases before the starting.

■Parameters common to this mode and the synchronous starting mode

Item	Parameter	Data	Description
Control mode	[AA121]	12	To use IVMS-start type sensor less vector control (SM/PMM)
Speed response	[HA115]	0~1000(%)	To adjust the responsiveness of the control. A larger value enhances the responsiveness.
SM(PMM) lowest frequency (switch)	[Hd130]	0~50(%)	The frequency at which the sensor less vector control is started. Set the ratio to the base frequency [Hd104].
SM(PMM) no-load current	[Hd131]	0~100(%)	Set the ratio of the no-load current to the rated current during the sensor less vector control.
SM(PMM) start method	[Hd132]	00	Initial position estimation is disabled.
		01	Initial position estimation is enabled.
SM(PMM) initial position estimation zero-V stand-by times	[Hd133]	0~255	This is a stand-by adjustment value to stabilize the reference value for the initial position estimation detection.
SM(PMM) initial position estimation detection stand-by times	[Hd134]		This is an adjustment value to stabilize the current rise of the initial position estimation operation.
SM(PMM) initial position estimation detection times	[Hd135]		This is a detection-operation adjustment value of the initial position estimation operation.
SM(PMM) initial position estimation voltage gain	[Hd136]	0~200(%)	This is a output-voltage adjustment gain of the initial position estimation operation.
SM(PMM) initial position estimation magnetic-pole position offset	[Hd137]	0~359(°)	To conduct corrections in a case where the initial position estimation operation has a certain error.
DC braking selection	[AF101]	01	Internal DC braking: enabled
DC braking force at the start	[AF108]	0~100(%)	To adjust the DC braking force. Setting of 100% will provide maximum braking force.
DC braking time at the start	[AF109]	0.0~60.0(s)	Enabled during the internal DC braking. When the operation command is turned ON, DC braking is started.
Over current detection level	[bb160]	Depend on the Inverter model	To Set the level at which the over current is detected.

■Set-up procedures of IVMS start mode

1 Set the protection for the PM motor.

- Setting the over current detection level [bb160]
- Setting the electronic thermal level [bc110]

- The over-current detection level should be set appropriately by taking into account the maximum current (demagnetization level) of the PM motor to be used. Set the over-current detection level so that the SM (PMM)'s maximum current (demagnetization level) is not below 150% of the over-current detection level.
- See also "12.7.1 Conduct the electronic thermal protection on motors," and set it appropriately

2 Set the PM motor's Plate Data.

- Setting the capacitance [Hd102]
- Setting the number of poles [Hd103]
- Setting the base frequency [Hd104]
- Setting the maximum frequency [Hd105]
- Setting the rated voltage [Hd106]
- Setting the rated current [Hd108]
- See also "12.3.1 S**et plate data of motor as parameters,**" and set them appropriately.

3 Set the PM motor constants.

- Setting the motor constant R [Hd110]
- Setting the motor constant Ld [Hd112]
- Setting the motor constant Lq [Hd114]
- Setting the motor constant Ke [Hd116]
- Setting the motor constant J [Hd118]
- See also "12.3.2 Set Motor Constants" and set them appropriately.

4 Conduct the IVMS auto-tuning

- Set the control mode [AA121] at 12 (SM-IVMS).
- Set the auto-tuning selection [HA-01] at 03 (IVMS).
- Input the command for starting the auto-tuning (operation command).
- The inverter is in an automatic operation.
- Tuning is finished.

For the procedures from the auto-tuning start to the auto-tuning finish, check **"12.3.3 Auto-tune motor,"** and follow the procedures.

- In the IVMS auto-tuning, the tuning should be done as the motor shaft is being rotated little by little. When the motor shaft is locked, or when the load is heavy, even a normal finish of the auto-tuning may result in a adjustment failure. Conduct the IVMS auto-tuning with nothing attached to the motor shaft.
- When an over current occurs during the automatic operation of the IVMS auto-tuning, check the following items.
  (1) Motor lock caused by braking and/or foreign objects.
  (2) Setting over-current detection level [bb160]
  Check these items, and when there is no problem, conduct the IVMS auto-tuning by incrementing the minimum pulse width adjustment [Hd-50] by 10 each time.
- It may take approximately 5 minute to conduct the IVMS auto-tuning.

5 Run test running

- Set the main-speed command [FA-01] at a value that is smaller than the lowest frequency (switch) [Hd130], and check that stable drive can be provided for the forward revolutions, the backward revolutions, the acceleration, and the deceleration.
- Then, Set the main-speed command [FA-01] at a value that is larger than the lowest frequency (switch) [Hd130], and check that stable drive can be provided for the forward revolutions, the backward revolutions, the acceleration, and the deceleration.

- When the adjustment has been conducted repeatedly but no trial operation can be conducted, it may be due to the unavailability of IVMS start mode for use. Use the synchronous starting mode, or please contact the sales officer of our company.

Becoming unstable.

Stable operation.

• Change the following parameter settings re-conduct **"4 Conduct IVMS auto-tuning".**

(1) Open-phase voltage-detection gain selection [Hd-43]:
Adjust by Incrementing the value from 00 to 03 by one each time.

(2) Minimum pulse width adjustment [Hd-50]:
Adjust by incrementing the value by 10 each time.

• Finish the test running.
Proceed to "6 Conduct real operation."

6 Conduct real operation

- Combine the target motor with a load device that you want to drive actually and then start the operation, and then check whether the motor can provide a stable drive. • The drive performance may be improved by conducting a parameter adjustment. For more details, see the following.
- For the adjustment of the high-speed (lowest frequency (switch) or higher), see also the descriptions of the synchronous starting mode.

- During the real operation, do not change the following parameters set in **4 "conduct the IVMS auto-tuning,"** and **"5 Conduct a trial operation."** Such change may destabilize the operations.
- Open-phase voltage-detection gain selection [Hd-43]
- Minimum pulse width adjustment [Hd-50]

■Not successful

Phenomenon▶	Estimated cause(s)▶	Exemplar measures to be taken
Over current occurs at the start. At the start, the motor loses synchronization and no acceleration is observed.	• Insufficient starting torque ▶Misalignment of the output phases and the motor's magnetic-pole positions	• Enable the selection of open-phase switch threshold correction [Hd-44]. • Adjust each of the speed control P gain [Hd-45] and the speed control I gain [Hd-46] by 10 each time. The adjustment should be conducted so that [Hd-45] ≤ [Hd-46]. Some motor characteristics require an adjustment by raising and lowering the settings. • Adjust the waiting time for open-phase switching [Hd-47] by incrementing it by 5 each time. Some motor characteristics require an adjustment by raising and lowering the settings.
Loss of synchronization, hunting, and/or over current occur at low speeds (at the lowest frequency (switch) or even lower).	• Insufficient torque • Misalignment of the output phases and the motor's magnetic-pole positions	• Enable the selection of open-phase switch threshold correction [Hd-44]. • Adjust each of the speed control P gain [Hd-45] and the speed control I gain [Hd-46] by 10 each time. The adjustment should be conducted so that [Hd-45] ≤ [Hd-46]. Some motor characteristics require an adjustment by raising and lowering the settings. • Adjust the waiting time for open-phase switching [Hd-47] by incrementing it by 5 each time. Some motor characteristics require an adjustment by raising and lowering the settings.
Loss of synchronization, hunting, and/or over current occur at low speeds (at the lowest frequency (switch) or even lower) and with a heavy load.		• Adjust by decrementing the current limit of IVMS threshold [Hd-51] by 5 each time. Some motor characteristics may provide instability with excessively small settings. • Adjust by decrementing the IVMS threshold gain [Hd-52] by 5 each time. Some motor characteristics require an adjustment by raising and lowering the settings.
The drive becomes unstable at low speeds (at the lowest frequency (switch) or even lower).	• Misalignment of the output phases and the motor's magnetic-pole positions	• Adjust by decrementing the IVMS detection current filter gain [Hd-42] by 5 each time. Some motor characteristics require an adjustment by raising and lowering the settings. • Adjust the waiting time for open-phase switching [Hd-47] by incrementing it by 5 each time. Some motor characteristics require an adjustment by raising and lowering the settings.

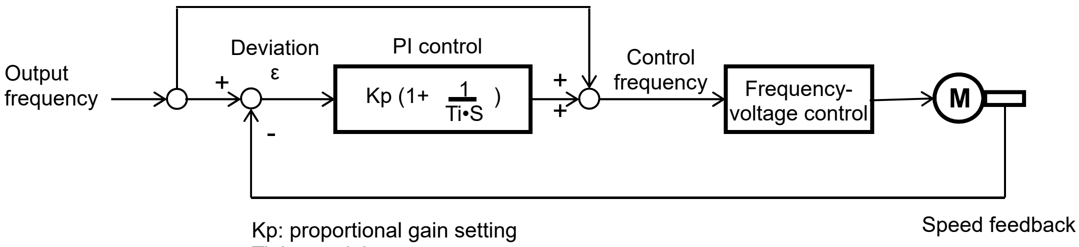
- When the above-described procedures fail to allow successful adjustment, special adjustment may be necessary. Please contact the sales officer of our company.

12.9.13 Use V/f control with sensor (constant torque characteristics)

- The feedback of the encoder signal from the motor allows highly accurate frequency control.
- For the adjustment of V/f control (constant torque characteristics), see "12.9.2 Drive with V/f control (constant torque characteristics)."

- When [CA-90] = 02, Input terminals [DFH] and [DHH] are switched to the terminals for feedback control.
  When [CA-90] ≠ 02, terminals [EA] and [EB] of the feedback option HF-FB are enabled.
  See "12.9.17 Use encoder."

- In the V/f control with feedback (FB), a correction of PI control is conducted on the command frequency for the fed-back frequency to control the motor.



Kp: proportional gain setting
Ti: integral time
Ki: integral gain setting (Ki = Ti/Kp)
s: operator
ε: deviation

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	04	To use V/f control with sensor (constant torque characteristics).
Control with sensor slip compensation P gain	[Hb170]	0~1000(%)	This is the P gain for the slip compensation of control with sensor.
Control with sensor slip compensation I gain	[Hb171]		This is the I gain for the slip compensation of control with sensor.

- Please refer to the following in addition to the notes for each control mode.

Phenomenon►	Estimated cause(s)►	Exemplar measures to be taken
• The motor speed follows the command slowly.	• Response of the output is slow and the change in the fed-back value is slow.	• Increment the proportional (P) gain [Hb170].
• The motor operates unstably. • Overshoot and/or hunting occur.	• Response to the fed-back value is too quick.	• Decrement the proportional (P) gain [Hb170].
• The motor speed oscillates gently. • Stabilization of the operation requires a long time.	• Response to the integral operation is slow.	• Increment the integral (I) gain [Hb171].
• It takes time for the command value and the motor speed to be equal to each other.	• Response of the output is slow and the change in the fed-back value is slow.	• Decrement the integral (I) gain [Hb171].

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like.
  When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

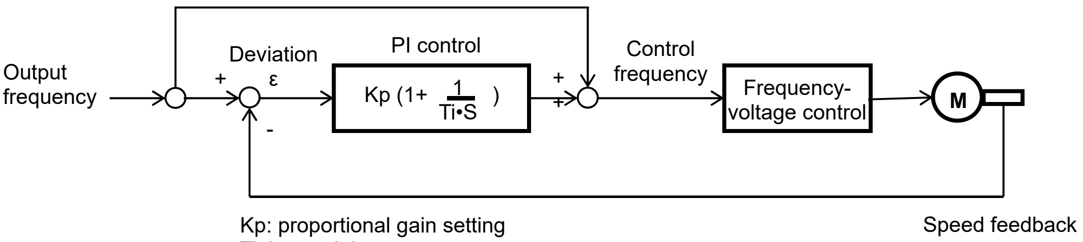
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change frequencies automatically, such as the stall prevention function, non-stop at momentary-stop, and over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.14 Use V/f control with sensor (reducing torque characteristics)

- The feedback of the encoder signal from the motor allows highly accurate frequency control.
- For the adjustment of V/f control (reducing torque characteristics), see "12.9.3 Drive with V/f control (reducing torque characteristics)."

- When [CA-90] = 02, Input terminals [DFH] and [DHH] are switched to the terminals for feedback control. When [CA-90] ≠ 02, terminals [EA] and [EB] of the feedback option HF-FB are enabled. See "12.9.17 Use encoder."

- In the V/f control with feedback (FB), a correction of PI control is conducted on the command frequency for the fed-back frequency to control the motor.



Kp: proportional gain setting
Ti: integral time;
Ki: integral gain setting (Ki = Ti/Kp)
s: operator
ε: deviation

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	05	To use V/f control with sensor (reducing torque characteristics).
Control with sensor slip compensation P gain	[Hb170]	0~1000(%)	This is the P gain for the slip compensation of control with sensor.
Control with sensor slip compensation I gain	[Hb171]		This is the I gain for the slip compensation of control with sensor.

- Please refer to the following in addition to the notes for each control mode.

Phenomenon▸	Estimated cause(s)▶	Exemplar measures to be taken
• The motor speed follows the command slowly.	• Response of the output is slow and the change in the fed-back value is slow.	• Increment the proportional (P) gain [Hb170].
• The motor operates unstably. • Overshoot and/or hunting occur.	• Response to the fed-back value is too quick.	• Decrement the proportional (P) gain [Hb170].
• The motor speed oscillates gently. • Stabilization of the operation requires a long time.	• Response to the integral operation is slow.	• Increment the integral (I) gain [Hb171].
• It takes time for the command value and the motor speed to be equal to each other.	• Response of the output is slow and the change in the fed-back value is slow.	• Decrement the integral (I) gain [Hb171].

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like. When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

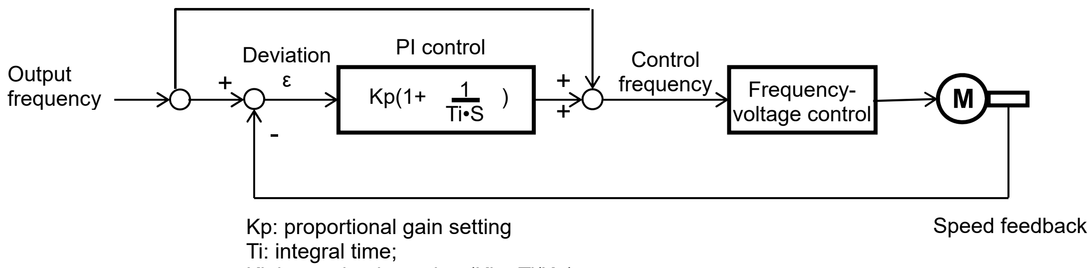
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change frequencies automatically, such as the stall prevention function, non-stop at momentary-stop, and over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.15 Use free V/f control with sensor

- The feedback of the encoder signal from the motor allows highly accurate frequency control.
- For the adjustment of V/f control (free V/f), see "12.9.4 Drive with V/f control (free V/f)."

- When [CA-90] = 02, Input terminals [DFH] and [DHH] are switched to the terminals for feedback control. When [CA-90] ≠ 02, terminals [EA] and [EB] of the feedback option HF-FB are enabled. See "12.9.17 Use encoder."

- In the V/f control with feedback (FB), a correction of PI control is conducted on the command frequency for the fed-back frequency to control the motor.



Kp: proportional gain setting
Ti: integral time;
Ki: integral gain setting (Ki = Ti/Kp)
s: operator
ε: deviation

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	06	To use V/f control with sensor (free V/f).
Control with sensor slip compensation P gain	[Hb170]	0~1000(%)	This is the P gain for the slip compensation of control with sensor.
Control with sensor slip compensation I gain	[Hb171]		This is the I gain for the slip compensation of control with sensor.

- Please refer to the following in addition to the notes for each control mode.

Phenomenon►	Estimated cause(s)►	Exemplar measures to be taken
• The motor speed follows the command slowly.	• Response of the output is slow and the change in the fed-back value is slow.	• Increment the proportional (P) gain [Hb170].
• The motor operates unstably. • Overshoot and/or hunting occur.	• Response to the fed-back value is too quick.	• Decrement the proportional (P) gain [Hb170].
• The motor speed oscillates gently. • Stabilization of the operation requires a long time.	• Response to the integral operation is slow.	• Increment the integral (I) gain [Hb171].
• It takes time for the command value and the motor speed to be equal to each other.	• Response of the output is slow and the change in the fed-back value is slow.	• Decrement the integral (I) gain [Hb171].

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like.
  When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.

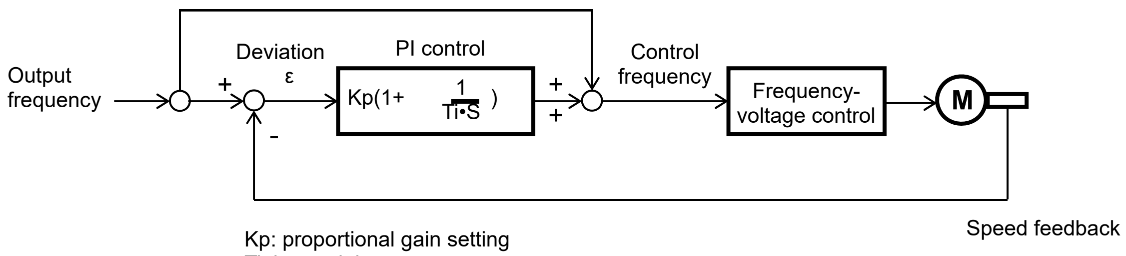
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], a functions which change frequencies automatically, such as the stall prevention function, non-stop at momentary-stop, and over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.16 Use automatic boost function with sensor

- The feedback of the encoder signal from the motor allows highly accurate frequency control.
- For the adjustment of the automatic boost control, see, "12.9.7 Automatically adjust torque."

- When [CA-90] = 02, Input terminals [DFH] and [DHH] are switched to the terminals for feedback control.
  When [CA-90] ≠ 02, terminals [EA] and [EB] of the feedback option HF-FB are enabled.
  See "12.9.17 Use encoder."

- In the V/f control with feedback (FB), a correction of PI control is conducted on the command frequency for the fed-back frequency to control the motor.



Kp: proportional gain setting
Ti: integral time
Ki: integral gain setting (Ki = Ti/Kp)
s: operator
ε: deviation

■Parameters

Item	Parameter	Data	Description
Control mode	[AA121]	07	To use the automatic torque boost with sensor.
Control with sensor slip compensation P gain	[Hb170]	0~1000(%)	This is the P gain for the slip compensation of control with sensor.
Control with sensor slip compensation I gain	[Hb171]	0~1000(%)	This is the I gain for the slip compensation of control with sensor.

• Please refer to the following in addition to the notes for each control mode.

Phenomenon►	Estimated cause(s)►	Exemplar measures to be taken
• The motor speed follows the command slowly.	• Response of the output is slow and the change in the fed-back value is slow.	• Increment the proportional (P) gain [Hb170].
• The motor operates unstably. • Overshoot and/or hunting occur.	• Response to the fed-back value is too quick.	• Decrement the proportional (P) gain [Hb170].
• The motor speed oscillates gently. • Stabilization of the operation requires a long time.	• Response to the integral operation is slow.	• Increment the integral (I) gain [Hb171].
• It takes time for the command value and the motor speed to be equal to each other.	• Response of the output is slow and the change in the fed-back value is slow.	• Decrement the integral (I) gain [Hb171].

- When the revolution of the motor is hindered by breaking or the motor lock caused by foreign objects may cause over current or the like. When no such adjustment as ones mentioned above improves the state, checking the portion around the motor may sometimes improves it.
- If an application of load results in a great amount of change in the inverter's output frequency monitor [dA-01], functions which change frequencies automatically, such as the stall prevention function, non-stop at momentary-stop, and over voltage suppression function may work depending upon the settings of the functions. For details, see "Chap. 18: Troubleshooting."

12.9.17 Use encoder

- In HF-430NEO, the control with sensor and the absolute position control can be conducted by inputting the feedback from the motor into the controller circuit terminal table of the main body or into the feedback option HF-FB.

- When [CA-90] ≠ 00, Input terminals [DFH] and [DHH] of the main body are switched to the terminals for feedback control.
- When [CA-90] = 02, the control with sensor and the absolute position control are possible with Input terminals [DFH] and [DHH].
- When [CA-90] ≠ 02, the control with sensor and the absolute position control are possible with terminals [EAP], [EBP], [EAN], and [EBN] of the feedback option HF-FB.
- To conduct the pulse train position control, terminals [SAP], [SBP], [SAN], and [SBN] of the feedback option HF-FB are used.
- When the feedback option HF-FB was once set in a slot and was removed later, a trip occurs with a feedback option connection error [E112].
- Trips are triggered by an encoder disconnection error [E100] by setting switches on the feedback option HF-FB. For more details, see the instruction manual of HF-FB.

■Parameters

Item	Parameter	Data	Description
Encoder constant set-up	[CA-81]	0~65535(pls)	Setting the encoder constant
Encoder phase sequence selection	[CA-82]	00	Phase-A is leading.
		01	Phase-B is leading.
Motor gear ratio's numerator	[CA-83]	1~10000	Setting the numerator of the gear ratio of a motor.
Motor gear ratio's denominator	[CA-84]		Setting the denominator of the gear ratio of a motor.
Pulse train input (main body) detection target selection	[CA-90]	00	PCNT function
		01	Command
		02	Control with speed feedback
		03	Pulse count
Pulse train input (main body) mode selection	[CA-91]	00	MD0: 90-degree phase difference pulse train
		01	MD1: Forward-backward rotation command + pulse train
		02	MD2: Forward-rotation pulse train + backward-rotation pulse train.
Encoder constant set-up (HF-FB)	[ob-01]	0~65535(pls)	Setting the encoder constant
Encoder phase sequence selection (HF-FB)	[ob-02]	00	Phase-A is leading.
		01	Phase-B is leading.
Motor gear ratio's numerator (HF-FB)	[ob-03]	1~10000	Setting the numerator of the gear ratio of a motor.
Motor gear ratio's denominator (HF-FB)	[ob-04]		Setting the denominator of the gear ratio of a motor.
Pulse train input SA/SB (HF-FB) detection target selection	[ob-10]	00	Command
		01	Pulse train position command
Pulse train input SA/SB (HF-FB) mode selection	[ob-11]	00	MD0: 90-degree phase difference pulse train
		01	MD1: Forward-backward rotation command + pulse train
		02	MD2: Forward-rotation pulse train + backward-rotation pulse train.

■Encoder's setting table

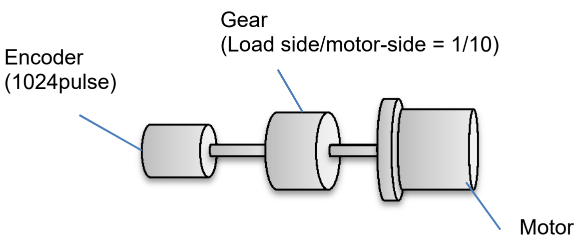
	Setting description	Terminals [DFH] and [DHH] of main body	Terminals [EAP], [EBP], [EAN], and [EBN] of HF-FB.
(1)	Encoder constant set-up	[CA-81]	[ob-01]
(2)	Encoder phase-sequence selection	[CA-82]	[ob-02]
(3)	Encoder gear ratio's numerator	[CA-83]	[ob-03]
(4)	Encoder's gear ratio's denominator	[CA-84]	[ob-04]

- Table (1) Encoder constant-setup sets up the actual number of pulses of the encoder based on the terminals to be used.
- Table (2) encoder phase sequence selection is set up in accordance with the encoder's phase sequence.
- When [CA-90] = 02, the main-body speed feedback is enabled while [CA-90] ≠ 02, HF-FB speed feedback is enabled.

- When either [CA-82] or [ob-02] = 00, meaning that phase-A is leading, and when the operation is of forward rotation, the phase of the phase-A advances 90-degrees more than that of the phase-B in a normal case.
- When either [CA-82] or [ob-02] = 01, meaning that phase-B is leading, and when the operation is of forward rotation, the phase of the phase-B advances 90-degrees more than that of the phase-A in a normal case.
- To check if the encoder input into the main body or into HF-FB is correct, set [AA121] = 00, meaning V/f control (00), and check the monitor for the [dA-08] frequency detection values.
  The wiring is correct if the forward operation [FR] has a positive (+) value and if the reversal operation [RR] has a negative (-) value.
  If it is incorrect, either revising the wiring or switching the corresponding encoder phase sequence selection [CA-82] or [ob-02].

■Adjustment in cases where a gear exists between the motor and the encoder.
- When the encoder and the motor shaft are connected to each other by means of a gear, for Tables (3) and (4) conversion is made possible by setting up (3) Encoder gear-ratio's numerator/ (4) encoder gear-ratio's denominator.
- Set the values ((3)/ (4)) so as to be within a range between (1/50) to (20).

- An exemplar case where a gear is attached there.



- When the encoder's rotating rate for the motor's standard encoder becomes 1/10 for 1024 pulses,
  Table (1) Encoder constant set-up: 1024 pulses
  Table (3): Encoder's gear ratio's numerator: 1.
  Table (4): Encoder's gear ratio's denominator: 10
  Set up as above.

■Encoder's speed detection
- To acquire the frequency that was input through the encoder, the following settings are necessary.
  - Set-up of Tables (1), (3), and (4)
  - Set-up of the number of motor poles
  * When the selected control mode [AA121] is the induction motor control ([AA121] = 00 to 10), IM motor's number of motor poles [Hb103] is set as the number of motor poles.

■Set-up of functions of the encoder feedback.

1 Check the encoder's set-up from the encoder's specifications.

(1) Check the encoder's or the pulse trains' input specs.

(2) Open collector input	(3) Line driver input
(See, "7.7.3 Wiring portion under the controller circuit.")	(See, HF-FB's instruction manual)
Control using the HF-430NEO main body's terminals [DFH] and [DHH] ⇒ Set [CA-90] = 02.	Control using HF-FB's [EAP], [EAN], [EBP], and [EBN] ⇒ Check that [CA-90] ≠ 02.

2 Set up the control method.

(1) Check whether the speed control or the position control is to be conducted with the control with sensor.

(2) Conduct the speed control with sensor.	(3) Conduct the absolute position control.
In accordance with the mode to be used, select one of the following three controls: • V/f control with sensor ([AA121] = 04 to 06) • Automatic boost with sensor ([AA121] = 07) • Vector control with sensor ([AA121] = 10) (see, "12.9.1 Selection of control mode.") * When [AA121] = 10, the vector control mode selection [AA123] = 00.	Select the vector control with sensor ([AA121] = 10), and set as the vector control mode selection [AA123] either • 02: Absolute position control; or • 03: High-resolution absolute position control (See, "12.17.8 Stop at predetermined position)

12.9.18 Check the set-up for the pulse train input.

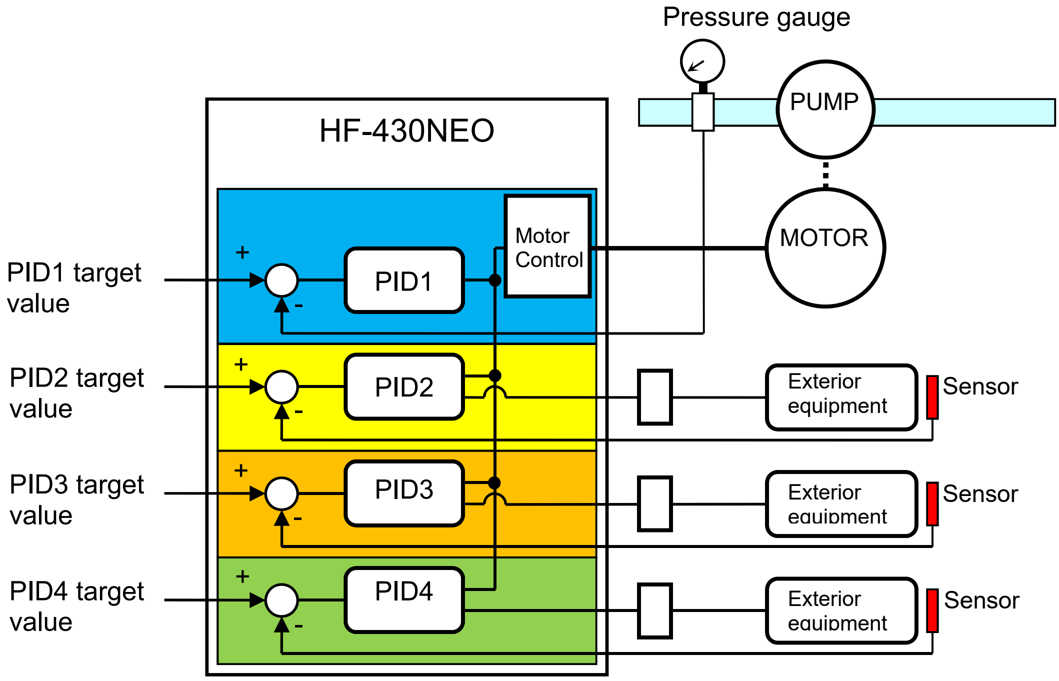
Function to be used	Setting check	For pulse-train input
Speed control with sensor	Necessary settings • Control with sensor ([AA121] = 04 to 07) or • Vector control with sensor ([AA121] = 10 and [AA123] = 00) • Selection of target for pulse train input detection ([CA-90], See the right-hand side.) Related section "12.9 Select motor control method in accordance with motor and load"	• Input into HF-430NEO main body's terminals [DFH] and [DHH] ([CA-90] = 02) • Input into P1-FB's terminals [EAP], [EAN], [EBP], and [EBN] ([CA-90] ≠ 02).
Speed-torque control with sensor	Necessary settings • Vector control with sensor ([AA121] = 10 and [AA123] = 00) • Selection of target for pulse train input detection ([CA-90], See the right-hand side.) Related section "12.9.11 Use vector control with sensor" "12.11 Control torque in accordance with load"	
Absolute position control	Necessary settings • Vector control with sensor ([AA121] = 10 and [AA123] = 02, or [AA121] = 10 and [AA123] = 03) • Selection of target for pulse train input detection ([CA-90], See the right-hand side.) Related section "12.9.11 Use vector control with sensor" "12.17.9 Control in the origin-based absolute position"	
Pulse train position control	Necessary settings • Vector control with sensor ([AA121] = 10 and [AA123] = 01) • Pulse train input SA/SB ([ob-10] = 01) Related section "12.17.7 Conduct pulse train position control"	• To input HF-FB's terminals [SAP], [SAN], [SBP], and [SBN]. The following items can be used for the motor's vector control. • Input into HF-430NEO main body's terminals [DFH] and [DHH] ([CA-90] = 02) • Input into HF-FB's terminals [EAP], [EAN], [EBP], and [EBN] ([CA-90] ≠ 02).
Pulse train frequency command (main body)	Necessary settings • Frequency command ([AA101] = 12) • Selection of target for pulse train input detection ([CA-90] = 01) Related section "12.4.6 Make pulse train input command."	• Input into HF-430NEO main body's terminals [DFH] and [DHH].
Pulse train frequency command (HF-FB)	Necessary settings • Frequency command ([AA101] = 13) • Pulse train input SA/SB ([ob-10] = 00) Related section "12.4.6 Make pulse train input command."	• To input HF-FB's terminals [SAP], [SAN], [SBP], and [SBN].
Pulse count	Necessary settings • Selection of target for pulse train input detection ([CA-90] = 03) Related section "12.24.6 Check number of input pulses."	• Input into P1 main body's terminals [DFH] and [DHH].

- The following table lists a function where a function of inputting the related pulse train into the main body's terminals [DFH] and [DHH], and into the HF-FB's terminals: [EAP], [EAN], [EBP], [EBN], [SAP], [SAN], [SBP], and [SBN].

12.10 PID Control

12.10.1 Use PID Control

- HF-430NEO is equipped with 4 independent PID functions, and each PID can be set independently.
- Four PID functions can be used for motor control by switching the [PIO1]/ [PIO2] terminals.
- PID not used for motor control can be used for operation of exterior PID not related to inverter control freely. This helps to save space and cost because there is no need to install a separate PID controller.
- PID1 can be controlled based on 3 deviations.
- Connecting PID1 and PID2 can make 2-layer PID control possible.



- For PID control, you can select feed-forward control to attempt stabilizing disturbance in advance, in addition to feedback control to stabilize disturbance.

- To control output frequency sent to the motor by the PID function, selection of PID1-4 and setting of frequency command are required.

- In the soft-start function, operating normally for a certain period of distance at the start can raise output automatically and then shift to PID control. See "12.10.5 PID Soft-Start Function".

- Sleep mode operation, which is more energy saving, can be set for when the flow rate or air volume is increased. See "12.10.6 PID Sleep Condition Selection Function".

- During PID operation, PID functions are disabled and normal output is performed with the command selected as a target value, while the input terminal function [PID] signal is ON.

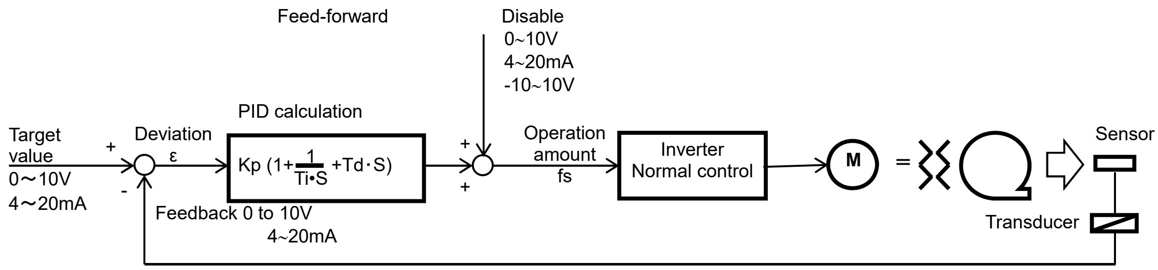
- Multi-layer command by PID control command is feasible.

- In the case of controlling the motor by PID control, frequency command destination needs to be set to PID output.
- The upper/lower limiter function operates for command frequency by PID output. It does not operate for PID target value.

e.g.) Follow the steps below to perform simple PID control by inputting a target value [VRF] and a feedback (FB) value [IRF] from where parameters are default.

[1] Set [AH-01] to 01 (enable)
[2] Set 15 (PID calculation) to the main speed command selection [AA101]
[3] Set 01 (Ai1) to the PID1 target value 1 input destination [AH-07]
[4] Set 02 (Ai2) to the PID1 FB 1 input destination [AH-07]
[5] Set the PID gain of PID1 to [AH-61] to [AH-63]
[6] Put the command set to operation command selection [AA111] and start PID control

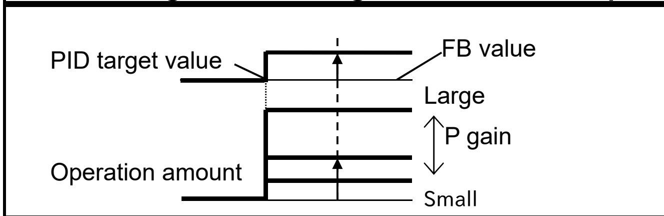
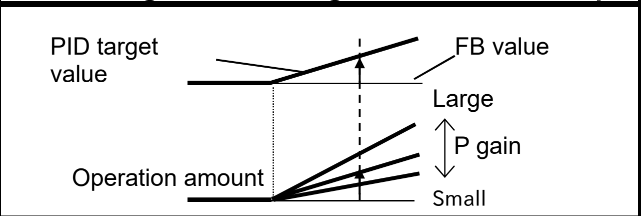
■Basic composition of PID control



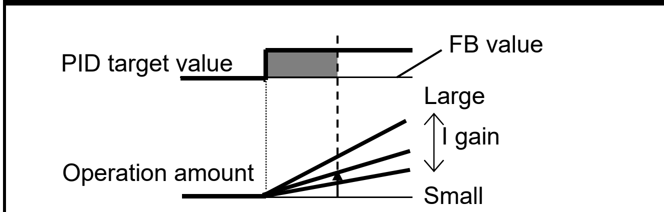
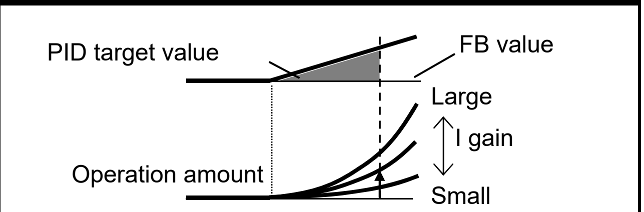
Kp: Proportional gain
Ti: Integral time
Td: Differential time
s: Operator
ε: Deviation
Ki: Integral gain setting (Ki=Ti/Kp)
Kd: Differential gain setting (Kd=Kp×Td)

■PID operation
- This section explains of a situation when PID target value is constant and feedback (FB) value is changed by using an example.

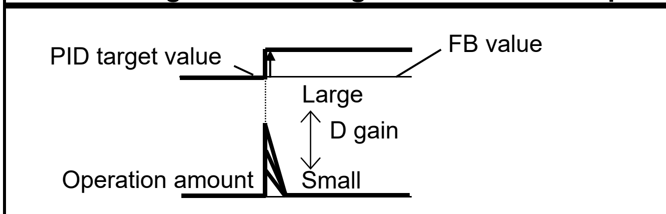
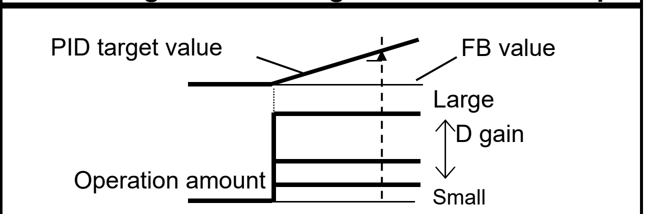
[1] P operation: P gain Kp
- This is an operation that an operation amount of PID command value is proportional to the deviation between PID target value and current feedback (FB) value.
- Command operation amount can be adjusted by P gain.
- Deviation becomes (PID target value - FB value).

When target value changed to above the step	When target value changed to above the ramp
	

[2] I operation: I gain Ki (=Ti/Kp)
- This is an operation that an operation amount of PID command value is proportional to the time integral value of the deviation between PID target value and current feedback (FB) value.
- Command operation amount can be adjusted by I gain.
- Integral value can be cleared by the PIDC terminal function.
- Because output change becomes smaller as PID target value and FB value come closer based on an operation amount and it takes time to reach the target value in P operation, it is compensated with I operation.

When target value changed to above the step	When target value changed to above the ramp
	

[3] D operation: D gain Kd (=Kp × Td)
- This is a n operation that an operation amount of PID command value is proportional to the change of the deviation between PID target value and current feedback (FB) value.
- Command operation amount can be adjusted by D gain.
- D operation has an effect to compensate the responsiveness of P operation and I operation.

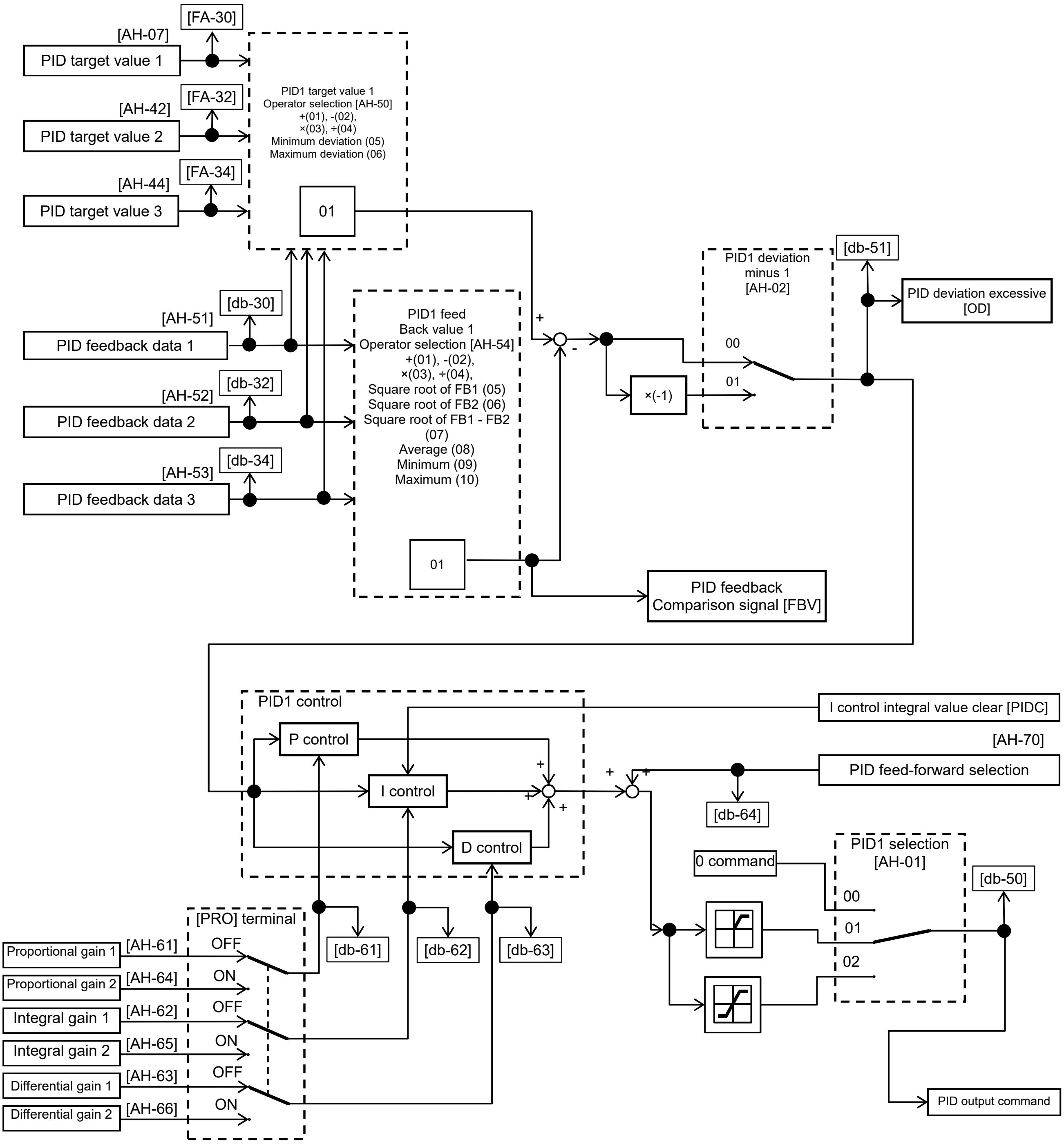
When target value changed to above the step	When target value changed to above the ramp
	

- PI operation is an operation with [1] and [2] combined.
- PD operation is an operation with [1] and [3] combined.
- PID operation is an operation with [1], [2] and [3] combined.

12.10.2 Use PID1

- PID1 can receive 3 inputs together with PID target value/PID feedback value.
- Check the following schematic diagram.
- PID gain 1 and 2 can be switched by the input terminal function [PRO].
- PID1 output can be used as a target value of PID2.

■Block diagram of PID1 control



■Parameter

Item	Parameter	Data	Description
PID1 selection	[AH-01]	00	Disable
		01	Enable (if command becomes negative, it does not output in a reverse direction)
		02	Enable (if command becomes negative, it outputs in a reverse direction)
PID1 deviation negative	[AH-02]	00	Disable
		01	Disable (polarity inversion of deviation)
PID1 target value 1 input destination selection	[AH-07]	00~13	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-10] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 1 set value 1	[AH-10]	-100.00~100.00(%)	This is a set value 1 of PID1 target value 1.
PID1 target value 2 input destination selection	[AH-42]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 2 set value	[AH-44]	-100.00~100.00(%)	This is a set value of PID1 target value 2.
PID1 target value 3 input destination selection	[AH-46]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-48] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 3 set value	[AH-48]	-100.00~100.00(%)*1)	This is a set value of PID1 target value 3.
PID1 target value 1 operator selection	[AH-50]	01	(Target value 1) + (Target value 2)
		02	(Target value 1) - (Target value 2)
		03	(Target value 1) x (Target value 2)
		04	(Target value 1) / (Target value 2)
		05	Minimum deviation among input destinations 1, 2, and 3
		06	Maximum deviation among input destinations 1, 2, and 3

*1) Data range varies according to [AH-04] - [AH-06] settings.

Item	Parameter	Data	Description
PID1 feedback Data 1 Input destination selection	[AH-51]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input, 06: Ai6-COM input/08: RS 485 communication 09: Option 1/10: Option 2/11: Option 3 12: Pulse train input (main unit), 13: Pulse train input (HF-FB)
PID1 feedback Data 2 Input destination selection	[AH-52]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input, 06: Ai6-COM input/08: RS 485 communication 09: Option 1/10: Option 2/11: Option 3 12: Pulse train input (main unit), 13: Pulse train input (HF-FB)
PID1 feedback Data 3 Input destination selection	[AH-53]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input /03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/08: RS 485 communication 09: Option 1/10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 feedback Operator selection	[AH-54]	01	(FB1)+(FB2)
		02	(FB1)-(FB2)
		03	(FB1)×(FB2)
		04	(FB1)÷(FB2)
		05	Square root of FB1
		06	Square root of FB2
		07	Square root of (FB1 - FB2)
		08	Average of FB1/FB2/FB3
		09	Minimum of FB1/FB2/FB3
		10	Maximum of FB1/FB2/FB3
PID1 gain switch	[AH-60]	00	Disable (gain 1 is used)
		01	Switch by [PRO] terminal
PID1 proportional (P) gain 1	[AH-61]	0.0~100.0	Proportional gain
PID1 integral (I) gain 1	[AH-62]	0.0~3600.0(s)	Integral gain
PID1 differential (D) gain 1	[AH-63]	0.00~100.00(s)	Differential gain
PID1 proportional (P) gain 2	[AH-64]	0.0~100.0	Proportional gain
PID1 integral (I) gain 2	[AH-65]	0.0~3600.0(s)	Integral gain
PID1 differential (D) gain 2	[AH-66]	0.00~100.00(s)	Differential gain
PID1 gain switch time	[AH-67]	0~10000(ms)	Time for switch by [PRO] terminal operation
PID feed-forward selection	[AH-70]	00	Disable
		01	[VRF terminal input
		02	[IRF] terminal input
		03	[VF2] terminal input
		04	[Ai4] terminal input
		05	[Ai5] terminal input
		06	[Ai6] terminal input

■Input terminal function

Item	Terminal name	Data	Description
PID disable function	[PID]	041	Disables the PID1 function by turning ON the terminal function. When disabled, operation is done by using the command set for target value as command frequency.
PID1 I control integral value clear	[PIDC]	042	Clears integral value of PID1 control.
Multi-layer target command terminal 1	[SVC1]	051	Switches multiple target values.
Multi-layer target command terminal 2	[SVC2]	052	
Multi-layer target command terminal 3	[SVC3]	053	
Multi-layer target command terminal 4	[SVC4]	054	
PID gain switch	[PRO]	055	Switches PID gain 1 and 2 by terminal.

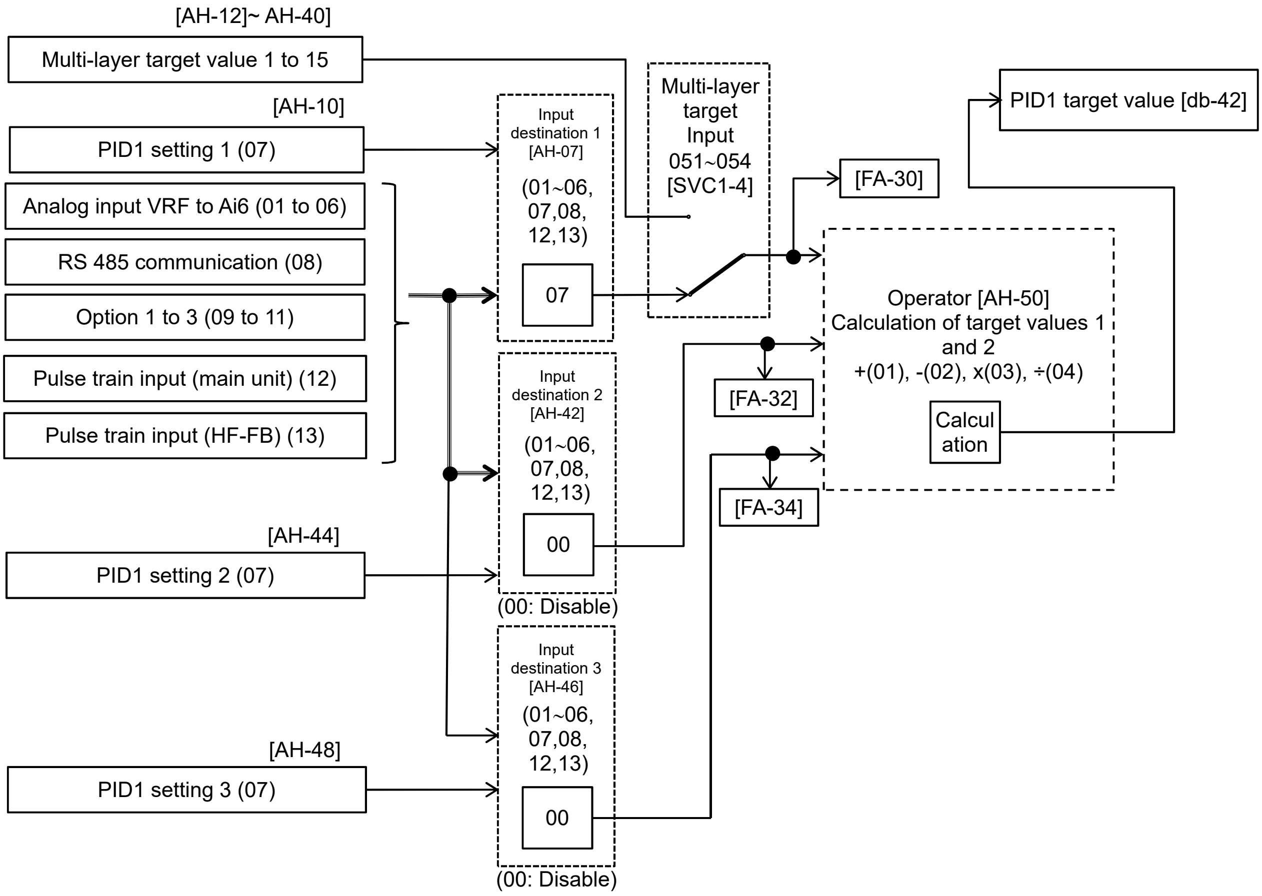
■Data monitor function

Item	Parameter	Data	Description
PID1 target value 1	[FA-30]	-100.00~100.00(%)*1)	Displays PID1 target value. This value is changeable when [AH-07] = 07 or multi-layer target value 1-15 is enabled.
PID1 target value 2	[FA-32]		Displays PID1 target value 2. This value is changeable when [AH-42] = 07.
PID1 target value 3	[FA-34]		Displays PID1 target value 3. This value is changeable when [AH-46] = 07.
PID1 feedback monitor 1	[db-30]		Displays PID1 feedback value 1.
PID1 feedback monitor 2	[db-32]		Displays PID1 feedback value 2.
PID1 feedback monitor 3	[db-34]		Displays PID1 feedback value 3.
PID1 target value monitor (after calculation)	[db-42]		Displays target value after calculation by [AH-50].
PID1 feedback monitor (after calculation)	[db-44]		Displays feedback value after calculation by [AH-54].
PID1 output monitor	[db-50]	-100.00~100.00(%)	Displays PID1 output value.
PID1 deviation monitor	[db-51]		Displays PID1 deviation.
PID1 deviation 1 monitor	[db-52]		Monitors 3 deviations of PID1 when [AH-50] = 05 or 06.
PID1 deviation 2 monitor	[db-53]		
PID1 deviation 3 monitor	[db-54]		
PID current P gain monitor	[db-61]	0.0~100.0	Displays current P gain.
PID current I gain monitor	[db-62]	0.00~3600.00(s)	Displays current I gain.
PID current D gain monitor	[db-63]	0.00~100.00(s)	Displays current D gain.
PID feed-forward monitor	[db-64]	-100.00~100.00(%)	Displays feed-forward command value.

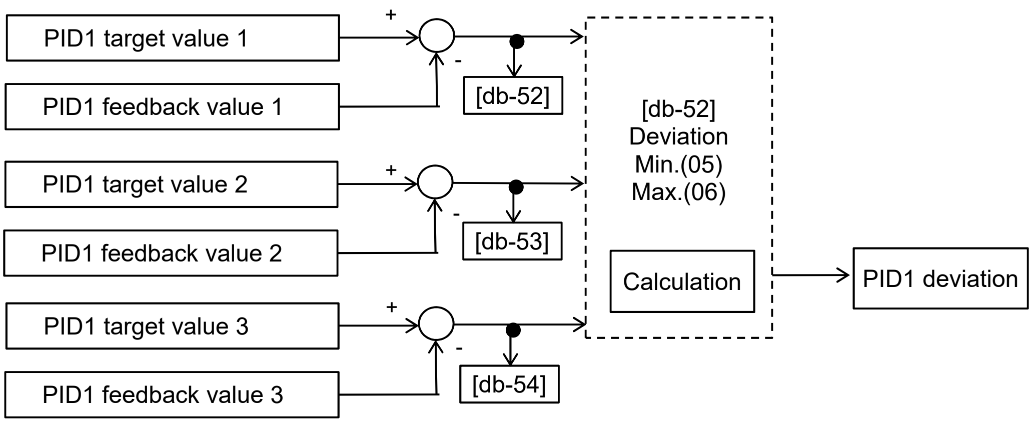
*1) Data range varies according to [AH-04] - [AH-06] settings.

■PID1 target value selection
- Select PID1 target value.
- In the case of setting target value with one input, set 00: None to [AH-42]/[AH-46] and 01: Add to [AH-50] to disable the input destination 2/3.
- Calculation result of operator [AH-50] will be restricted in a range of -100.00 to 100.00 (%).
- When 01 to 04 is selected in operator [AH-50], calculation is targeted to target value 1 and target value 2.

■When operator [AH-50] is 01 to 04



■When operator [AH-50] uses 05 or 06
- When 05 or 06 is selected in operator [AH-50],
  (Target value 1) - (Feedback value 1)
  (Target value 2) - (Feedback value 2)
  (Target value 3) - (Feedback value 3)
  these 3 deviations are compared and PID calculation is performed by using the deviation of minimum (05)/maximum (06).
- Select 00: Disable for target value and feedback value not in use.



■PID target value multi-layer switch function

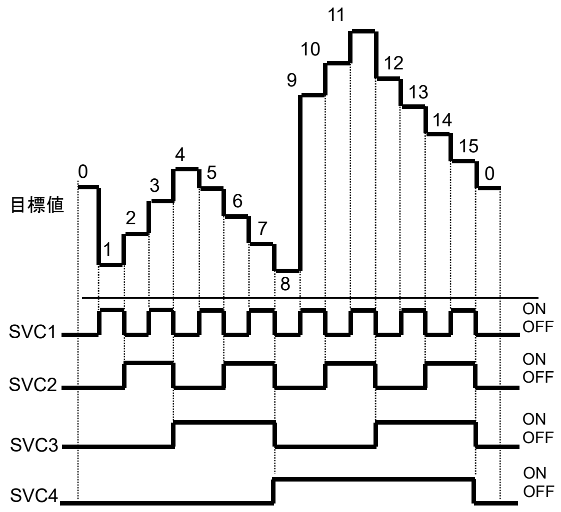
- PID1 multi-layer target value (0 to 15 speed) become selectable by assigning 051 to 054 ([SVC1] to [SVC4]) to input terminals FR to RST, DFH or DHH selection [CA-01] to [CA-11].
- Stand-by time until terminal input finalization is settable by multi-layer input finalize time [CA-55]. It prevents the transition status of switching terminals from being selected.
- Data is finalized after the elapse of a set time for [AC-55] without input changes. Please be noted that setting a longer finalize time makes the input response slow.

■Operation table

Multi-layer target	SVC4	SVC3	SVC2	SVC1	Parameter
Target value 0	OFF	OFF	OFF	OFF	[AH-10]*1)
Target value 1	OFF	OFF	OFF	ON	[AH-12]
Target value 2	OFF	OFF	ON	OFF	[AH-14]
Target value 3	OFF	OFF	ON	ON	[AH-16]
Target value 4	OFF	ON	OFF	OFF	[AH-18]
Target value 5	OFF	ON	OFF	ON	[AH-20]
Target value 6	OFF	ON	ON	OFF	[AH-22]
Target value 7	OFF	ON	ON	ON	[AH-24]
Target value 8	ON	OFF	OFF	OFF	[AH-26]
Target value 9	ON	OFF	OFF	ON	[AH-28]
Target value 10	ON	OFF	ON	OFF	[AH-30]
Target value 11	ON	OFF	ON	ON	[AH-32]
Target value 12	ON	ON	OFF	OFF	[AH-34]
Target value 13	ON	ON	OFF	ON	[AH-36]
Target value 14	ON	ON	ON	OFF	[AH-38]
Target value 15	ON	ON	ON	ON	[AH-40]

*1) When [AH-07] = 07. Follow the setting of [AH-07].

■Operation graph



■Input terminal function

Item	Terminal name	Data	Description
Multi-layer target command terminal 1	[SVC1]	051	Switches multiple target values.
Multi-layer target command terminal 2	[SVC2]	052	
Multi-layer target command terminal 3	[SVC3]	053	
Multi-layer target command terminal 4	[SVC4]	054	

•

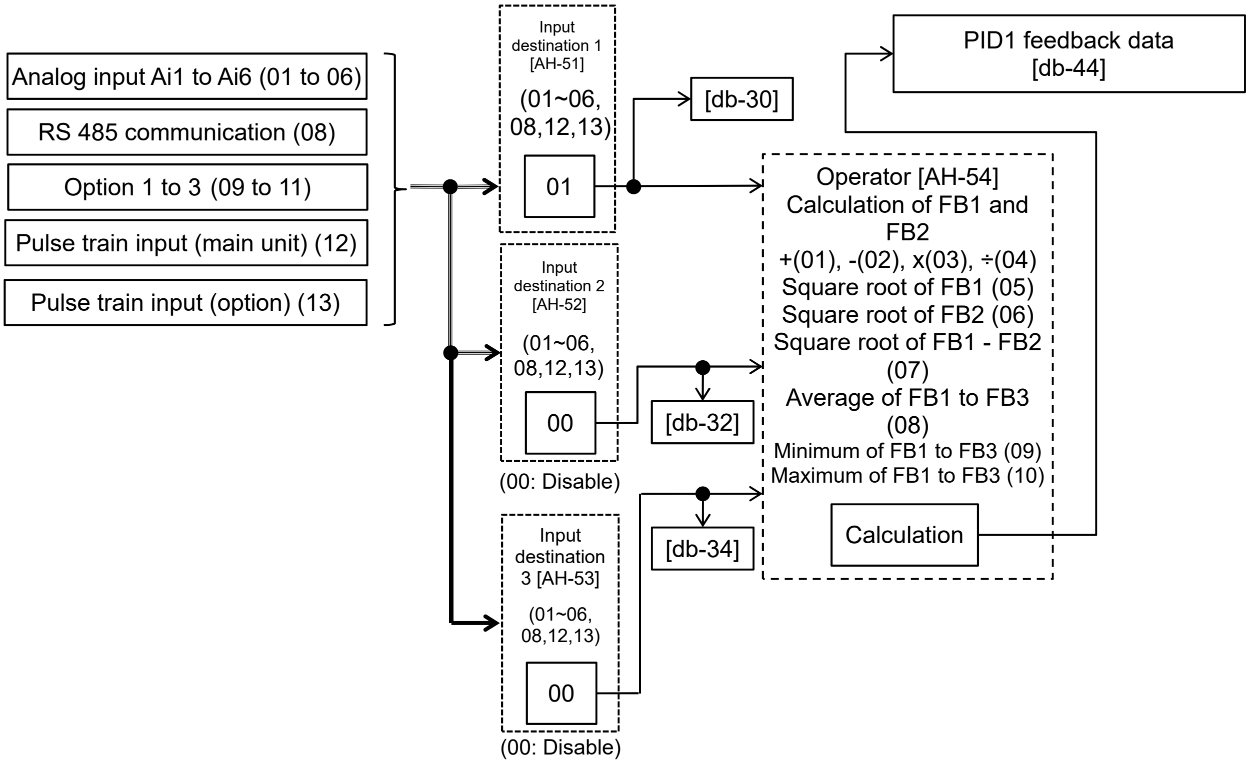
■PID1 target value selection

Item	Parameter	Data	Description
PID1 target value 1 input destination	[AH-07]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-10] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 1 set value	[AH-10]	0.00~100.00[%]*1)	Parameter set value.
PID1 multi-layer target value 1	[AH-12]		
PID1 multi-layer target value 2	[AH-14]		
PID1 multi-layer target value 3	[AH-16]		
PID1 multi-layer target value 4	[AH-18]		
PID1 multi-layer target value 5	[AH-20]		
PID1 multi-layer target value 6	[AH-22]		
PID1 multi-layer target value 7	[AH-24]		
PID1 multi-layer target value 8	[AH-26]		
PID1 multi-layer target value 9	[AH-28]		
PID1 multi-layer target value 10	[AH-30]		
PID1 multi-layer target value 11	[AH-32]		
PID1 multi-layer target value 12	[AH-34]		
PID1 multi-layer target value 13	[AH-36]		
PID1 multi-layer target value 14	[AH-38]		
PID1 multi-layer target value 15	[AH-40]		
PID1 target value 2 input destination selection	[AH-42]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 2 set value	[AH-44]	0.00~100.00[%]*1)	Parameter set value.
PID1 target value 3 input destination selection	[AH-46]	00~13	00: Invalid/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-48] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID1 target value 3 set value	[AH-48]	0.00~100.00[%]*1)	Parameter set value.
PID1 target value operator selection	[AH-50]	01	(Target value 1) + (Target value 2)
		02	(Target value 1) - (Target value 2)
		03	(Target value 1) x (Target value 2)
		04	(Target value 1) / (Target value 2)
		05	Minimum of deviation 1 (Target value 1 - FB 1) deviation 2 (Target value 2 - FB 2), and deviation 3 (Target value 3 - FB 3)
		06	Maximum of deviation 1 (Target value 1 - FB 1) deviation 2 (Target value 2 - FB 2), and deviation 3 (Target value 3 - FB 3)

*1) Data range varies according to [AH-04] - [AH-06] settings.

■PID1 feedback data selection

- This selects PID1 feedback data.
- In the case of setting feedback data with one input, set 00: None to [AH-52] [AH-53] and 01: Add to [AH-54] to disable the input destination 2/3.
- Calculation result of operator [AH-54] will be restricted in a range of -100.00 to 100.00 (%).



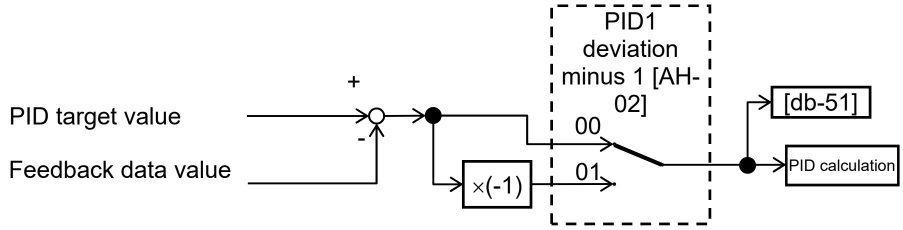
■Operation of operator [AH-54]

- When 01 to 07 is selected in operator [AH-54], calculation will be targeted to feedback data 1 and feedback data 2.
- When 08 to 10 is selected in operator [AH-54], calculation will be targeted to feedback data 1 to 3.

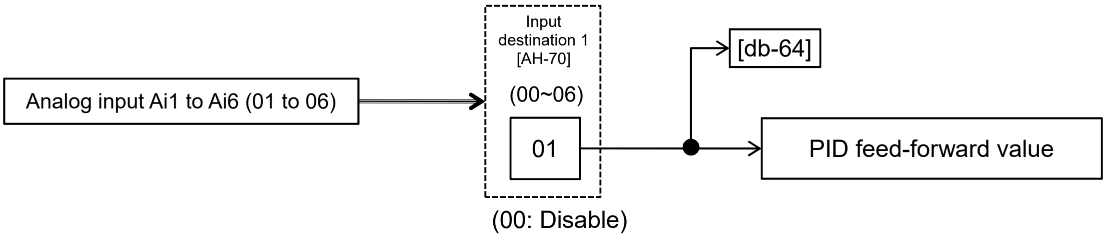
- Select 00: Disable for feedback value not in use.
- Operator [AH-54] will be available to be selected only when 01 to 04 is selected for target value operator [AH-50].

■Output of ± switching PID1 deviation
- Output is feasible by switching ± PID1 deviation.
- When PID1 deviation minus [AH-02] is 00, calculation will be performed by (PID target value - FB value). With 01, it will be the same operation as (FB value - PID target value).
- Use this when the polarity of deviation of PID target value and FB value does not much with the command from the inverter due to sensor characteristics, etc.

e.g.) Control the compressor for refrigerator.
When the temperature sensor specification is -20 to 100°C: 0 to 10 (V) and the target value is 0°C, and if the current temperature is 10°C, the speed will decrease in normal PID control as it is (FB value) > (PID target value).
- The inverter will raise the speed if [AH-02] = 01 is set.

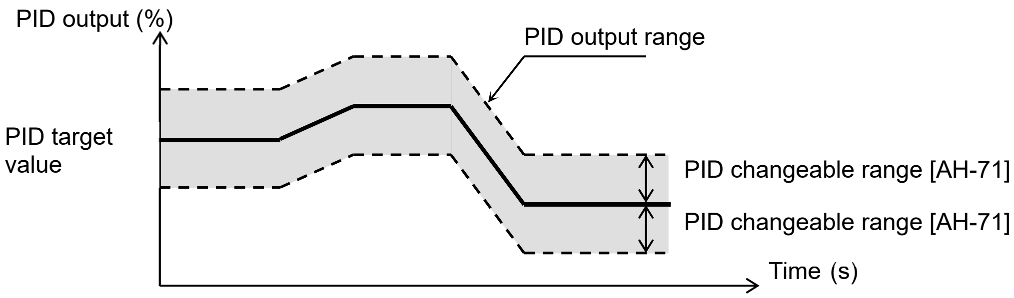


■PID1 feed-forward value selection
- Select PID1-feed forward value.
- Feed-forward control operates by setting [AH-70] to anything other than 00 (None).



■PID1 changeable range limitation
- PID output is restricted to a changeable range based on the target value.
- When [AH-71] is 0.00, the function will be disabled.

- In the case of using this function, set PID changeable range [AH-71].
  Restriction will be made in a range of PID target value ± [AH-71] with the maximum speed as 100%.



■Parameter

Item	Terminal name	Data	Description
PID changeable range	[AH-71]	0.00~100.00(%)	Changeable range based on the target value

■PID1 reverse output
- In normal PID control, the inverter does not output a negative figure for frequency command and limits at 0 Hz, when result of PID calculation was negative.
  If you select 02 (with reverse output) for PID1 selection [AH-01], frequency command can be output in a reverse direction, when result of PID calculation was negative.

- When [AH-01] is set to 02 (with reverse output), the PID changeable range limit function [AH-71] will be extended to the negative direction.

■PID1 I control integral reset function [PIDC]
- This is a function to clear the integral figure of PID operation.
- In the case of turning ON the [PIDC] terminal, do so when PID is not in operation.

- Turning ON the [PIDC] terminal during PID operation clears the integral value added to the PID output command and changes the PID output command value abruptly, resulting in an over-current error.

■PID1 disable function [PID]
- Turning ON the terminal temporarily disables PID operation and performs output according to frequency command.
- The input value as PID command will be adopted for frequency command.

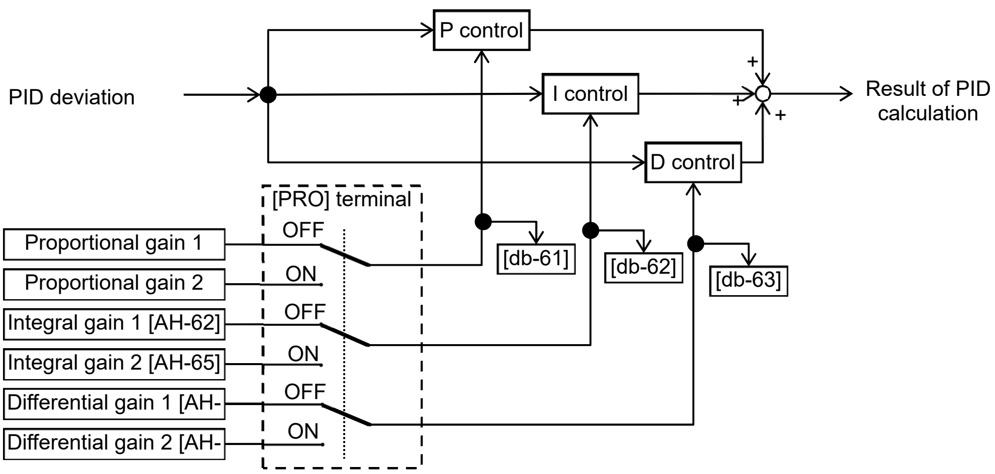
■Adjust PID1 control

- When response is not stabilized in PID function operation, adjust according to the following procedure.
- If acceleration/deceleration time is set too long, following of output frequency will be delayed and control may not be successful. In this case, set the acceleration/deceleration time short.

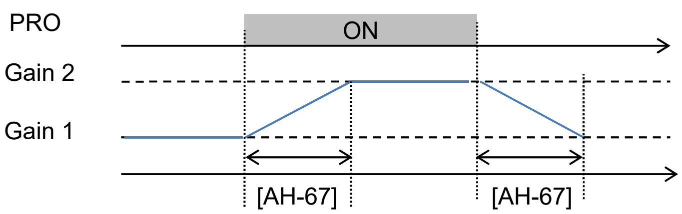
Phenomenon ▸	Examples of measures
• Output response is slow and feedback value does not change swiftly even if PID target value was changed.	• Increase PID1 proportional (P) gain 1 [AH-61].
• Feedback value changes swiftly and is not stabilized. • Overshooting or hunting occurs.	• Decrease PID1 proportional (P) gain 1 [AH-61].
• Feedback value vibrates mildly. • t takes time for operation to be stabilized.	• Increase PID1 integral (I) gain 1 [AH-62].
• PID target value and feedback value do not match easily.	• Decrease PID1 integral (I) gain 1 [AH-62].
• Response is slow even if proportional gain was increased. • Small hunting occurs.	• Increase PID1 differential (D) gain 1 [AH-63].
• Response due to disturbance is large and it takes time until stabilization.	• Decrease PID1 differential (D) gain 1 [AH-63].

■Control by switching PID1 gain

- PID gain 1 and 2 can be switched by switching the input terminal function 055 [PRO].
- In the case of using the [PRO] terminal, set 01 to PID1 gain switch method selection [AH-60].



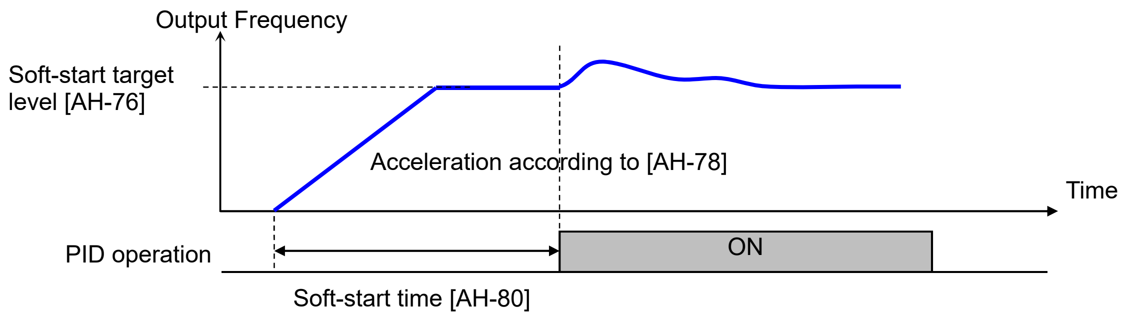
- PID gain is time for PID1 gain to switch [AH-67] and switches continuously.
- Each gain selected for PIDs can be checked by respective monitors [db-61] to [db-63].



12.10.3 PID Soft-start

■PID soft-start function

- In the case of using this function, enable PID control and set 01 to the [AH-75] PID soft-start function selection.
- It will move to PID control automatically after the elapse of the time set in [AH-80].
- It accelerates to soft-start target level [AH-76] after start of soft-start.



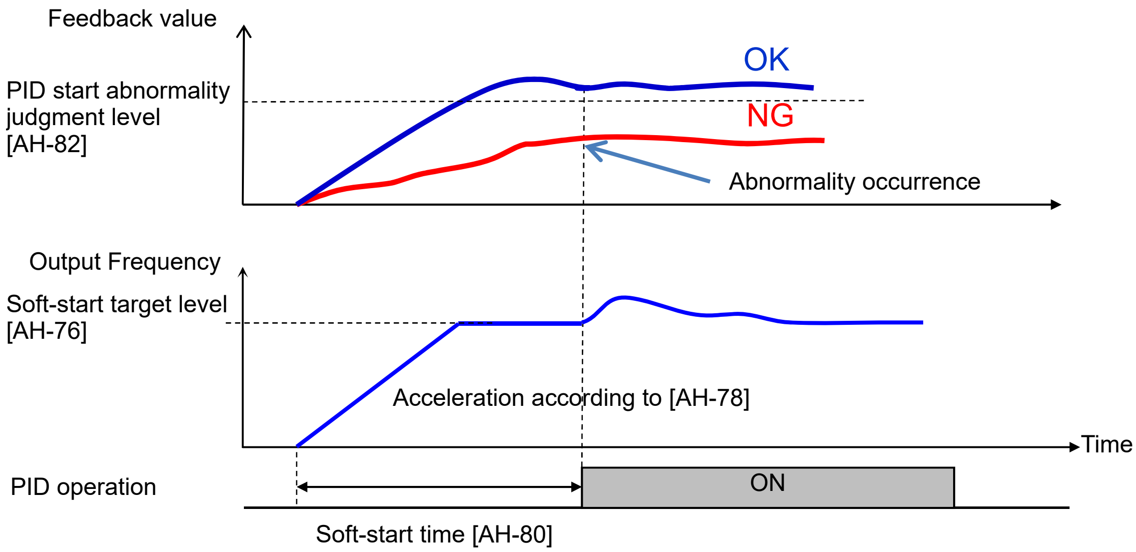
■Parameters

Item	Parameter	Data	Description
PID soft-start function selection	[AH-75]	00	Disable
		01	Enable
PID soft-start target level	[AH-76]	0.00~100.00(%)	It is a target value of the soft-start range with the maximum frequency as 100%.
For PID soft-start acceleration time	[AH-78]	0.00~3600.00(s)	Sets acceleration time at the time of soft-start.
PID soft-start time	[AH-80]	0.00~100.00(s)	This is soft-start operation time.

■PID start abnormal judgment

- It is a function to detect breakage of pipes such as water leakage.
- Abnormality will be judged when PID-FB value is lower than [AH-82] PID start abnormality judgment level after the elapse of [AH-80] soft-start time following PID soft-start.

- Abnormal operations vary depending on the setting of [AH-81] PID start abnormality judgment implementation selection at the time of abnormality judgment.
  - Nothing will be done when [AH-81] is 00.
  - When [AH-81] is 01, it will trip with [E120] PID start abnormality error after the abnormal status elapsed the set time for [AH-80].
  - When [AH-81] is 02, the [SSE] terminal will be turned ON after the abnormal status elapsed the set time of [AH-80].
    The [SSE] terminal will stay ON until it stops.



■Parameters

Item	Parameter	Data	Description
PID start abnormal judgment implement selection	[AH-81]	00	Disable
		01	Enable It will trip with [E120] PID start abnormality error when start abnormality is judged.
		02	Enable The [SSE] terminal will be turned ON when start abnormality is judged.
PID start abnormality judgment level	[AH-82]	0.00~100.00(%)	This is a level to judge start abnormality

12.10.4 PID Sleep

■PID sleep function

- In the case of using this function, set 01 (output low) or 02 (SLEP terminal) to PID sleep condition selection [AH-85].
- You can change the start/cancel time and level of the sleep operation depending on the usage.

- You can choose cancellation of the PID sleep status from 01 (deviation amount), 02 (feedback low), and 03 (WAKE terminal) of the PID wake condition selection [AH-93].
- In the case of canceling the PID sleep status by deviation, cancellation will only be activated when deviation increases in a direction of lower output, even if PID1 deviation [AH-02] was set to 01 and PID deviation ± was switched.

■Parameters

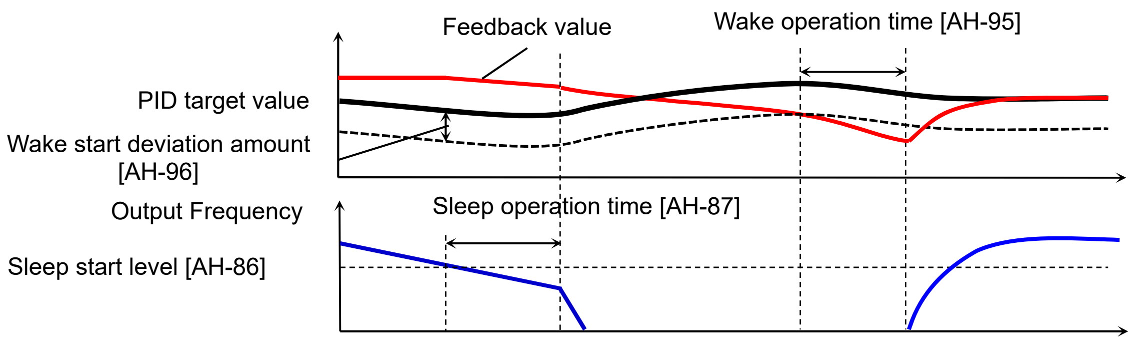
Item	Parameter	Data	Description
PID sleep condition selection	[AH-85]	00	Disable
		01	Starts sleep operation when output is low
		02	Starts operation at the rising edge of the [SLEP] terminal.
PID sleep start level	[AH-86]	0.00~590.00(Hz)	This is a level of making a judgment of sleep operation for the output speed when [AH-85] = 01.
PID sleep operation time	[AH-87]	0.00~100.00(s)	Stand-by time before shifting to sleep operation.
Boost selection prior to PID sleep	[AH-88]	00	Disable
		01	Boosts target value before sleep operation.
Boost time prior to PID sleep	[AH-89]	0.00~100.00(s)	Actuation time prior to PID sleep.
Boost amount prior to PID sleep	[AH-90]	0.00~100.00(%)	Sets a boost amount to be added to target value before sleep.
Minimum operation time prior to PID sleep	[AH-91]	0.00~100.00(s)	This function does not start sleep operation until [AH-91] has elapsed from start.
PID sleep status minimum retaining time	[AH-92]		Retains the sleep status until [AH-92] has elapsed, once the sleep operation started.
PID wake condition selection	[AH-93]	01	Cancels the sleep operation when a deviation amount increases in a deceleration direction.
		02	Cancels the sleep operation when feedback value decreases.
		03	Cancels the operation at the rising edge of the [WAKE] terminal
PID wake start level	[AH-94]	0.00~100.00(%)	Cancels the operation when feedback value goes below the set value when [AH-93] is 02.
PID wake operation time	[AH-95]	0.00~100.00(s)	Stand-by time for operation cancellation when [AH-93] is 02.
PID wake start deviation amount	[AH-96]	0.00~100.00(%)	Cancels the operation when a deviation between target value and feedback value increases when [AH-93] is 01.

■Input terminal function

Item	Terminal name	Data	Description
PID sleep start terminal	[SLEP]	057	Starts the sleep function with the terminal when [AH-85] = 02.
PID sleep cancel terminal	[WAKE]	058	Cancels the sleep function with the terminal when [AH-93] = 03.

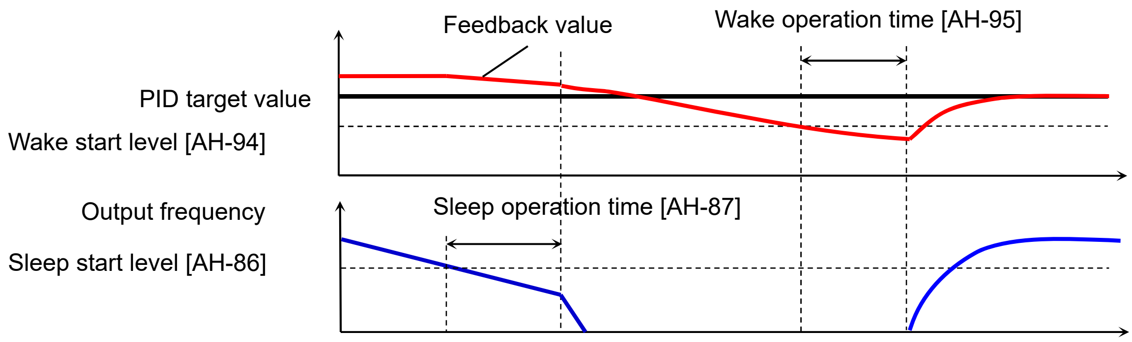
Example 1) [AH-85] sleep start: 01 (output low)
- Sleep operation starts will start when the output frequency stays below the level of [AH-86] continuously for the set time of [AH-87].

[AH-93] Sleep cancel: 01 (deviation amount)
- Cancel operation will start when PID deviation stays over [AH-96] continuously for the set time of [AH-95]. Deviation operates with either figure (±).



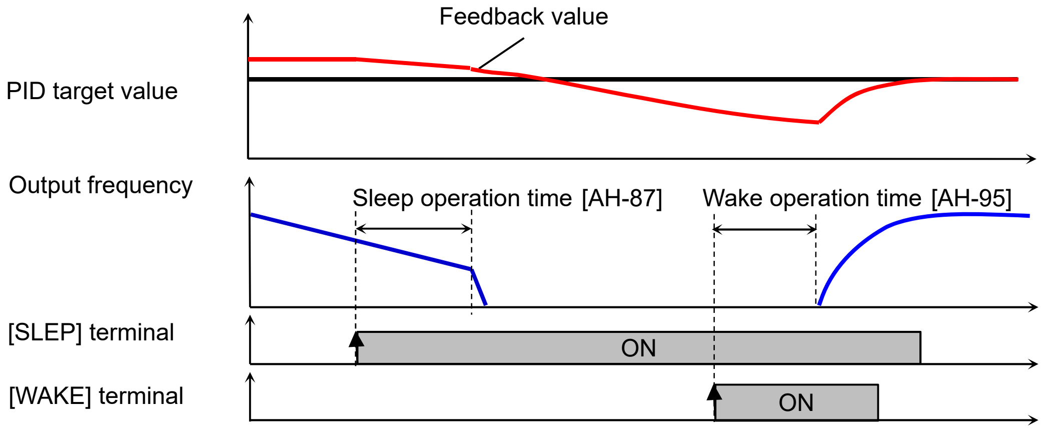
Example 2) [AH-85] sleep start: 01 (output low)
- Sleep operation will start when the output frequency stays below [AH-86] continuously for the set time of [AH-87].

[AH-93] Sleep cancel: 02 (feedback low)
- Cancel operation will start when feedback stays below [AH-94] continuously for the set time of [AH-95].



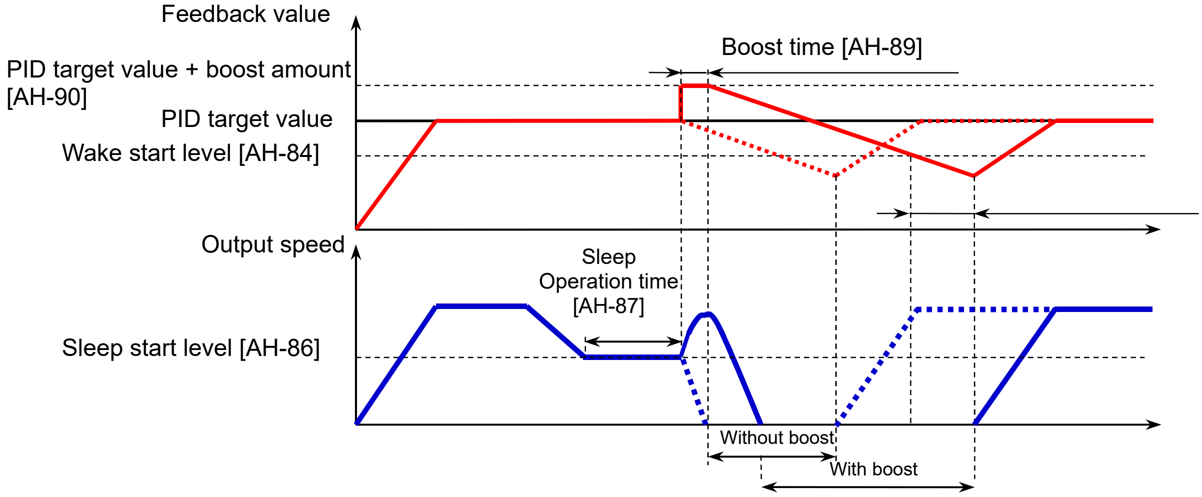
Example 3) [AH-85] sleep start: 02 ([SLEP] terminal)
- Sleep operation starts after the elapse of [AH-87] from the ON edge of the [SLEP] terminal.

[AH-93] Sleep cancel: 03 ([WAKE] terminal)
- Sleep operation will start after the elapse of [AH-95] from the ON edge of the [WAKE] terminal.



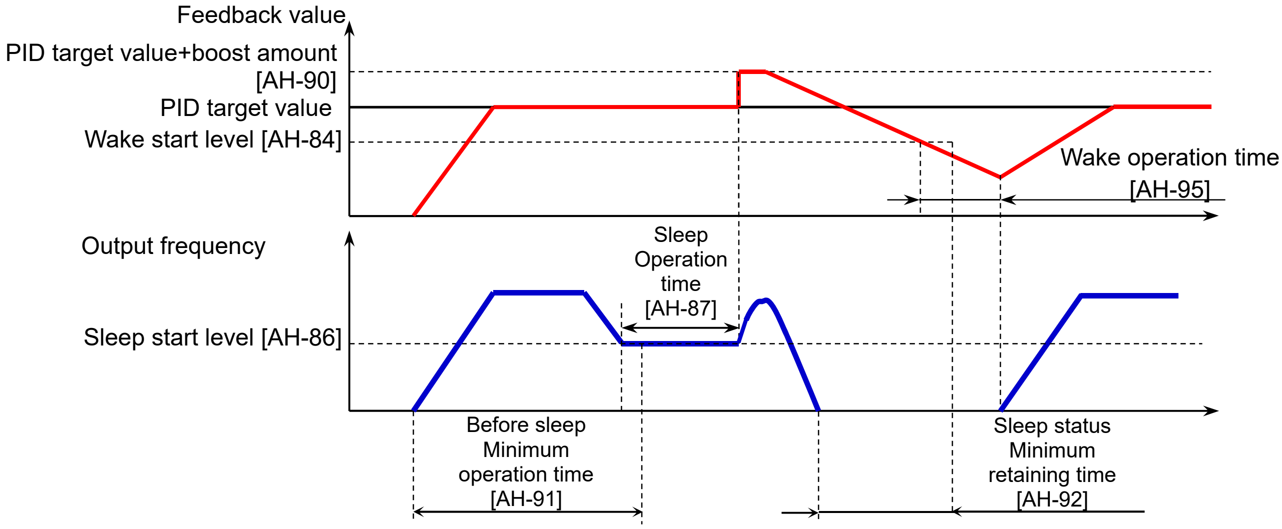
■Boost function prior to sleep

- This raises the PID target value before sleep and increases the feedback amount once. By this, the sleep status can be maintained for a long period of time.
- The diagram below is an example when 01 is set to [AH-85] and 02 to [AH-93].
- When [AH-85] is 01, the set value of [AH-90] will be added to the PID target value for the set time of [AH-89], if the output frequency stayed below [AH-86] continuously.



■Sleep function disable time

- Minimum operation time from start to sleep [AH-91] and minimum retaining time of the sleep status [AH-92] can be set.
- PID sleep operation can prevent the operation of switching between the sleep status and operation status frequently.

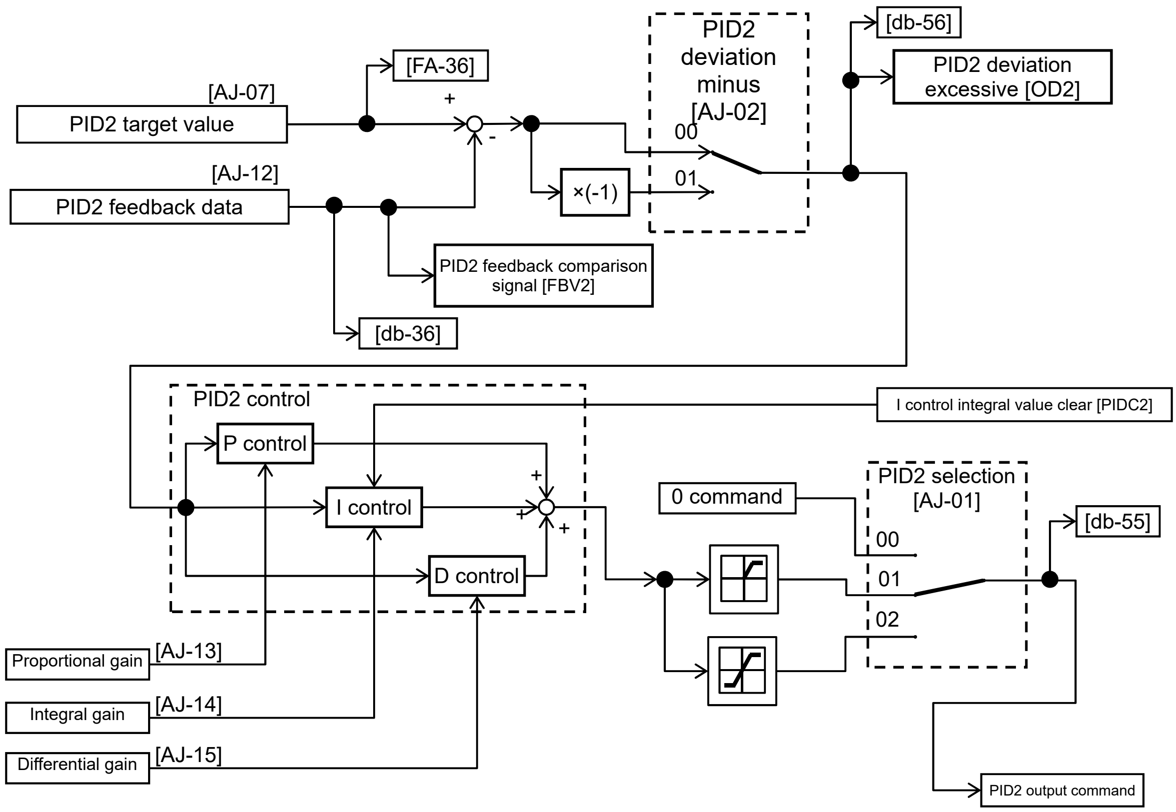


12.10.5 Use PID2/PID3/PID4

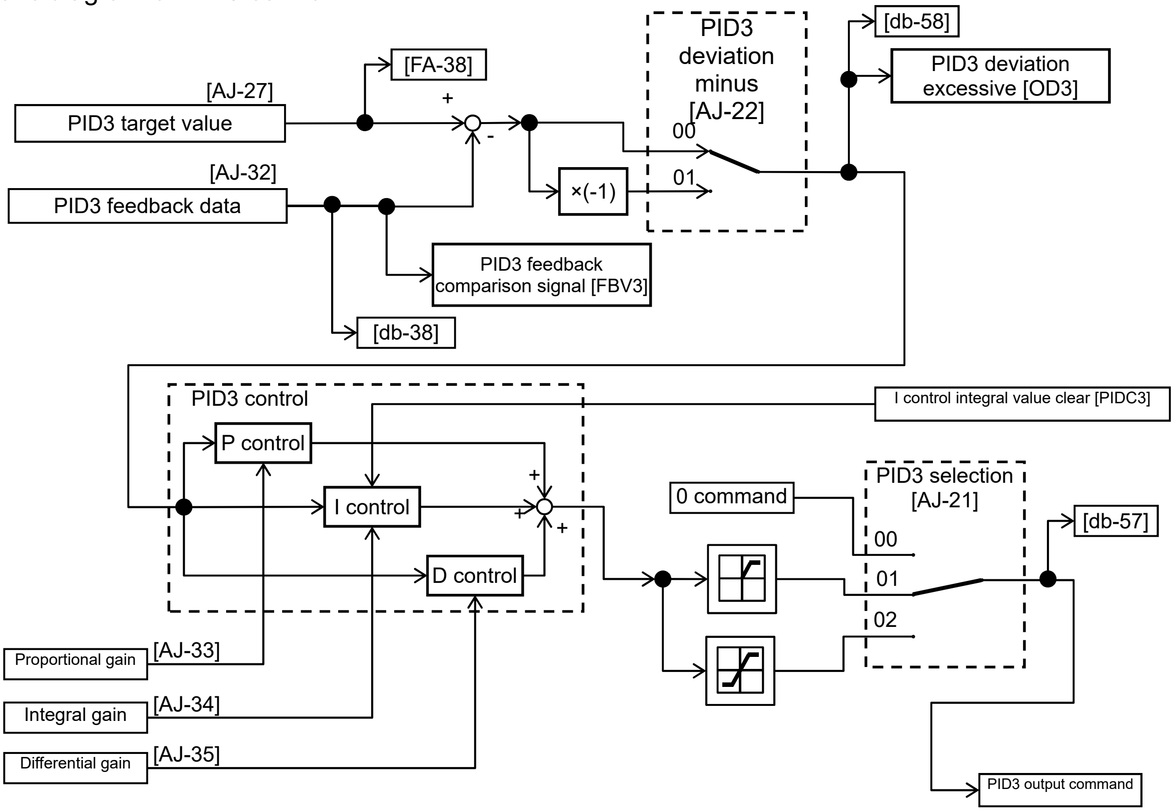
■PID2/PID3/PID4 control

- PID1 to PID4 controls operate independently.
- Switching PID1 to 4 by terminal enables the use for switching batch control, etc.
- In PID2, selecting PID1 output to target value enables control in consideration of influences from the 2 systems.

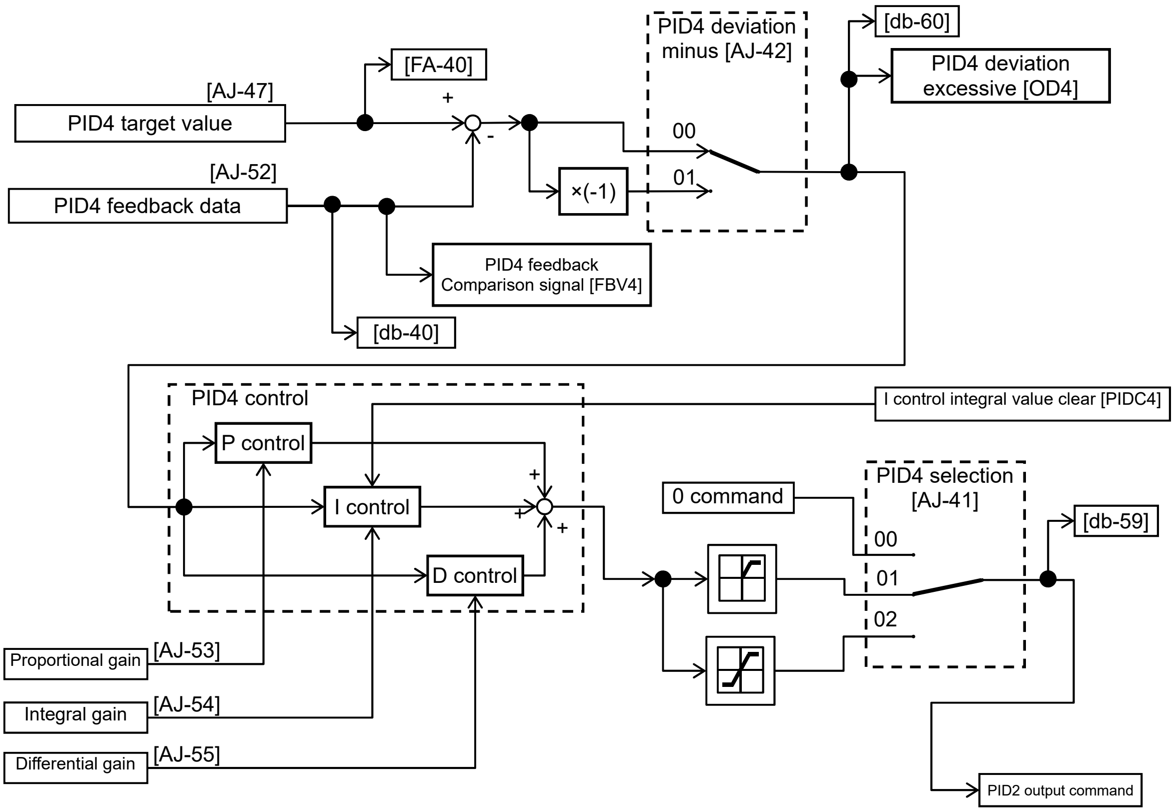
■Schematic diagram of PID2 control



■Schematic diagram of PID3 control



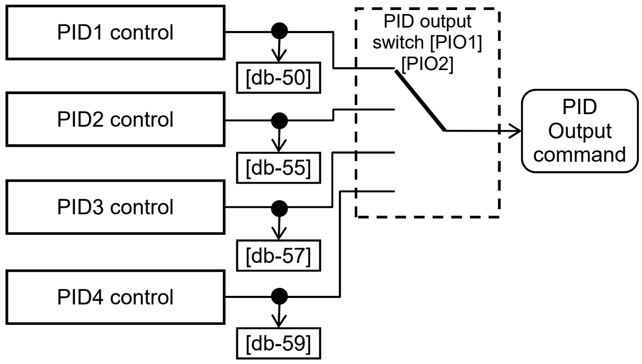
■Schematic diagram of PID4 control



■Switch PID1 to 4
• Switching the input terminal function 056[PIO1]/057[PIO2] enables switching and controlling of PID1 to PID4.

Combination of PIO1/PIO2

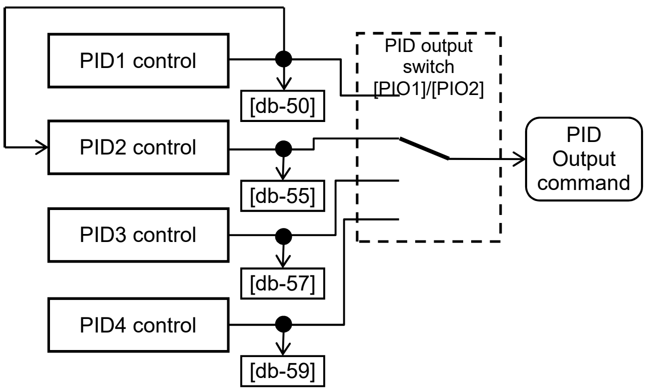
	[PIO2]	[PIO1]
PID1 is enabled	OFF	OFF
PID2 is enabled	OFF	ON
PID3 is enabled	ON	OFF
PID4 is enabled	ON	ON



■Connect PID1 and PID2
• Setting the target value of PID2 to PID1 output ([AJ-07] = 15) enables double-layer control of PID. (PID3/PID4 cannot be selected.)
• Enable PID2 output command as follows.

Combination of PIO1/PIO2

	[PIO2]	[PIO1]
PID2 is enabled	OFF	ON



■ Parameters

Item	Parameter	Data	Description
PID2 selection	[AJ-01]	00	Disable
		01	Enable (if command becomes negative, it does not output in a reverse direction)
		02	Enable (if command becomes negative, it outputs in a reverse direction)
PID2 deviation negative	[AJ-02]	00	Disable
		01	Disable (polarity inversion of deviation)
PID2 target value input destination	[AJ-07]	00~15	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1, 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)/15: PID1 output
PID2 target value set value	[AJ-10]	0.00~100.00(%)*1)	Parameter set value.
PID2 feedback data input destination	[AJ-12]	00～13	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: P option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13:Pulse train input (HF-FB)
PID2 proportional (P) gain	[AJ-13]	0.0~100.0	Proportional gain
PID2 integral (I) gain	[AJ-14]	0.0~3600.0(s)	Integral gain
PID2 differential (D) gain	[AJ-15]	0.00~100.00(s)	Differential gain
PID3 selection	[AJ-21]	00	Disable
		01	Enable (if command becomes negative, it does not output in a reverse direction)
		02	Enable (if command becomes negative, it outputs in a reverse direction)
PID3 deviation negative	[AJ-22]	00	Disable
		01	Enable (polarity inversion of deviation)
PID3 target value input destination	[AJ-27]	00~13	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13: Pulse train input (HF-FB)
PID3 target value set value	[AJ-30]	0.00~100.00(%)*2)	Parameter set value.
PID3 feedback data input destination	[AJ-32]	00~13	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit), 13: Pulse train input (HF-FB)
PID3 proportional (P) gain	[AJ-33]	0.0~100.0	Proportional gain
PID3 integral (I) gain	[AJ-34]	0.0~3600.0(s)	Integral gain
PID3 differential (D) gain	[AJ-35]	0.00~100.00(s)	Differential gain

*1) Data range varies according to [AJ-04] - [AJ-06] settings.
*2) Data range varies according to [AJ-24] - [AJ-26] settings.

■Parameters

Item	Parameter	Data	Description
PID4 selection	[AJ-41]	00	Disable
		01	Enable (if command becomes negative, it does not output in a reverse direction)
		02	Enable (if command becomes negative, it outputs in a reverse direction)
PID4 deviation negative	[AJ-42]	00	Disable
		01	Enable (polarity inversion of deviation)
PID4 target value input destination	[AJ-47]	00~15	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input, 06: Ai6-COM input/07: Parameter setting [AH-44], 08: RS 485 communication/09: P option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13:Pulse train input (HF-FB)
PID4 target value set value	[AJ-48]	0.00~100.00(%) *3)	Parameter set value.
PID4 feedback data input destination	[AJ-50]	00~13	00: Disable/01: VRF-COM input 02: IRF-COM input/03: VF2-COM input 04: Ai4-COM input/05: Ai5-COM input, 06: Ai6-COM input/07: Parameter setting [AH-44] 08: RS 485 communication/09: Option 1 10: Option 2/11: Option 3 12: Pulse train input (main unit) 13:Pulse train input (HF-FB)
PID4 proportional (P) gain	[AJ-53]	0.0~100.0	Proportional gain
PID4 integral (I) gain	[AJ-54]	0.0~3600.0(s)	Integral gain
PID4 differential (D) gain	[AJ-55]	0.00~100.00(s)	Differential gain

*3) Data range varies according to [AJ-44] - [AJ-46] settings.

■ Input terminal function

Item	Terminal name	Data	Description
PID2 disable function	[PID2]	043	Disables the PID2 function by turning ON the terminal function. Frequency equivalent to the target value of PID2 will be commanded when the terminal is turned ON.
PID2 I control integral value clear	[PIDC2]	044	Clears the integral value of PID2 control.
PID3 disable function	[PID3]	045	Disables the PID3 function by turning ON the terminal function. Frequency equivalent to the target value of PID3 will be commanded when the terminal is turned ON.
PID3 I control integral value clear	[PIDC3]	046	Clears the integral value of PID3 control.
PID4 disable function	[PID4]	047	Disables the PID4 function by turning ON the terminal function. Frequency equivalent to the target value of PID4 will be commanded when the terminal is turned ON.
PID4 I control integral value clear	[PIDC4]	048	Clears the integral value of PID4 control.
PID output switch 1	[PIO1]	056	Switches PID output by a combination of PIO1 and PIO2.
PID output switch 2	[PIO2]	057	

■Data monitor function

Item	Parameter	Data	Description
PID2 target value	[FA-36]	-100.00~100.00(%) *1)	Displays the target value of PID2. Changeable when [AJ-07] = 09.
PID2 feedback monitor	[db-36]		Displays the feedback value of PID2.
PID2 output monitor	[db-55]		Displays the output value of PID2.
PID2 deviation monitor	[db-56]	-200.00~200.00(%) *1)	Displays the deviation of PID2.
PID3 target value	[FA-38]	-100.00~100.00(%) *2)	Displays the target value of PID3. Changeable when [AJ-27] = 09.
PID3 feedback monitor	[db-38]		Displays the feedback value of PID3.
PID3 output monitor	[db-57]		Displays the output value of PID3.
PID3 deviation monitor	[db-58]	-200.00~200.00(%) *2)	Displays the deviation of PID3.
PID4 target value	[FA-40]	-100.00~100.00(%) *3)	Displays the target value of PID4. Changeable when [AJ-47] = 09.
PID4 feedback monitor	[db-40]		Displays the feedback value of PID4.
PID4 output monitor	[db-59]		Displays the output value of PID4.
PID4 deviation monitor	[db-60]	-200.00~200.00(%) *3)	Displays the deviation of PID4.

*1) Data range varies according to [AJ-04] - [AJ-06] settings.
*2) Data range varies according to [AJ-24] - [AJ-26] settings.
*3) Data range varies according to [AJ-44] - [AJ-46] settings.

■Adjust PID2/PID3/PID4 control

- When response is not stabilized in PID function operation, adjust according to the following procedure.
- Adjust respective PID gains for each PID2/PID3/PID4.
- If acceleration/deceleration time is set too long, following of output frequency will be delayed and control may not be successful.
  In this case, set the acceleration/deceleration time short.

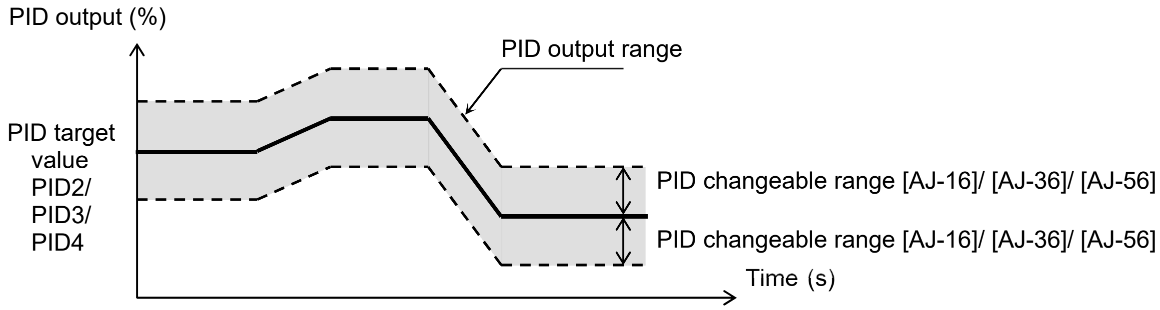
Phenomenon ▶	Examples of measures
• Output response is slow and feedback value does not change swiftly even if PID target value was changed.	• Increase PID proportional gain according to the correspondence table [1].
• Feedback value changes swiftly and is not stabilized. • Overshooting or hunting occurs.	• Decrease PID proportional gain according to the correspondence table [1].
• Feedback value vibrates mildly. • It takes time for operation to be stabilized.	• Increase PID integral gain according to the correspondence table [2].
• PID target value and feedback value do not match easily.	• Decrease PID integral gain according to the correspondence table [2].
• Response is slow even if proportional gain was increased. • Small hunting occurs.	• Increase PID differential gain according to the correspondence table [3].
• Response due to disturbance is large and it takes time until stabilization.	• Decrease PID differential gain according to the correspondence table [3].

• Gain correspondence table

	[1] Proportional gain	[2] Integral gain	[3] Differential gain
PID2	[AJ-13]	[AJ-14]	[AJ-15]
PID3	[AJ-33]	[AJ-34]	[AJ-35]
PID4	[AJ-53]	[AJ-54]	[AJ-55]

■PID2/PID3/PID4 changeable range limitation

- PID output is restricted to a changeable range based on the target value.
- The limitation function of PID for which 0.00 was set for the following changeable range will be disabled.
- In the case of using this function, set the corresponding PID changeable range ([AJ/16]/[AJ-36]/[AJ-56]). Restriction will be set with the maximum speed as 100% (PID target value ± changeable range).



■Parameter

Item	Terminal name	Data	Description
PID2 changeable range	[AJ-16]	0.00~100.00(%)	Changeable range based on PID2 target value
PID3 changeable range	[AJ-36]		Changeable range based on PID3 target value
PID4 changeable range	[AJ-56]		Changeable range based on PID4 target value

■PID2/PID3/PID4 reverse output

- In normal PID control, the inverter does not output a negative figure for frequency command and limits at 0 Hz.
  If you select 02 (with reverse output) for each selection [AJ-01]/[AJ-21]/[AJ-41] of PID2/PID3/PID4, frequency command can be output in a reverse direction, if the result of the corresponding PID calculation was negative.
- When [AJ-01]/[AJ-21]/[AJ-41] is set to 02 (with reverse output), the PID changeable range limit function [AJ-16]/[AJ-36]/[AJ-56] will be extended to the negative direction.

■Parameter

Item	Terminal name	Data	Description
PID2 selection	[AJ-01]	02	Enable (if command becomes negative, it outputs in a reverse direction)
PID3 selection	[AJ-21]		
PID4 selection	[AJ-41]		

■PID2/PID3/PID4 I control integral reset function [PIDC2] [PIDC3] [PIDC4]

- This is a function to clear an integral figure of the corresponding PID operation.
- In the case of turning ON the [PIDC2] [PIDC3] [PIDC4] terminal, do so when the corresponding PID is not in operation.
- Turning ON the [PIDC2] [PIDC3] [PIDC4] terminal during PID operation clears the integral value added to the PID output command and changes the PID output command value abruptly, resulting in an over-current error.

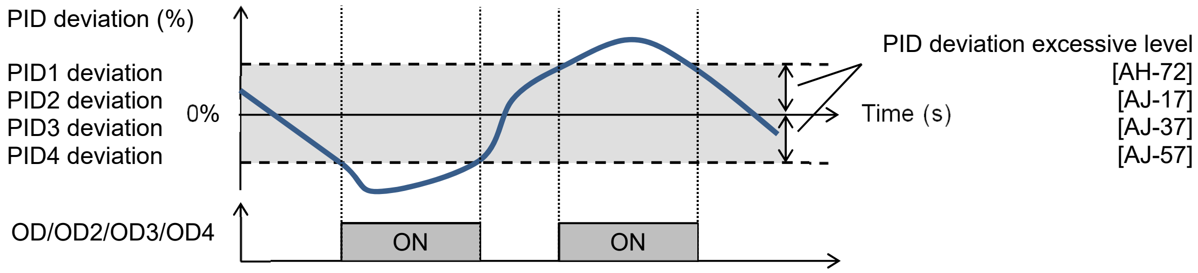
■PID2/PID3/PID4 disable function [PID2] [PID3] [PID4]

- Turning ON the corresponding terminal disables PID operation temporarily and performs output according to frequency command.
- The input value as PID command will be adopted for frequency command.

12.10.6 PID Signal Output

■PID deviation excessive

- This outputs a deviation excessive signal in the case of each PID deviation exceeding the set level of the corresponding PID.



■Parameters

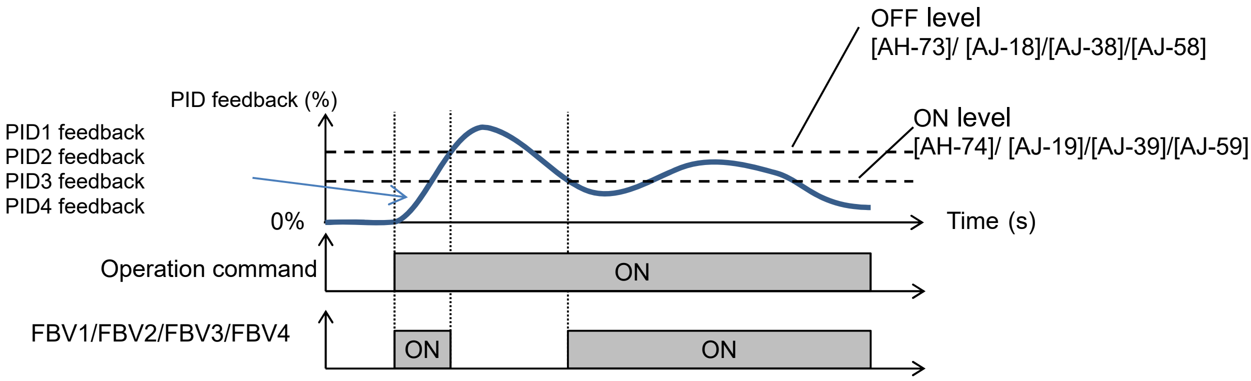
Item	Terminal name	Data	Description
PID1 deviation excessive level	[AH-72]	0.00~100.00(%)	045 [OD] signal output judgment level
PID2 deviation excessive level	[AJ-17]		047 [OD2] signal output judgment level
PID3 deviation excessive level	[AJ-37]		089 [OD3] signal output judgment level
PID4 deviation excessive level	[AJ-57]		091 [OD4] signal output judgment level

■Output signal function

Item	Terminal name	Data	Description
PID1 deviation excessive signal	OD	045	Signal will be turned ON when the difference between PID target value and feedback value exceeds the range of PID1 deviation excessive level.
PID2 deviation excessive signal	OD2	047	Signal will be turned ON when the difference between PID target value and feedback value exceeds the range of PID2 deviation excessive level.
PID3 deviation excessive signal	OD3	089	Signal will be turned ON when the difference between PID target value and feedback value exceeds the range of PID3 deviation excessive level.
PID4 deviation excessive signal	OD4	091	Signal will be turned ON when the difference between PID target value and feedback value exceeds the range of PID4 deviation excessive level.

■PID feedback signal

- Output terminal signal will be turned OFF when each PID feedback reaches beyond respective PID set ranges.
- Set PID1 feedback to be OFF level ≥ ON level. OFF operation will be prioritized when it is set to Off level < ON level.
- Setting ON level/OFF level to be other than 0.00 starts outputting of a feedback comparison signal.



■Parameters

Item	Terminal name	Data	Description
PID1 feedback comparison signal OFF level	[AH-73]	0.00~100.00(%)	FBV1 signal output OFF judgment level
PID1 feedback comparison signal ON level	[AH-74]		FBV1 signal output ON judgment level
PID2 feedback comparison signal OFF level	[AJ-18]		FBV2 signal output OFF judgment level
PID2 feedback comparison signal ON level	[AJ-19]		FBV2 signal output ON judgment level
PID3 feedback comparison signal OFF level	[AJ-38]		FBV3 signal output OFF judgment level
PID3 feedback comparison signal ON level	[AJ-39]		FBV3 signal output ON judgment level
PID4 feedback comparison signal OFF level	[AJ-58]		FBV4 signal output OFF judgment level
PID4 feedback comparison signal ON level	[AJ-59]		FBV4 signal output ON judgment level

■Feedback comparison signal

Item	Terminal name	Data	Description
PID1 feedback comparison signal	[FBV1]	046	PID1 feedback signal [FBV1] OFF: Exceeded the OFF level. ON: Went below the ON level.
PID2 feedback comparison signal	[FBV2]	048	PID2 feedback signal [FBV2] OFF: Exceeded the OFF level. ON: Went below the ON level.
PID3 feedback comparison signal	[FBV3]	090	PID3 feedback signal [FBV3] OFF: Exceeded the OFF level. ON: Went below the ON level.
PID4 feedback comparison signal	[FBV4]	092	PID4 feedback signal [FBV4] OFF: Exceeded the OFF level. ON: Went below the ON level.

12.10.7 PID Unit Change

■Unit change of target value and feedback value

- This function enables to change the unit and scale of the following parameters.

■PID1 display conversion parameter

Item	Parameter
PID1 target value 1	[FA-30]
PID1 target value 2	[FA-32]
PID1 feedback monitor 1	[db-30]
PID1 feedback monitor 2	[db-32]
PID1 target value 1 set value	[AH-10]
PID1 multi-layer target value1 to 15	[AH-12]~[AH-40]
PID1 target value 2 set value	[AH-44]

■PID2 display conversion parameter

Item	Parameter
PID2 target value	[FA-36]
PID2 feedback monitor	[db-36]
PID2 target value set value	[AJ-10]

■PID3 display conversion parameter

Item	Parameter
PID3 target value	[FA-38]
PID3 feedback monitor	[db-38]
PID3 target value set value	[AJ-30]

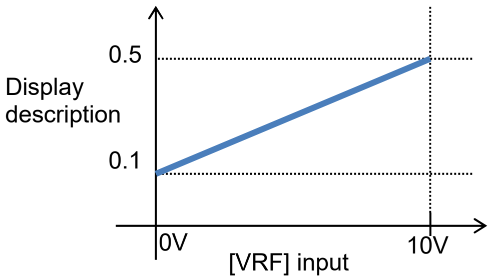
■PID4 display conversion parameter

Item	Parameter
PID4 target value	[FA-40]
PID4 feedback monitor	[db-40]
PID4 target value set value	[AJ-50]

- In this setting, display descriptions of zero point and maximum point are set.
- An adjustment example is displayed at the bottom of this section.

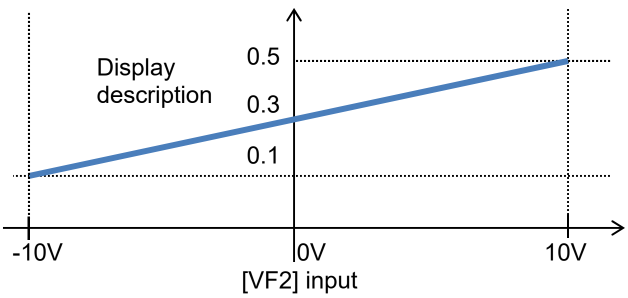
Adjustment example 1)
If you want to display 0 to 10V (0 to 100%) as 0.1 to 0.5kPa in [db-30] when the voltage is feed-backed to the analog input 1 [VRF]

- Unit [AH-03] = 56 (kPa), decimal point position [AH-06] = 02, zero point [AH-04] = 10, end point [AH-05] = 50



Adjustment example 2)
If you want to display -10 to 10V (-100 to 100%) as 0.1 to 0.5kPa in [db-30] when the voltage is feed-backed to the analog input 3 [VF2]

- Unit [AH-03] = 56 (kPa), decimal point position [AH-06] = 02, zero point [AH-04] = 30, end point [AH-05] = 50



■Unit table

No.	Unit	No.	Unit	No.	Unit	No.	Unit
00	non	15	pls	30	m	45	gal/min
01	%	16	mH	31	cm	46	gal/h
02	A	17	Vdc	32	°F	47	ft^3/s
03	Hz	18	°C	33	l/s	48	ft^3/min
04	V	19	kWh	34	l/min	49	ft^3/h
05	kW	20	mF	35	l/h	50	lb/s
06	W	21	mVs/rad	36	m^3/s	51	lb/min
07	hr	22	Nm	37	m^3/min	52	lb/h
08	s	23	min^{-1}	38	m^3/h	53	mbar
09	kHz	24	m/s	39	kg/s	54	bar
10	ohm	25	m/min	40	kg/min	55	Pa
11	mA	26	m/h	41	kg/h	56	kPa
12	ms	27	ft/s	42	t/min	57	PSI
13	P	28	ft/min	43	t/h	58	mm
14	kgm^2	29	ft/h	44	gal/s		

■Parameters

Item	Parameter	Data	Description
PID1 unit selection	[AH-03]	* Refer to the unit table in the previous section	Sets the unit of PID1 display conversion parameter.
PID1 scale adjustment (0%)	[AH-04]	-10000~10000	Sets the criteria of input 0% of PID1 display conversion parameter.
PID1 scale adjustment (100%)	[AH-05]		Sets the criteria of input 100% of PID1 display conversion parameter.
PID1 data decimal point position	[AH-06]	00	00000.
		01	0000.0
		02	000.00
		03	00.000
		04	0.0000
PID2 unit selection	[AJ-03]	* Refer to the unit table in the previous section	Sets the unit of PID2 display conversion parameter.
PID2 scale adjustment (0%)	[AJ-04]	-10000~10000	Sets the criteria of input 0% of PID2 display conversion parameter.
PID2 scale adjustment (100%)	[AJ-05]		Sets the criteria of input 100% of PID2 display conversion parameter.
PID2 data decimal point position	[AJ-06]	00	00000.
		01	0000.0
		02	000.00
		03	00.000
		04	0.0000
PID3 unit selection	[AJ-23]	* Refer to the unit table in the previous section	Sets the unit of PID3 display conversion parameter.
PID3 scale adjustment (0%)	[AJ-24]	-10000~10000	Sets the criteria of input 0% of PID3 display conversion parameter.
PID3 scale adjustment (100%)	[AJ-25]		Sets the criteria of input 100% of PID3 display conversion parameter.
PID3 data decimal point position	[AJ-26]	00	00000.
		01	0000.0
		02	000.00
		03	00.000
		04	0.0000
PID4 unit selection	[AJ-43]	* Refer to the unit table in the previous section	Sets the unit of PID4 display conversion parameter.
PID4 scale adjustment (0%)	[AJ-44]	-10000~10000	Sets the criteria of input 0% of PID4 display conversion parameter.
PID4 scale adjustment (100%)	[AJ-45]		Sets the criteria of input 100% of PID4 display conversion parameter.
PID4 data decimal point position	[AJ-46]	00	00000.
		01	0000.0
		02	000.00
		03	00.000
		04	0.0000

12.11 Torque Control

12.11.1 Speed Control and Torque Control

- There are several ways to control the motor torque by having the inverter output as follows:
  - Speed control: A method of output control by having the motor speed follow a certain frequency command and sending torque at a certain speed, and
  - Torque control: A method of output control by changing the speed so that output torque follows a certain command torque.

- In the case of controlling by torque command, 08: Sensor less vector control and 10: Sensor vector control need to be selected in the [AA121] control method.
- The torque limit function in speed control can be used for 08: Sensor less vector control and 09: Sensor less vector control in the zero speed area and 10: Sensor vector control in the [AA121] control method. In the zero speed area of 09: Sensor less vector control in the zero speed area, however, control to send torque is prioritized.

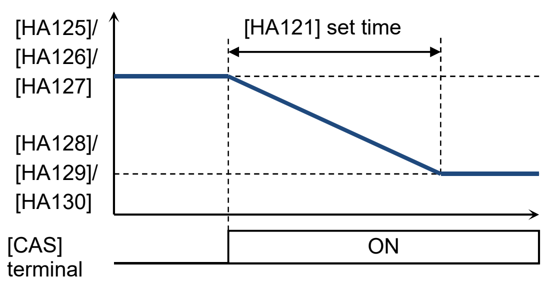
Control method	Speed control	Torque control
Control target	Control is done to maintain the motor speed per frequency command.	Control is done to output the motor torque per torque command.
Operation	Output will be controlled to maintain the speed when loading is changed. If loading becomes bigger, control will be done to send a lager torque. When loading becomes smaller, control will be done to send a smaller torque.	When loading is changed, output will be controlled to maintain the torque. If loading becomes bigger, control will be done to maintain the torque by raising the speed, etc. If loading becomes smaller, control will be done to maintain the torque by slowing the speed, etc.

12.11.2 Set Response Gain of Motor Control

- This switches control gain (ASR gain) of motor control.
- In the control gain switch function, two types of PI gains are switched and applied by turning ON and OFF the input terminal function [CAS].

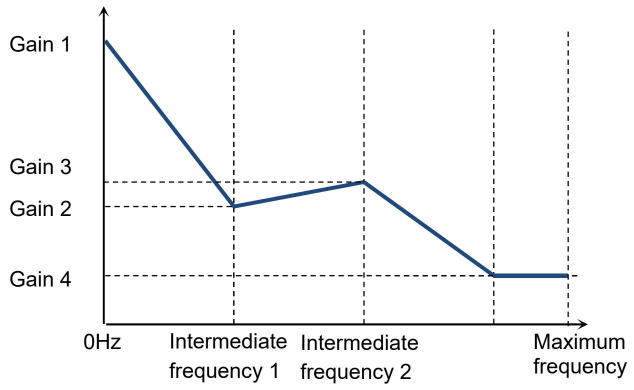
- If switching is done by the [PPI] terminal when the control gain mapping function is used, [HA130] of gain mapping P control P gain 2 will be applied.
- In the case of using this function, sensor less vector control, sensor less vector control in the zero speed area, and sensor vector control need to be selected in the [AA121] control method.
- In the case of using this function in SM (PMM) control, P gain is adopted.
- In the gain mapping function to be switched by setting, setting multiple control gains corresponding to the speed can change the gain with the speed change.
- The gains to be applied by switching of the [CAS] terminal are as follows.

■When [CAS] terminal switch [HA120] = 00



Terminal function	[PPI]OFF	[PPI]ON
[CAS]OFF	PI control P gain 1 [HA125] PI control I gain 1 [HA126]	P control P gain 1 [HA127]
[CAS]ON	PI control P gain 2 [HA128] PI control P gain 2 [HA129]	P control P gain 2 [HA130]

■In the case of switching by setting [HA120] = 01
• The gains to be applied by switching of the control gain mapping function are as follows.



Speed	Applied gain	[PPI] Off	[PPI] On
Zero Hz	Gain 1	PI control P gain 1 [HA125] PI control I gain 1 [HA126]	P control P gain 1 [HA127]
Intermediate frequency 1	Gain 2	PI control P gain 2 [HA128] PI control I gain 2 [HA129]	P control P gain 2 [HA130]
Intermediate frequency 2	Gain 3	PI control P gain 3 [HA131] PI control I gain 3 [HA132]	
Maximum frequency	Gain 4	PI control P gain 4 [HA133] PI control I gain 4 [HA134]	

■Parameters

Item	Parameter	Data	Description
Gain switch selection	[HA120]	00	Switches gain 1 and 2 by the [CAS] terminal.
		01	Switches by speed based on the setting.
PID1 gain switch time	[HA121]	0~10000(ms)	Switches the gain over the set time when [CAS] gain is switched.
Gain switch intermediate frequency 1	[HA122]	0.00~590.00(Hz)	Frequency for which the control gain 2 of the gain mapping function is applied.
Gain switch intermediate frequency 2	[HA123]		Frequency for which the control gain 3 of the gain mapping function is applied.
Gain switch maximum frequency	[HA124]		Frequency for the control gain 4 of the gain mapping function.
Gain mapping PI control P gain 1	[HA125]	0.0~1000.0(%)	Sets the P gain of PI control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping PI control I gain 1	[HA126]		Sets the I gain of PI control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping P control P gain 1	[HA127]	0.00~10.00	Sets the P gain of P control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping PI control P gain 2	[HA128]	0.0~1000.0(%)	Sets the P gain of PI control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping PI control I gain 2	[HA129]		Sets the I gain of PI control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping P control P gain 2	[HA130]	0.00~10.00	Sets the P gain of P control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping PI control P gain 3	[HA131]	0.0~1000.0(%)	Sets the P gain of PI control when the gain mapping intermediate frequency is at 2.
Gain mapping PI control I gain 3	[HA132]		Sets the I gain of PI control when the gain mapping intermediate frequency is at 2.
Gain mapping PI control P gain 4	[HA133]		Sets the P gain of PI control at the gain mapping maximum frequency.
Gain mapping PI control I gain 4	[HA134]		Sets the I gain of PI control at the gain mapping maximum frequency.
Control gain switch	[CA-01]~[CA-11]	063	Switches gains by the [CAS] terminal.
PPI control switch		062	Switches PI control and P control by the [CAS] terminal.

12.11.3 Perform Drooping Control

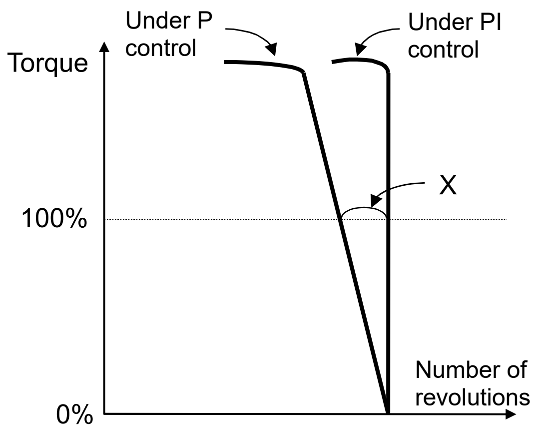
- This switches the control gain (ASR gain) of motor control from PI control to P control.
- Use the following formula when calculating P control P gain.

$$(\text{P control P gain}) = \frac{10}{(\text{Speed fluctuation ratio})} \ (\%)$$

The relationship between speed fluctuation ratio and speed tolerance is calculated based on the following schematic formula.

$$(\text{Speed fluctuation ratio}) = \frac{\text{Speed tolerance at the rated torque } X(\text{min}^{-1})}{\text{Synchronous rotation at the base speed } (\text{min}^{-1})} \ 100\%$$

- In the case o f using this function, [AA121] control method, sensorless vector control, sensorless vector control in the zero speed area, and sensor vector control need to be selected.
- When [E007] excessive voltage error occurs, the situation may be improved by setting to P control.



■When [CAS] terminal switch [HA120] = 00

Terminal function	[PPI]OFF	[PPI]ON
[CAS]OFF	PI control P gain 1 [HA125] PI control I gain 1 [HA126]	P control P gain 1 [HA127]
[CAS]ON	PI control P gain 2 [HA128] PI control I gain 2 [HA129]	P control P gain 2 [HA130]

■When the control gain mapping function [HA120] = 01

Speed	Applied gain	[PPI] Off	[PPI] On
0Hz	Gain 1	PI control P gain 1 [HA125] PI control I gain 1 [HA126]	P control P gain 1 [HA127]
Intermediate frequency 1	Gain 2	PI control P gain 2 [HA128] PI control I gain 2 [HA129]	P control P gain 2 [HA130]
Intermediate frequency 2	Gain 3	PI control P gain 3 [HA131] PI control I gain 3 [HA132]	
Maximum frequency	Gain 4	PI control P gain 4 [HA133] PI control I gain 4 [HA134]	

■Parameters

Item	Parameter	Data	Description
Gain switch selection	[HA120]	00	Switches gain 1 and 2 by the [CAS] terminal.
		01	Switches by speed based on the setting.
PID1 gain switch time	[HA121]	0~10000(ms)	Switches the gain over the set time when [CAS] gain is switched.
Gain switch intermediate frequency 1	[HA122]	0.00~590.00(Hz)	Frequency for which the control gain 2 of the gain mapping function is applied.
Gain switch intermediate frequency 2	[HA123]		Frequency for which the control gain 3 of the gain mapping function is applied.
Gain switch Maximum set frequency	[HA124]		Frequency for which the control gain 4 of the gain mapping function is applied.
Gain mapping PI control P gain 1	[HA125]	0.0~1000.0(%)	Sets the P gain of PI control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping PI control I gain 1	[HA126]		Sets the I gain of PI control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping P control P gain 1	[HA127]	0.00~10.00	Sets the P gain of P control when the [CAS] terminal is OFF or the gain mapping is at zero speed.
Gain mapping PI control P gain 2	[HA128]	0.0~1000.0(%)	Sets the P gain of PI control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping PI control I gain 2	[HA129]		Sets the I gain of PI control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping P control P gain 2	[HA130]	0.00~10.00	Sets the P gain of P control when the [CAS] terminal is ON or the gain mapping intermediate frequency is at 1.
Gain mapping PI control P gain 3	[HA131]	0.0~1000.0(%)	Sets the P gain of PI control when the gain mapping intermediate frequency is at 2.
Gain mapping PI control I gain 3	[HA132]		Sets the I gain of PI control when the gain mapping intermediate frequency is at 2.
Gain mapping PI control P gain 4	[HA133]		Sets the P gain of PI control at the gain mapping maximum frequency.
Gain mapping PI control I gain 4	[HA134]		Sets the I gain of PI control at the gain mapping maximum frequency.
Control gain switch	[CA-01]~ [CA-11]	063	Switches gains by the [CAS] terminal.
PPI control switch		062	Switches PI control and P control by the [PPI] terminal.

12.11.4 Operation under Limitation of Torque

- This limits torque when the speed is controlled.
- In the case of using [AA121] control method, sensorless vector control, sensorless vector control in the zero speed area, and sensor vector control, this limits output torque of the motor.
- The torque limit function is set in [bA110].
- When a torque limiting signal is selected in output selection, the output terminal 022 [TRQ] torque limiting signal will be turned ON once the torque limit function above starts operation.

- If the torque limiting function [TL] is set to an input terminal, the torque limit function set to [bA110] will be enabled, only when [TL] is turned ON. When it is OFF, the torque limit setting will be disabled and the torque limit value will be the maximum value.
- If the torque liming function [TL] is not set to an input terminal, the torque limit function set to the torque limit selection [bA110] will be enabled constantly.
- The torque limit value [bA-11] in this function is based on the inverter output current. Therefore, output torque varies by the combination of motors. Please be aware that these are not absolute figures of torque.

1. Analog input mode
- It is a mode to set a torque limit value in all operation states by applied voltage/current by setting the VRF/IRF/VF2 terminal on the control terminal block in the torque limit selection [bA110].
- In the case of setting torque bias, values corresponding to analog input are as follows.

■Input to VRF/IRF terminal

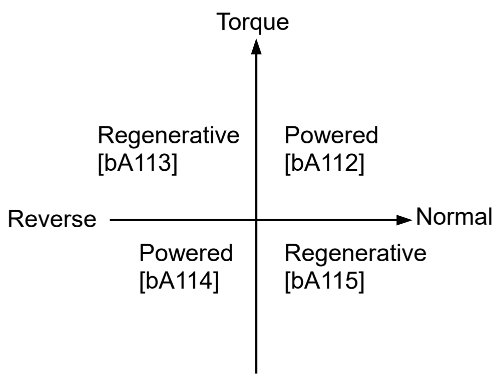
0 to 10 (V)/0 to 20 (mA) corresponding value
Torque command addition 0.0 to 500.0(%)

■Input to VF2 terminal

-10 to 10 (V) corresponding value
Torque command addition -500.0 to 500.0(%)

- The setting of the ratio above can be changed by adjusting the analog input start end function. See "12.24.5 Adjust Analog Input".
(e.g.) In the case of setting 0.0 to 50.0% to the torque command addition value for 0-10 (V)/0-20 (mA) input as [Ai1], set 10.0% for [Cb-04] to make it 50.0% against maximum 500.0%. ([Cb-03]=0.0,[Cb-04]=10.0,[Cb-05]=0.0,[Cb-06]=100.0)

2. 4 Quadrant specific setting mode
- It is a mode to set respective torque limits 1 to 4 ([bA112] to [bA115]) in the four quadrants of normal powered, normal regenerative, reverse powered, and reverse regenerative.
- It will be enabled when torque limit selection [bA110] = 07 (parameter setting) and torque limit mode selection [bA111] = 00 (by each quadrant).
- The relationship of four quadrants and torque limits is shown in the figure below.

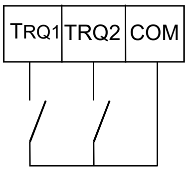


3. Terminal switch mode
- Set values of torque limits 1 to 4 ([bA112] to [bA115]) in all operation states are enabled by the combination of torque limit switch terminals 1 and 2 (TRQ1, TRQ2) set to the input terminal.
- When torque limit selection [bA110] = 07 (parameter setting) or torque limit mode selection [bA111] = 01 ([TRQ] terminal switch) is selected, torque limit 1 to 4 that can be switched by switching the torque limit switch 1/2 assigned to the input terminal will be set as shown in the figure on the right.

■Maintain acceleration/deceleration command of speed control when torque control is switched.
- If torque pulsation occurs at the time of canceling after torque limit operation, enabling [bA116] torque LAD stop selection may be effective.

(e.g.) When the 061 [TRQ1] torque limit switch 1 is assigned to the input terminal 7 and the 062 [TRQ2] torque limit switch 2 to the input terminal 8

Input terminal function
7 8



OFF OFF → [bA112]
ON OFF → [bA113]
OFF ON → [bA115]
ON ON → [bA114]

■Parameters

Item	Parameter	Data	Description
Torque limit selection	[bA110]	00~11	00 (Disable/01) 01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input) 07 (Parameter setting) 08 (RS 485) 09 (Option 1) 10 (Option 2) 11 (Option 3)
Torque limit parameter mode selection	[bA111]	00	Four Quadrant specific
		01	[TRQ] terminal switch
Torque limit 1 Torque limit 2 Torque limit 3 Torque limit 4	[bA112] [bA113] [bA114] [bA115]	0.0~500.00(%)	The torque limit function will operate when output torque exceeds this set value.
Torque LAD stop selection	[bA116]	00	Disable
		01	Enable: retains frequency information when the torque limit is switched. (at the time of deceleration operation)

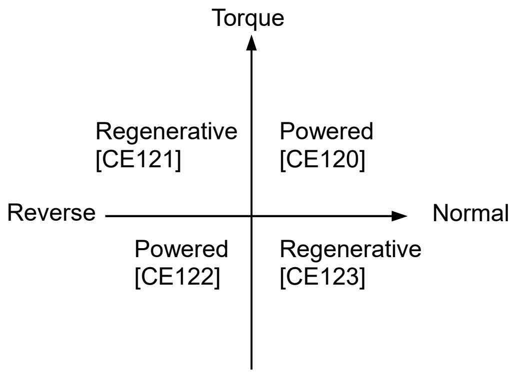
■Input terminal function [CA-01] to [CA-11]

Item	Terminal name	Data	Description
Enable/disable torque limit	[TL]	060	Switches enable/disable of the torque limit function.
Torque limit switch 1	[TRQ1]	061	Torque limit switch terminal 1.
Torque limit switch 2	[TRQ2]	062	Torque limit switch terminal 2.

■Output terminal [CC-01] to [CC-07]

Item	Terminal name	Data	Description
Under torque limit	[TRQ]	022	Signal turns ON when the torque limit function is enabled.

■Emit a signal when torque rises or drops
- The output terminal 019 [OTQ] over torque signal will be turned ON when the torque output value [dA-17] exceeds [CE120] to [CE123].
- In the case of using as an under torque signal, output will be feasible when the output terminal a/b [NO/NC] setting [CC-11] to [CC-17] corresponding to the output terminal function [CC-01] to [CC-07] assigned with 019 [OTQ] is switched from 00 to 01.



■Monitor torque limit value
- You can check the torque limit value switched by selection on the [dA-16] torque limit monitor.

■Parameters

Item	Parameter	Data	Description
Torque limit monitor	[dA-16]	-500.00~500.00(%)	Displays the limit value of the torque limit function.
Output torque monitor	[dA-17]		Displays the output torque.
Over torque level (normal powered)	[CE120]	0.00~500.00(%)	Turns On the [OTQ] output terminal function when the output torque exceeds respective levels.
Over torque level (reverse regenerative)	[CE121]		
Over torque level (reverse powered)	[CE122]		
Over torque level (normal regenerative)	[CE123]		

■Output terminal [CC-01] to [CC-07]

Item	Terminal name	Data	Description
Over torque	[OTQ]	019	A signal turns ON when it exceeds the over torque level.

12.11.5 Send Torque from Multiple Motors

- In the case of performing high torque multi-operation control, connect two motors with the same specification to one inverter and perform sensorless vector control (IM).
- Motor constant needs to be set as follows.

- In the case of operating different loads on two motors, the load fluctuation on one motor may influence the operation status of the other and cause inappropriate control. Make sure to operate them with a load that can be considered as one load.
- See “Chapter 12.9 Select Motor Control Method Conforming to Motor and Load" for adjustment method.

■Motor base parameter

Item	Parameter	Data	Description
Motor capacity selection	[Hb102]	0.01~75.00 (kW)	Sets a 2-fold capacity of a motor in high torque multi-operation.
Selection of number of motor poles	[Hb103]	2 to 48 (poles)	Sets the number of poles per motor.
Base frequency	[Hb104]	1.00~590.00 (Hz)	Sets the base frequency per motor.
Maximum frequency	[Hb105]		Sets the maximum frequency per motor.
Motor rated voltage	[Hb106]	1~1000 (V)	Sets the rated voltage per motor.
Motor rated current	[Hb108]	0.01~10000.00(A)	Sets a 2-fold rated current of a motor in high torque multi-operation.

■IM motor constant parameter

Item	Parameter	Data	Description
Motor constant R1	[Hb110]	0.000001~1000.000000(Ω)	Sets half of primary resistance of a motor in high torque multi-operation.
Motor constant R2	[Hb112]		Sets half of secondary resistance of a motor in high torque multi-operation.
Motor constant L	[Hb114]	0.000001~1000.000000(mH)	Sets half of leaked inductance value of a motor in high torque multi-operation.
Motor constant I0	[Hb116]	0.01~10000.00(A)	Sets a 2-fold non-load current value of a motor in high torque multi-operation.
Motor constant J	[Hb118]	0.00001~10000.00000(kgm^2)	Sets a 2-fold system inertia moment of a motor in high torque multi-operation.

■Parameter

Item	Parameter	Data	Description
Control method	[AA121]	08: Sensor less vector control (IM) 09: Sensor less vector control in zero speed area (IM)	Uses the sensor less vector control function or sensor less vector control in the zero speed area.

12.11.6 Operate by Adding Torque Command

- The torque bias function operates by enabling torque bias mode selection at the time of speed control.
- The torque bias function will be enabled when the [AA121] control method is set to the sensorless vector control, sensorless vector control in the zero speed area, and sensor vector control.
- The torque bias function operates in either speed control or torque control.

- When the 068 [TBS] torque bias enable function is set to the input terminal, the torque bias function will be enabled, only when [TBS] is turned ON. When it is OFF, the torque bias setting will be disabled and the torque addition will be 0.

- In the torque bias function, switching forward/reverse can switch the adding direction.

1. When it is per the sign [±] of [Ad-14] = 00
   Regardless of the operation direction, torque will be added to the forward direction, when the torque bias value is (+), and to the reverse direction, when the torque bias is (-).

2. When it is dependent on the operation direction [Ad-14] = 01
   The sign of torque bias value and the direction of action of torque bias change based on the direction of operation command.
   Forward command: Add torque in the same direction as the torque bias value.
   Reverse command: Add torque in the reverse direction as the torque bias value.

- The torque bias function increases current because torque command is added.
- In the case of setting torque bias, values corresponding to analog inputs are as follows.

■Input to VRF/IRF terminal

0 to 10 (V)/0 to 20 (mA) corresponding value
Torque command addition 0.0 to 500.0(%)

■Input to VF2 terminal

-10 to 10 (V) corresponding value
Torque command addition -500.0 to 500.0(%)

- The setting of the ratio above can be changed by adjusting the analog input start end function.
  See "12.24.5 Adjust Analog Input".
  (e.g.) In the case of setting 0.0 to 50.0% to the torque command addition value for 0-10 (V)/0-20 (mA) input as [Ai1], set 10.0% for [Cb-04] to make it 50.0% against maximum 500.0%. ([Cb-03]=0.0,[Cb-04]=10.0,[Cb-05]=0.0,[Cb-06]=100.0)

■Monitor torque bias command value
- Commanded torque bias value can be monitored on the [FA-16] torque bias monitor.
- In the case of [Ad-11] = 07, the setting can be changed on the [FA-16] monitor.

- The torque command monitor (after calculation) [dA-15] displays the value with torque bias added to the present torque command.

■Parameters

Item	Parameter	Data	Description
Torque bias input selection	[Ad-11]	01~13,15	00 (Disable) 01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input) 07 (Parameter setting) 08 (RS 485) 09 (Option 1) 10 (Option 2) 11 (Option 3) 12 (Pulse train input: main unit) 13 (Pulse train input: HF-FB) 15 (PID calculation)
Torque bias setting	[Ad-12]	-500.0~500.0(%)	Adds a torque addition amount.
Torque bias polarity selection	[Ad-13]	00 (Per sign)	Regardless of the operation direction, torque will be added to the forward direction, when the value is (+), and to the reverse direction, when the value is (-).
		01 (Follow the revolution direction)	Changes the sign of the value and the direction of torque bias action into the operation command.
Torque bias enable terminal [TBS] selection	[Ad-14]	00	Disable
		01	Enable
Torque bias monitor	[FA-16]	-500.00~500.00(%)	Is the torque bias set monitor.
Torque command monitor (after calculation)	[dA-15]		Is the torque command monitor calculated set value and bias value.
Input terminal function	[CA-01]~[CA-11]	068	[TBS]: Can switch enable/disable of bias by the terminal ON/OFF switch when [TBS] is assigned and [Ad-11] = 01. ON: Enable/OFF: Disable

12.11.7 Switch Torque Control and Speed Control

- In the case of operating by switching torque control and speed control, turn ON the input terminal function 067 [ATR] function.
- If the torque command changes in a step manner when switching from speed control to torque control, the current may rise instantaneously.

■Parameter

Item	Parameter	Data	Description
Speed/torque control switch time	[Ad-04]	0~1000(ms)	Switches to torque command gradually based on the set time when switching speed control to torque control.

■Input terminal function

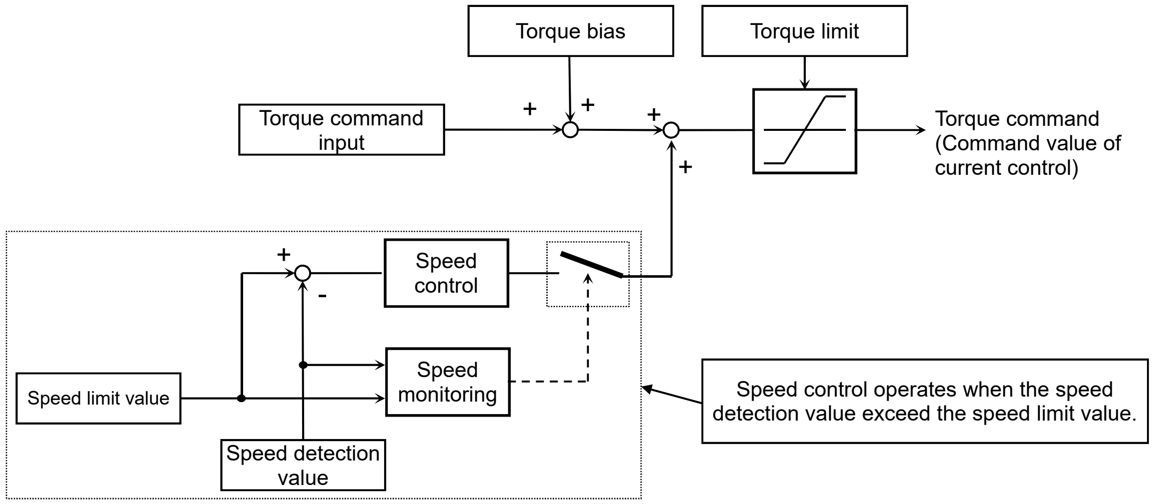
Item	Parameter	Data	Description
Input terminal FR to RST, DFH or DHH selection	[CA-01]~[CA-11]	067	[ATR]: Torque command input approval

12.11.8 Operate by Commanding Torque

- In the case of using [AA121] control method in sensorless vector control, sensorless vector control in the zero speed area, and sensor vector control, this drives the motor based on torque command.
- This function can be used not only in speed control/pulse train position control but also in torque control. It can also be applied to a winding machine.
- Using the torque bias function at the time of torque control adds a torque bias amount to torque command.

- Because the speed under torque control is decided by the balance with load, set [Ad-40] torque control speed limit value input selection for prevention of runaway. In the case of 07: Parameter setting, set the speed limit value setting [Ad-41]/[Ad-42].

- In the case of operating by torque control, assign 067 [ATR] to any of the input terminals. Turning ON the [ATR] terminal switches from speed control to torque control.
- Torque command handles the input value selected in the torque command setting [Ad-01] as a command.



■Parameters

Item	Parameter	Data	Description
Speed/torque control switch time	[Ad-04]	0~1000(ms)	It is time to switch from torque command to speed control. Set longer time when an error occurs at the time of switching control.
Torque control speed limit value input selection	[Ad-40]	01~13	01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input) 07 (Parameter setting) 08 (RS 485) 09 (Option 1) 10 (Option 2) 11 (Option 3) 12 (Pulse train input: main unit) 13 (Pulse train input: HF-FB)
Torque control frequency limit value (for normal rotation)	[Ad-41]	0.00~590.00(Hz)	Sets frequency to limit in the normal rotation during torque control.
Torque control frequency limit value (for reverse rotation)	[Ad-42]		Sets frequency to limit in the reverse rotation during torque control.

■Monitor torque command and output torque
- The torque command monitor [FA-15] displays a current command value that has been commanded.
- In the case of [Ad-01] = 07, the torque command set value can be changed on the [FA-15] monitor.

- The torque command monitor (after calculation) [dA-15] displays the value with torque bias added to the current torque command.
- Current output torque can be monitored on the output torque monitor [FA-16].

■Parameters

Item	Parameter	Data	Description
Torque command input selection	[Ad-01]	01~13,15	00 (Disable) 01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input) 07 (Parameter setting) 08 (RS 485) 09 (Option 1) 10 (Option 2) 11 (Option 3) 12 (Pulse train input: main unit) 13 (Pulse train input: HF-FB) 15 (PID calculation)
Torque command setting	[Ad-02]	-500.0~500.0(%)	Adds a torque addition amount.
Torque command polarity selection	[Ad-03]	00 (Per sign)	Regardless of the operation direction, torque will be added to the forward direction, when the value is (+), and to the reverse direction, when the value is (-).
		01 (Follow the revolution direction)	Changes the sign of value and the direction of torque bias action based on the operation command direction.
Torque command monitor (after calculation)	[dA-15]	-500.00~500.00(%)	It is the torque command monitor calculated set value and bias value.
Output torque monitor	[dA-17]		Displays the output torque.
Torque command monitor	[FA-15]		It is the torque command set monitor.

■Input terminal function

Item	Parameter	Data	Description
Input terminal FR to RST, DFH or DHH selection	[CA-01]~[CA-11]	067	Torque command input approval [ATR]

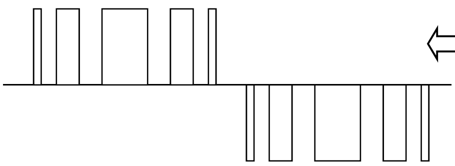
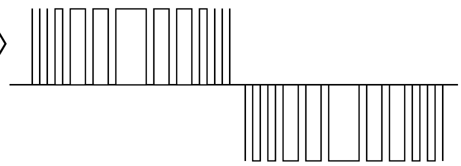
12.12 Carrier Frequency

12.12.1 Adjusting carrier frequency

- The carrier frequency is the frequency at which the element that controls the inverter output changes.
- The carrier frequency can be changed using the [bb101] setting.
- It is also effective in avoiding resonance of mechanical systems and motors.

- With the selection using [Ub-03] Load specifications, the carrier frequency setting will be automatically restrained.
- The relation between allowable output current and carrier frequency depends on the inverter type. Derate the output current as shown in the table on the next page when increasing the carrier frequency.
- If the [AA121] control method selection when driven by induction motor (IM) is automatic torque boost (03), sensor less vector control (08), or zero speed area sensor less vector control (09), set the carrier frequency to 2.0 kHz or higher.
- If the [AA121] control method selection is the synchronous motor/permanent magnet motor (SM/PMM) sensor less vector control (11), set the carrier frequency to 8.0 kHz or higher.
- The carrier frequency should be set to 10 times or higher of the [Hb105] IM highest frequency or [Hd105] SM (PMM) highest frequency.
  (Ex.) When [Hb105] = 60 Hz, [bb101] = 0.6 kHz (600 Hz) or higher
- When using the carrier frequency of 2.1 kHz or higher, see the derating characteristics described in "Chapter 20 Specifications".

■Carrier frequency and its extent of the effect

Carrier frequency	Low ←→	High
Motor electromagnetic noise	Loud	Quiet
Noise	Quiet	Loud
Inverter heat generation	Little	Much
Leakage current	Low	High
Inverter output voltage waveform example (PWM output)	Carrier frequency: Low 	Carrier frequency: High 

■Parameter

Item	Parameter	Data	Description
Carrier frequency	[bb101]	0.5~16.0(kHz) *1)	Changes the carrier frequency.

*1) The following constraints will be applied internally.
Maximum 12.0 kHz at rated LD, maximum 10.0 kHz at rated VLD

12.12.2 Automatically lowering carrier frequency

- The automatic carrier frequency reduction selection can be changed using the [bb103] setting.
- The higher the inverter carrier frequency is, the more the temperature inside the inverter tends to increase.
- The Automatic carrier frequency reduction function reduces life degradation of the elements by lowering the carrier frequency automatically according to the output current or temperature.

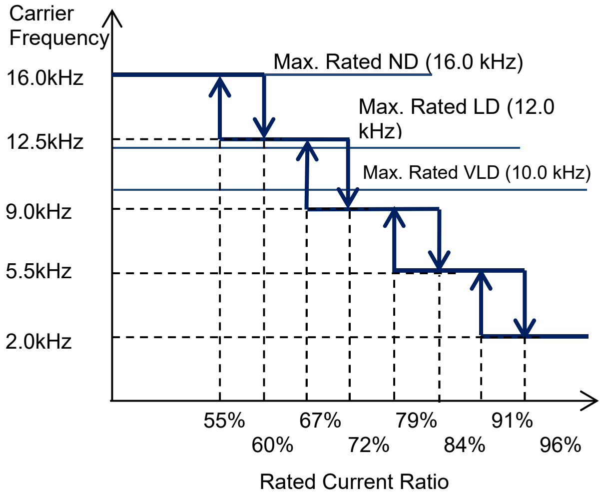
- When the automatic carrier frequency reduction function is activated, the electromagnetic noise of the motor changes.
- If the carrier frequency [bb101] is 2.0 kHz or lower, this function will not be activated.
- The operation rate when the carrier frequency was changed during operation will be 2 kHz in 1 s.
- When the automatic carrier frequency reduction function is activated, the electromagnetic noise generated by the motor changes slowly.

■Parameter

Item	Parameter	Data	Description
Automatic carrier frequency reduction selection	[bb103]	00	[bb101] Follows the carrier frequency.
		01	Reduces the carrier frequency according to the inverter output current.
		02	Reduces the carrier frequency according to the inverter temperature.

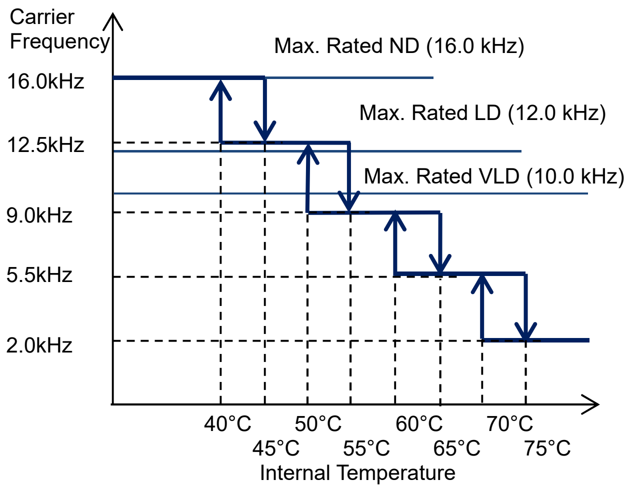
■ Output current-dependent ([bb103] = 01)

- Carrier frequency reduction starts once the current exceeds a certain value to the rated current.
- When the current decreases, the carrier frequency is automatically regained.



■Cooling fin temperature-dependent ([bb103] = 02)

- Carrier frequency reduction starts once the temperature of the internal output element exceeds a certain value.
- When the temperature lowers, the carrier frequency is automatically regained.



12.12.3 Reducing electromagnetic noise of motor

- Sprinkle carrier pattern selection can be changed using the [bb102] setting.
- The inverter carrier frequency is about the same as when output at 3 kHz.

- Changing the sprinkle carrier pattern selection cuts the electromagnetic noise of a certain area and changes the electromagnetic noise of the motor.

■Parameter

Item	Parameter	Data	Description
Sprinkle carrier pattern selection	[bb102]	00	Disabled (Follows other carrier frequency setting)
		01	Pattern 01
		02	Pattern 02
		03	Pattern 03

12.13 Trip less Function

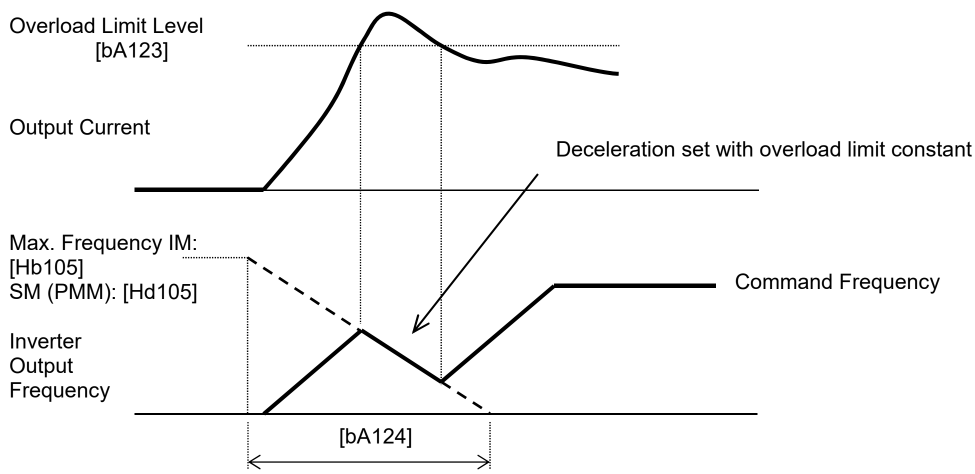
12.13.1 Restraining to avoid overloading

- Set [bA122] overload limit function to any value other than 00, and the output frequency automatically lowers according to overload limit time once the output current reaches [bA123] overload limit level.
- When [bA122] = 01, the output current is monitored during acceleration or at constant speed. It limits the excess inertial moment during acceleration and overload state caused by sudden acceleration.
- When [bA122] = 02, the output current is monitored only at constant speed. It prevents overloading caused by sudden load fluctuation at constant speed without decelerating during acceleration.
- When [bA122] = 03, the output current is monitored during acceleration or at constant speed. In addition to the operation with [bA122] = 01, it accelerates to prevent overloading when regenerative load is applied at constant speed.

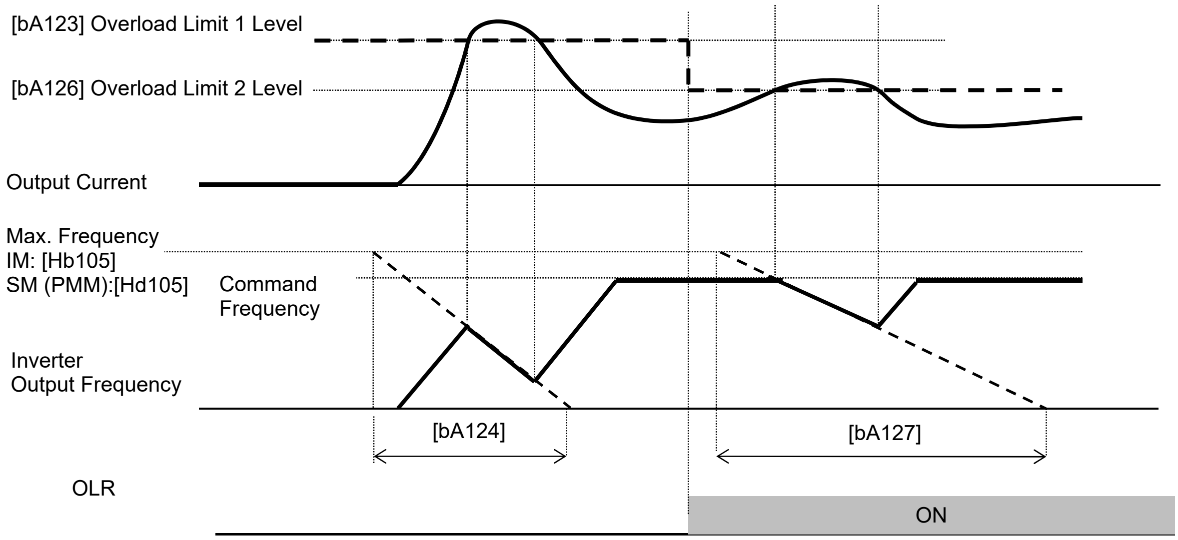
- Setting the overload limit operation time to be too short will cause this function to perform automatic deceleration even during acceleration, which may lead to overvoltage tripping caused by regenerative energy from the motor.
- If this function is activated during acceleration and the frequency does not reach the target frequency, the situation can be improved with the adjustments shown below.
  - Make the acceleration time longer
  - Adjust the torque boost
  - Increase the overload limit level

- [bA124] overload limit time is the time to decelerate from the maximum frequency to 0 Hz or to accelerate from 0 Hz to the maximum frequency.
- If this function is activated while the inverter is accelerating, the acceleration time will be longer than the set time.

■Operation example



- Using [bA122] to [bA124] of overload limit 1 and [bA126] to [bA128] of overload limit 2, you can set two types of overload limit functions.
- You can switch between overload limit 1 and overload limit 2 with the input terminal function 038[OLR]. Turning on the [OLR] enables the overload limit 2.



■Parameters

Item	Parameter	Data	Description
Overload limit 1 selection Overload limit 2 selection	[bA122] [bA126]	00	Disabled
		01	Enabled during acceleration and at constant speed
		02	Enabled at constant speed
		03	Enabled during acceleration and at constant speed (Speed increases during regeneration)
Overload Limit 1 Level Overload Limit 2 Level	[bA123] [bA127]	Inverter rated current × (0.20~2.50)	Overload limit function is activated when the output current exceeds this set value.
Overload limit 1 operation time Overload limit 2 operation time	[bA124] [bA128]	0.10~3600.00(s)	Acceleration/Deceleration time when exceeded the overload limit level.

■Input terminal function

Item	Parameter	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	038	[OLR] Overload limit switching OFF: Overload limit 1 enabled. ON: Overload limit 2 enabled.

12.13.2 Restraining to avoid overcurrent

- Setting [bA120] overcurrent suppression selection to 01 enables the overcurrent suppression function.
- This function suppresses the overcurrent caused by steep current increase due to sudden acceleration, etc.

- Disable this function when using for elevators, etc. Suppressing the current causes insufficient torque, which may result in sliding down of the panier or anything hanging.
- The overcurrent tripping may take place even if this function is enabled if the current increases sharply due to shock load, etc.
- This function will be automatically enabled during DC braking.

- If the overcurrent suppression function is enabled, the overcurrent suppression function will be activated when the motor current exceeds the set value for [bA121] with momentary current increase.

■Parameters

Item	Parameter	Data	Description
Overcurrent suppression selection	[bA120]	00	Disabled
		01	Enabled (Overcurrent suppression is activated.)
Overcurrent suppression level	[bA121]	Inverter rated current × (0.00~2.50)	Sets the operation level of the overcurrent suppression function.
Overcurrent suppression level when resuming with frequency pull-in	[bb-46]		Sets the operation level of the overcurrent suppression function (when activated with frequency pull-in.* 1)

*1) See "12.14.4 Starting with frequency pull-in" for details.

12.13.3 Controlling frequency to avoid overvoltage

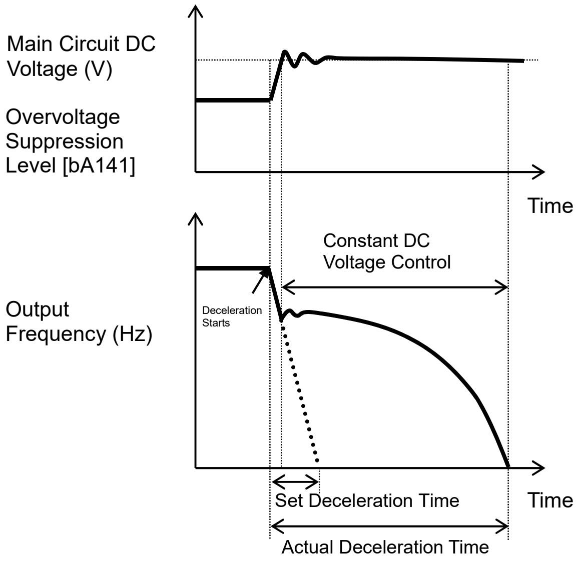
- [bA140] overvoltage suppression function selection allows you to enable the overvoltage suppression function.
- The overvoltage suppression function will be activated when the internal DC voltage of the inverter main circuit capacitor exceeds the value set by [bA141] overvoltage suppression level.

- When this function is enabled, the actual deceleration time may get longer than the set value.
- When using this function, it may take long time before the motor stops depending on the motor load moment of inertia.
- Depending on the deceleration rate or load status, the overvoltage tripping may be triggered even if this function is enabled.
- Set [bA141] to be receiving voltage x $\sqrt{2}$ × 1.1 or higher. Setting a value lower than the P-N voltage in operation may prevent the motor from stopping.

■Parameters

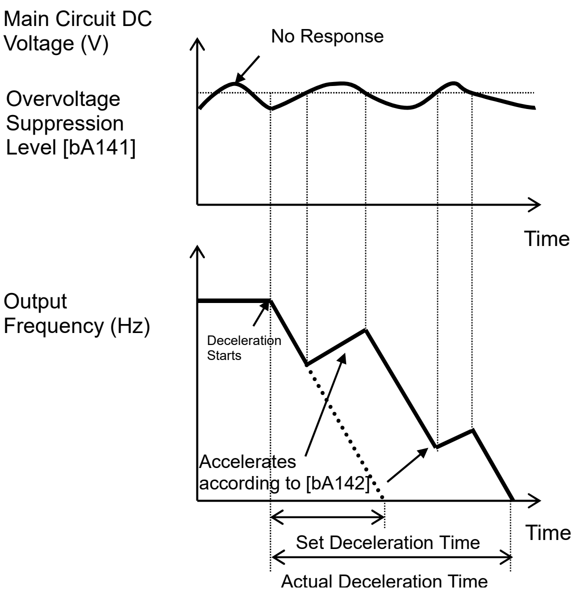
Item	Parameter	Data	Description
Overvoltage suppression function	[bA140]	00	Disabled
		01	Constant DC voltage-controlled deceleration
		02	Function to avoid overvoltage acceleration (only in deceleration)
		03	Function to avoid overvoltage acceleration
Overvoltage suppression level setting	[bA141]	200 V class: 330.0 - 400.0 (V) 400 V class: 660.0 - 800.0 (V)	Sets the level at which the overvoltage suppression function starts.
Overvoltage suppression operating time	[bA142]	0.00~3600.00(s)	Acceleration time when the overvoltage suppression function is activated.
Constant DC voltage control Proportional (P) gain	[bA144]	0.00~5.00	Proportional gain for PI control in constant DC voltage control.
Constant DC voltage control Integral (I) gain	[bA145]	0.00~150.00	Integral gain for PI control in constant DC voltage control.

■For constant DC voltage control [bA140] = 01

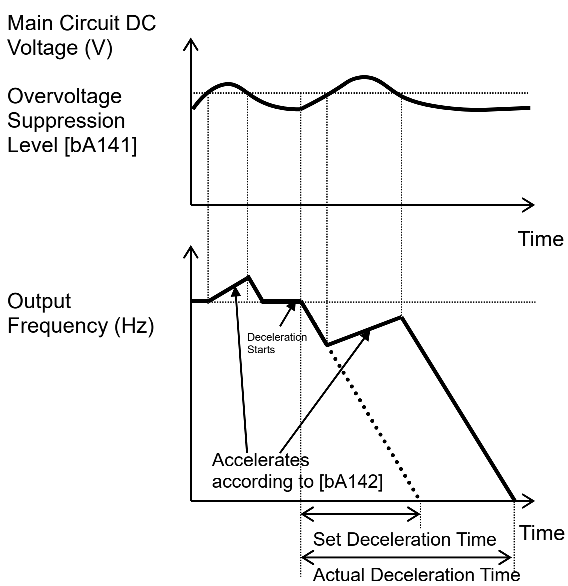


- When [bA141] is 01, PI control is performed so that the internal DC voltage will be constant.
- Setting the proportional gain [bA143] to be large will accelerate the response. However, setting it to be too large will dissipate the control, tending to cause tripping.
- Setting the integral gain [bA144] to be short will accelerate the response. However, setting it to be too short will tend to cause tripping.
- If the internal DC voltage increases when [bA141] is 02 or 03, acceleration control is performed.
- The acceleration control accelerates to the highest frequency setting according to the overvoltage suppression operating time [bA142]. After the acceleration, it decelerates to the target value according to the normal deceleration time.
- If the overvoltage suppression operating time [bA142] is set to be too short, it accelerates more than decelerating and may prevent the motor from stopping. In this case, increase the setting of the overvoltage suppression level setting [bA141].

■For function to avoid overvoltage acceleration (only in deceleration) [bA140] = 02



■For function to avoid overvoltage acceleration [bA140] = 03



12.13.4 Controlling output to avoid overvoltage

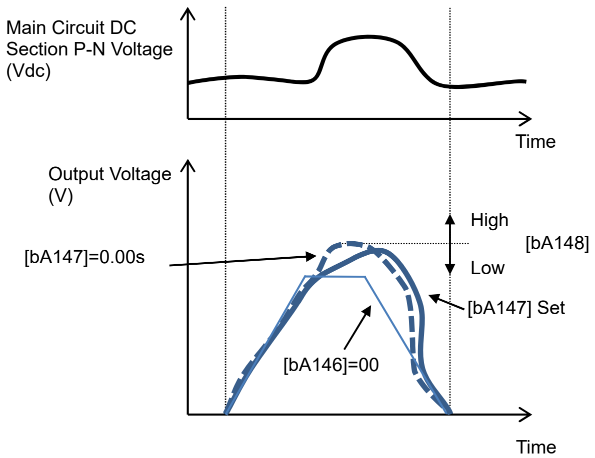
- [bA146] overexcitation function selection allows you to enable the overexcitation function.
- When this function is enabled, the current may increase as the output voltage increases.
- When using this function, the motor will be overexcited and the heat generated by the motor may increase.
- Depending on the deceleration rate or load status, the overvoltage tripping may be triggered even if this function is enabled.
- The over excitation function is activated when controlling VC characteristics of V/f control, VP characteristics, and free V/f control.
- The overexcitation function increases the motor loss and reduces energy to be regenerated in order to suppress the overvoltage and prevent tripping.

■Parameters

Item	Parameter	Data	Description
Over excitation function selection	[bA146]	00	Disabled
		01	Always active
		02	Active only during deceleration
		03	Level operation
		04	Level operation during deceleration
Over excitation output filter time constant	[bA147]	0.00~1.00(s)	Filter time constant applied to the over excitation output.
Over excitation voltage gain	[bA148]	50~400(%)	Gain for the over excitation output voltage.
Over excitation suppression level	[bA149]	200 V class: 330.0 - 400.0 (V) 400 V class: 660.0 - 800.0 (V)	The level at which the over excitation function starts its operation.

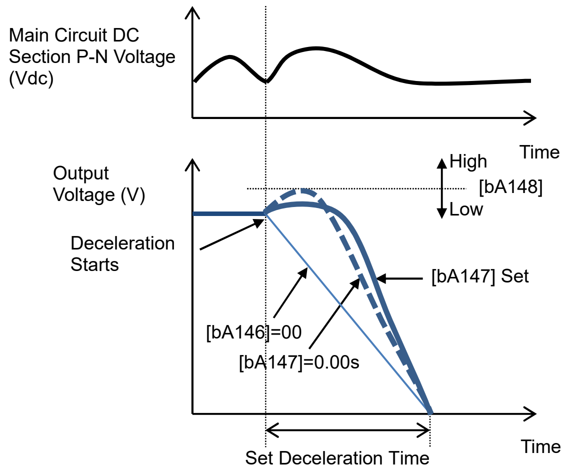
■When always active [bA146] = 01

- Always activated according to the P-N voltage



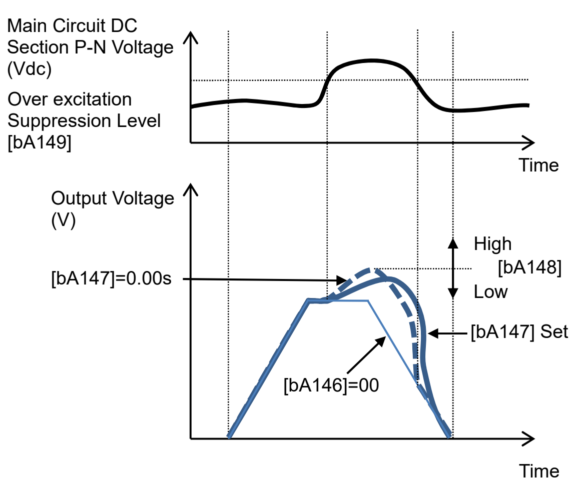
■When activated only during deceleration [bA146] = 02

- Activated according to the P-N voltage during deceleration



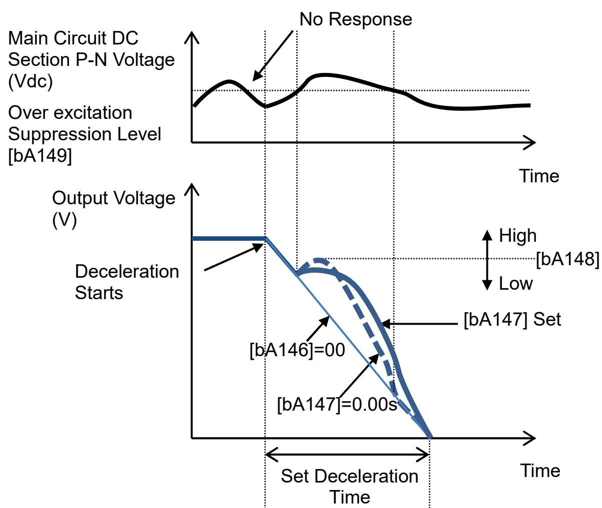
■For level operation [bA146] = 03

- Activated when the P-N voltage exceeds the set level



■For level operation during deceleration [bA146] = 04

- Activated when the P-N voltage exceeds the set level only during deceleration



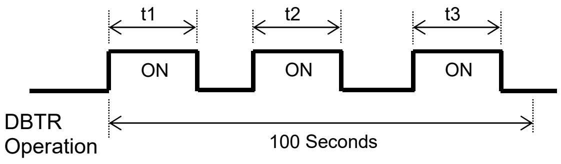
12.13.5 Suppressing overvoltage with braking resistor

- This is a function concerning braking circuit (DBTR).
- This function is to consume the regenerative energy from the motor as heat using the external resistor.

- You can also use the optional DBTR unit instead of using the built-in braking circuit (DBTR).
  If using the DBTR unit, no setting needs to be made.
- The DBTR ON level is the level setting for the main circuit DC smoothing capacitor inside the inverter.
  It needs to be set to a value exceeding the input voltage time's √2.
- See the selection and wiring of regenerative braking resistor for minimum resistance that can be connected and DBTR use rate for each model.

■Operation rate

The motor will trip when the operation rate exceeds the use rate.



$$\text{Operation Rate (\%)} = \frac{(t1+t2+t3)}{100\ \text{Seconds}} \times 100$$

■Parameters

Item	Parameter	Data	Description
Braking resistor circuit (DBTR) use rate	[bA-60]	0.0~100.0(%) The upper limit depends on [bA-63]	If it is set to 0.0, the DBTR function will not be activated. If the setting is other than 0.0, the motor will trip when [dA-41] DBTR load factor monitor exceeds the DBTR use rate.
Braking resistor circuit (DBTR) selection	[bA-61]	00	Disabled
		01	Enabled (Disable while being stopped)
		02	Enabled (Enabled while being stopped)
Braking resistor circuit (DBTR) ON level	[bA-62]	200 V class: 330.0 - 400.0 (V) 400 V class: 660.0 - 800.0 (V)	The ON level at which the DBTR is activated.
Braking resistor circuit (DBTR) resistance	[bA-63]	Minimum resistance ~600 (Ω)	Setting the DBTR resistance to be connected automatically sets the maximum value for [bA-60].

■Monitoring

Item	Parameter	Data	Description
DBTR load factor monitor	[dA-41]	0.00~100.00(%)	The value in accordance with the DBTR use rate will be displayed.

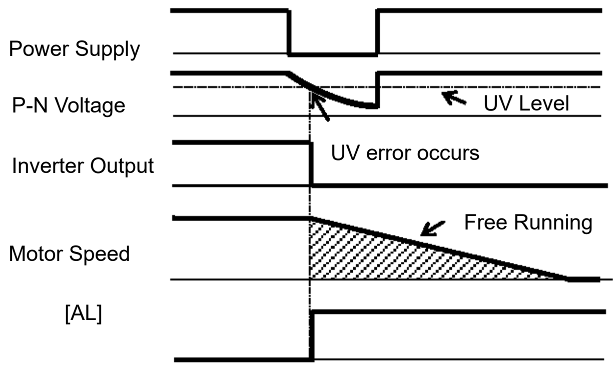
12.13.6 Restarting after under voltage

- You can select either tripping ([bb-21] = 00) with power supply recovery or retrying restarting ([bb-21] ≠ 00) when the main power (R, S, T) fails.
- If the input power supply to the inverter is input separately to main power supply (R, S, T) and control power supply (r1, t1), the operation depends on how the power to the main power supply (R, S, T) drops.
- When [bb-27] = 00, you can avoid under voltage error if the main power supply is to be turned off for saving energy while the inverter output is being stopped.
- When [bb-27] = 02, you can avoid under voltage error caused by power shutdown during deceleration and stop.
- If the input power supply to the inverter is input to the control power supply (r1, t1) via main power supply (R, S, T), instantaneous power failure tripping or instantaneous power failure retry may be triggered first depending on the operating situation.
- If the control power supply has failed completely, the action to be taken is the powering on.
- After 40 seconds with the main power supply (R, S, T) failed, the under voltage will occur and the motor will trip even if [bb-27] = 00 or 02.
- Inverter internal P-N voltage can be monitored with [dA-40].

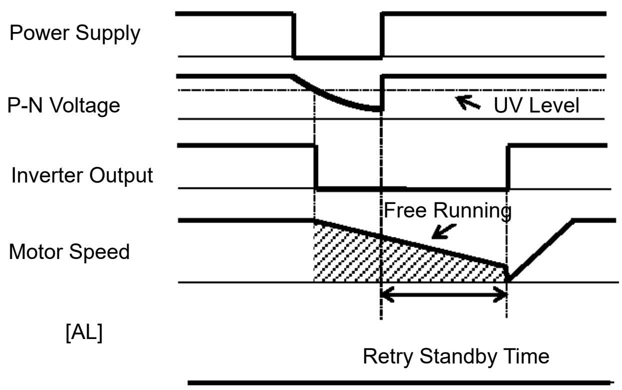
■Parameters

Item	Parameter	Data	Description
Under voltage retry count selection	[bb-21]	00~16/ ∞(255) (Counts)	Sets the under voltage retry restarting counts. If this is set to 0, the motor will trip upon under voltage.
Instantaneous power failure/under voltage retry selection	[bb-24]	00	Restarts at 0 Hz
		01	Restarts with the frequency matching
		02	Restarts upon frequency pull-in
		03	Detection speed (frequency) <v2.00 or higher>
		04	Trips after decelerating and stopping with the frequency matching
Instantaneous power failure/under voltage retry standby time	[bb-26]	0.3~100.0(s)	Starts after waiting for the set time upon power voltage recovery.
Instantaneous power failure/under voltage tripping selection during stop	[bb-27]	00	Disabled
		01	Enabled
		02	Disabled during stop and deceleration stop

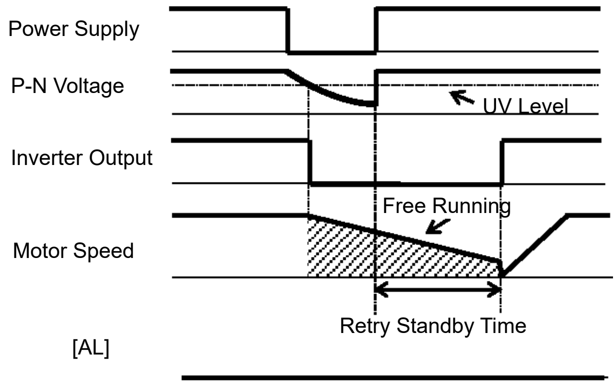
(Ex. 1) When [bb-21] = 00, tripping occurs



(Ex. 2) When [bb-21] ≠00 and [bb-24] = 00, it restarts at 0 Hz.

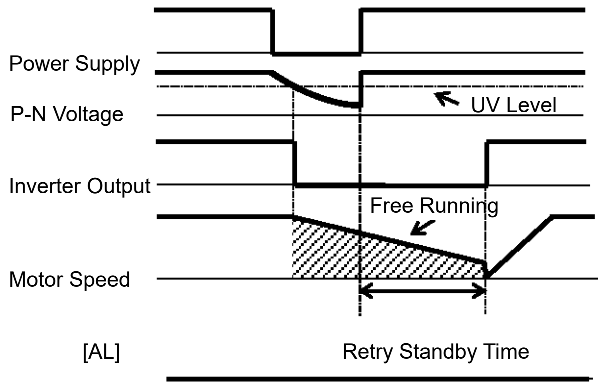


(Ex. 3) When [bb-21] ≠00 and [bb-24] = 01, it restarts by picking up the frequency.



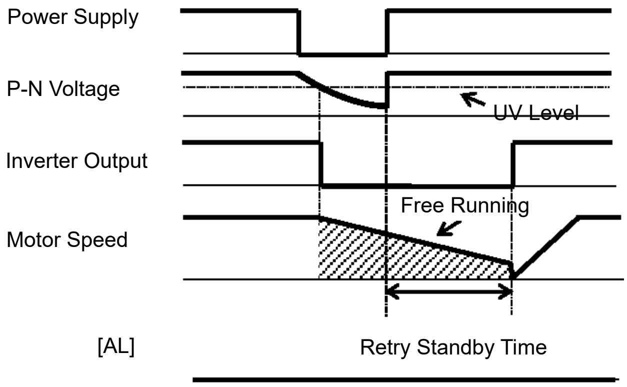
• See "12.14.3 Starting by picking up frequency" for details.

(Ex. 4) When [bb-21] ≠00 and [bb-24] = 02, it restarts with frequency pull-in.



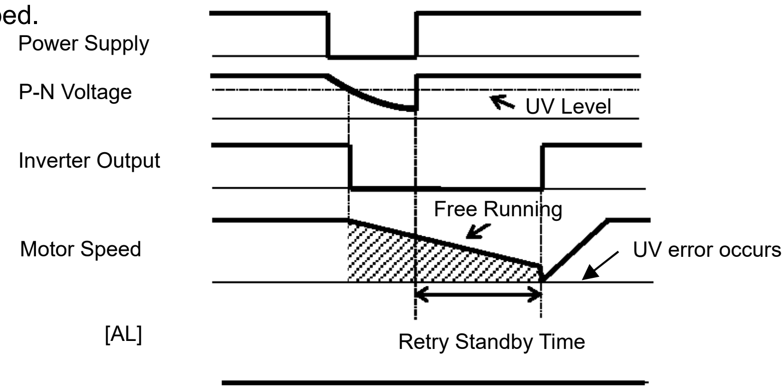
• See "12.14.4 Starting with frequency pull-in" for details.

(Ex. 5) When [bb-21] ≠00 and [bb-24] = 03, it restarts using the motor speed feedback.



- For motor speed feedback, the feedback input to the input terminals DFH and DHH, or feedback input to the optional cassette HF-FB is required.

(Ex. 6) When [bb-21] ≠00 and [bb-24] = 04,
it restarts by picking up frequency, and then after deceleration according to the setting, the motor trips when stopped.



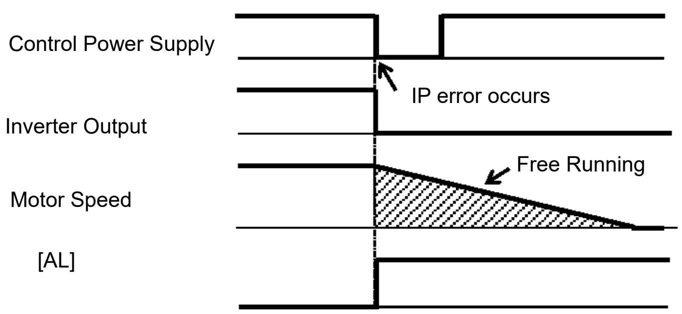
12.13.7 Restarting upon recovery after instantaneous power failure

- When the power supply shows the voltage falling short of the under voltage level, you can select either tripping ([bb-20] = 00) by recovering the power supply or retrying restarting ([bb-20] ≠ 00).
- If the input power supply to the inverter is input separately to main power supply (R, S, T) and control power supply (r1, t1), the instantaneous power failure is detected based on how much the power to the main power supply (R, S, T) drops.
- When [bb-27] = 00, you can avoid instantaneous power failure error before the control power supply is turned off for saving energy while the inverter output is being stopped.
- When [bb-27] = 02, you can avoid instantaneous power failure error caused by power shutdown during deceleration and stop.
- The judgement of instantaneous power failure of the inverter is based on the detection of voltage drop in the main power supply (R, S, T).
- Depending on the fluctuation rate of the main power supply (R, S, T), errors other than instantaneous power failure may occur.
- If the input power supply to the inverter is input to the control power supply (r1, t1) via main power supply (R, S, T), under voltage tripping or under voltage retry may be triggered first depending on the operating situation.
- When the power supplied to the control power supply (r1, t1) is shut off, the power will be lost as quick as in about 80 ms. In this case, it will be a power shutdown.

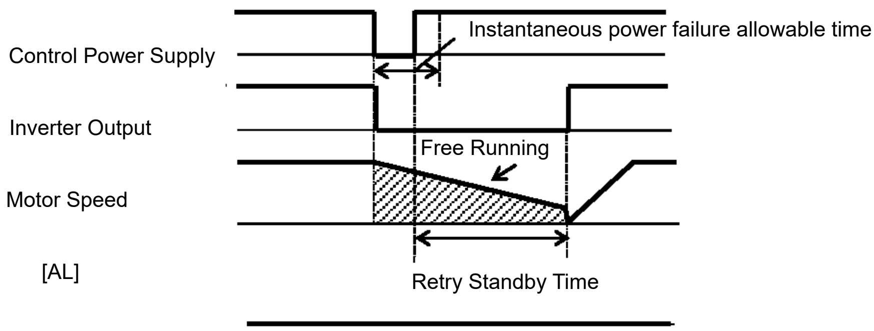
■Parameters

Item	Parameter	Data	Description
Instantaneous power failure tripping selection	[bb-20]	0~16/ ∞(255) (Counts)	Sets the retry counts in case of instantaneous power failure. If this is set to 0, the motor will trip upon recovery from instantaneous power failure.
Instantaneous power failure/under voltage retry selection	[bb-24]	00	Restarts at 0 Hz
		01	Restarts with the frequency matching
		02	Restarts upon frequency pull-in
		03	Detection speed (frequency)
		04	Trips after decelerating and stopping with the frequency matching
Instantaneous power failure allowable time	[bb-25]	0.3~25.0(s)	Restarts if the instantaneous power failure time is within the set value.
Instantaneous power failure/under voltage retry standby time	[bb-26]	0.3~100.0(s)	Starts after waiting for the set time upon power voltage recovery.
Instantaneous power failure/under voltage tripping selection during stop	[bb-27]	00	Disabled
		01	Enabled
		02	Disabled during stop and deceleration stop

(Ex. 1) When [bb-20] = 00, tripping occurs

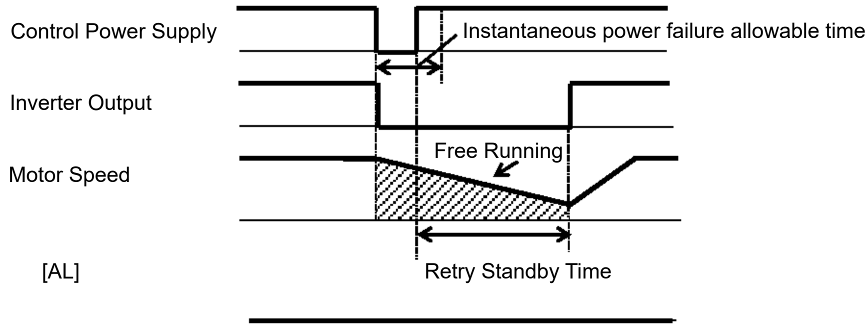


(Ex. 2) When [bb-20] ≠00 and [bb-24] = 00, it restarts at 0 Hz.



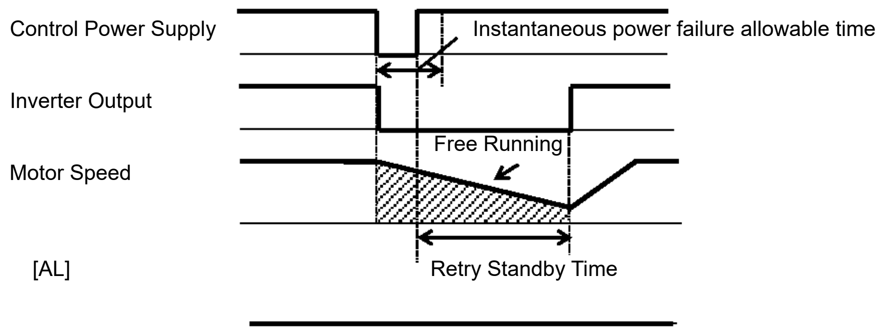
*) The motor will trip after instantaneous power failure allowable time.

(Ex. 3) When [bb-20] ≠00 and [bb-24] = 01, it restarts by picking up the frequency.



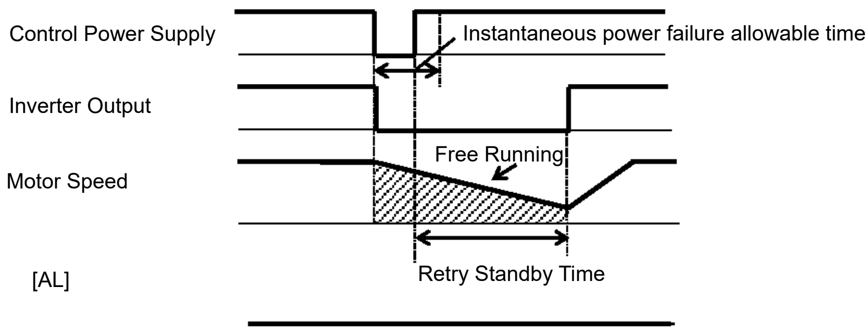
*) The motor will trip after instantaneous power failure allowable time.
- See "12.14.3 Starting by picking up frequency" for details.

(Ex. 4) When [bb-20] ≠00 and [bb-24] = 02, it restarts with frequency pull-in.



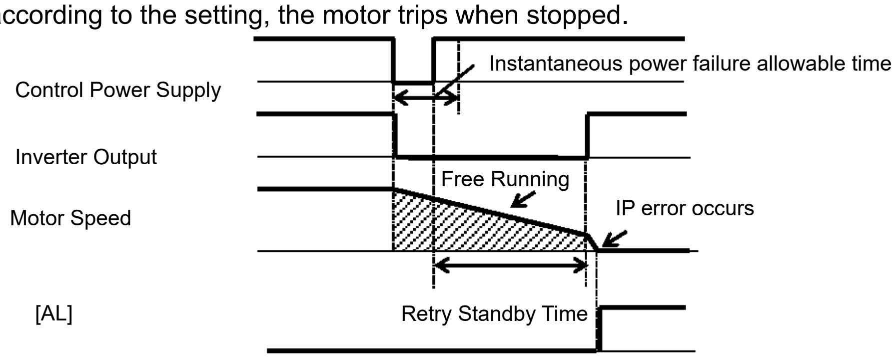
*) The motor will trip after instantaneous power failure allowable time.
- See "12.14.4 Starting with frequency pull-in" for details.

(Ex. 5) When [bb-20] ≠00 and [bb-24] = 03, it restarts using the motor speed feedback.



*) The motor will trip after instantaneous power failure allowable time.
- For motor speed feedback, the feedback input to the input terminals DFH and DHH, or feedback input to the optional cassette HF-FB is required.

(Ex. 6) When [bb-20] ≠00 and [bb-24] = 04, it restarts by picking up the frequency, and then after deceleration according to the setting, the motor trips when stopped.



*) The motor will trip after instantaneous power failure allowable time.

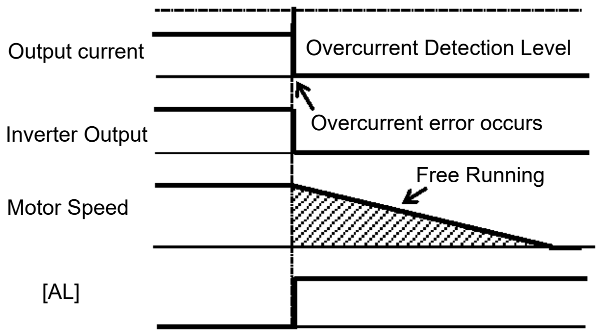
12.13.8 Restarting after overcurrent

- In case of overcurrent, you can restart without causing tripping.
- If overcurrent continues to be observed, there are some possible causes: short acceleration time, heavy load, locked motor, etc.

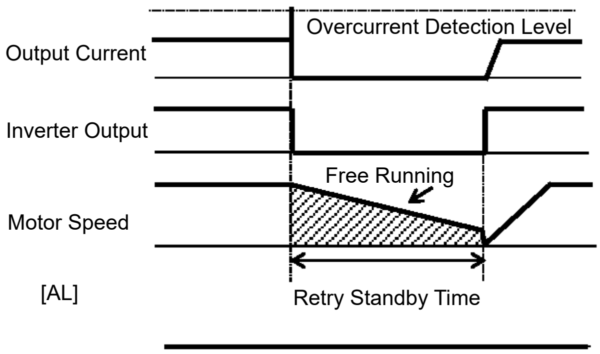
■Parameters

Item	Parameter	Data	Description
Overcurrent detection level	[bb160]	Depend on the inverter model	Sets the level at which the overcurrent is to be detected.
Overcurrent retry count selection	[bb-22]	0~5 (Counts)	Sets the retry counts in case of overcurrent. If this is set to 0, the motor will trip upon overcurrent.
Overcurrent tripping retry selection	[bb-28]	00	Restarts at 0 Hz
		01	Restarts with the frequency matching
		02	Restarts upon frequency pull-in
		03	Detection speed (frequency)
		04	Trips after decelerating and stopping with the frequency matching
Overcurrent retry standby time	[bb-29]	0.3~100.0(s)	Restarts after waiting for the set time upon overcurrent.

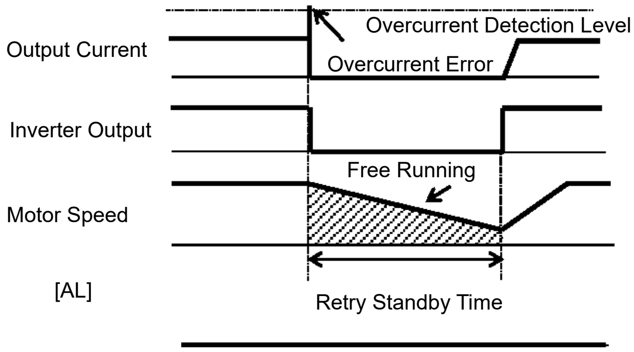
(Ex. 1) When [bb-22] = 00, tripping occurs



(Ex. 2) When [bb-22] ≠00 and [bb-28] = 00, it restarts at 0 Hz.

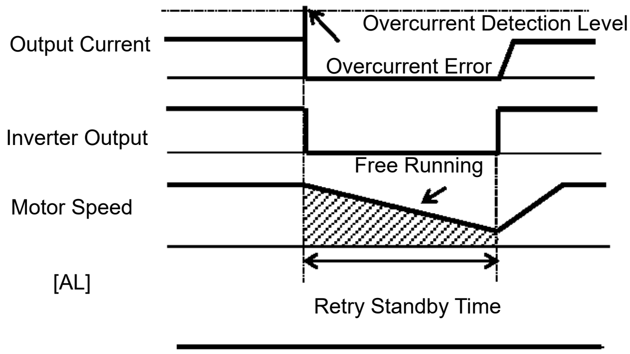


(Ex. 3) When [bb-22] ≠00 and [bb-28] = 01, it restarts by picking up the frequency.



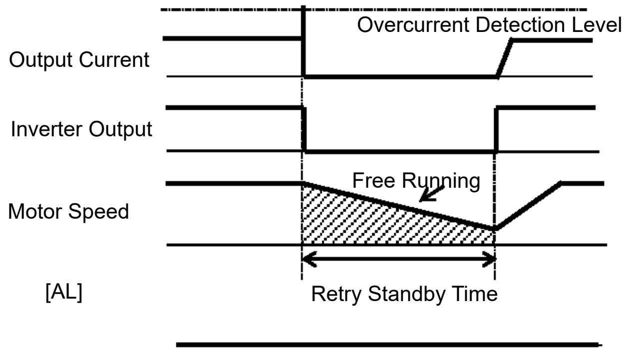
• See "12.14.3 Starting by picking up frequency" for details.

(Ex. 4) When [bb-22] ≠00 and [bb-28] = 02, it restarts with frequency pull-in.



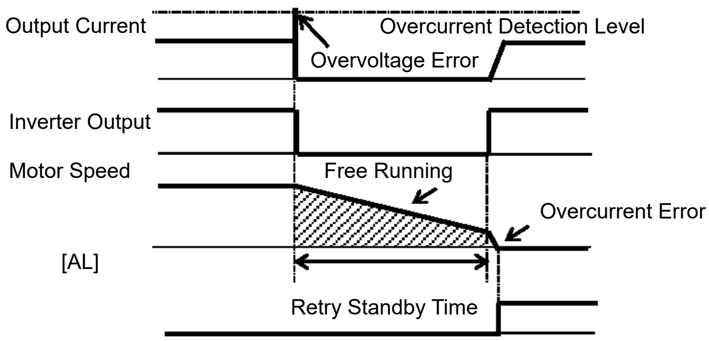
• See "12.14.4 Starting with frequency pull-in" for details.

(Ex. 5) When [bb-22] ≠00 and [bb-28] = 03, it restarts using the motor speed feedback.



• For motor speed feedback, the feedback input to the input terminals DFH and DHH, or feedback input to the optional cassette HF-FB is required.

(Ex. 6) When [bb-22] ≠00 and [bb-28] = 04, it restarts by picking up the frequency, and then after deceleration according to the setting, the motor trips when stopped.



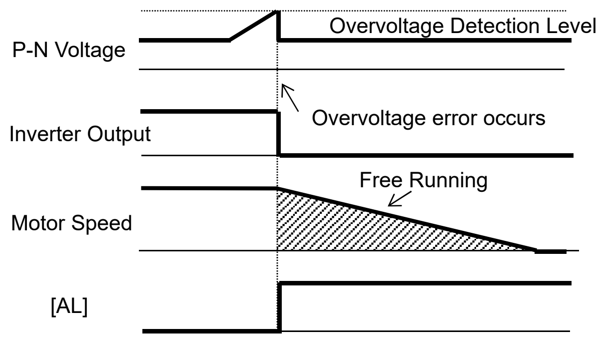
12.13.9 Restarting after overvoltage

- In case of overvoltage, you can restart without causing tripping.
- If overvoltage continues to be observed, there are some possible causes: short deceleration time, heavy load, motor operated by external force, etc.

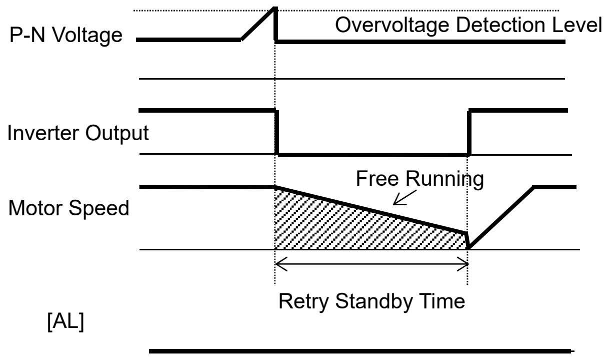
■Parameters

Item	Parameter	Data	Description
Overvoltage tripping selection	[bb-23]	0~5 (Counts)	Sets the retry counts in case of overvoltage. If this is set to 0, the motor will trip upon overvoltage.
Overvoltage tripping retry selection	[bb-30]	00	Restarts at 0 Hz
		01	Restarts with the frequency matching
		02	Restarts upon frequency pull-in
		03	Detection speed (frequency)
		04	Trips after decelerating and stopping with the frequency matching
Overvoltage retry standby time	[bb-31]	0.3~100.0(s)	Restarts after waiting for the set time upon overvoltage.

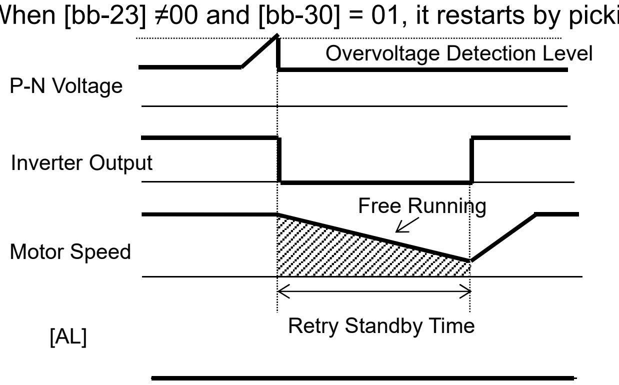
(Ex. 1) When [bb-23] = 00, tripping occurs



(Ex. 2) When [bb-23] ≠00 and [bb-30] = 00, it restarts at 0 Hz.

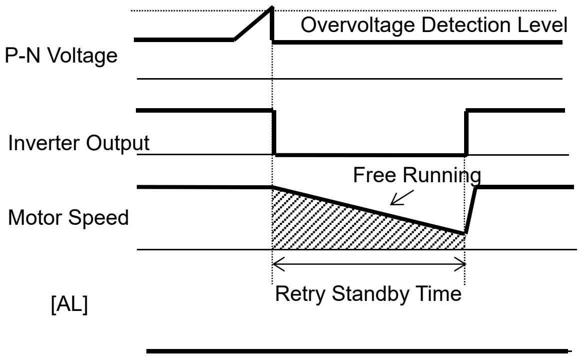


(Ex. 3) When [bb-23] ≠00 and [bb-30] = 01, it restarts by picking up the frequency.



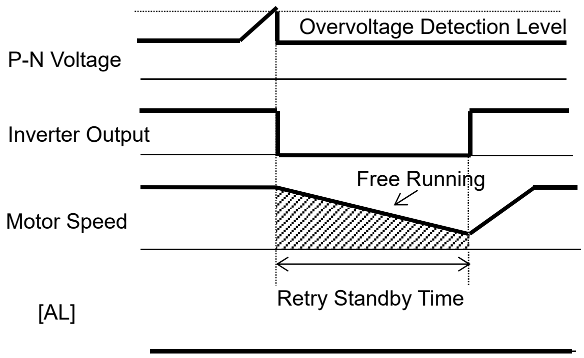
- See "12.14.3 Starting by picking up frequency" for details.

(Ex. 4) When [bb-23] ≠00 and [bb-30] = 02, it restarts with frequency pull-in.



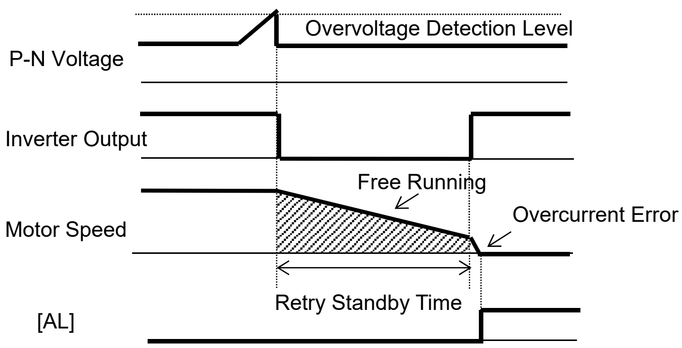
- See "12.14.4 Starting with frequency pull-in" for details.

(Ex. 5) When [bb-23] ≠00 and [bb-30] = 03, it restarts using the motor speed feedback.



- For motor speed feedback, the feedback input to the input terminals DFH and DHH, or feedback input to the optional cassette HF-FB is required.

(Ex. 6) When [bb-23] ≠00 and [bb-30] = 04, it restarts by picking up the frequency, and then after deceleration according to the setting, the motor trips when stopped.



12.13.10 Continuing motor operation during instantaneous power failure for deceleration and stop

- This function allows deceleration and stop of the motor while maintaining the voltage under the overvoltage level when the power supply is shut down during operation.
- One of the three modes can be selected with [bA-30] instantaneous power failure non-stop selection.
- Instantaneous power failure non-stop operation is activated when the input to the main power supply (R, S, T) drops.
- When [bA-30] is 01 or 02, the motor decelerates and stops after the function is activated.
  You need to turn off the operation command and turn it on again to restart after the stop.
  Even if the [bA-30] is 03, you still need to turn off the operation command and turn it on again if the motor decelerated and stopped without recovery after the function is activated.
- If the control power supply (r1, t1) is not input separately from main power supply, supply the P-N voltage to the control power supply (r1, t1) to use the instantaneous power failure non-stop function.
  When using this function, disconnect the J51 connector line connected to the r1 and t1 terminals and connect the wire from main terminal P to r1, and N to t1.
  Use electrical wire of 0.75mm^2 or larger.

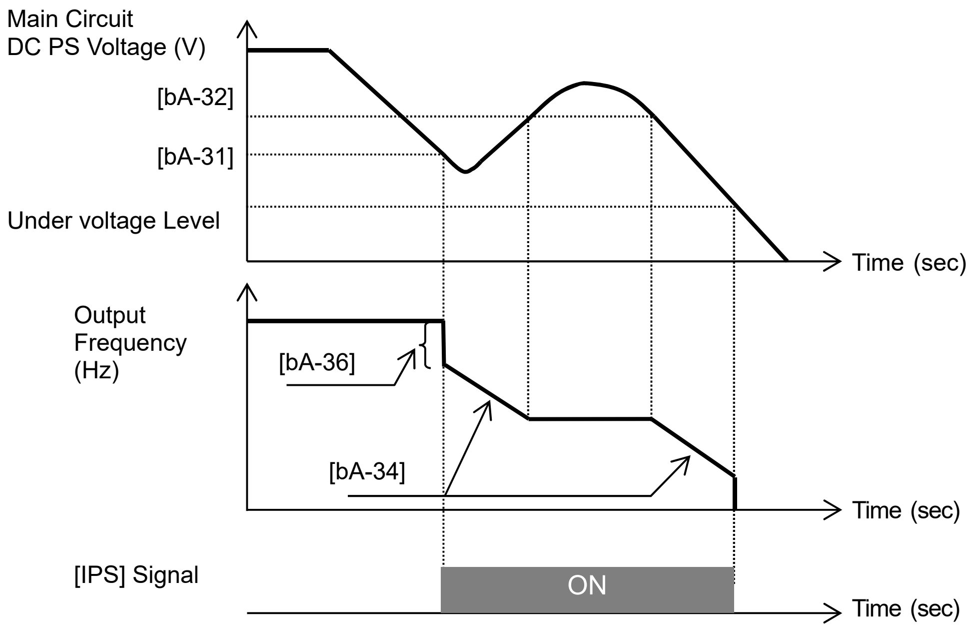
■Parameters

Item	Parameter	Data	Description
Instantaneous power failure non-stop selection	[bA-30]	00	Disabled
		01	Decelerates and stops, and maintains the stop status.
		02	Decelerates and stops with constant DC voltage control, and maintains the stop status.
		03	Decelerates and stops with constant DC voltage control, and maintains the stop status. If the power supply recovers during the process, the operation continues.
Instantaneous power failure non-stop function starting voltage	[bA-31]	(200 V class) 0.0~410.0(v) (400 V class) 0.0~820.0(v)	This is the voltage level at which the instantaneous power failure non-stop control starts when the internal power supply voltage drops.
Instantaneous power failure non-stop frequency constant voltage level	[bA-32]	(200 V class) 0.0~410.0(v) (400 V class) 0.0~820.0(v)	Switches the deceleration temporarily to constant speed operation when the internal power supply voltage increases due to deceleration.
Instantaneous power failure non-stop deceleration time	[bA-34]	0.01~3600.00(s)	Deceleration time setting for instantaneous power failure non-stop deceleration and stop operation.
Instantaneous power failure non-stop deceleration starting range	[bA-36]	0.00~10.00(Hz)	The setting for starting deceleration by lowering frequency during instantaneous power failure non-stop deceleration and stop operation.
Instantaneous power failure non-stop constant DC voltage control P control	[bA-37]	0.00~5.00	Proportional gain for PI control during constant DC voltage control.
Instantaneous power failure non-stop constant DC voltage control I control	[bA-38]	0.00~150.00(s)	Integral gain for PI control during constant DC voltage control.
Output terminal function	[CC-01]~[CC-07]	023	[IPS] Outputs the signal during instantaneous power failure non-stop deceleration. OFF: The function is not active. ON: Instantaneous power failure non-stop deceleration in function.

■Instantaneous power failure non-stop Deceleration/Stop ([bA-30] = 01)

- This function allows deceleration and stop of the motor while maintaining the voltage under the instantaneous power failure non-stop frequency constant voltage level [bA-32] after the power supply was shut down during operation.
- If the power supply was shut down during operation, deceleration starts at the frequency lowered by deceleration starting width [bA-36] when the voltage drops to the instantaneous power failure non-stop function activating voltage [bA-31] or lower, and then decelerates for the instantaneous power failure non-stop deceleration time [bA-34].
- In case of regenerative status caused by deceleration torque during deceleration and if the internal power supply voltage reaches the frequency-constant voltage level [bA-32] or higher, the motor will be at constant speed until the internal power supply voltage falls below the overfrequency-constant voltage level [bA-32].

- If the frequency-constant voltage level [bA-32] < Function starting voltage [bA-31], it works by taking [bA-32] at the same level as [bA-31]. (However, the set values will not be changed)
- If the frequency-constant voltage level [bA-32] is lower than the input voltage multiplied by $\sqrt{2}$, the constant speed state will be maintained and deceleration will not take place if the power recovers while this function is in operation. (Power should be shut off and turned on again, or [bA-32] needs to be reset during operation.) The [bA-32] must be set to a value greater than the input voltage multiplied by $\sqrt{2}$.
- This function will not be disabled until the operation stop will be completed. To recover power and restart the operation while this function is in operation, input the stop command (operation command OFF) and then input the operation command again after the motor stopped.
- If the instantaneous power failure non-stop deceleration starting range [bA-34] is too large, sudden deceleration will cause overcurrent tripping. • If the value of [bA-36] is too low or the instantaneous power failure non-stop deceleration time [bA-34] is too long, insufficient regenerative force will cause undervoltage tripping.



■Instantaneous power failure non-stop constant DC voltage control
([bA-30] = 02: No recovery, [bA-30] = 03: Recovery)

- This function maintains the main circuit DC voltage to the value set by [bA-32] instantaneous power failure non-stop level while decelerating if instantaneous power failure occurs or the main circuit DC voltage drops during operation.
- The condition to activate this function is when all the conditions below are met.
  - [bA-30] is 02 or 03
  - In operation (It will not function while being tripped, under voltage or stopped)
  - When the instantaneous power failure occurs at the control power supply or when the main circuit DC voltage drops to b051, instantaneous power failure non-stop function starting voltage, or lower.

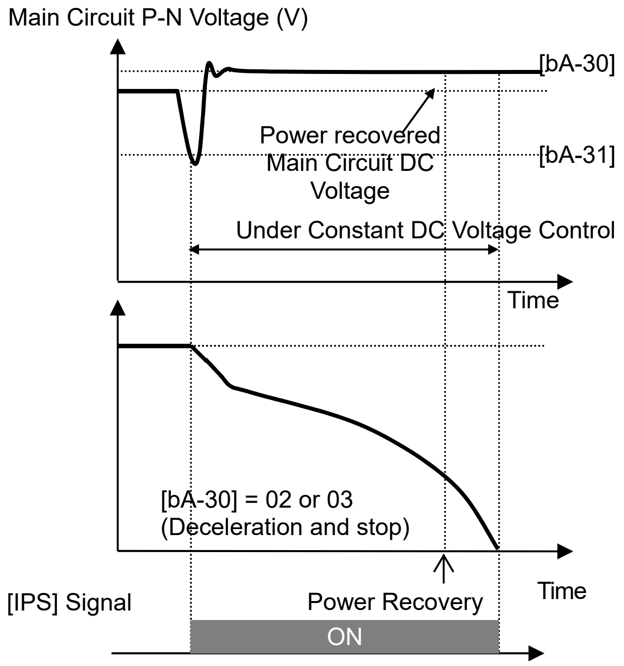
- If the instantaneous power failure time is short, continuous operation without interrupting output is possible. However, if undervoltage is observed upon instantaneous power failure, the output is interrupted immediately and this function will be terminated.
  The operation after recovering from the instantaneous power failure depends on the selection of how to restart after instantaneous power failure and undervoltage.

- When [bA-30] is 03, the normal operation can be restored if recovered from the instantaneous power failure and the power is received before the output will be interrupted. However, it may decelerate and stop depending on the [bA-31] setting. Details are given below.

[bA-30]	[bA-31]	Action
02 (No recovery)	[bA-32] > Main circuit DC voltage upon power recovery	Deceleration stop (constant DC voltage control) (Ex. 1)
	[bA-32] < Main circuit DC voltage upon power recovery	Deceleration stops (normal operation) (Ex. 2)
03 (With recovery)	[bA-32] > Main circuit DC voltage upon power recovery	Deceleration stop (constant DC voltage control) (Ex. 1)
	[bA-32] < Main circuit DC voltage upon power recovery	Operation (normal operation) (Ex. 2)

- This function is activated if the conditions to start operation mentioned above are met even if the power line for J51 connector connected to r1 and t1 terminals are disconnected to be connected from P of the main terminal to r1 and from N to t1, or even if the control power supply and main circuit power supply are powered independently.
- If the motor decelerates and stops as a result of this function activated, it will be forced to stop even if [FR] is ON.
  Verify that the power is restored before powering on [FR] again when restarting.

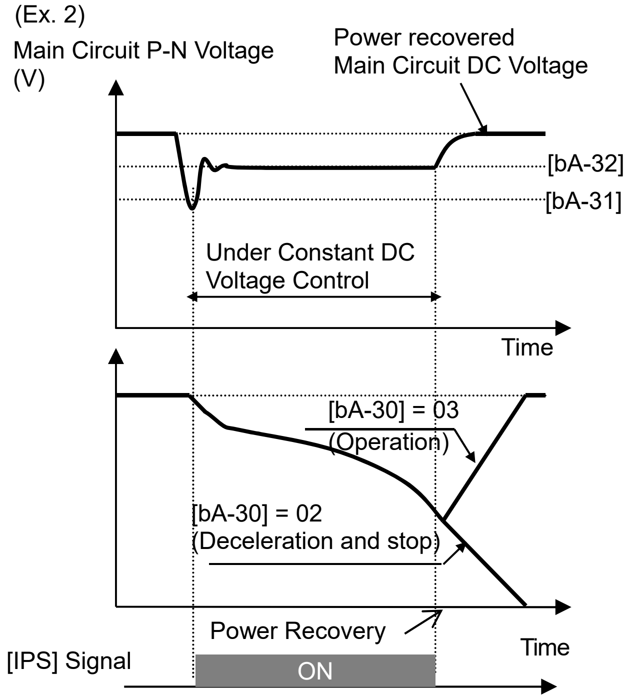
(Ex. 1)



Note) Depending on the proportional gain and integral time settings, the main circuit DC voltage level while the function is being activated may be lower than [bA-32].

- Keep the settings for [bA-31] and [bA-32] to the under voltage recovery level (P-N voltage 180 V (200 V class), 360 V (400 V class)) or higher. The function will not be activated in case of under voltage.
- Make setting so that [bA-31] will be lower than [bA-32]. If the difference between the settings for [bA-31] and [bA-32] is great, setting the proportional gain [bA-37] to be too large may cause sudden acceleration immediately after this function is activated and may cause overcurrent.

(Ex. 2)



- When [bA-30] is 02 or 03, PI control is performed so that the internal DC voltage will be constant.
- Setting the proportional gain [bA-37] to be large will accelerate the response. However, setting it to be too large will dissipate the control, tending to cause tripping.
- Setting the integral gain [bA-38] to be short will accelerate the response. However, setting it to be too short will also tend to cause tripping.
- If the proportional gain [bA-37] is small, the motor will trip due to undervoltage because the voltage will drop immediately after the function is activated.
- If you would like to retry even if the power failure may be relatively long, supply the P-N voltage to r1 and t1.

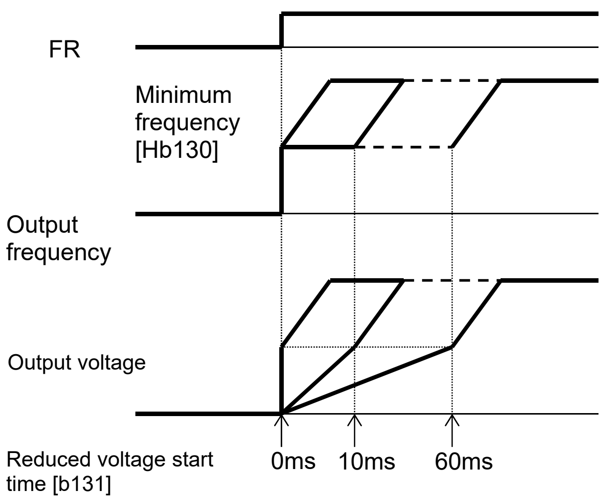
12.14 Start Mode

12.14.1 Starting with increasing voltage gradually

- This function allows you to make the inverter increase the voltage gradually when starting the motor while outputting the minimum frequency.
- The time to reach the output voltage for the reduced voltage start can be set with [Hb131].

- Set a small value for the reduced voltage start time [Hb131] if you intend to increase the start torque. On the other hand, setting a small value will cause the inverter to perform full-voltage starting and to easily trip because of overcurrent.
- This function is effective only when V/f control (constant torque characteristics, reduced torque characteristics, or free V/f control) is selected for the control method [AA121].

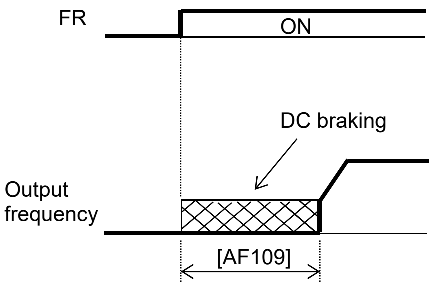
Item	Parameter	Data	Description
Minimum frequency	[Hb130]	0.00~10.00(Hz)	This is the start frequency.
Reduced voltage start time	[Hb131]	0~2000(ms)	Increases the output voltage over the set time, from the operation start to the voltage command equivalent to the minimum frequency.



12.14.2 Starting with DC braking

- Before outputting the frequency to the motor, apply DC braking to stop the motor rotating. And then, start operation.
- To use DC braking for starting, the following settings are required:
  - Set [AF101] DC braking selection to 01
  - Set [AF102] Braking mode selection to 00
  - Set [AF109] DC braking time for starting to other than 0.0
- In DC braking for starting, DC braking is performed, after the operation command is given, for the period of time set for the DC braking time for starting [AF109].
- Depending on the set braking force, the carrier frequency may automatically go down to protect the inverter.
- When setting or operating [AF108] DC braking force for starting and [AF109] DC braking time for starting, pay attention to heat generation on the motor.

■Example of a case where the DC braking function for starting is applied



■Parameters

Item	Parameter	Data	Description
DC braking selection	[AF101]	00	Internal DC braking: Disabled
		01	Internal DC braking: Enabled
		02	Internal DC braking: Enabled (operable only at the set frequency)
Braking mode selection	[AF102]	00	Enables the DC braking.
DC braking force for starting	[AF108]	0~100(%)	Adjusts the DC braking force. The maximum braking force is achieved when set to 100%.
DC braking time for starting	[AF109]	0.0~60.0(s)	Valid when the internal DC braking is enabled. Starts the DC braking when the operation command is turned on.

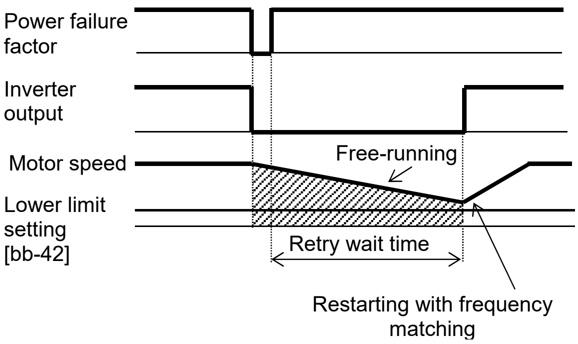
- If [AF101] DC braking selection is set to 02, DC braking will be started when both the frequency command and the output frequency become equal to or lower than [AF103] DC braking frequency setting, regardless of whether the motor is running or stopped. See “12.15.2 Stopping with DC braking” for details.
- If [AF102] Braking mode selection is set to other than 00, see "12.14.9 Starting after applying servo-lock".

12.14.3 Starting by picking up frequency

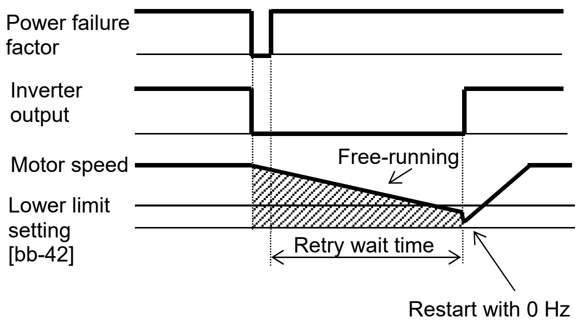
- To achieve these goals when the motor is idling due to a trip or terminal function, enable the frequency matching function so that the inverter is started by picking up frequency applied to each function.
- Obtain the cycle of the motor residual voltage to start operation.
- Frequency matching lower limit setting [bb-42] is the parameter common to frequency matching functions.

- Even if frequency matching restart is selected, the inverter may restart with 0 Hz if:
  1. Output frequency is equal to or lower than 1/2 of the base frequency,
  2. Voltage induced on the induction motor quickly attenuates, or
  3. Frequency matching lower limit setting [bb-42] is set and the inverter detects a frequency equal to or lower than that.
- If the restart after free-run stop or the restart after reset is performed, the inverter will restart after the retry wait time after instantaneous power failure/under-voltage has elapsed.
- The restart after free-run stop and the restart after reset will be performed if the operation command is continuously input via a terminal command or other ways.
- If the frequency matching restart does not go well because the residual voltage rapidly decreases or for other reasons, it may go well by using the frequency pull-in restart. See "12.14.4 Starting with frequency pull-in".

(Ex. 1) The motor speed is equal to or more than the frequency matching lower limit setting.



(Ex. 2) The motor speed is equal to or lower than the frequency matching lower limit setting



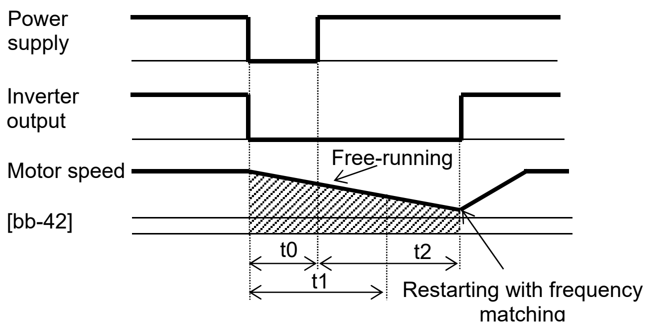
■Parameter

Item	Parameter	Data	Description
Frequency matching lower limit setting	[bb-42]	0.00~590.00(Hz)	When the detected value is equal to or lower than the set value, the inverter restarts with 0 Hz.
Frequency matching filter gain	[bb-50]	0~1000(%)	This adjusts the frequency acquisition process filter used during a frequency matching restart.

- For the retry function, see "12.13 Using Trip Avoidance Function" as well.

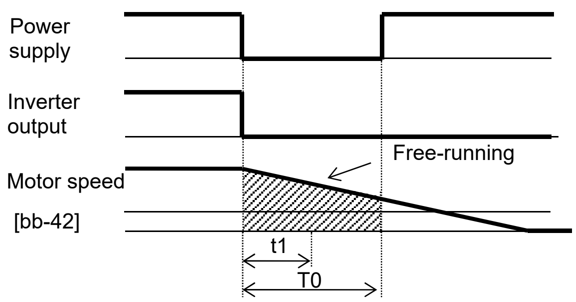
■When instantaneous power failure/under-voltage occurs [bb-24]=01

Ex. 1: Power recovery within Allowable instantaneous power failure time [bb-25]



t0: Instantaneous power failure time
t1: Allowable instantaneous power failure time [bb-25]
t2: Retry wait time [bb-26]

Ex. 2: Power recovery after Allowable instantaneous power failure time [bb-25]



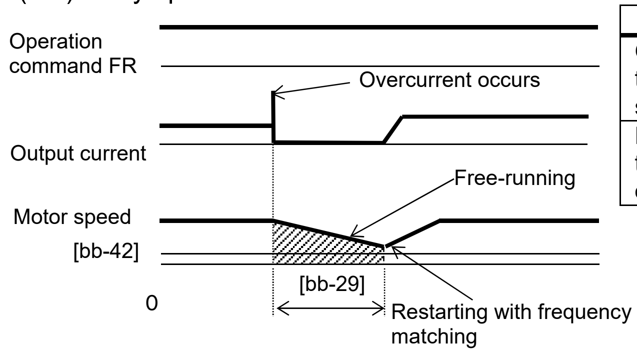
■Parameters

Item	Parameter	Data	Description
Selection of instantaneous power failure/under-voltage retry	[bb-24]	01	Performs frequency matching restart.
Allowable instantaneous power failure time	[bb-25]	0.3~25.0(s)	Restarts the motor if it is within the allowable time.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.

- If a power failure has occurred so that the power to the inverter's control power supply terminals (r1,t1) is lost, and then the inverter is restarted, it is considered as power-on and the inverter will operate in accordance with the restart after reset [bb-41].
- Even if the power to control power supply terminals (r1, t1) is lost, it will take time until the internal power supply is completely lost.
- Trip after instantaneous power failure/under-voltage can be switched between "enabled" and "disabled" by using [bb-27] Selection of instantaneous power failure/under-voltage trip during stopping. This will prevent the occurrence of an error during stopping. If the error is prevented, the output terminal [AL] will not turn on.

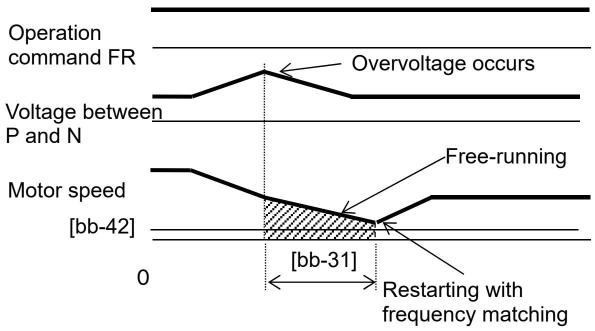
- In a system where the power to control power supply terminals (r1, t1) gradually decreases, it is possible to cause a trip when Allowable instantaneous power failure time has elapsed.
- To make the power to control power supply terminals (r1, t1) last as much as possible by the inverter alone during an instantaneous power failure, remove the J51 connector cables from terminals r1 and t1, and connect a cable from P on the main circuit terminal block to r1, and N on the main circuit terminal block to t1. Use 0.75 mm^2 or heavier wires for the connections.

■Retry on overcurrent [bb-28] =01
(Ex.) Retry operation on overcurrent



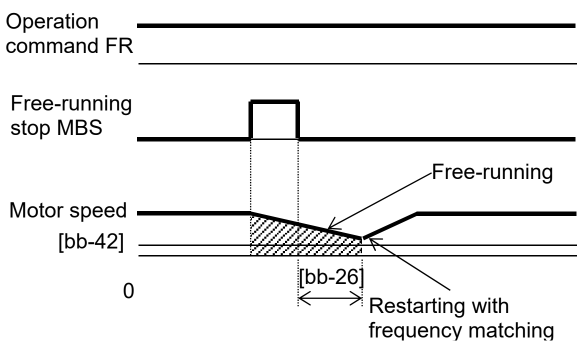
Item	Parameter	Data	Description
Overvoltage trip/retry selection	[bb-28]	01	Performs frequency matching restart.
Retry wait time after overcurrent	[bb-29]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Retry on overvoltage [bb-30] =01
(Ex.) Retry operation on overvoltage



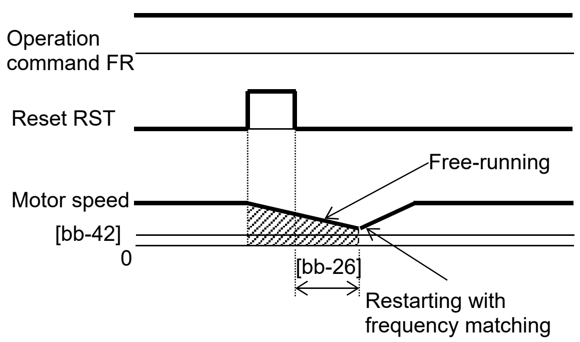
Item	Parameter	Data	Description
Overvoltage trip/retry selection	[bb-30]	01	Performs frequency matching restart.
Retry wait time on overvoltage	[bb-31]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Frequency matching after free-run stop [MBS]
[bb-40]=01
(Ex.) Frequency matching operation after free-run stop [MBS]



Item	Parameter	Data	Description
Restart after free-run stop	[bb-40]	01	Performs frequency matching restart.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Frequency matching after reset [RST] [bb-41] =01
(Ex.) Frequency matching operation after reset [RST]



Item	Parameter	Data	Description
Restart after reset	[bb-41]	01	Performs frequency matching restart.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~ 100.0(s)	Sets the wait time after the operation command.

*) If the frequency matching after reset has been set, starting after power-on will also occur with matched frequency.

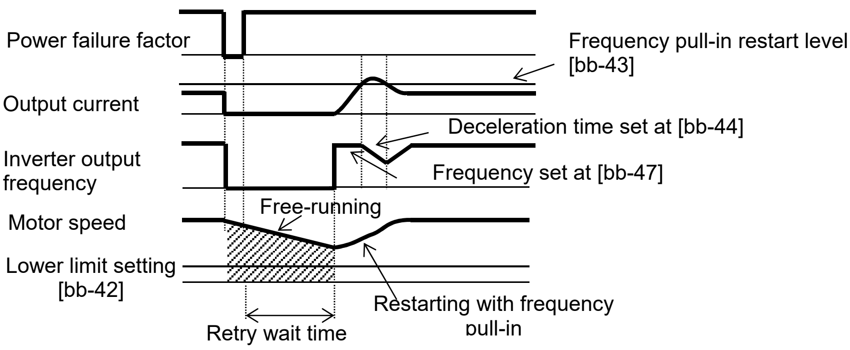
12.14.4 Starting with frequency pull-in

- To achieve these goals when the motor is idling due to a trip or terminal function, enable the frequency pull-in function so that the inverter is started with the output frequency specified to each function.
- Even if a motor residual voltage is lost, the inverter will restart at the frequency selected in [bb-47] Start frequency selection for frequency pull-in restart.

- If the restart after free-run stop or the restart after reset is performed, the inverter will restart after the retry wait time after instantaneous power failure/under-voltage has elapsed.
- The restart after free-run stop and the restart after reset will be performed when the operation command is given.
- The frequency pull-in restart function can be used only for induced motor drive. In addition, if [AA121] Control mode is set to other than the V/f control, restart may become unstable. In this case, see "12.14.3 Starting by picking up frequency".

- When frequency pull-in with the V/f control is selected, the inverter starts with a suppressed output voltage during the time set for [bb-45] Frequency pull-in operation time (voltage).
  When sensor less vector control, zero-speed range sensor less vector control, or vector control with sensor is selected, the frequency is automatically pulled in while controlling the current.
- If the current increases during frequency pull-in to exceed [bb-43] Restart level, the motor will decelerate over the time set for [bb-44] Frequency pull-in operation time (frequency).
- If the current rapidly increases during frequency pull-in to exceed [bb-46] Overcurrent suppression level for frequency pull-in restart, the overcurrent suppression function will automatically set in.

(Ex.) How the frequency pull-in works

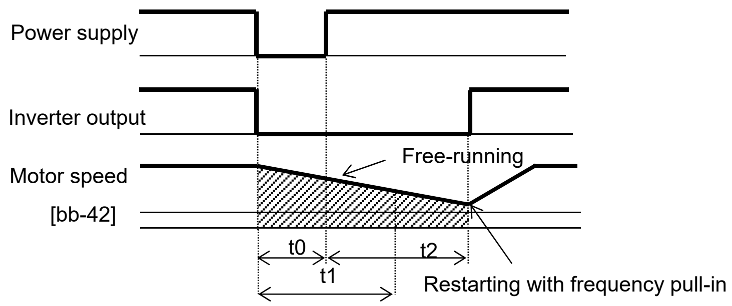


■Parameters

Item	Parameter	Data	Description
Frequency matching lower limit setting	[bb-42]	0.00~590.00(Hz)	When the detected value is equal to or lower than the set value, the inverter restarts with 0 Hz.
Frequency pull-in restart level	[bb-43]	Inverterrated current × (0.20 to 2.50)	Determines whether or not the current has increased at restart.
Frequency pull-in operation time (frequency)	[bb-44]	0.10~30.00(s)	Sets the deceleration time for an increase in the current.
Frequency pull-in operation time (voltage)	[bb-45]		Sets the time to start with reduced output voltage.
Overcurrent suppression level for frequency pull-in restart	[bb-46]	Inverterrated current × (0.00 to 2.50)	Sets the level of the current at which a sudden current increase at restarting is prevented.
Start frequency selection for frequency pull-in restart	[bb-47]	00	Starts at the frequency at the previous shutoff.
		01	Starts at the maximum frequency.
		02	Starts at the current frequency command.
Frequency matching filter gain	[bb-50]	0~1000(%)	This adjusts the frequency acquisition process filter used during a frequency matching restart.

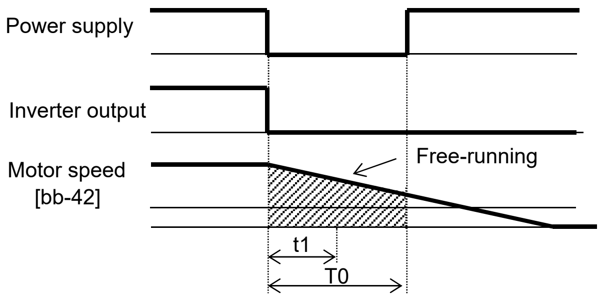
■When instantaneous power failure/under-voltage occurs [bb-24]=02

Ex. 1: Power recovery within Allowable instantaneous power failure time [bb-25]



t0: Instantaneous power failure time
t1: Allowable instantaneous power failure time [bb-25]
t2: Retry wait time [bb-26]

Ex. 2: Power recovery after Allowable instantaneous power failure time [bb-25]

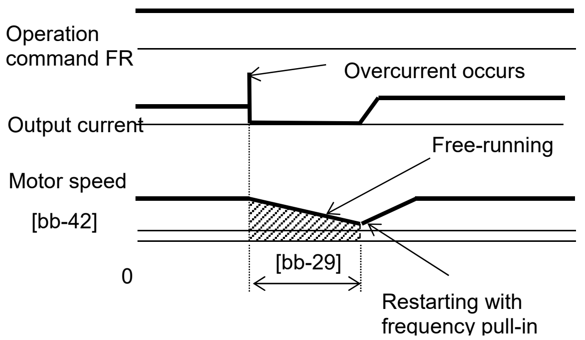


■Parameters

Item	Parameter	Data	Description
Selection of instantaneous power failure/under-voltage retry	[bb-24]	02	Performs frequency pull-in restart.
Allowable instantaneous power failure time	[bb-25]	0.3~25.0(s)	Restarts the motor if it is within the allowable time.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.

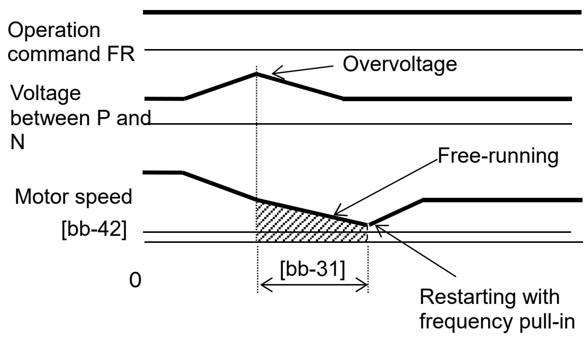
- If a power failure has occurred so that the power to the inverter's control power supply terminals (r1,t1) is lost, and then the inverter is restarted, it is considered as power-on and the inverter will operate in accordance with the restart after reset [bb-41].
- Even if the power to control power supply terminals (r1, t1) is lost, it will take time until the internal power supply is completely lost.
- Trip after instantaneous power failure/under-voltage can be switched between "enabled" and "disabled" by using [bb-27] Selection of instantaneous power failure/under-voltage trip during stopping. This will prevent the occurrence of an error during stopping. If the error is prevented, the output terminal [AL] will not turn on.
- In a system where the power to control power supply terminals (r1, t1) gradually decreases, it is possible to cause a trip when Allowable instantaneous power failure time has elapsed.
- To make the power to control power supply terminals (r1, t1) last as much as possible by the inverter alone when an instantaneous power failure occurs, remove the J51 connector cables from terminals r1 and t1, connect the main circuit terminals P and r1 to each other, and connect the main terminals N and t1 to each other. Use 0.75 mm^2 or heavier wires for the connections.

■Retry on overcurrent [bb-28] =01
(Ex.) Retry operation on overcurrent



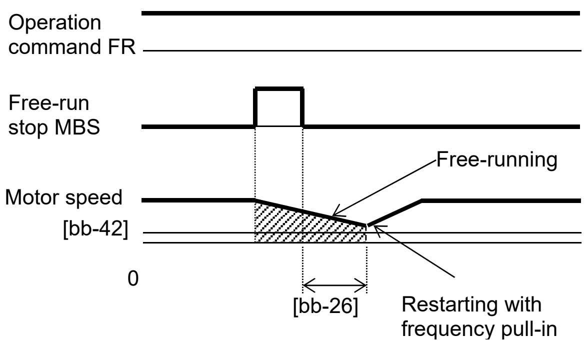
Item	Parameter	Data	Description
Overcurrent trip/retry selection	[bb-28]	02	Performs frequency pull-in restart.
Retry wait time after overcurrent	[bb-29]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Retry on overvoltage [bb-30] =01
(Ex.) Retry operation on overvoltage



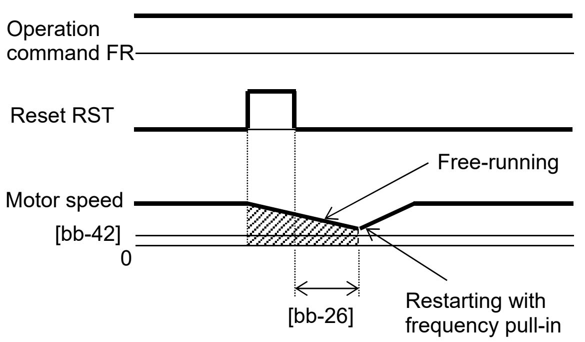
Item	Parameter	Data	Description
Overvoltage trip/retry selection	[bb-30]	02	Performs frequency pull-in restart.
Retry wait time on overvoltage	[bb-31]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Frequency matching after free-run stop [MBS] [bb-40] =01
(Ex.) Frequency matching operation after free-run stop [MBS]



Item	Parameter	Data	Description
Restart after free-run stop	[bb-40]	02	Performs frequency pull-in restart.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~ 100.0(s)	Sets the wait time after the operation command.

■Frequency matching after reset [RST] [bb-41] =01
(Ex.) Frequency matching operation after reset [RST]



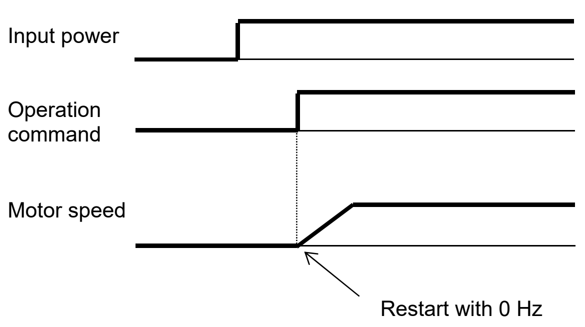
Item	Parameter	Data	Description
Restart after reset	[bb-41]	02	Performs frequency pull-in restart.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~ 100.0(s)	Sets the wait time after the operation command.

*) If the frequency matching after reset has been set, starting after power-on will also occur matched with frequency.

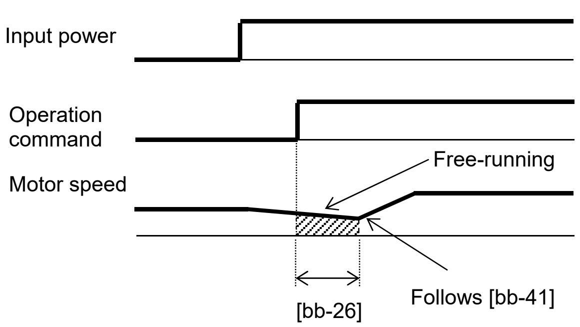
12.14.5 Starting after power-on

- Sets the start mode at power-on.
- The operation at power-on is the same as that of the restart after reset stop which occurs when the inverter recovers from reset.
- If the frequency pull-in restart is used, the rotational direction of the output frequency is the same as that of the frequency command.
- If a power failure lasts long and the inverter's internal power supply is lost, recovery will take place by the restart after reset instead of the restart after instantaneous power failure/under-voltage.
- In the case of [bb-41] =01, if the residual voltage generated by the motor cannot be detected, the 0 Hz restart may take place.

(Ex. 1) Restart operation with 0 Hz: [bb-41] =00



(Ex. 2) Frequency pull-in operation [bb-41] =01 to 03



■Parameters

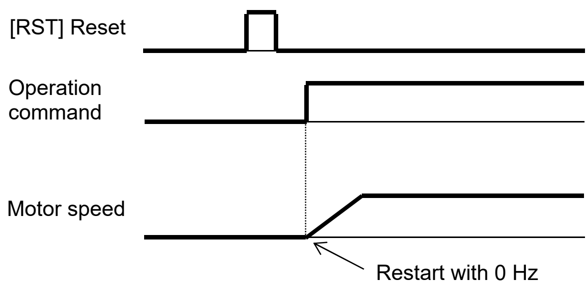
Item	Parameter	Data	Description
Restart after reset	[bb-41]	00	Performs the 0 Hz restart.
		01	Performs frequency matching restart.* 1)
		02	Performs frequency pull-in restart.* 2)
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.

*1) See "12.14.3 Starting by picking up frequency".
*2) See "12.14.4 Starting with frequency pull-in".

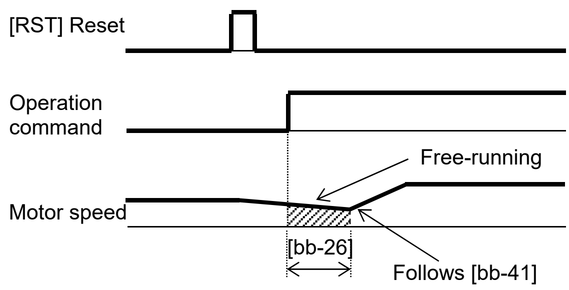
12.14.6 Starting after reset

- Set the start mode after a trip reset or a reset input via the [RST] terminal (input terminal function 028).
- The restart after reset, which occurs when the inverter recovers from a reset, is the same as the mode at power-on.
- If the frequency pull-in restart is used, the rotational direction of the output frequency is the same as the command direction at shut-off.
- If a power failure lasts long and the inverter's internal power supply is lost, recovery will take place by the restart after reset instead of the restart after instantaneous power failure/under-voltage.
- In case of the 0 Hz restart, there is no wait time.

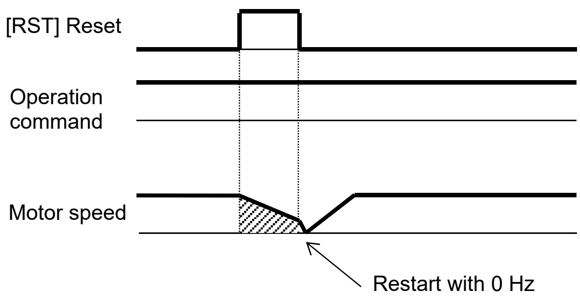
(Ex. 1) Restart operation with 0 Hz: [bb-41]=00



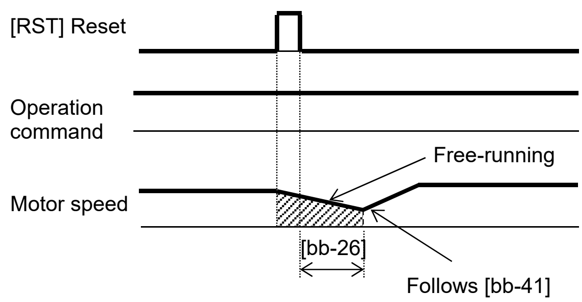
(Ex. 2) Frequency pull-in [bb-41]=01 to 03



(Ex. 3) Restart with 0 Hz: [bb-41] =00



(Ex. 4) Frequency pull-in [bb-41] =01 to 03



■Parameters

Item	Parameter	Data	Description
Restart after reset	[bb-41]	00	Performs the 0 Hz restart.
		01	Performs frequency matching restart.* 1)
		02	Performs frequency pull-in restart.* 2)
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.

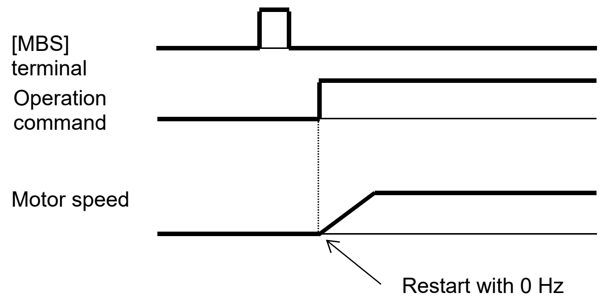
*1) See "12.14.3 Starting by picking up frequency"
*2) See "12.14.4 Starting with frequency pull-in".

12.14.7 Starting after free-run stop

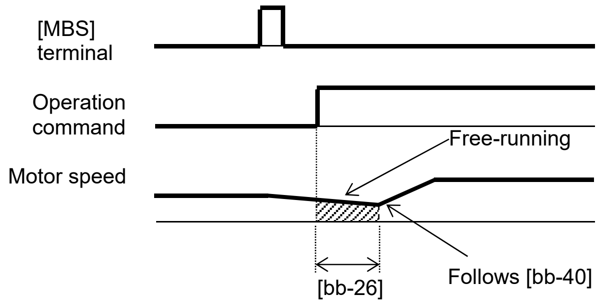
- Set the start mode after free-run stop command is input via the [MBS] terminal (input terminal function 032), (Ex.1) to (Ex. 4), or start mode after stop when MBS (free run to stop) is specified for [AA115] Stop mode selection, (Ex. 5) and (Ex. 6).
- (Ex. 1) to (Ex. 4) below are examples where a free-run stop command is input using the [MBS] terminal.

- The restart after reset, which occurs when the inverter recovers from a reset, is the same as the mode at power-on.
- If the frequency pull-in restart is used, the rotational direction of the output frequency is the same as that of the frequency command.
- If a power failure lasts long and the inverter's internal power supply is lost, recovery will take place by the restart after reset instead of the restart after instantaneous power failure/under-voltage.
- At power-on, the inverter will start operation with 0 Hz.
- In case of the 0 Hz restart, there is no wait time.

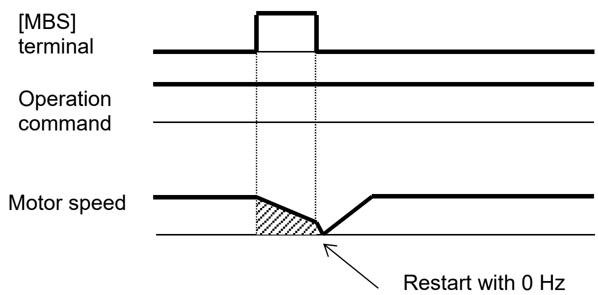
(Ex. 1) Restart with 0 Hz: [bb-40] =00



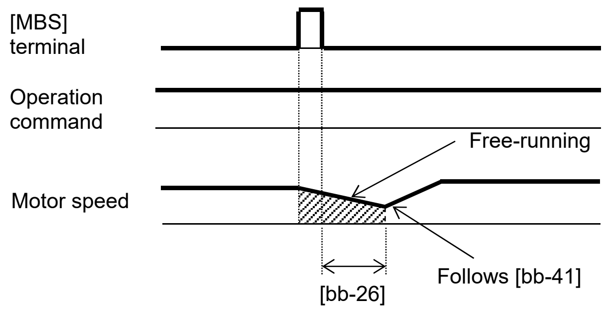
(Ex. 2) Frequency pull-in [bb-40] =01 to 03



(Ex. 3) Restart with 0 Hz: [bb-40] =00

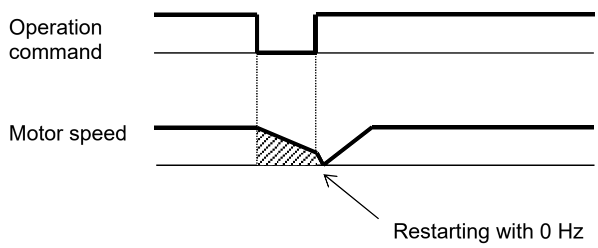


(Ex. 4) Frequency pull-in [bb-40] =01 to 02

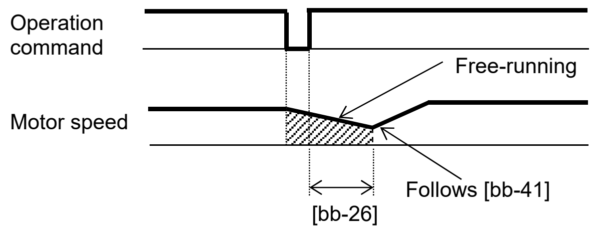


- (Ex. 5) and (Ex. 6) below show cases where the free-run stop is performed via the operation command.
- The free-run stop at stopping is used when an overvoltage error occurs at stopping, for example. However, the motor continues rotating through inertia.

(Ex. 5) Restarting with 0 Hz: [bb-40]=00



(Ex. 6) Frequency pull-in [bb-40]=01 to 02



■Parameters

Item	Parameter	Data	Description
Restart after free-run stop	[bb-40]	00	Performs the 0 Hz restart.
		01	Performs frequency matching restart.* 1)
		02	Performs frequency pull-in restart.* 2)
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.
Stop method selection	[AA115]	01	Performs the free-run stop when the operation command is off.

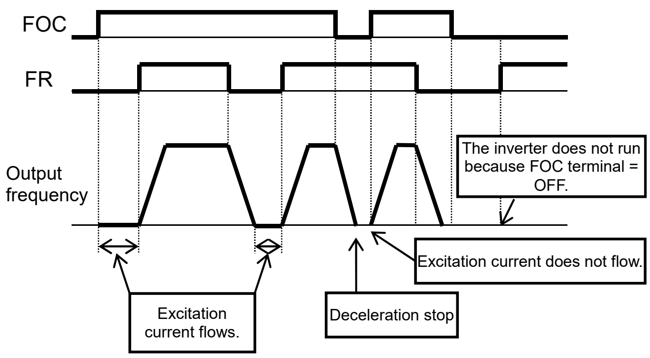
*1) See "12.14.3 Starting by picking up frequency".
*2) See "12.14.4 Starting with frequency pull-in".

12.14.8 Making torque rise faster

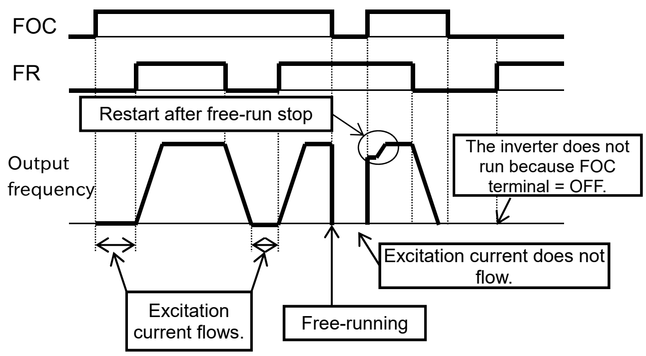
- This function is to preliminarily establish magnetic flux by applying an excitation current via the forcing terminal [FOC] command.
- This function operates if the input terminal function 066 [FOC] is assigned.

- This function is effective when the IM sensor less vector control, IM zero-speed range sensor less vector control, or IM vector control with sensor is selected for the control mode [AA121].
- If [FOC] is assigned to the input terminal function, operation will not be accepted unless [FOC] is turned on.
- If [FOC] is turned off during operation, the inverter will be operated according to [AA115] Stop mode selection. If a free run occurs, restart will take place according to the setting for the restart after free-run stop.

- When [AA115] Stop mode selection is set to 00



- When [AA115] Stop mode selection is set to 01



■Parameters

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	066	Forcing function [FOC]
Stop mode selection	[AA115]	00	Performs the deceleration stop when the operation command is off.
		01	Performs the free-run when the operation command is off.
Restart after free-run stop	[bb-40]	00	Performs the 0 Hz restart.
		01	Performs frequency matching restart.* 1)
		02	Performs frequency pull-in restart.* 2)
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0(s)	Sets the wait time after the operation command.

*1) See "12.14.3 Starting by picking up frequency".
*2) See "12.14.4 Starting with frequency pull-in".

- If torque at starting is insufficient, it may improve by adjusting the boost amount at starting [HC111], [HC112] or the speed response [HA115].
  See "12.9 Selecting the Motor Control Mode according to Motor and Load".

- If torque at starting is insufficient, it may improve by using the torque bias function. See "12.11.6 Operating with torque command added".

12.14.9 Starting after applying servo-lock

- Before outputting the frequency to the motor, perform the servo-lock to stop the motor rotating. And then, start operation.
- To apply DC braking for starting (servo-lock control), the following settings are required:
  - [AA121] Control mode (see the right section)
  - Set [AF101] DC braking selection to 01
  - Set [AF102] Braking mode selection to 01 or 02.
  - Set [AF109] DC braking time for starting to other than 0.0
- If the DC braking for starting (servo-lock control) is enabled, DC braking (servo-lock control) will be performed after the operation command is given, for the period of time set as DC braking time for starting [AF109].

- Depending on the set braking force, the carrier frequency may automatically go down to protect the inverter.
- To use the servo-lock control, it is necessary to set [AA121] Control mode. If the applicable control mode is not selected, the inverter will operate as if [AF102] has been set to 00: DC braking.

(1) When [AF102] Braking mode selection is set to 01: Speed servo-lock

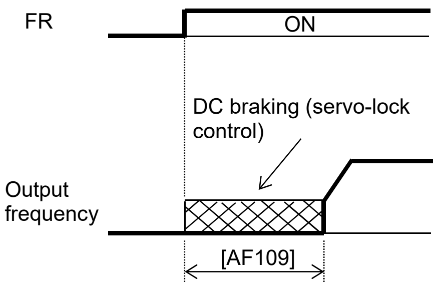
No.	[AA121] Control mode
1	09: Zero-speed range sensorless vector control
2	10: Vector control with sensor

(2) When [AF102] Braking mode selection is set to 02: Position servo-lock

No.	[AA121] Control mode
1	10: Vector control with sensor

- For [AA121] Control mode and [AA123] Vector control mode selection, it is necessary to set the parameter of vector control. See "12. 9 Selecting the Motor Control Method According to Motor and Load".
- The output of the servo-lock control is automatically calculated according to the selected control mode.

■Example of a case where the servo-lock control at starting is enabled



■Parameters

Item	Parameter	Data	Description
DC braking selection	[AF101]	00	Internal DC braking: Disabled
		01	Internal DC braking: Enabled
		02	Internal DC braking: Enabled (The braking operates only with the set braking frequency.)
Braking mode selection	[AF102]	01	Enables the speed servo-lock.
		02	Enables the position servo-lock.
DC braking time for starting	[AF109]	0.0~60.0(s)	Valid when the internal DC braking is enabled. Starts the servo-lock when the operation command is turned on.
Control mode	[AA121]	08	Sensorless vector control
		09	Zero-speed range sensorless vector control
		10	Vector control with sensor

12.15 Stop Mode

12.15.1 Selecting the stop mode

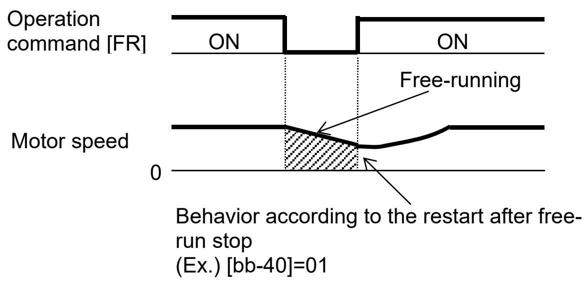
- Use [AA115] Stop mode selection to select one of the two methods of stopping the motor when the operation command is turned off. One is to stop the motor according to the deceleration time; the other is to immediately cut off the output to shut down.
- If a free-run stop is to be input from a terminal, assign 032 [MBS] to an input terminal, and turn on the terminal.

- If [AA115] =01 free-run stop is selected, the output will be shut off when the operation command is turned off.
- If the free-run stop is selected, the restart when an operation command is given the next time will follow the selection at [bb-40] Restart after free-run stop.

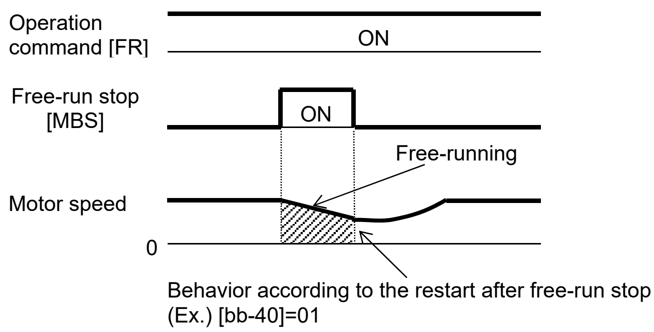
■Parameters

Item	Parameter	Data	Description
Stop mode selection	[AA115]	00	Normal stop (deceleration → stop)
		01	Free-run stop
Restart after free-run stop	[bb-40]	00	Restart with 0 Hz
		01	Frequency matching restart
		02	Frequency pull-in restart
Input terminal selection	[CA-01]~[CA-11]	032	Uses the Free-run stop function [MBS].

■When free-run stop is selected: [AA115]=01



■When the [MBS] terminal is used



12.15.2 Stopping with DC braking

・To use DC braking for stopping, the following settings are required:
- Set [AF101] DC braking selection to 01
- Set [AF102] Braking mode selection to 00
- [AF105] DC braking force
- Set [AF106] DC braking time to other than 0.0

・To use DC braking with frequency command, the following settings are required:
- Set [AF101] DC braking selection to 02
- Set [AF102] Braking mode to 01 or 02.
- Set [AF103] DC braking frequency setting to other than 0.00
- [AF105] DC braking force
- Set [AF106] DC braking time to other than 0.0

・The carrier frequency during DC braking depends on [bb101], but it is limited to at maximum 5 kHz. Depending on the set braking force, the carrier frequency may automatically go down to 2 kHz.
・When the motor is stopped by using [DB] external DC braking function (input terminal function 030), a high output frequency or a high-inertia load may cause an overcurrent error or overvoltage error.

■Parameters

Item	Parameter	Data	Description
DC braking selection	[AF101]	00	Internal DC braking: Disabled
		01	Internal DC braking: Enabled
		02	Internal DC braking: Enabled (The braking operates only with the frequency command.)
Braking mode selection	[AF102]	00	Enables the DC braking.
DC braking frequency setting	[AF103]	0.00~590.00(Hz)	With internal DC braking enabled, DC braking is started when the output frequency reaches or becomes less than the frequency set for stopping.
DC braking delay time	[AF104]	0.00~5.00(s)	Specifies the delay in starting DC braking while temporally shutting off the output.
DC braking force	[AF105]	0~100(%)	Adjusts the DC braking force. When "0%" is specified, no braking operation will be performed.
DC braking time	[AF106]	0.00~60.00(s)	Sets the duration for DC braking. This setting is valid for the [DB] terminal in edge mode or for the internal DC braking. When "0.00 s" is specified, no braking operation will be performed.
DC braking edge or level selection	[AF107]	00	Edge mode (Examples 1,2,7,9,10,11)
		01	Level mode (Examples 3,4,8,12,13,14)
Input terminal function	[CA-01]~[CA-11]	030	DC braking is enabled by using the [DB] terminal. OFF: DC braking is disabled. ON: DC braking is enabled.

■DC braking force for stopping

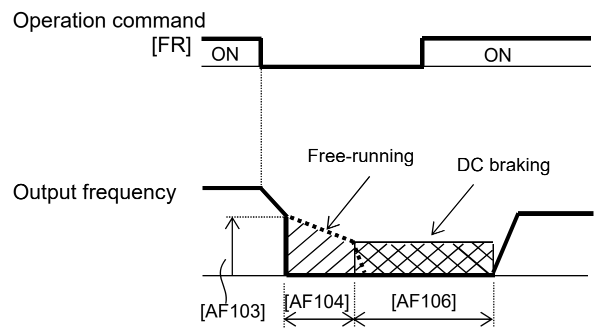
- To use the DC braking force for stopping, set [AF101] DC braking selection to 01, [AF102] Braking mode selection to 00, [AF106] DC braking time to other than 0.00 s, and [AF105] DC braking force to any value. When the frequency output is shut off, DC braking force will be applied.
- The braking force is adjusted at the [AF105] DC braking force.
- When [AF104] DC braking delay time is set, and if the operation command is turned off and the decelerated frequency falls below [AF103] DC braking frequency, the output will be shut off once, and after [AF104] has elapsed, DC braking will be started.

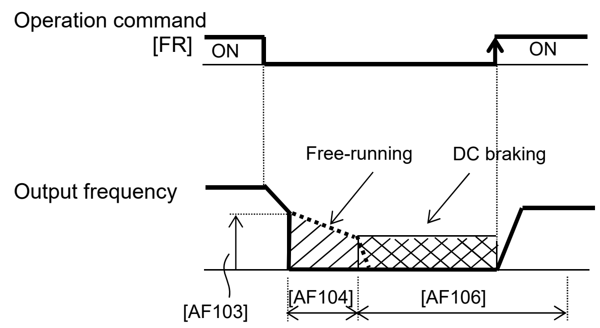
- Edge mode: [AF107]=00
  [AF106] DC braking time setting is given priority, and the inverter performs DC braking for the time set for [AF106]. After the operation command is turned off, if the output frequency falls below [AF103] DC braking frequency, DC braking will be applied for the time set for [AF106]. Even if the operation command is turned on during DC braking, DC braking continues until the time set for [AF106] elapses. (Ex. 1), (Ex. 2)

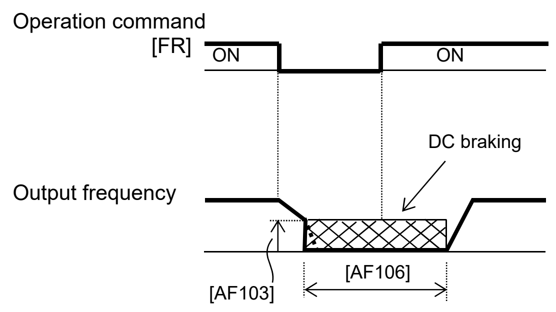
- The operation to be performed when the operation command is switched from the stop command to the start command varies depending on the setting of [AF107] DC braking/edge or level selection.
- When setting [AF105] DC braking force and [AF106] DC braking time, pay attention to the heat generation on the motor.

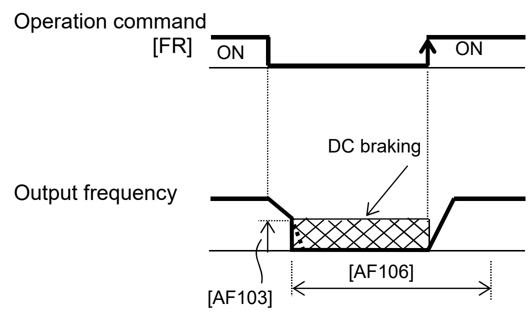
- Level mode: [AF107]=01
  Operation commands are given priority. The inverter ignores [AF106] DC braking time and transits to the normal operation. If the start command is turned on during DC braking, the inverter ignores the time set for [AF106] and returns to the normal operation. (Ex. 3), (Ex. 4)

<table>
<tr><th>Edge mode: [AF107]=00</th><th>Level mode: [AF107]=01</th></tr>
<tr><td>(Ex. 1) When stopped ([AF104]≠0.00)


</td><td>(Ex. 3) When stopped ([AF104]≠0.00)

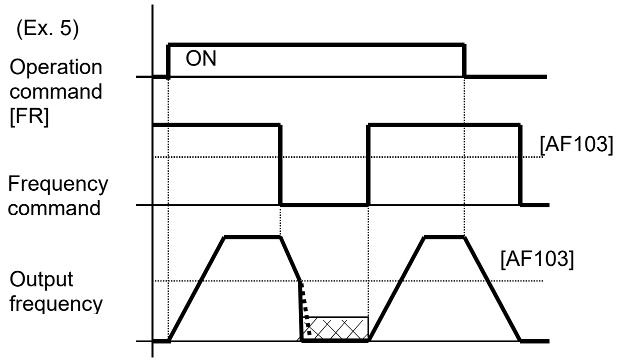

</td></tr>
<tr><td>(Ex. 2) When stopped ([AF104]=0.00)


</td><td>(Ex. 4) When stopped ([AF104]=0.00)


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

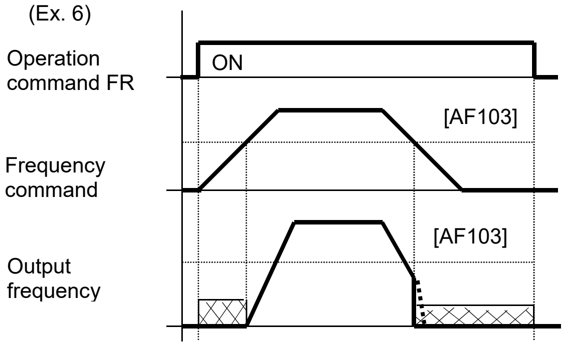
■DC braking with frequency command

- To use the DC braking with frequency command, set [AF101] DC braking selection to 02, and [AF106] DC braking time to other than 0.0 s. DC output can be started by changing the frequency command.
- The inverter starts DC braking when both the frequency set by the frequency command and the output frequency fall to [AF103] or below. (Ex. 5)
- This function operates only when the operation command is on.

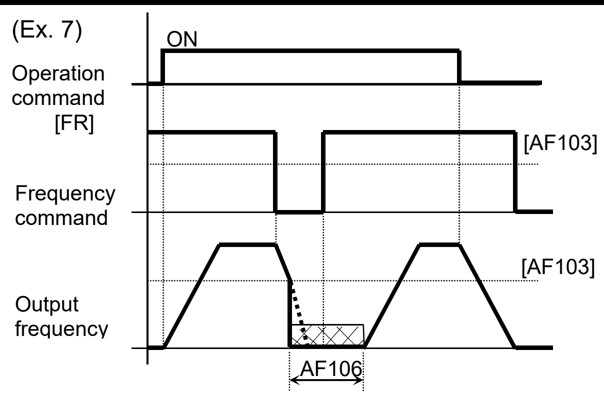
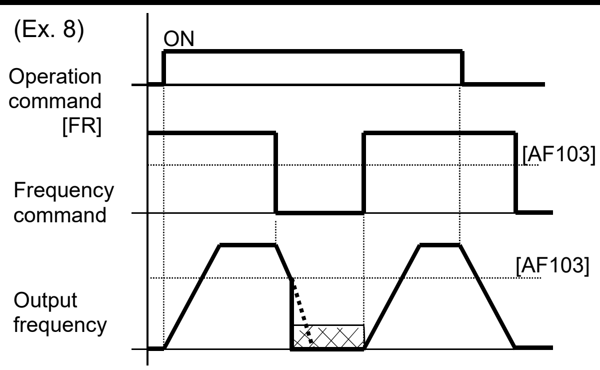


- How the inverter returns to the normal operation varies depending on the setting of the DC braking/edge or level selection [AF107].
- When "00" is specified for [AF107], the inverter returns to the normal operation after [AF106] DC braking time has elapsed. (Ex. 7)

- If the operation command is turned on after the frequency command has been established (where a value larger than [AF103] +2 Hz is input), the inverter will start operation with the normal output.
- If the frequency command at starting is "0" when the operation command is given via an analog input terminal, the inverter will start operation with DC braking because both the frequency set by the frequency command and current output frequency are "0". (Ex. 6)



- When [AF107]=01: The inverter starts acceleration when the frequency command exceeds [AF103]+2 Hz. (Ex. 8)

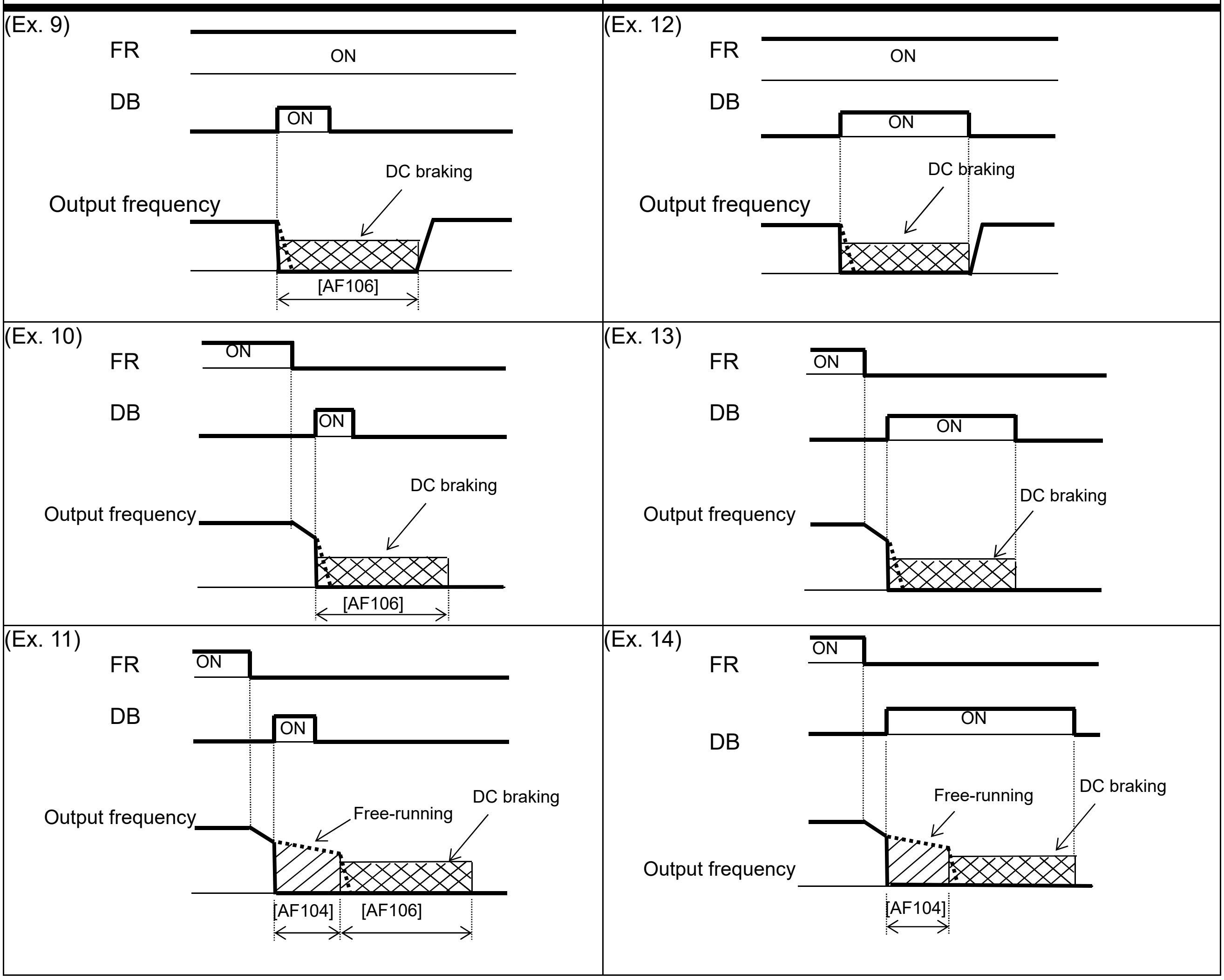
Edge mode: [AF107]=00	Level mode: [AF107]=01
	

- If the function of the DC braking with frequency command is enabled, [DB] (input terminal 030) will be disabled.
- If the function of the DC braking with frequency command is enabled, the setting of [AF102] will be disabled and DC braking with [AF102]=00 will operate.

■External DC braking via terminal function
- Assign 030 [DB] to input terminal functions [CA-01] to [CA-11].
- When [AF101]=00 or 01, DC braking will be applied depending on whether the [DB] terminal is on or off.
- Adjust the braking force by adjusting the [AF105] DC braking force.
- When you set the [AF104] DC braking delay time, the inverter output will be shut off within the set period of delay, and the motor will run freely during the period. (Ex. 11), (Ex. 14)
- DC braking will be restarted after the set period has elapsed.
- Select the braking mode by the DC braking/edge or level selection [AF107], and then make any other necessary settings suitable for your system.
- When [AF107]=00: After [DB] is turned on, the inverter performs DC braking for the time set for [AF106] . (Example 9) to (Example 11)
- When [AF107]=01: The inverter performs DC braking only when [DB] is on. (Ex. 12) to (Ex. 14)

- When setting [AF105] DC braking force, [AF106] DC braking time, or the ON time of the [DB] terminal (input terminal function 030), pay attention to the heat generation on the motor.
- The setting for the [DB] terminal is given priority over operation commands. (Ex. 9), (Ex. 12)
- If the [DB] terminal is turned on when the motor speed is high, an overcurrent error or an overvoltage error may occur.
- When the [DB] terminal is turned on, DC braking mode that occurs when "00" is specified for [AF102] Braking mode selection is performed regardless of the setting for [AF102].

Edge mode: [AF107]=00	Level mode: [AF107]=01



12.15.3 Stopping with servo-lock

- To use DC braking for stopping (servo-lock control), the following settings are required:
  - [AA121] Control mode (see the right section)
  - Set [AF101] DC braking selection to 01
  - Set [AF102] Braking mode selection to 01 or 02.
  - Set [AF106] DC braking time to other than 0.0

- The carrier frequency during DC braking depends on [bb101], but it is limited to at maximum 5 Hz. Depending on the set braking force, the carrier frequency may automatically go down to 2 kHz.
- To use the servo-lock control, it is necessary to set [AA121] Control mode. If the applicable control mode is not selected, the inverter will operate as if [AF102] has been set to 00: DC braking.

(1) When [AF102] Braking mode selection is set to 01: Speed servo-lock

No.	[AA121] Control mode
1	09: 0Hz-range sensorless vector control
2	10: Vector control with sensor

(2) When [AF102] Braking mode selection is set to 02: Position servo-lock

No.	[AA121] Control mode
1	10: Vector control with sensor

- To use the servo-lock control, it is necessary to set [AA121] Control mode. See "12. 9 Selecting the Motor Control Method According to Motor and Load".
- The output of the servo-lock control is automatically calculated according to the selected control mode.

■Parameters

Item	Parameter	Data	Description
DC braking selection	[AF101]	00	Internal DC braking: Disabled
		01	Internal DC braking: Enabled
		02	Internal DC braking: Enabled (The braking operates only with the set braking frequency.)
Braking mode selection	[AF102]	01	Enables the speed servo-lock.
		02	Enables the position servo-lock.
DC braking frequency	[AF103]	0.00~590.00(Hz)	With internal DC braking enabled, DC braking is started when the output frequency reaches or becomes less than the frequency set for stopping.
DC braking delay time	[AF104]	0.00~5.00(s)	Specifies the delay in starting DC braking while temporally shutting off the output.
DC braking time	[AF106]	0.00~60.00(s)	Sets the duration for DC braking. This setting is valid for the [DB] terminal in edge mode or for the internal DC braking. When "0.00 s" is specified, no braking operation will be performed.
DC braking edge or level selection	[AF107]	00	Edge mode (Examples 1,2)
		01	Level mode (Example 3,4)
Input terminal function	[CA-01]~[CA-11]	054	Controls with the servo-on mode using the [SON] terminal. OFF: Servo lock is disabled. ON: Servo lock is enabled.
Control mode	[AA121]	08	Sensorless vector control
		09	Zero-speed range sensor less vector control
		10	Vector control with sensor

■DC braking for stopping (servo-lock control)

- To use DC braking for stopping (servo-lock control), set [AA121] Control mode and [AF101] DC braking selection to 01, [AF102] Braking mode selection to 01 or 02, and [AF106] DC braking time to other than 0.00 s. DC braking will operate after the frequency output has been shut off.
- When [AF104] DC braking delay time is set, and if the operation command is turned off and the decelerated frequency falls below [AF103] DC braking frequency, the output will be shut off once, and after [AF104] has elapsed, DC braking will be started.

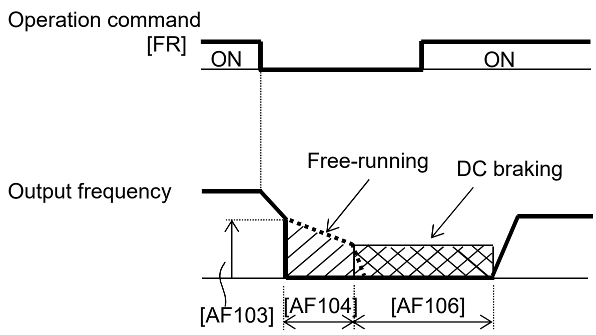
- Edge mode: [AF107]=00
  [AF106] DC braking time setting is given priority, and the inverter performs DC braking (servo-lock control) for the time set for [AF106]. After the operation command is turned off, if the output frequency falls below [AF103] DC braking frequency, DC braking will be applied for the time set for [AF106]. Even if the operation command is turned on during DC braking, DC braking continues until the time set for [AF106] elapses. (Ex. 1), (Ex. 2)

- The operation to be performed when the operation command is switched from the stop command to the start command varies depending on the setting of [AF107] DC braking/edge or level selection.
- When setting [AF106] DC braking time, pay attention to the heat generation on the motor.
- To use the servo-lock control, it is necessary to set [AA121] Control mode. See "12. 9 Selecting the Motor Control Method According to Motor and Load".
- The output of the servo-lock control is automatically calculated according to the selected control mode.

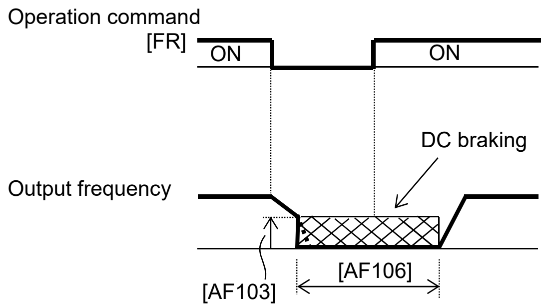
- Level mode: [AF107]=01
  Operation commands are given priority. The inverter ignores [AF106] DC braking time and transits to the normal operation. If the start command is turned on during DC braking, the inverter ignores the time set for [AF106] and returns to the normal operation. (Ex. 3), (Ex. 4)

Edge mode: [AF107]=00

(Ex. 1) When stopped ([AF104]≠0.00)

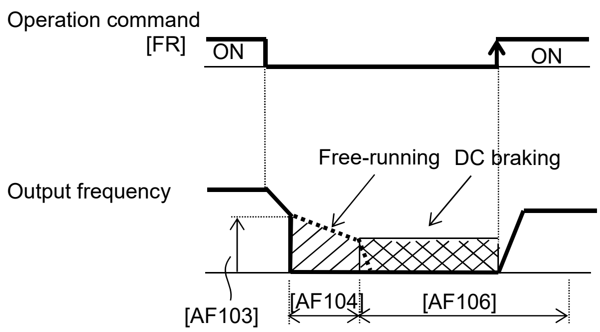


(Ex. 2) When stopped ([AF104]=0.00)

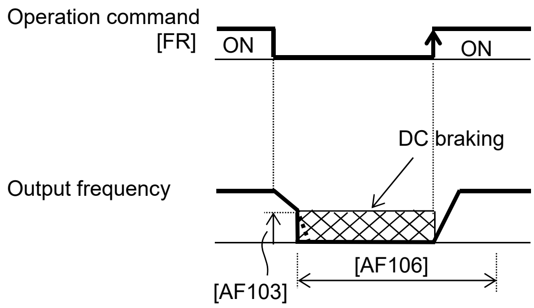


Level mode: [AF107]=01

(Ex. 3) When stopped ([AF104]≠0.00)



(Ex. 4) When stopped ([AF104]=0.00)



12.16 Protection Function

12.16.1 Detecting input phase loss

- Enable the input phase loss protection function by using [bb-65] Input phase loss protection selection.
- When the input phase loss protection function has been enabled, an input phase loss error [E024] will occur if a phase loss state due to disconnection or breakage of the input power cable continues for 1 second or more.
- When 3-phase AC is not input to power supply terminals R, S, and T, such as in cases where DC voltage is input to R and T or between P and N of the inverter, this function is disabled regardless of the setting for [bb-65].
- There will be no detection during an instantaneous power failure.

- If an input phase loss error [E024] occurs, it is necessary to cut off the power supply to the inverter and check the state of wiring and breakers.

■Parameter

Item	Parameter	Data	Description
Input phase loss protection selection	[bb-65]	00	Disabled
		01	Enabled

12.16.2 Detecting output phase loss

- Enable the output phase loss protection function by using [bb-66] Output phase loss protection selection.
- When the output phase loss protection function has been enabled, an output phase loss error [E034] will occur if a phase loss caused by disconnection or breakage of the motor cable continues.
- If the capacity of the drive motor is smaller than that of the inverter, the inverter may detect an output phase loss erroneously. In this case, decrease the value of [bb-67] or set [bb-66] to 00.
- If the carrier frequency [bb101] is low, the inverter may detect an output phase loss erroneously. It may improve by increasing the value of the carrier frequency [bb101].
- This function operates when the output speed is between 5 Hz and 100 Hz.
- Set the value of [bb-67] equal to or lower than the steadily flowing current, with the rated current being 100%.

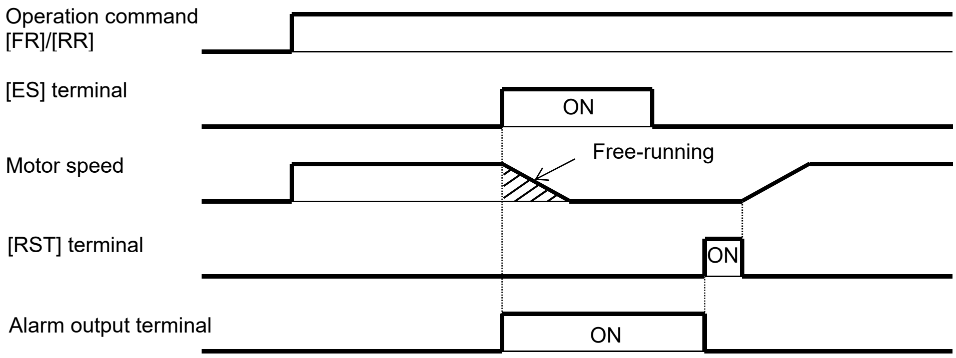
■Parameters

Item	Parameter	Data	Description
Output phase loss protection selection	[bb-66]	00	Disabled
		01	Enabled
Output phase loss detection sensitivity	[bb-67]	1 ~ 100(%)	Adjusts the sensitivity of the output phase loss
Carrier frequency	[bb101]	0.5~16.0(kHz) *1)	Changes the carrier frequency

*1) The following restriction is applied:
For LD rated capacity, 12.0 kHz at maximum
For VLD rated capacity, 10.0 kHz at maximum

12.16.3 Making the inverter trip from an external unit

- This function is enabled by setting 033 [ES] as an input terminal function. When a signal connected to the applicable terminal changes, an error [E012] occurs.
- Use this function when you want to trip the inverter via an error (trip) signal generated by a peripheral system.
- When the inverter trips with error code [E12] displayed, the trip is not reset even if the error signal from the external equipment is reset (ES terminal is turned off). To reset the trip, perform the reset operation or turn the power off and on again.
- If you reset the inverter while the terminal [ES] is turned on, [E012] will occur again.
- After the reset, the inverter follows [bb-41] Restart after reset. See "12.14.6 Starting after reset".
- When the terminal [ES] is turned on, an error will occur even if the inverter output is turned off, and the inverter trips with [E012] displayed.

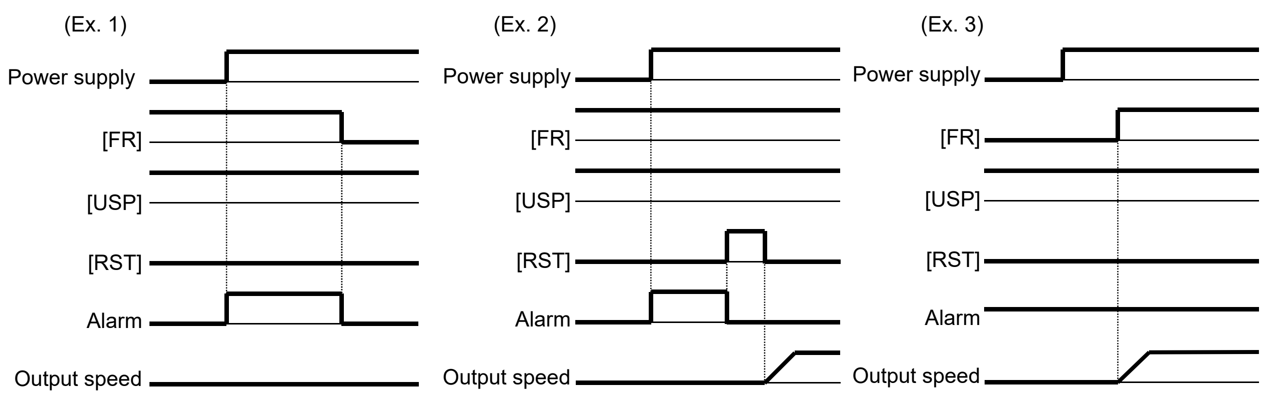


■Parameter

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	033	[ES]: When the terminal corresponding to the assigned position is turned on, an external trip occurs.

12.16.4 Preventing restart immediately after power recovery

- This function allows you to make the inverter trip with error code [E13] displayed if the inverter power is turned on when an operation command has been turned on.
- You can recover the inverter from tripping by performing the reset operation or turning the operation command off. (Ex. 1)
- If the inverter is recovered from tripping with the operation command left turned on, the inverter will start operation immediately after recovery. (Ex. 2)
- The inverter can operate normally when an operation command is turned on after the inverter power is turned on. (Ex. 3)
- Unlike other types of trip, the USP error [E013] automatically clears when the operation command is turned off.
- The power recovery restart prevention function operates for 2 seconds at maximum after the control power is input.



■Parameter

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	034	[USP]: If the applicable [USP] terminal assigned to an input terminal has been turned on, the inverter will trip when the power is recovered while an operation command is present.

12.16.5 Adjusting overcurrent error level

・By the setting of the overcurrent detection level [bb160], you can adjust the threshold current value used for detecting the overcurrent error [E001].
・If the threshold level for overcurrent is lowered, the overcurrent error [E001] is more likely to occur. Therefore, it is necessary to lower the levels for the stall prevention function and the overcurrent suppression function. For details, see "12.13 Using Trip Avoidance Function".

■Parameter

Item	Parameter	Data	Description
Overcurrent detection level	[bb160]	Depend on the inverter model	Sets the threshold level used for detecting overcurrent.

12.16.6 Making the inverter trip after an instantaneous power failure/under-voltage

・When direct current (P-N) is supplied to control power supply terminal r1 and t1, the inverter may detect under-voltage at power interruption and then trip. If there is any problem with your system, set [bb-27] to 00 or 02.
・Even if Selection of instantaneous power failure trip [bb-20] is set to other than 0 and Selection of instantaneous power failure/under-voltage trip during stopping [bb-27] is set to "Disabled" (00 or 02), [E016] Instantaneous power failure error will occur when the actual power failure time exceeds the allowable instantaneous power failure time.

■Parameters related to instantaneous power failure and under-voltage

Item	Instantaneous power failure	Under-voltage
・Always making the inverter trip when an instantaneous power failure/under-voltage occurs	Set [bb-20] to 0. [E016] Instantaneous power failure error	Set [bb-21] to 0. [E009] Under-voltage error
・Always making the inverter retry when an instantaneous power failure/under-voltage occurs	Set [bb-20] to 255.	Set [bb-21] to 255.
・Making the inverter trip after the specified number of retries are made after an instantaneous power failure/under-voltage has occurred	Set [b-20] to other than 0 or 255. [E016] Instantaneous power failure error	Set [b-21] to other than 0 or 255. [E009] Under-voltage error
・Outputting the state to an output terminal	Assigns 020 [IP] Instantaneous power failure signal.	Assigns 021 [UV] Under-voltage signal.
・Selecting whether to make the inverter trip when an instantaneous power failure or under-voltage occurs while the inverter is in a stopped state.	Sets [bb-27].	

・When selecting a retry function, see "12.3 Using Trip Avoidance Function".
・When the control circuit power supply is turn off and the power is lost, the operation mode will be the same as the mode at power-on. For subsequent operations, see the explanation about the restart after reset.

・Even during a retry operation, the retry will be interrupted if the instantaneous power failure/under-voltage condition continues for about 40 seconds, and error code [E009] Under-voltage or [E016] Instantaneous power failure will be displayed.
・When connecting separate power supplies to control power supply terminals (r1 and r1), and if an instantaneous power failure occurs at the main power supply terminals (R, S, and T), it will take about 1 second of the detection time before an instantaneous power failure error and under-voltage error occur. When braking is performed by [AL] alarm signal (output terminal function 017), the braking response will be slow, and therefore use the brake control function.

■Parameters

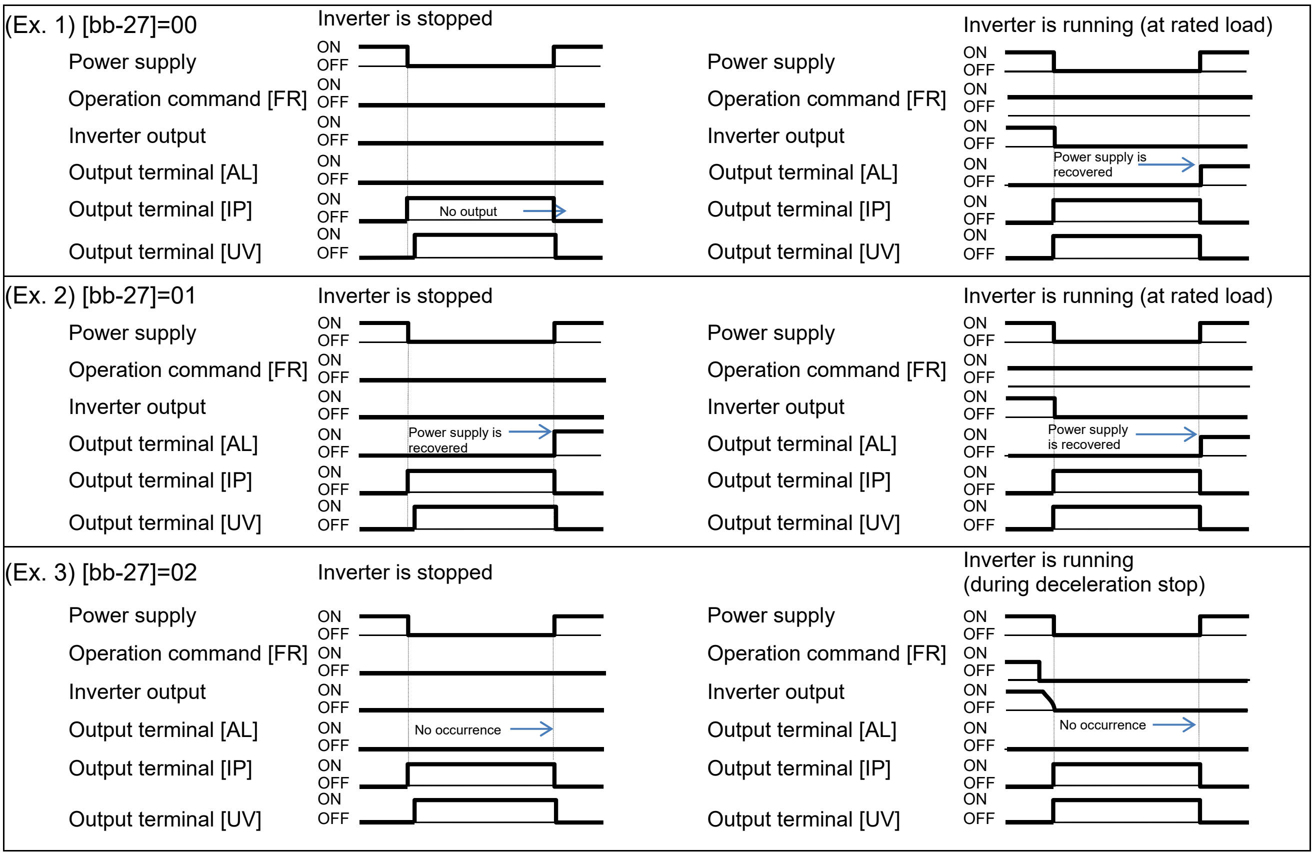
Item	Parameter	Data	Description
Selection of instantaneous power failure retry	[bb-20]	0~16 / 255	Detects a decrease in the control power supply and restarts the motor when the power supply is recovered. When 0 is specified, the inverter immediately trips when an instantaneous power failure occurs.
Selection of under-voltage retry	[bb-21]		Detects a decrease in the main power supply and restarts the motor when the power supply is recovered. When 0 is specified, the inverter immediately trips when an under-voltage condition occurs.
Selection of instantaneous power failure/under-voltage retry	[bb-24]	00	Restarts with 0 Hz at retry.
		01	Restarts with speed matching at retry.
		02	Restarts with frequency pull-in at retry.
		04	Restarts with speed matching at retry, and trips after deceleration stop.
Allowable instantaneous power failure time	[bb-25]	0.3~25.0 (s)	Restarts if the instantaneous power failure is within the set time. Trips if the instantaneous power failure exceeds the specified time.
Retry wait time after instantaneous power failure/under-voltage	[bb-26]	0.3~100.0 (s)	Sets the time before restarting.
Selection of instantaneous power failure/under-voltage trip during stopping	[bb-27]	00	Disabled
		01	Enabled
		02	Disabled during stopping and during deceleration stop after the operation command has been turned off.
Selection of output terminal function	[CC-01]~[CC-05]	017 020 021	017: Outputs [AL] Alarm signal. 020: Outputs [IP] Instantaneous power failure signal 021: Outputs [UV] Under-voltage signal.
Selection of relay output terminal function	[CC-06]		
Selection of relay output terminal function	[CC-07]		

■Alarm output when instantaneous power failure/under-voltage occurs during stopping

- Use this function to specify whether to output [AL] Alarm signal (error output) (output terminal function 028) when an instantaneous power failure or under-voltage occurs according to [bb-27] Selection of instantaneous power failure/under-voltage trip during stopping.
- Examples 1 to 6 show cases with no retry.

- When the power to control power supply terminals r1 and t1 is supplied from main power supply terminals R, S, and T, and if the control power supply terminals continue to be shut off for 80 ms or more, it is considered as power failure. After the power supply is recovered, the inverter performs power-on operation.
- Depending on the load conditions of the motor driven by the inverter, an under-voltage error [E009], instead of an instantaneous power failure error [E016], may occur.
- The inverter outputs the alarm while the power to control power supply terminals r1 and t1 remains.

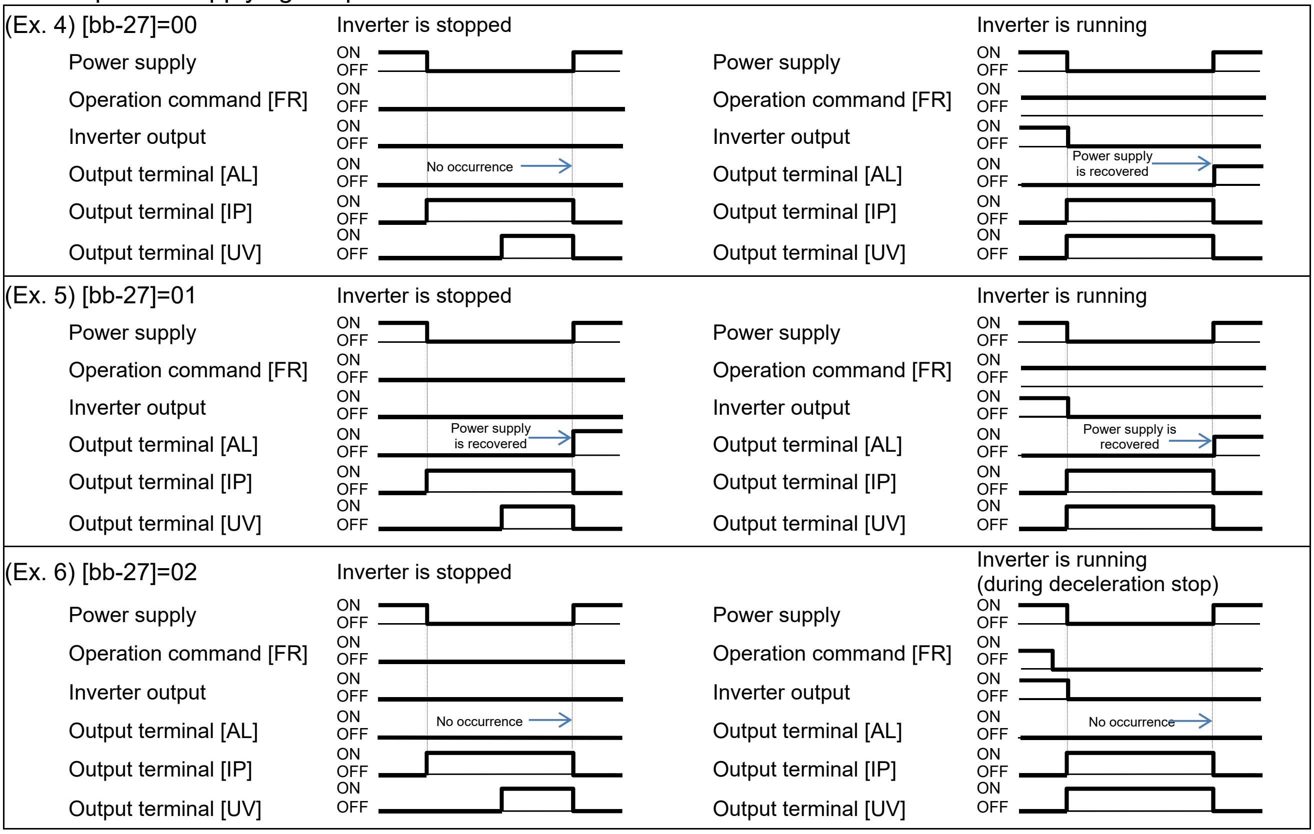
- Examples of supplying the power to r1 and t1 from R, S, and T



- Depending on the setting for [bb-25] Allowable instantaneous power failure time and the number of retries, the inverter's behavior varies.
- When "0" is specified for the number of retries (Error occurs)
  Power recovery within [bb-25] Allowable instantaneous power failure time
  ⇒ An error occurs.
  Power recovery after [bb-25] Allowable instantaneous power failure time has elapsed
  ⇒ An error does not occur. The same operation as when the power is turned on.

- When other than "0" is specified for the number of retries (Retry enabled)
  Power recovery within [bb-25] Allowable instantaneous power failure time
  ⇒ Retry operation
  Power recovery after [bb-25] Allowable instantaneous power failure time has elapsed.
  ⇒ An error occurs.

- Examples of supplying the power to r1 and t1 from P and N



- [IP] signals start to be detected after 3-phase power source has been input to main power supply terminals R, S, and T.
- If direct current is supplied between P and N, [IP] signals will not be output.

12.16.7 Avoiding mechanical resonance of motor and machine

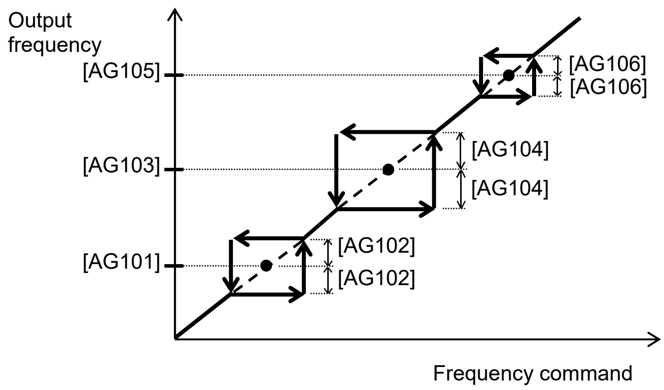
- Use the jump frequency function to operate the inverter while avoiding resonance points on the load-machine system.
- A jump frequency can be set at 3 points.
- The jump frequency function is a function to prevent output within the specified frequency command range. When a frequency command that is within the range of the jump frequency function is input, the output is automatically limited. While the output is limited, the LIM icon will be displayed.

- The output frequency within the range of the jump frequency command fluctuates continuously according to normal the acceleration/deceleration time.

■Parameters

Item	Parameter	Data	Description
Jump frequency 1	[AG101]	0.00~590.00(Hz)	Sets the center of the frequency range at which to execute a jump If 0.00 Hz is set, the jump frequency function is disabled.
Jump frequency 2	[AG103]		
Jump frequency 3	[AG105]		
Jump frequency width 1	[AG102]	0.00~10.00(Hz)	Set one-half of the frequency width in which to execute a jump. Frequencies that fall in the range of a jump frequency±jump width will be jumped.
Jump frequency width 2	[AG104]		
Jump frequency width 3	[AG106]		

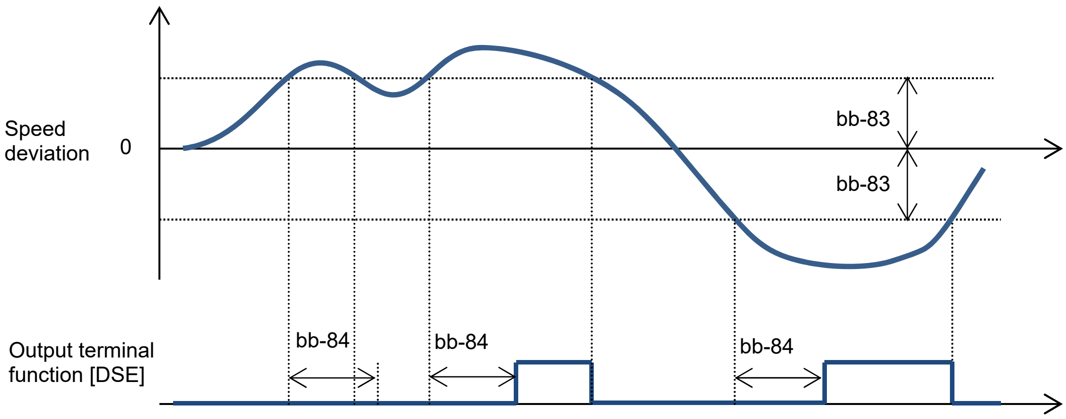
■Setting examples



12.16.8 Detecting speed deviation error

- The speed deviation error detection function judges that the deviation is excessive if the deviation between the frequency command and the feedback speed becomes large.
- This function operates when other than "0.0" is specified for [bb-83] Speed deviation error detection level setting.
- To use this function, speed feedback by the encoder is required.

- Speed deviation is the difference between [dA-12] Output frequency monitor and [dA-08] Detected frequency monitor.
- When the absolute value of speed deviation has exceeded [bb-83] Speed deviation error detection level and [bb-84] Speed deviation error detection time has elapsed, it is judged as a speed deviation error.
- If "00: Warning" is specified for [bb-82] Operation for speed deviation error, the inverter turns on the Output terminal function 041 [DSE] with a speed deviation error.
- If "01: Error" is specified for [bb-82] Operation for speed deviation error, the inverter turns on the Output terminal function 041 [DSE] with a speed deviation error, and trips with [E105] Speed deviation excessive error.



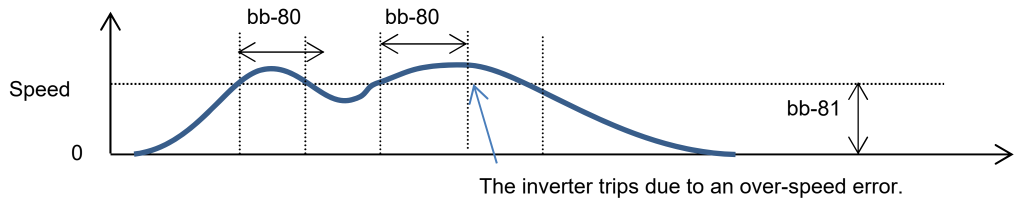
■Parameters

Item	Parameter	Data	Description
Operation for speed deviation error	[bb-82]	00	Turns on the output terminal function 041 [DSE].
		01	Turns on the output terminal function 041 [DSE], and trips with [E105] Speed deviation excessive error.
Speed deviation error detection level setting	[bb-83]	0.0~100.0(%)	Sets the level at which the speed deviation is judged as excessive.
Speed deviation error detection time	[bb-84]	0.0~5.0(s)	Sets the time to judge the deviation to be an error after it has excessively increased.
Detected frequency monitor	[dA-08]	-590.00~ 590.00(Hz)	Displays data obtained through encoder feedback.
Output frequency monitor	[dA-12]		Displays the frequency command given by the inverter.

12.16.9 Detecting over-speed error

- The over-speed error detection function judges that the speed is excessive if the feedback speed exceeds the over-speed level.
- This function operates when other than "0.0" is specified for [bb-80] Over-speed error detection level.
- To use this function, speed feedback by the encoder is required.

- Whether the speed is excessive is determined according to the feedback frequency displayed on [dA-08] Detected frequency monitor.
- When the speed has exceeded [bb-80] Over-speed error detection level and [bb-81] Over-speed error detection time has elapsed, it is judged as an over-speed error.
- When an over-speed error occurs, the inverter trips with [E107] Over-speed error.



■Parameters

Item	Parameter	Data	Description
Over-speed error detection level setting	[bb-80]	0.0~150.0(%)	Sets the speed level at which the speed is determined to be excessive.
Over-speed error detection time	[bb-81]	0.0~5.0(s)	Sets the time to judge the speed to be an error after it has excessively increased. The inverter trips with [E107] Over-speed error.
Detected frequency monitor	[dA-08]	-590.00~ 590.00(Hz)	Displays the data obtained through encoder feedback.

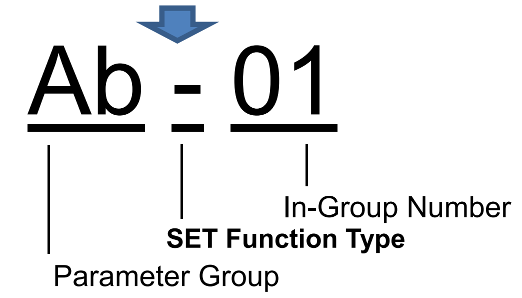
12.17 Operating the Inverter in Conjunction with the System

12.17.1 Using by Switching between Two Settings

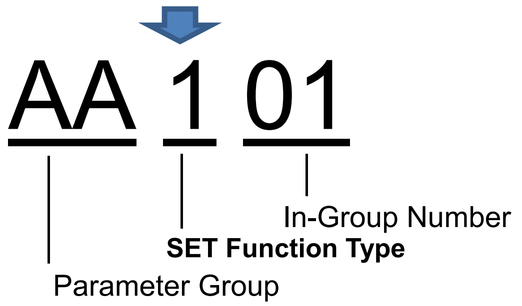
- This function changes the valid parameters by assigning 024[SET] to the input terminal function and turning it on. In conjunction with [SET], the output terminal 012[SETM] is turned on.
- The following is the notation for the parameters that are changed with the [SET] terminal.

- The [SET] terminal can be switched while the output of the inverter is blocked. If it is being switched during the output, it is switched after the output blockage.
- Even if you want to switch the [SET] terminal for immediate operation, take more than 1 s for the switching time.

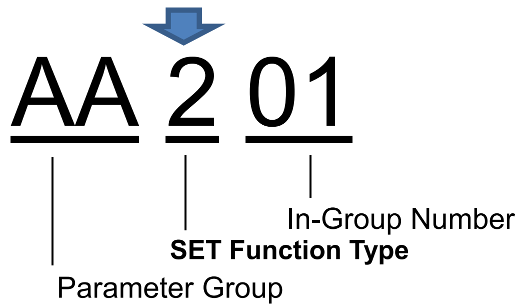
■Example of the Common Settings



■Example of the First Setting



■Example of the Second Setting



Example	SET Function Type Notation	Description
Common	The third digit of the parameter is "-": [Ab-01], [bA-30], [CC-01], etc.	The parameter is common to the first and second settings regardless of the SET function. Always valid.
First setting	The third digit of the parameter is "1": [AA101], [bC112], [Hb102], etc.	If the [SET] terminal is off or the [SET] function is not assigned (off), the first setting is applied. The data for which the third digit of the parameter is "1" are all valid.
Second setting	The third digit of the parameter is "2": [AA201], [bC212], [Hb202], etc.	If the [SET] terminal is on, the second setting is applied. The data for which the third digit of the parameter is "2" are all valid.

■Parameters

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	024	[SET]: Second setting function OFF: The first setting is valid. ON: The second setting is valid. ∗If the parameter does not have 024[SET] assigned, the first setting is valid.
Output terminal function	[CC-01]~[CC-07]	012	[SETM]: OFF when SET is OFF; ON when SET is ON.

12.17.2 Switching to a Commercial Power Supply (Commercial Switching)

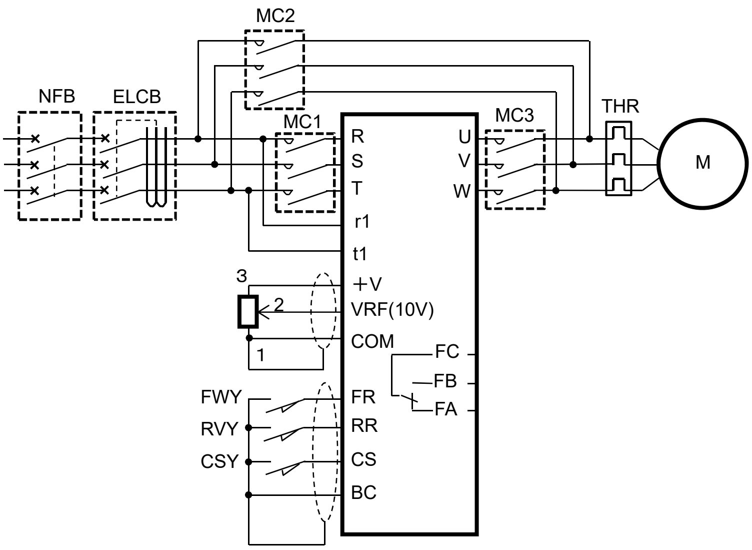
- This function can be used to drive the acceleration/deceleration with the inverter and drive in a constant speed with a commercial power supply for a system where the load inertia moment is large.
- If the 035[CS] terminal is turned from on to off with the status where an operation command is sent, the inverter starts with the frequency matched with the motor rotation speed in free-running after the retry waiting time [bb-26]. (Starting the frequency matching.)

- The operation at the [CS] terminal is similar to the case when starting the frequency matching is selected. Starting at 0 Hz may occur when:
  1. The output frequency is equal to or less than one-half of the base frequency.
  2. The induced voltage of the induction motor decays early
  3. The lower limit frequency for the frequency matching [bb-42] is set and a speed not more than the set speed is detected.
- For the frequency matching, extend the retry waiting time [bb-26] when the overcurrent trip occurs.
- The operation can be also restarted automatically when the power is turned on. In this case, the reset restart function is used. For more information, refer to "12.14 Changing the Start Mode".

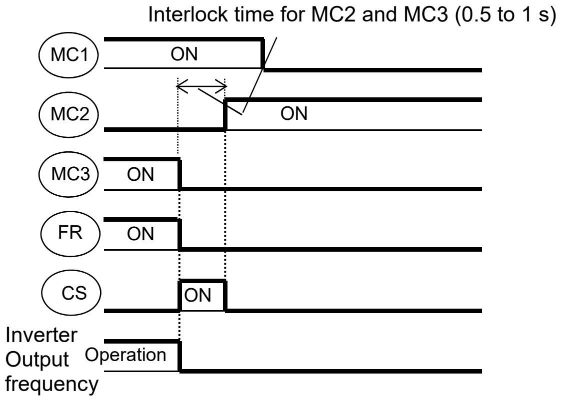
- For the behavior of the commercial switching, refer to the following sample connection diagram for the commercial switching operation and timing.
- Use light electrical relays for FWY, RVY, and CSY. The following sequence is a reference diagram for timing.

- Take a mechanical interlock for MC3 and MC2. Otherwise, you run the risk of damage to the inverter.
- Since the commercial circuit does not operate either when the earth leakage circuit breaker (ELCB) trips, connect the commercial circuit of another system to MC2 if the backup is required.

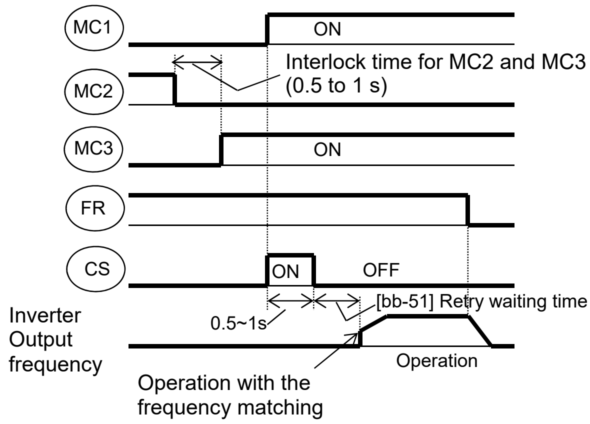
Sample connection diagram for the commercial switching operation and timing



Example of timing from INV to the commercial operation



Example of timing from the commercial operation to INV

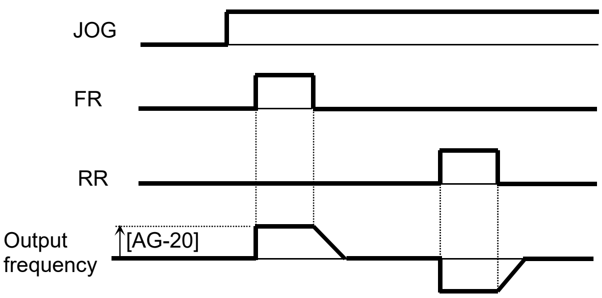


■Parameters

Item	Parameter	Data	Description
Selecting the input terminal	[CA-01]~[CA-11]	035	Used for the commercial switching [CS].
Instantaneous power failure/under voltage retry waiting time	[bb-26]	0.3~100.0(s)	Set the waiting time after an operation command.
Setting the lower limit for the speed matching	[bb-42]	0.00~590.00(Hz)	Starting at 0 Hz when the detected value is equal to or less than the set value.

12.17.3 Jogging/Inching Operation

- This function allows you to fine-tune the position where a motor stops.

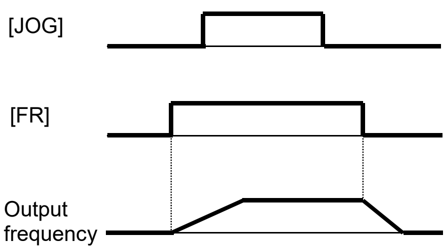


- The jogging operation is likely to trip due to its direct-on operation. Adjust the setting value for the jogging frequency [AG-20] so that the inverter does not trip.
- For the jogging operation, set the [AA111] operation command selection to 00, turn on the 029[JOG] terminal and then put the [FR]/[RV] terminal. The operation is not allowed with the [JOG] terminal alone.
- When [AG-21] = 00, 03 for the free-running at the time of the stop, the operation settings for free-running is required.
- When [AG-21] = 02, 05 for the DC-braking at the time of the stop, the settings for the DC-braking function is required. Refer to "12.15 Changing the Stop Mode" respectively.

■Parameters

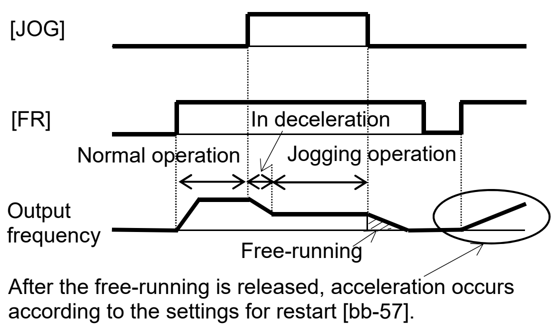
Item	Parameter	Data	Description
Jogging frequency	[AG-20]	Lowest frequency - 10.00 (Hz)	Frequency command at the time of the jogging operation command.
Selecting the jogging stop	[AG-21]	00	Invalid while operating Free-running at the time of the stop.
		01	Invalid while operating Decelerating stop at the time of the stop.
		02	Invalid while operating DC braking at the time of the stop.
		03	Valid while operating Free-running at the time of the stop.
		04	Valid while operating Decelerating stop at the time of the stop.
		05	Valid while operating DC braking at the time of the stop.
Input terminal function	[CA-01] ~[CA-11]	029	When the [JOG] terminal function is turned on, the jogging behavior occurs at the time of operation.

(Example 1)



When the setting for the jogging selection [AG-21] is 00, 01 or 02, the jogging behavior does not occur if the [FR] signal is turned on first.

(Example 2)



When the setting for [AG-21] is 03, 04 or 05, the jogging behavior occurs if the [FR] signal is turned on first. However, if the [JOG] signal is turned off first, the free-running stop occurs.

12.17.4 Performing the Brake Control

- Function to control the external brake used in a lifting system, etc. by the inverter. Changing the brake controlling function selection [AF130] enables you to select between two types of control methods.

1. Brake control 1: [AF130] = 01 or 02
   Releases and checks the brake while outputting the frequency.
2. Brake control 2: [AF130] = 03
   Controls the brake in conjunction with the servo lock control.

■Brake Control 1

- Available in those instances where the operations vary for lifting and lowering since different operations can be set for forward and reverse rotations.
- The 037[BRK] brake release signal for the output terminal function and the 037[BOK] brake check signal for the input terminal function are available.

- For using the brake control function, we recommend using controls that generate high torque when the control system [AA121] is started such as:
  08: Sensorless vector control,
  09: 0 Hz range sensorless vector control or
  10: Vector control with sensor.

- When an error occurs in the brake sequence, the inverter trips [E036], the brake control fault signal 038[BER] for the output terminal function is output.

- For the brake control, a trip occurs in the following cases.
  - After the brake release establishment waiting time, the output current was less than the release current.
  - When the brake check signal 037[BOK] is used, [BOK] was not turned on within the brake check waiting time at start-up.
  - When the brake check signal 037[BOK] is used, [BOK] was not turned off within the brake check waiting time at stop.
  - When the brake check signal 037[BOK] is used, the brake release signal 037[BRK] was being output, but [BOK] was turned off.

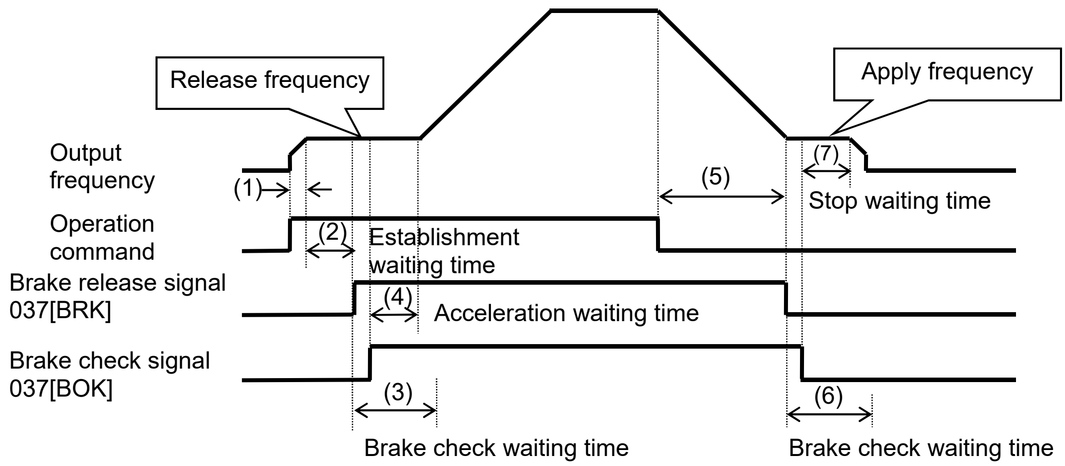
- [AF130] = 01: For the brake control function, the following parameters are valid.

Item	Valid for both forward and reverse
Brake release establishment waiting time	[AF131]
Acceleration waiting time	[AF132]
Stop waiting time	[AF133]
Brake check waiting time	[AF134]
Brake release frequency	[AF135]
Brake release current	[AF136]
Brake apply frequency	[AF137]

- [AF130] = 02: For the brake control function (forward/reverse), the following parameters are valid.

Item	Forward rotation side	Reverse rotation side
Brake release establishment waiting time	[AF131]	[AF138]
Acceleration waiting time	[AF132]	[AF139]
Stop waiting time	[AF133]	[AF140]
Brake check waiting time	[AF134]	[AF141]
Brake release frequency	[AF135]	[AF142]
Brake release current	[AF136]	[AF143]
Brake apply frequency	[AF137]	[AF144]

■Brake Control 1 Function (with the [BOK] Setting)



(1) Once the inverter receives an operation command, it starts the output and accelerate to the release frequency.

(2) When the brake release establishment waiting time passes after the release frequency is reached, the inverter outputs the brake release signal 037[BRK].

- At this time, if the output current is less than the current set for the release current, the brake release signal is not output and the trip occurs with the [E036] brake error outputting the brake fault signal 038[BER].

(3) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.

With [BOK] setting	The inverter turns on the release signal [BRK] and waits for the input (ON) for the check signal [BOK] without accelerating during the brake check waiting time. If the [BOK] is not turned on during the above time, the inverter trips with the [E036] brake error outputting the fault signal [BER].
Without [BOK] setting	After the release signal [BRK] is turned on, the process goes to the item 4 regardless of the brake check waiting time.

(4) If the brake check signal [BOK] is not selected, when the brake release signal is output, the inverter starts accelerating again to the set frequency after the acceleration waiting time passes.

(5) Once the operation command is turned off, the inverter decelerates to the brake apply frequency and turns off the brake release signal [BRK].

(6) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.

With [BOK] setting	The inverter turns off the release signal [BRK] and waits for the input (OFF) for the check signal [BOK] without decelerating during the brake check waiting time. If the [BOK] is not turned off during the above time, the inverter trips with the [E036] brake error outputting the fault signal [BER].
Without [BOK] setting	After the release signal [BRK] is turned off, the process goes to the item 7 regardless of the brake check waiting time.

(7) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.

With [BOK] setting	When the check signal [BOK] is turned off, the inverter decelerates again to 0 Hz after the stop waiting time passes.
Without [BOK] setting	When the release signal [BRK] is turned off, the inverter decelerates again to 0 Hz after the stop waiting time passes.

- If the operation command is the forward command, the parameters on the side of the forward rotation are adopted; if it is the reverse command, those on the side of the reverse rotation are adopted.

■Setting Items Required for the Brake Control 1 Function

Item		Parameter	Data	Description
Brake control function selection		[AF130]	00	Disabled
			01	Brake control enabled *1)
			02	Brake control enabled (forward/reverse set individually)
Brake release establishment waiting time	Forward rotation	[AF131]	0.00~5.00(s)	Sets the time after the release frequency is reached until the output current reaches the release current
	Reverse rotation	[AF138]		
Acceleration waiting time	Forward rotation	[AF132]		Sets the mechanical delay time after the release signal is sent until the brake is released
	Reverse rotation	[AF139]		
Stop waiting time	Forward rotation	[AF133]		Sets the mechanical delay time after the release signal is turned off until the brake is closed
	Reverse rotation	[AF140]		
Brake check waiting time	Forward rotation	[AF134]		Set the time not less than the time after the release signal is sent until the release completion signal output from the brake is input to the inverter.
	Reverse rotation	[AF141]		
Brake release frequency	Forward rotation	[AF135]	0.00~590.0(Hz)	Setting the frequency to output the brake release signal *2)
	Reverse rotation	[AF142]		
Brake release current	Forward rotation	[AF136]	Inverter rated current ×(0.0~2.00)	Setting the output current to allow the brake release *3)
	Reverse rotation	[AF143]		
Brake apply frequency	Forward rotation	[AF137]	0.00~590.0(Hz)	Setting the frequency to close the brake at the time of stop *2)
	Reverse rotation	[AF144]		
Input terminal function		[CA-01]~[CA-11]	037	[BOK] Brake check signal OFF: Brake released ON: Brake applied
Output terminal function		[CC-01]~[CC-07]	037	[BRK] Brake release signal OFF: Brake release command ON: Brake operation command
			038	[BER] Brake fault signal OFF: Brake sequence is normal ON: Brake sequence is abnormal

*1) If [AF130] = 01, the forward rotation settings, [AF131] to [AF137] are valid for both the forward and reverse rotations.
*2) Set the time greater than the value of the minimum speed [Hb130].
*3) Note that a low value for the setting may generate sufficient torque when releasing the brake.

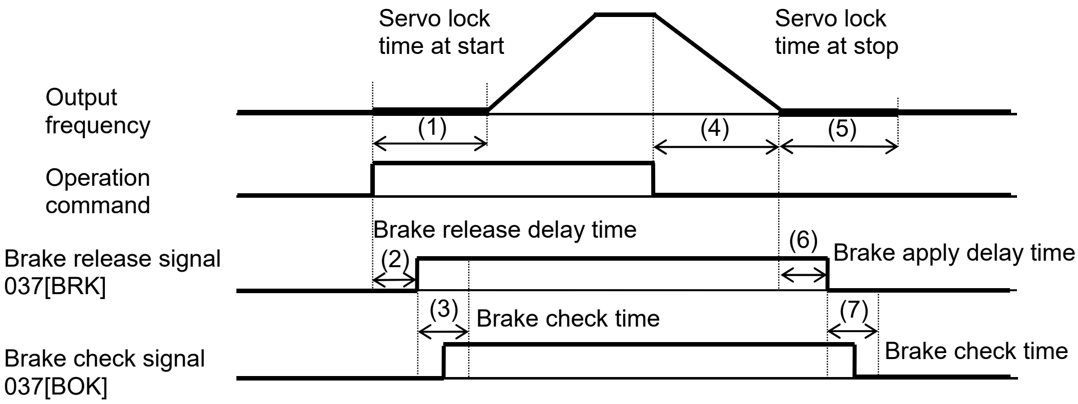
■Brake Control 2

- The brake control by managing time is available.
- The 037[BRK] brake release signal for the output terminal function and the 037[BOK] brake check signal for the input terminal function are available.

- [AF130] = 03: For the brake control function 2, the following parameters are valid.

Item	Valid for both forward and reverse
Brake release delay time	[AF150]
Brake apply delay time	[AF154]
Brake check time	[AF152]
Servo lock time at start	[AF153]
Servo lock time at stop	[AF154]

■Brake Control 2 Function



(1) The inverter starts the output and performs the servo lock for the servo lock time at start.
(If the [AA121] control method is neither 09: zero speed range sensorless vector control nor 10: vector control with sensor, the DC braking is applied.)

(2) After the brake release delay time passes, the brake release signal 037[BRK] is turned on.

(3) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.
After the servo lock time at start passes, there is an acceleration.

With [BOK] setting	If the 037[BOK] is not turned on during the brake check time, the inverter trips with the [E036] brake error outputting the fault signal 038[BER].
Without [BOK] setting	After the release signal 037[BRK] signal is turned on, there is a waiting for the servo lock time at start to pass.

(4) Once the operation command is turned off, the inverter decelerates and perform the servo lock.

(5) The servo lock is kept for the servo lock time at stop.

(6) After the brake apply delay waiting time passes, the brake release signal 037[BRK] is turned on.

(7) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.
There is a waiting for the servo lock time to pass.

With [BOK] setting	The inverter turns off the release signal 037[BOK], and if the 037[BOK] is not turned off during the brake check time, the inverter trips with the [E036] brake error outputting the fault signal 038[BER].
Without [BOK] setting	After the release signal [BRK] signal is turned off, there is a waiting for the servo lock time at stop to pass.

- Since the brake control 2 generates the servo lock status when the brake is on, use 09: zero speed range sensorless vector control or 10: vector control with sensor for the [AA121] control method.
- Selecting the control methods other than the above will replace the operation part of the servo lock with the DC braking operation.
- For the brake control 2, an error occurs with a trip in the following cases.
  - When the brake check signal 037[BOK] is used, [BOK] was not turned on within the brake check waiting time at start-up.
  - When the brake check signal 037[BOK] is used, [BOK] was not turned off within the brake check waiting time at stop.
  - When the brake check signal 037[BOK] is used, the brake release signal 037[BRK] was being output, but [BOK] was turned off.

■Setting Items Required for the Brake Control 2 Function

Item	Parameter	Data	Description
Brake control function selection	[AF130]	00	Disabled
		01	Brake control 1 enabled
		02	Brake control 1 enabled (forward/reverse set individually)
		03	Brake control 2 enabled
Brake release delay time	[AF150]	0.00~2.00(s)	Set the brake release delay time.
Brake apply delay time	[AF151]		Set the brake apply delay time.
Brake check time	[AF152]	0.00~5.00(s)	Set the time to check the brake.
Servo lock time at start	[AF153]	0.00~10.00(s)	Set the servo lock time at start.
Servo lock time at stop	[AF154]		Set the servo lock time at stop.
DC braking force at the time of the stop.	[AF105]	0~100(%)	If the control method is neither 09: zero speed range sensorless vector control nor 10: vector control with sensor, the DC braking is applied. Set the braking force (at the time of stop).
DC braking force at the time of the start.	[AF108]		If the control method is neither 09: zero speed range sensorless vector control nor 10: vector control with sensor, the DC braking is applied. Set the braking force (at the time of start).

12.17.5 Performing the Contactor Control

- For performing the contactor operation, set the [AF120] contactor control selection to 01.
- The 039[CON] contactor control signal for the output terminal function and the 112[COK] contactor check signal for the input terminal function are available.

- The contactor control requires this function because operating a contactor during the inverter output generates a surge causing damage to the inverter.
- When an error occurs in the contactor sequence, the inverter trips at [E110].

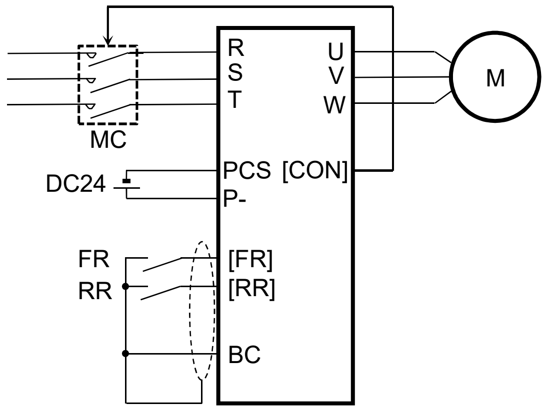
- For the contactor control, a trip occurs in the following cases.
  - When the contactor check signal 112[COK] is used, [COK] is not turned on within the contactor check time at start-up.
  - When the contactor check signal 112[COK] is used, [COK] is not turned off within the contactor check time at stop.
  - When the contactor check signal 112[COK] is used, [COK] is turned off while the contactor control signal 039[CON] is on

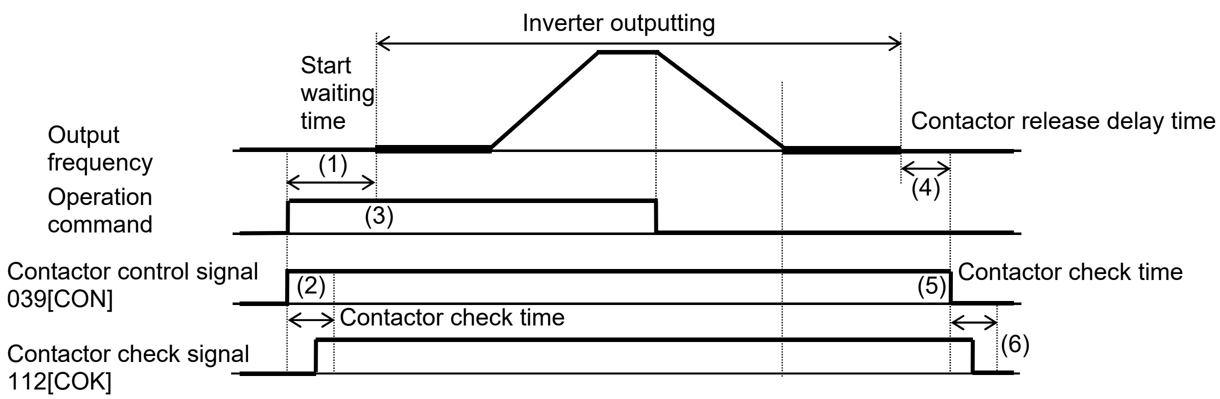
■Setting Items Required for the Contactor Control Function

Item	Parameter	Data	Description
Contactor control selection	[AF120]	00	Disabled
		01	Enabled (primary side) Place a contactor on the primary side of the inverter to reduce standby power.
		02	Enabled (secondary side) Place a contactor on the secondary side of the inverter to implement the function as a brake sequence.
Waiting time at start	[AF121]	0.00~2.00(s)	Set the waiting time from the input of an operation command to the start of the inverter output.
Contactor release delay time	[AF122]		Set the time from the output shutoff of the inverter to the control of the contactor.
Contactor check time	[AF123]	0.00~5.00(s)	Set the time from the operation command to the control of the contactor.
Input terminal function	[CA-01]~[CA-11]	112	[COK] Contactor check signal OFF: Contactor released ON: Contactor in operation
Output terminal function	[CC-01]~[CC-07]	039	[CON] Contactor control signal OFF: Contactor release command ON: Contactor operation command

■Example of Energy Saving on the Primary Side Contactor
(AF120 = 01: Enabled (Primary Side))

- Reduce standby power in combination with the control power supply DC24V input.
- Connecting the auxiliary contact MC for the main circuit power supply to the setting terminal of the output terminal function [CON] shuts off the power input to the inverter main circuit while the inverter output is suspended to implement the operation sequence for energy saving.





(1) The inverter waits for the output until the start waiting time passes.

(2) It turns on the contactor control signal 039[CON] at the same time.
The operation varies depending on whether the contactor check signal 112[COK] is set to the input terminal function.

With [COK] setting	If the 112[COK] is not turned on during the contactor check time, the inverter trips with the [E110] contactor error.
Without [COK] setting	After the contactor control signal 039[CON] is turned on, there is a waiting time for the start waiting time to pass.

(3) After the start waiting time passes, there is an acceleration.

(4) After the inverter stops the output, there is a waiting time for the contactor release delay time to pass.

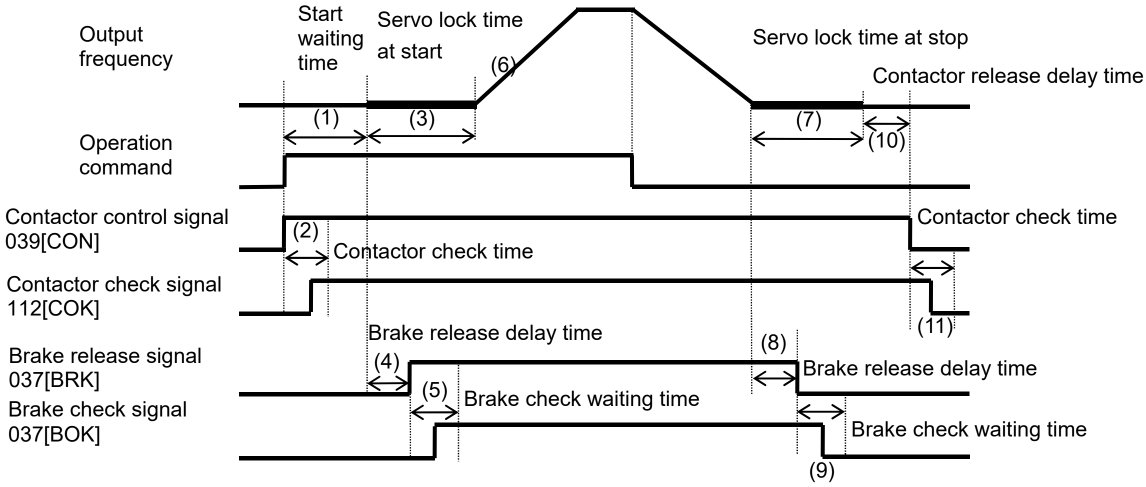
(5) After the contactor release delay time passes, the contactor control signal 039[CON] is turned off.

(6) The operation varies depending on whether the contactor check signal 112[COK] is set to the input terminal function.

With [COK] setting	If the 112[COK] is not turned off during the contactor check time, the inverter trips with the [E110] contactor error.
Without [COK] setting	The inverter still does nothing.

■Example of the Control on the Secondary Side
(AF120 = 02: Enabled (secondary side))

• When Enabled (secondary side) is selected, using in combination with the brake control 2 is available.



(1) Once the operation command is received, the inverter turns on the control signal 039[CON].

(2) The operation varies depending on whether the contactor check signal 112[COK] is set to the input terminal function.

With [COK] setting	The inverter turns on the control signal 039[CON] and, if the 112[COK] is not turned on during the contactor check time, the inverter trips with the [Er110] contactor error.
Without [COK] setting	After the control signal 039[CON] is turned on, there is a waiting time for the start waiting time to pass.

(3) The inverter starts the output and is in the servo lock status at the present location for the servo lock time at start.

(4) After the brake release delay time passes, the brake release signal 037[BRK] is turned on.

(5) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.

With [BOK] setting	If the 037[BOK] is not turned on during the brake check waiting time, the inverter trips with the [E036] brake error outputting the fault signal 038[BER].
Without [BOK] setting	After the release signal 037[BRK] signal is turned on, there is a waiting for the servo lock time at start to pass.

(6) After the servo lock time at start passes, there is an acceleration.

(7) Once the operation command is turned off, the inverter decelerates and is in the position servo lock status for the servo lock time at stop.

(8) After the brake release delay time passes, the brake release signal 037[BRK] is turned off.

(9) The operation varies depending on whether the brake check signal 037[BOK] is set to the input terminal function.

With [BOK] setting	The inverter turns off the release signal 037[BOK], and if the 037[BOK] is not turned off during the brake check time, the inverter trips with the [E036] brake error outputting the fault signal 038[BER].
Without [BOK] setting	After the release signal [BRK] signal is turned off, there is a waiting for the servo lock time at stop to pass.

(10) The inverter shuts off the output and, after the contactor release delay time passes, the control signal 039[CON] is turned off.

(11) The operation varies depending on whether the contactor check signal 112[COK] is set to the input terminal function.

With [COK] setting	If the 112[COK] is not turned off during the contactor check time, the inverter trips with the [E110] contactor error.
Without [COK] setting	The inverter still does nothing.

12.17.6 Performing the Forced Operation

- Performing this function enables the inverter to run in the forced operation mode (Em-Force mode) in which it operates at a constant speed without shutting off the inverter output until the power-off.
- Set the [PA-01] forced operation to enabled 01 and turn on the [EMF] emergency forced operation terminal (input terminal: 105) to enter the forced operation mode.
- The command for the forced operation mode is set with the [PA-02] Em-Force mode frequency setting and the rotation direction command in the [PA-03] Em-Force mode.

- Once the forced operation mode is turned on, the inverter keeps operating until the power is off.
- When using the forced operation mode, make sure that the system is safe if the operation continues.
- Enabling the overcurrent retry, overvoltage retry, under voltage retry or instantaneous power failure retry requires a separate setting.
- After the [EMF] emergency forced operation terminal (input terminal: 105) is turned on, the input terminal function except for the following are disabled.
  ⇒[COK]: Contactor check signal

■Parameter Setting

Item	Parameter	Data	Description
Em-Force mode selection	[PA-01]	00	Disabled
		01	Enabled
Em-Force mode frequency setting	[PA-02]	0.00~590.00(Hz)	Set the frequency command in the forced operation mode.
Rotation direction in the Em-Force mode	[PA-03]	00	Forward rotation command
		01	Reverse rotation command

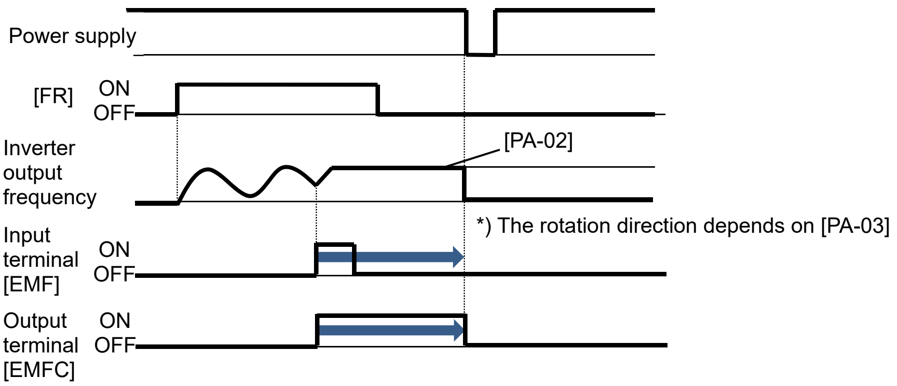
■Input Terminal Setting

Item	Parameter	Data	Description
Selecting the input terminal	[CA-01]~[CA-11]	105	[EMF] emergency forced operation terminal. OFF: Disabled ON: Forced operation mode (when [PA-01] = 01)

■Output Terminal Setting

Item	Parameter	Data	Description
Selecting the output terminal	[CC-01]~ [CC-07]	076	[EMFC] Signal in Em-Force. OFF: Disabled ON: In the forced operation mode

■Behavior in the Forced Operation
- Turn on the [EMF] emergency forced operation terminal (input terminal: 105) to enter the forced operation mode.
- The inverter performs the output at the frequency set to the [PA-02] Em-Force mode frequency setting and rotation direction set to the rotation direction command in the [PA-03] Em-Force mode until the power-off.

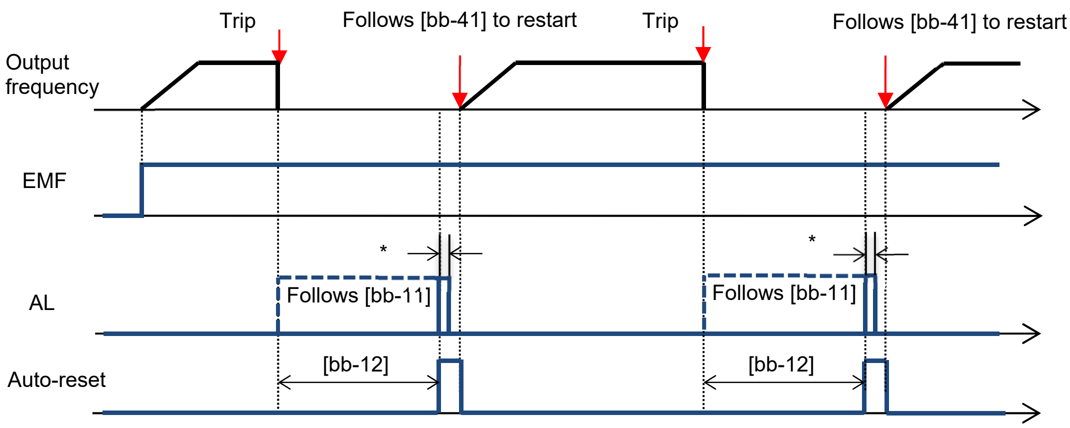


- In the forced operation mode, the following functions are operating automatically.

(1) Soft lock status (equivalent to [UA-16] = 01) The parameters can be no longer changed.
To restore the settings, turn off [EMF], restore the power and then change the parameters.
(2) Auto-reset (equivalent to [bb-10] = 02) When a trip that can be released occurs, the reset is performed automatically to restart.
(3) STOP key disabled (equivalent to [AA-13] = 00) Disable the STOP/RESET keys on the operator keypad.
(4) Operation enabled during the optional start ([oA-13] = 01, [oA-23] = 01, [oA-33] = 01)
The operation is allowed even in the optional start-up.

- The functions except for the above operate according to the settings.

■Auto-Reset Behavior in the Forced Operation
- When an error occurs during the forced operation and the inverter trips, the reset equivalent to the one at power-on is performed.



*000000000For the AL relay terminal, due to the MCU reset (equivalent to Power ON reset), on for a moment no matter what is assigned.

■Auto-Reset at the Forced Behavior
(The following parameters themselves are not changed)

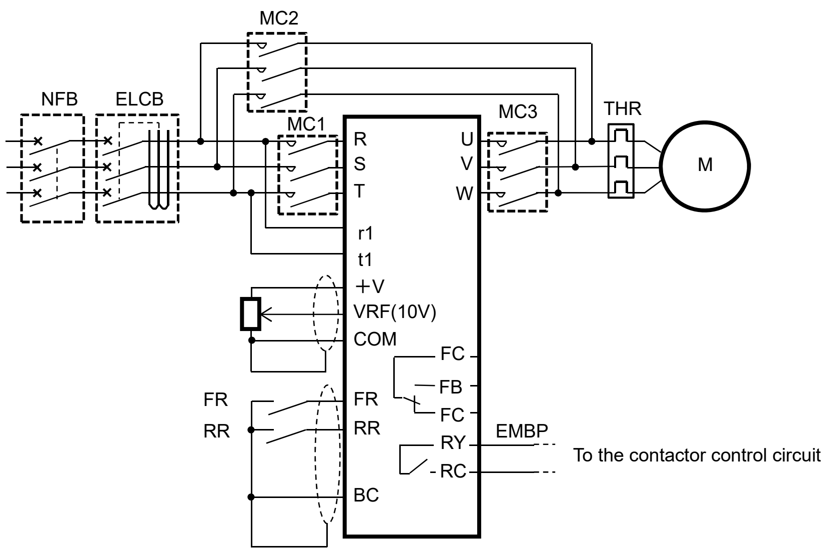
Item	Equivalent Parameter	At the Forced Behavior	Description
Auto-reset selection	-	All errors reset in addition to [bb-10]=02	[bb-10]=02 is applied to all errors regardless setting (02: valid executed after the time defined by [bb-12])
Alarm output selection when the auto-reset is enabled	[bb-11]	Follows the setting for [bb-11]	Parameter setting is enabled. However, due to the system reset, AL is turned on for a moment even if AL is set for the output.
Auto-reset waiting time	[bb-12]	Follows the setting for [bb-12]	Parameter setting is enabled.
Auto-reset count setting	[bb-13]	Change to no limit	Forcibly reset an infinite number of times regardless the settings.
Restart after the reset is released	[bb-41]	Follows the setting for [bb-41]	Parameter setting is enabled. For other retry settings ([bb-20] to [bb-31]), the parameter settings are enabled.

■Switching to the Commercial Operation (Bypass Mode)

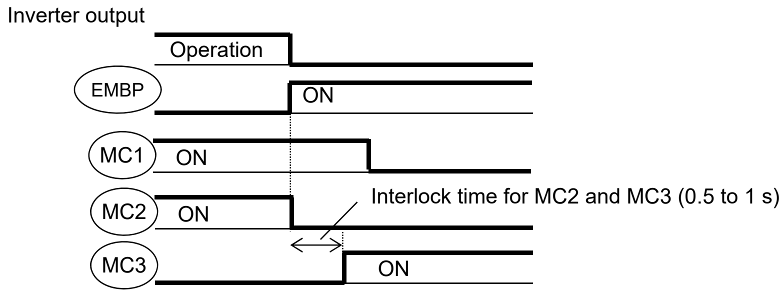
- When the [PA-04] bypass function selection is set to 01: Enabled, switching to the commercial operation mode (bypass mode) is allowed if the specified operation mode is not entered during the forced operation.
- In the bypass mode, [EMBP] bypass mode signal (output terminal: 076) is turned on and the inverter output is shut off.
- For the behavior in the bypass mode, refer to the following sample connection diagram for the commercial switching operation and timing.
- Perform the contactor control based on the [EMBP] bypass mode signal (output terminal: 076).

- For using the bypass mode, it is necessary to implement a interlock taking into consideration the operation delay of the contactor when shifting to the commercial operation. Make sure that the system operation is safe in using the mode.
- The timing of the contactor control can be taken using the [EMBP] bypass mode signal (output terminal: 076) as the contactor control signal. Take a interlock between the contactor on the commercial power supply side and that on the inverter output side.
- Since the commercial circuit does not operate either when the earth leakage circuit breaker (ELCB) trips, connect the commercial circuit of another system to MC2 if the backup is required.

Sample connection diagram when shifting to the commercial operation and timing



Example of timing from INV to the commercial operation



■Parameter Setting

Item	Parameter	Data	Description
Commercial power supply bypass function selection	[PA-04]	00	Disabled
		01	Enabled
Bypass function delay time	[PA-05]	0.0~1000.0(s)	Set the delay time until the bypass mode operation.

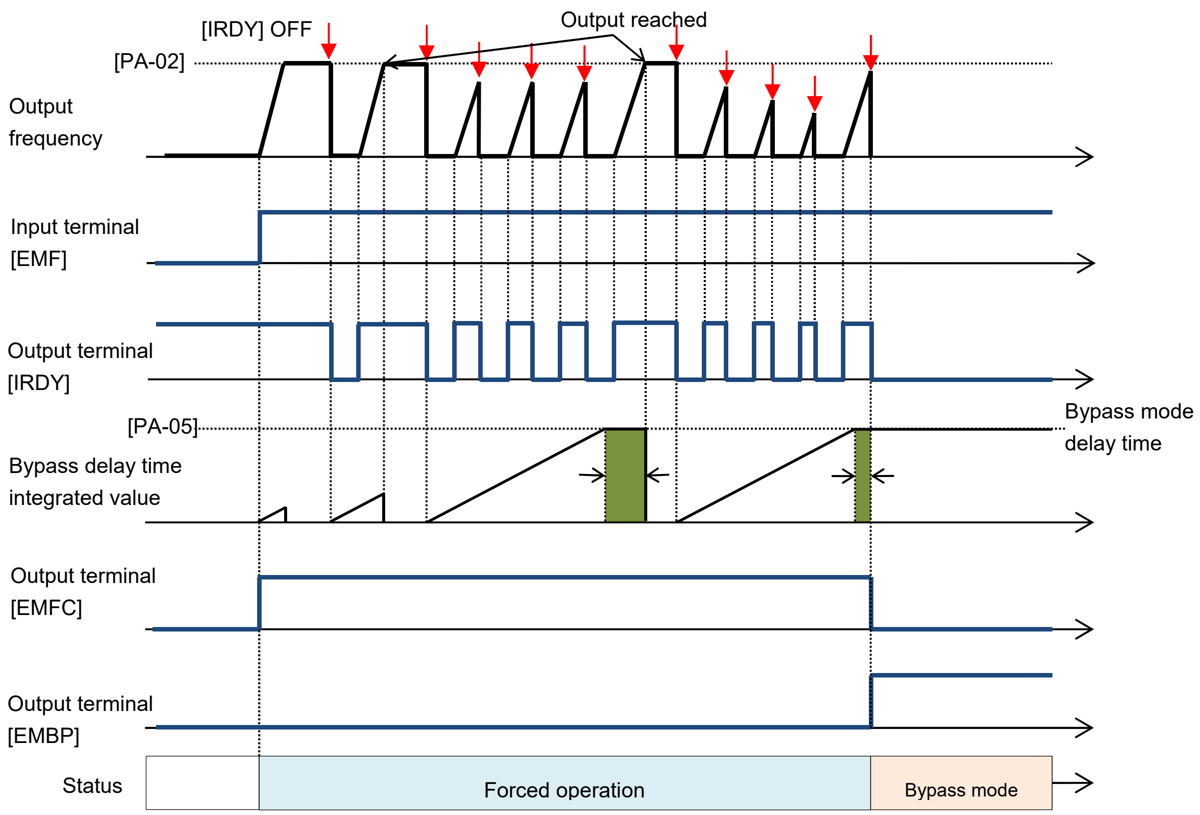
■Output Terminal Setting

Item	Parameter	Data	Description
Selecting the output terminal	[CC-01]~ [CC-07]	076	[EMBP] bypass mode signal. OFF: Disabled ON: In the bypass mode

■Decision for Switching to the Bypass Mode

- When the [PA-04] bypass function selection is set to 01: Enabled, if the [PA-05] bypass function delay time passes during the forced operation without reaching the Em-Force mode frequency setting [PA-02] and the inverter enters the operation ready incomplete status (output terminal [IRDY] is OFF), it operates in the commercial operation mode (bypass mode).

- Once the bypass mode is turned on, the inverter keeps shutting off until the power is off.
- While the inverter is operating immediately after the reset, the output terminal [IRDY] is turned off for about a second, however, the bypass mode is not entered for that period.
- When frequency doesn't reach to Em-Force mode frequency setting [PA-02] while upper limiter function is activated, accumulation of delay time is added.



- In the bypass mode, the following functions are operating automatically.

(1) Soft lock status (equivalent to [UA-16] = 01) The parameters can be no longer changed. To restore the settings, turn off [EMF], restore the power and then change the parameters.
(2) Auto-reset (equivalent to [bb-10] = 00)
Auto-reset is disabled.
(3) STOP key disabled (equivalent to [AA-13] = 00) Disable the STOP/RESET keys on the operator keypad.
(4) Operation enabled during the optional start ([oA-13] = 01, [oA-23] = 01, [oA-33] = 01)
The operation is allowed even in the optional start-up.

- The functions except for the above operate according to the settings.

12.17.7 Pulse Train Position Control

- The pulse train can be input to the SA/SB terminal of the feedback option (HF-FB) to perform the position control.
- In the position control mode, the acceleration/deceleration time is disabled.
  (The inverter output is performed following the speed command. (refer to the following right.))
  The larger the position loop back gain is, the shorter the acceleration/deceleration time becomes.
- Start the input of the pulse train by assigning the 073[STAT] pulse train position command input permission to the input terminal and turning on the terminal.

- Using this function requires the following settings.
  - [AA121] Control method 10: Vector control with sensor
  - [AA123] Vector control mode
    01: Pulse train position control mode
  - [ob-10] Pulse train input SA/SB (HF--FB) mode selection
    01: Pulse train position command

The speed command in the pulse train position control mode is calculated by the following formula.

$$\text{Speed} \quad \frac{P}{2} \times Kv \times \frac{\Delta P}{4 \times ENC}$$

P: Number of motor poles
Kv: Position loop gain
ENC: Number of encoder pulses
⊿P: Position deviation

- See also "12.9.17 Use Encoder".

■Setting Items for the Pulse Train Position Control

Item	Parameter	Data	Description
Control Method	[AA121]	10	Vector control with sensor
Vector control mode selection	[AA123]	01	Pulse train position control mode ∗
Pulse train input SA/SB (HF-FB) detection target selection	[ob-10]	00	Pulse train frequency command
		01	Pulse train position command
Pulse train input SA/SB (HF-FB) mode selection	[ob-11]	00	MD0: 90° phase difference pulse train
		01	MD1: Forward/reverse rotation command + pulse train
		02	MD2: Forward rotation pulse train + reverse rotation pulse train
Electronic gear installation position selection	[AE-01]	00	FB: Feedback side
		01	REF: Command side
Electronic gear ratio numerator	[AE-02]	1~9999	Numerator of th electronic gear
Electronic gear ratio denominator	[AE-03]		Denominator of th electronic gear
Positioning completion range setting	[AE-04]	0~10000	Set the value equivalent to encoder 4 multiplication
Positioning completion delay time setting	[AE-05]	0.00~9.99(s)	Set the time from the positioning completion to the output of the [POK] signal.
Position feed forward	[AE-06]	0.00~655.35	Position feed forward gain.
Position loop gain	[AE-07]	0.00~100.00	Position loop gain.
Position bias amount	[AE-08]	-2048~2048	Set the bias value of the position.

By turning ON or OFF the SPD terminal the control method is switched as shown below.
・When SPD is OFF : Pulse train position control
・When SPD is ON : Speed control

∗While the SPD is ON the Pulse train position deviation is 0. Hence when changing the SPD from ON to OFF, the deviation is 0 at the beginning of the position control operation.

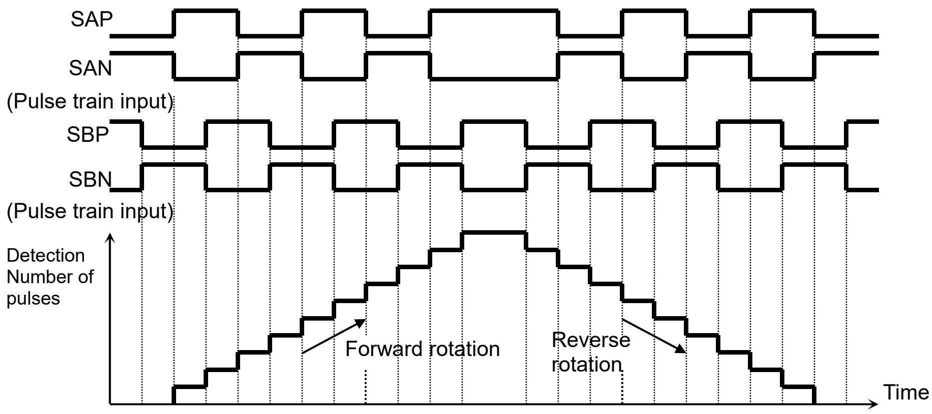
■Setting Items for the Pulse Train Position Control

Item	Parameter	Data	Description
Adding frequency	[AA106]	-590.00~590.00(Hz)	Frequency added when the [ADD] terminal is turned on.
Behavior when the position deviation is abnormal	[bb-85]	00	The excessive position deviation signal [PDD] is output.
		01	The output of the excessive position deviation signal [PDD] and the position deviation error [E106] cause a trip.
Abnormal position deviation detection level	[bb-86]	0~65535(×100pls)	The level for deciding an abnormal position deviation.
Abnormal position deviation time	[bb-87]	0.0~5.0(s)	Set the time after an abnormal status occurs until the output of [PDD] and error.
Selecting the input terminal	[CA-01]~ [CA-11]	014	ADD: Set speed addition
		072	PCLR: Position deviation clear
		073	STAT: Input permission of the pulse train position command
		074	PUP: Adding the position bias
		075	PDN: Subtracting the position bias
Selecting the output terminal	[CC-01]~ [CC-07]	042	PDD: Excessive position deviation signal
Pulse train position deviation monitor	[dA-26]	-2147483647~ 2147483647	Displays the position deviation for the position command and position feedback.

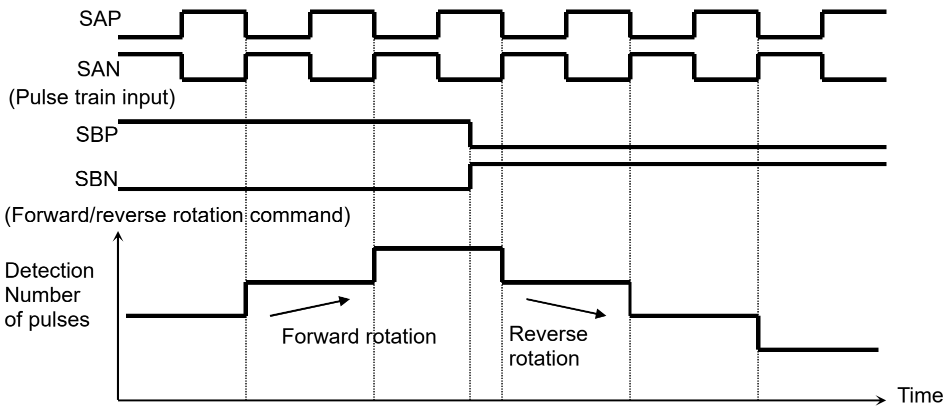
■Input Mode for the Pulse Train Position Control

- For more information about the pulse train input mode, refer to the following.

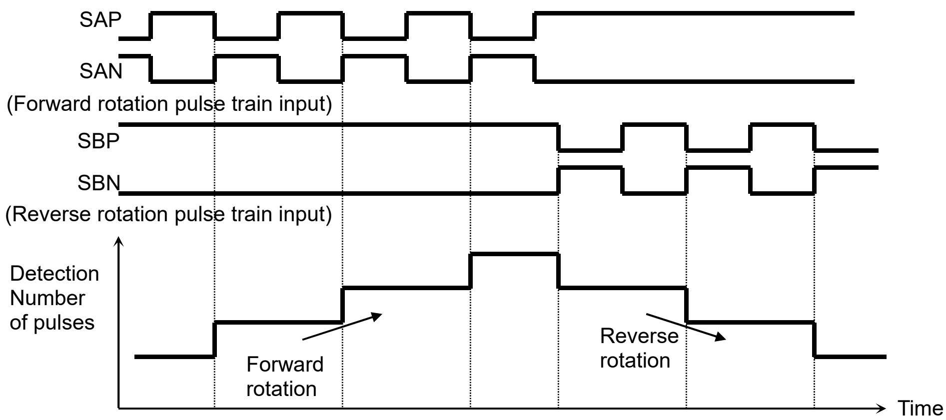
1. MD0: 90° phase difference pulse train



2. MD1: Forward/reverse rotation command + pulse train

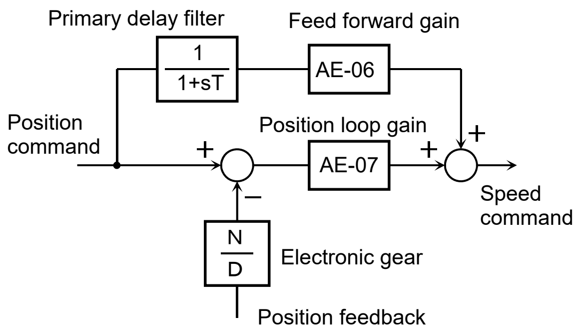


3. MD2: Forward rotation pulse train + reverse rotation pulse train

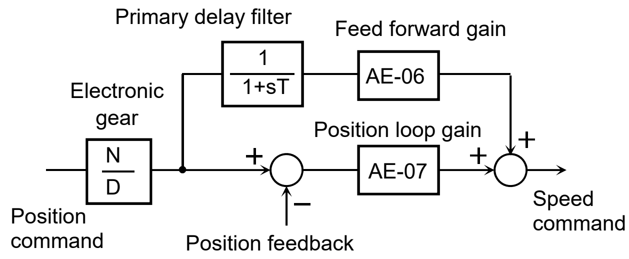


■Electronic Gear Function
- This function enables you to set the gain for the position command or position feedback to change the rotation ratio of the main and sub motors when performs the synchronous operation.
- Make sure that the setting of N/D is in the range of 1/50 ≤ N/D ≤ 20.
  N: [AE-02] Electronic gear ratio numerator
  D: [AE-03] Electronic gear ratio denominator

[AE-01] = 00 (feedback side)



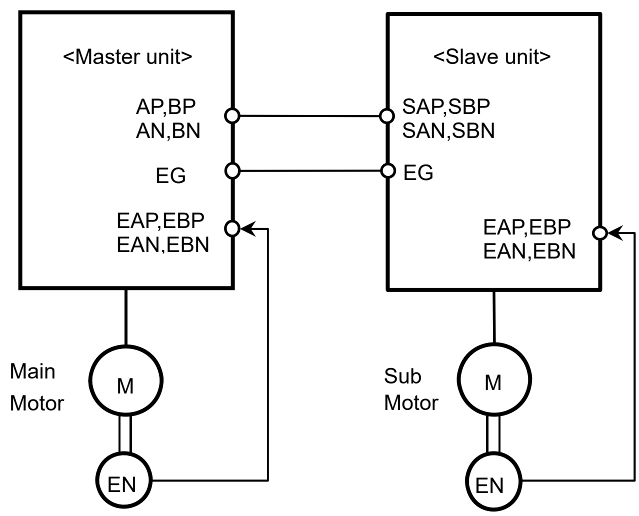
[AE-01] = 01 (command side)



■Example of Synchronous Operation between Master and Slave
- The master unit is operable with any control methods ([AA121]).
- The salve unit performs the pulse train position control with vector control. ([AA121] =10,[AA123]=01,[ob-10]=01)
- Assign the 073[STAT] pulse train position command input permission to an unused input terminal and turn on the terminal.
  When the 073[STAT] is off, the pulse train input is not accepted.

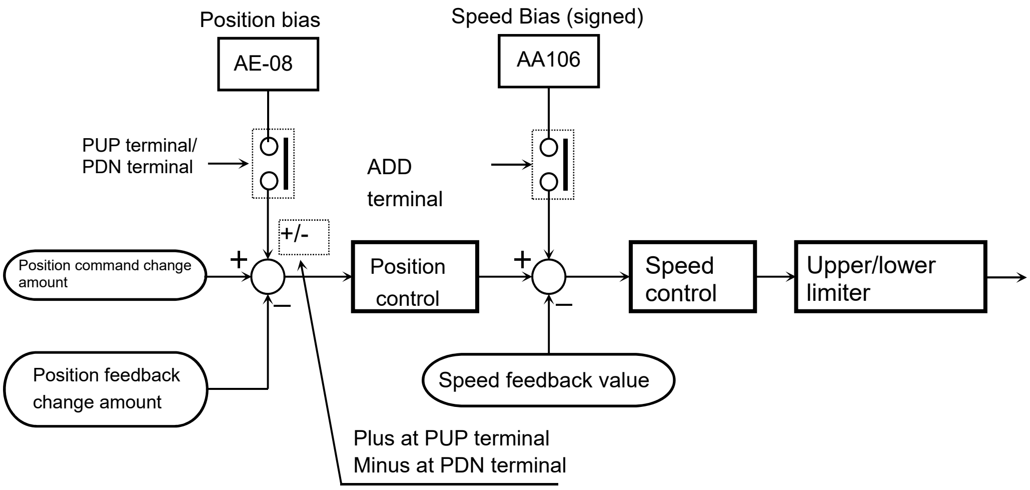
<Setting Examples>
- Main motor: Number of encoder pulses is 1024
- Sub motor: Number of encoder pulses is 3000
- Main motor rotation speed: sub motor rotation speed =2 : 1
  For the operation with the above conditions, set the following data to the slave unit.
    [ob-11] Pulse train input mode selection: 00
    [AE-01] Electronic gear installation position: 01 (REF)
    [AE-02]Electronic gear ratio numerator: 3000
    [AE-03]Electronic gear ratio denominator: 1024 × 2 = 2048

- The encoder output [AP][BP][AN][BN] of the main motor is retrieved as the pulse train position command [SAP][SBP][SAN] [SBN] of the slave unit.
- When the main motor speed is high, the change amount of the pulse per unit time is getting large and the speed command of the slave unit is also getting large. •When the main motor speed is low, the speed command of the slave unit is also getting small.
- This causes the sub motor follows the main motor to operate.
- If the follow-up response on the slave side is slow, adjust by raising the [AE-06] feed forward gain or [AE-07] position loop gain.



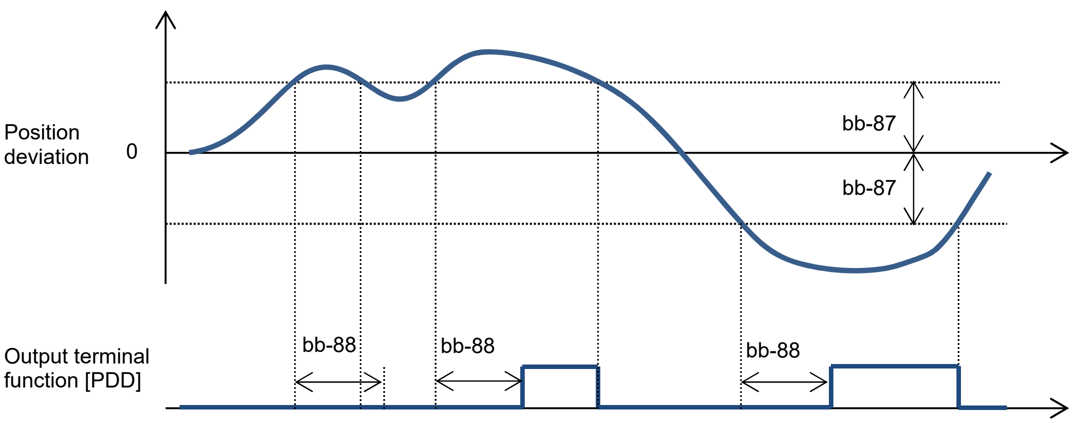
■Position Bias Function
- Used to apply a bias to the position command for the pulse train position control.
- Add/subtract the set number of pulses to the change amount every 1 ms. Used to adjust the phase of the synchronization point during the synchronous operation, etc.
- Set the bias amount to the [AE-08] position bias amount.
- Assign either 074(PUP) or 075(PDN) of the input terminal function.
  The bias amount is added while the PUP terminal is on and is subtracted while the PDN terminal is on.

■Speed Bias Function
- The function to apply a speed command bias when the pulse train position control is performed.
- Set the bias amount to the [AA106] adding frequency setting.
- Assign 014(ADD) to any of the input terminal function. The bias amount is added/subtracted to the speed command while the ADD terminal is on.



■Detecting Excessive Position Deviation
- When the [bb-87] abnormal position deviation time passes with the deviation of the position feedback against the position command exceeding the [bb-86] abnormal position deviation detection level, it is determined to be abnormal.
- The position deviation can be checked with the [dA-26] pulse train position deviation monitor.

- When the behavior of the abnormal position deviation [bb-85] is 00, the output terminal [PDD] is turned on.
- When the behavior of the abnormal position deviation [bb-85] is 01, the output terminal [PDD] is turned on and there is a trip with the [E106] position deviation error.
- The position deviation is cleared with on/off of the input terminal 072[PCLR] position deviation clear or the trip reset.

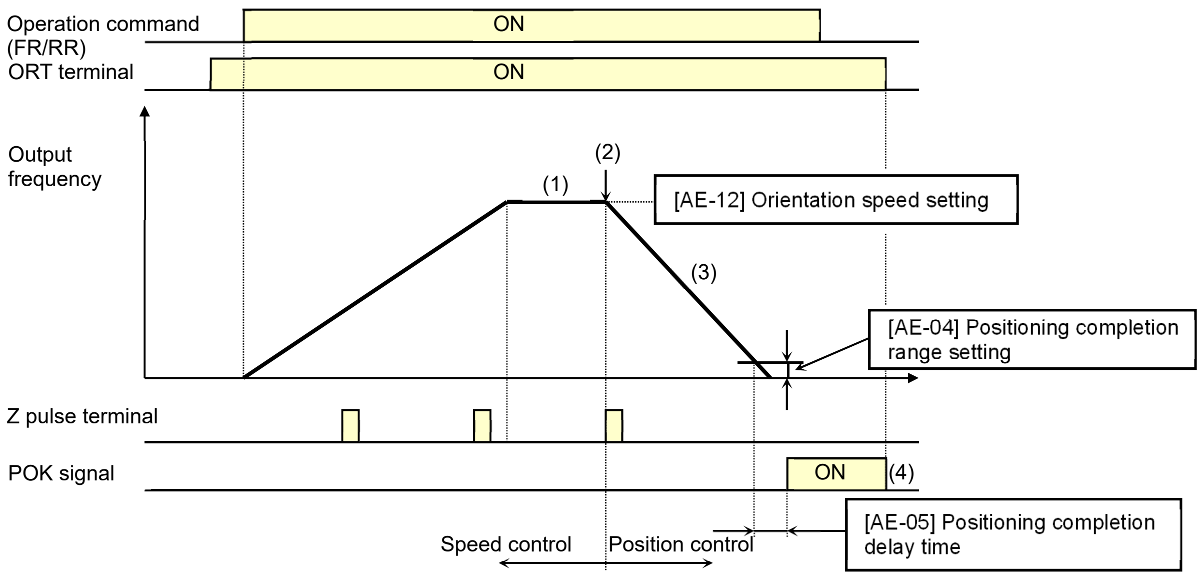


12.17.8 Stopping at Designated Position

- The orientation control is available for the pulse train position control.
- Used with the [AA121] control method set to 10: vector control with sensor and the [AA123] vector control mode set to 00: speed torque control mode or 01: pulse train position control mode.
- This function enables you to determine the position at any point within one rotation of the motor. This can be used for replacing the main axis of a machine tool, etc.

- For using this function, it is required to set the [AA121] control method to 10: vector control with sensor and use the encoder feedback.
- See also "12.9.17 Using Encoder".
- The Z pulse (one rotation position signal) is used as the reference signal for the positioning.

(1) When the encoder is connected to the HF-FB option:
Input the Z pulse between EZP-EZN.
(2) When the encoder is connected to the control circuit terminal block:
Assign the input terminal function 109: PLZ to any of the input terminal and input the Z pulse.

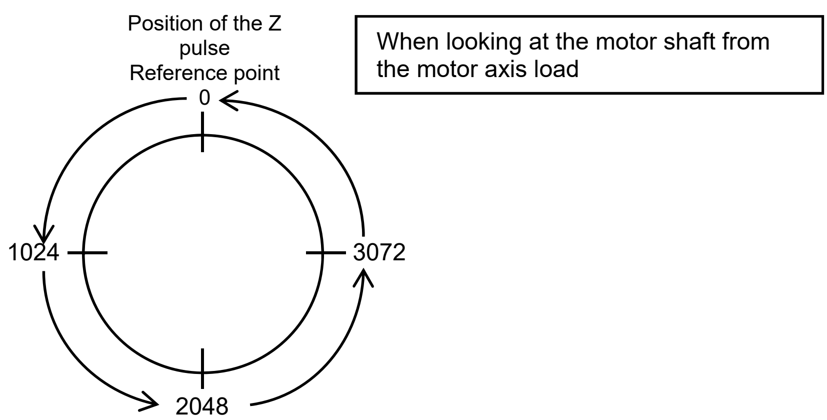


(1) When the operation command is turned on while the [ORT] terminal is on, there is an acceleration until the [AE-12] orientation speed and a constant speed is entered.
(During the operation, the speed is shifted to the orientation speed as soon as the ORT terminal is tuned on.)
(2) After the orientation speed is reached, there is a shift to the position control when the first Z pulse is detected.
(3) The position control is operated at the [AE-11] orientation stop position + one rotation for the forward rotation and the [AE-11] orientation stop position + two rotations for the reverse rotation as a target value.
The larger the [AE-07] position loop gain is, the shorter the deceleration time becomes.
(The deceleration time setting is not followed.)
(4) When the [AE-05] positioning completion delay time passes after the remaining number of pulses enters the [AE-04] positioning completion range setting, the [POK] signal is output.
(The output continues until the ORT terminal is turned off.)
After the positioning completes, the servo lock status continues until the operation command is turned off.

■Parameters

Item	Function Code	Data/Data Range	Description
Control Method	[AA121]	10	Vector control with sensor
Vector control mode selection	[AA123]	00	Speed/Torque control mode
		01	Pulse train position control mode
Pulse train input (internal) Detection target selection	[CA-90]	00	PCNT function
		01	Pulse train frequency command
		02	Speed feedback
		03	Pulse count
Encoder constant setting (main body)	[CA-81]	32~65535	Setting of the number of pulses.
Encoder phase sequence setting (main body)	[CA-82]	00	A phase precedes
		01	B phase precedes
Encoder constant setting (HF-FB)	[ob-01]	32~65535	Setting of the number of pulses.
Encoder phase sequence setting (HF-FB)	[ob-02]	00	A phase precedes
		01	B phase precedes
Orientation Stop position input destination selection	[AE-10]	00	Parameter setting
		01	Option 1
		02	Option 2
		03	Option 3
Orientation stop position	[AE-11]	0~4095	Note 2)
Orientation speed setting	[AE-12]	0.00~120.00(Hz)	Note 1)
Orientation direction setting	[AE-13]	00	Forward rotation side
		01	Reverse rotation side
Positioning completion range setting	[AE-04]	0~10000(pls)	Set the value equivalent to encoder 4 multiplication
Positioning completion delay time	[AE-05]	0.00~10.00(s)	Set the time from the positioning completion to the output of the [POK] signal.
Position control feed forward	[AE-06]	0~655.35	Position feed forward gain.
Position loop gain	[AE-07]	0.00~100.00(rad/s)	Position loop gain.
Input terminal	[CA-01]~[CA-11]	069	ORT: Orientation
		109	PLZ: Pulse train input Z
Output terminal	[CC-01]~[CA-06]	043	POK: Positioning completion
Relay output terminal	[CA-07]		

- Do not set the orientation speed to a high frequency because the deceleration behavior becomes the positioning status within two rotations. The overvoltage protection may cause a trip.
- Set the orientation stop position by dividing one rotation to 4095 (0 to 4095) in the forward rotation direction starting the reference point. (4096 division regardless of the number of pulses for the encoder.)
  The reference point is where the pulse is input between EZP-EZN and the stop target position is located in a layout shown in the diagram to the left from the viewpoint of the motor axis load. (For a positive phase connection)



■Adjustment of Positioning Control

Adjusting the stop position at the positioning operation

Occurrence	Workaround Examples
Stop position is long Position overruns.	• Adjust by increasing [AE-64] by 5%. or • Adjust by increasing [AE-65] by 5%.
Stop position is short Position shortens.	• Adjust by decreasing [AE-64] by 5%. or • Adjust by decreasing [AE-65] by 5%.

■Parameters

Item	Function Code	Data/Data Range	Description
For calculating the deceleration stop distance Gain	[AE-64]	50.00~200.00(%)	Adjust against the stop distance.
For calculating the deceleration stop distance Bias	[AE-65]	0.00~655.35(%)	Adjust the output frequency for the positioning operation.

Adjusting the control gain at the positioning operation

- Set [AE-66] and [AE-67] to the ratios against the [Hb105] maximum frequency.
- Once the positioning operation is entered, the control starts at the speed set to the [AE-67] APR start speed.
- During the positioning operation, the speed is limited to that set to the [AE-66] APR control speed limit. During the positioning, the acceleration/deceleration time is 0 and the output follows the internal position control results.

- For the positioning operation, specify the stop behavior with the following functions
  - Absolute value control
  - Zero return
  - Orientation
  - SON terminal operation (at position servo)
  - DC braking (at position servo lock control)

Occurrence	Workaround Examples
The follow-up for the positioning stop is bad.	• Adjust by increasing [AE-07] by 5%. or • Adjust by increasing [AE-67] and [AE-66] by 1%.
An abrupt behavior occurs at the positioning stop.	• Adjust by decreasing [AE-07] by 5%. or • Adjust by decreasing [AE-67] and [AE-66] by 1%.
An axis vibrates during the stop	• Adjust by decreasing [AE-07] by 5%.

■Parameters

Item	Function Code	Data/Data Range	Description
Position loop gain	[AE-07]	0.00~100.00	Adjust the position loop gain.
APR control speed limit	[AE-66]	0.00~100.00(%)	Limit the output at the positioning.
APR start speed	[AE-67]		Set the speed at the positioning start.

■The reference position for the POK output signal regarding the absolute position control

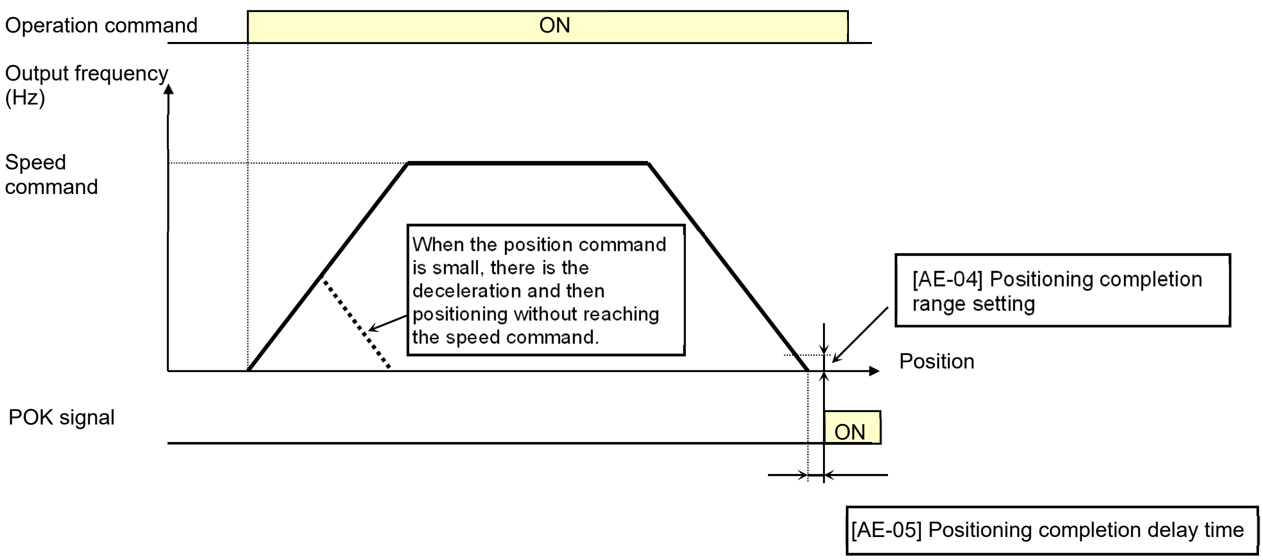
・The POK signal is output when the aimed target position is reached. In the homing function, the aimed target position is the origin (point zero). In the SON function, the aimed target position is the position where the SON signal is turning on.

12.17.9 Controlling at Absolute Position of Origin Reference

- For the absolute position control, there is a move to a target position according to
  (1) Position command,
  (2) Speed command (frequency command),
  (3) Acceleration time, deceleration time, and then the position servo lock status is entered.
  (The servo lock status is kept until the operation command is turned off.)

- For the frequency command and acceleration/deceleration command at the absolute position control, those selected at that time are followed.
- When the position command is small, there may be the deceleration and then positioning without reaching the speed command value.
- The direction of the operation command (FR, RR) in the absolute position control mode does not have a meaning as the rotation direction. They behave as the signals for operating/stopping. The rotation direction specifies the forward rotation if (target position - current position) is plus and the reverse rotation if minus.
- When the zero return operation (as discussed later) is not performed, if the [AE-61] current position memory at power-off is 00, the position at power-on is treated as the origin (position = 0). •If the [AE-61] is 01, the position at the previous power-off is treated as the (position = 0).
- When the deviation between the position command and current position is 0, if the operation command is turned on, the positioning operation is performed immediately.
- The current position command can be monitored with the [FA-20] position command monitor.

- For using this function, set the [AA121] control method to 10 (vector control with sensor, and set the [AA123] vector control mode selection to 02: absolute position control or 03: high resolution absolute position control.
- This function requires using the encoder feedback
- See also "12.9.17 Using Encoder".
- When the [AA123] vector control mode selection is set to 03: high resolution absolute position control, the control is performed with the 4 multiplication number of pulses used for the internal calculation.
  (Set the multistage position command and position range designation with the 4 multiplication accuracy.)
- The position command can be switched at a maximum of 16 stages in combination of the input terminals.
- The trip reset or reset signal input does not clear the current position counter.
- When the PCLR terminal is assigned, turning on the PCLR terminal clears the current position counter.
- In the absolute position control mode, the ATR terminal is disabled. (The torque control does not operate.)
- In the absolute position control mode, the STAT terminal is disabled. (The pulse train position control does not operate.)

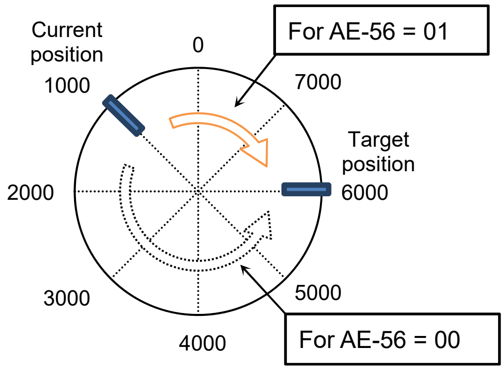


■Shortest Position Control

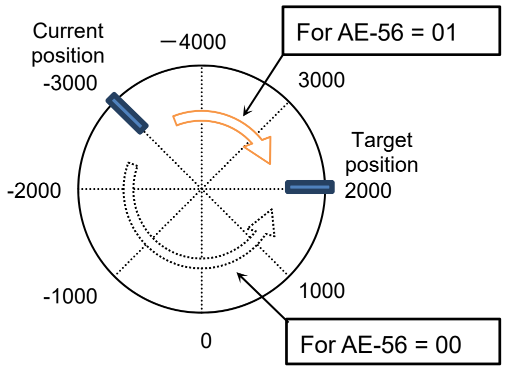
- When the [AE-56] positioning mode selection is set to 01 (without limit), the rotation direction is determined so that the moving distance to a target position is the shortest for applications such as a turntable.

Application example) A turntable with eight positioning points

- Assume a case of moving from the current position (1000 pulse) to the target position (6000 pulse).
- When [AE-56] = 00 (with limit), since (target position) - (current position) = +5000 pulse, the rotation is in the forward direction.
- When [AE-56] = 01 (without limit), the move is in the reverse direction with the shorter moving distance comparing the forward and reverse directions.
  Moving distance in the forward direction: +5000 pulse
  Moving distance in the reverse direction: -3000 pulse



- For the above example, Set the [AE-52] forward rotation side position range designation = 7999 and [AE-54] reverse rotation side position rang designation = 0.
  Also, each positioning point is required to be set in this range.
- Depending on the setting for the position range designation, the following settings are also allowed.
  [AE-52]=3999
  [AE-53]=-4000



- When [AE-56] = 01, the [E104] position control range error does not occur.
- In the following left case, when moving the position of 7000 pulse to that of 1000 pulse, the forward rotation side position range (7999) is exceeded, however, the current position counter gets back to 0.

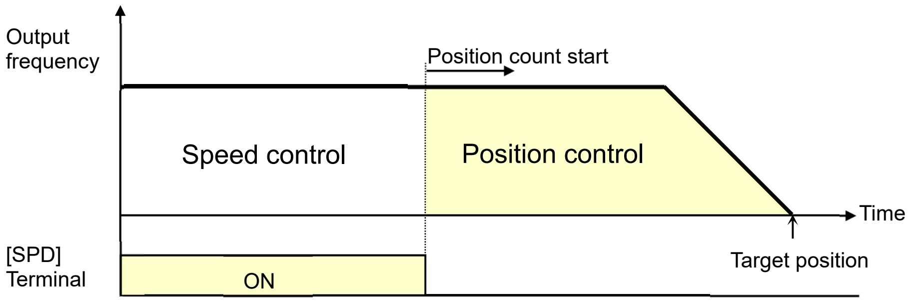
■Multistage Position Switching Function

- By combining 076 to 079 ([CP1] terminal to [CP4] terminal), the multistage position commands 0 to 15 can be switched.
- For setting the position command, use the multistage position command 0 to 15 ([AE-20] to [AE-50]).
- When there no terminal assignments, the multistage position command 0 ([AE-20]) becomes the position command.

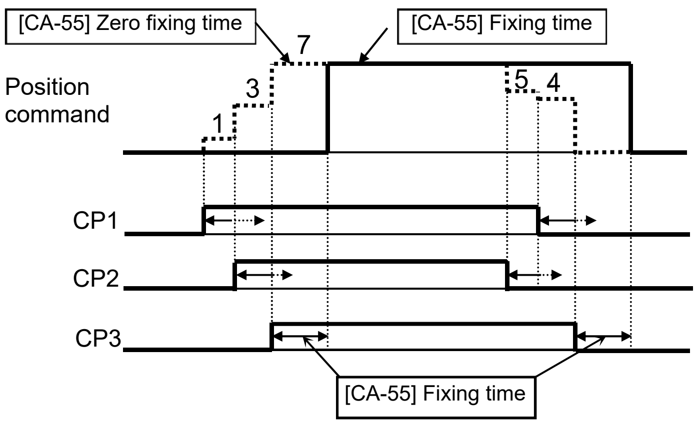
Position command	CP4	CP3	CP2	CP1
Multistage position 0	OFF	OFF	OFF	OFF
Multistage position 1	OFF	OFF	OFF	ON
Multistage position 2	OFF	OFF	ON	OFF
Multistage position 3	OFF	OFF	ON	ON
Multistage position 4	OFF	ON	OFF	OFF
Multistage position 5	OFF	ON	OFF	ON
Multistage position 6	OFF	ON	ON	OFF
Multistage position 7	OFF	ON	ON	ON
Multistage position 8	ON	OFF	OFF	OFF
Multistage position 9	ON	OFF	OFF	ON
Multistage position 10	ON	OFF	ON	OFF
Multistage position 11	ON	OFF	ON	ON
Multistage position 12	ON	ON	OFF	OFF
Multistage position 13	ON	ON	OFF	ON
Multistage position 14	ON	ON	ON	OFF
Multistage position 15	ON	ON	ON	ON

■Speed/Position Switching Function

- Turn on this terminal when the speed control operation is performed in the absolute position control mode.
- While the 084[SPD] terminal is on, the current position counter is 0. Therefore, when the [SPD] terminal is turned off during the operation, the position control operation starts at that time. (Speed/position switching)



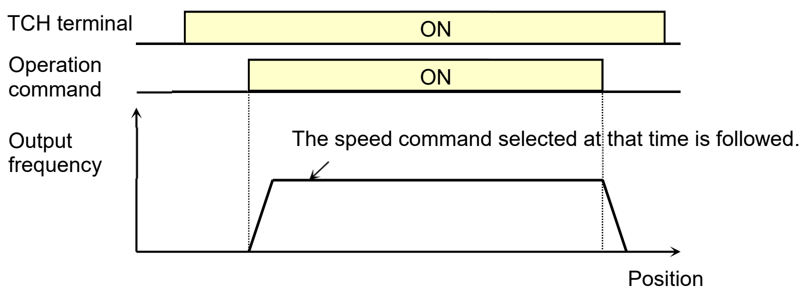
- When inputting the multistage position command, the waiting time until the terminal input is fixed can be set. The transition state before the input is fixed can be prevented from being adopted as the input.
- With the [CA-55] multistage input fixing time, the fixing time can be adjusted. Finally, after the [CA-55] setting time passes without any changes of the input, the data is fixed.
  (Note that a longer fixing time causes a bad performance of the input response.)
- Example using [CP1] to [CP3] as the input terminals



- When switching the speed to position, if the deviation between the position command and current position is 0, the stop operation is performed immediately.
  (Depending on the position loop gain, there is a possibility of hunting)
- Also, while the [SPD] terminal is on, there is a move in the direction depending on the operation command. For switching the speed to position, note the sign of the command.

■Teaching Function

- Function to rotate and stop a motor and store the position as a position command at any position command area.
- Assign 110[TCH].
  When the [AA123] vector control mode selection is 02 (absolute position control) or 03 (high resolution absolute position control), the teaching terminal is functioning.
  (1) Select the position command to set at the [AE-60] teaching selection.
  (2) Operate the work.
  - Enter the operation command while the [TCH] terminal is on. • For the speed command and acceleration/deceleration command at this time, those selected at that time are followed.



(3) Once the desired position is reached, press the save (2 key) on the operator keypad.
(4) The current position is set in the corresponding to the position command destination set to the [AE-60] teaching selection. (However, [AE-60] itself is not saved. After power-off or the reset, it becomes 00 (X00).)

[AE-60] setting value	Position command to be set
00	[AE-20]: Multistage position command 0
01	[AE-22]: Multistage position command 1
02	[AE-24]: Multistage position command 2
03	[AE-26]: Multistage position command 3
04	[AE-28]: Multistage position command 4
05	[AE-30]: Multistage position command 5
06	[AE-32]: Multistage position command 6
07	[AE-34]: Multistage position command 7
08	[AE-36]: Multistage position command 8
09	[AE-38]: Multistage position command 9
10	[AE-40]: Multistage position command 10
11	[AE-42]: Multistage position command 11
12	[AE-44]: Multistage position command 12
13	[AE-46]: Multistage position command 13
14	[AE-48]: Multistage position command 14
15	[AE-50]: Multistage position command 15

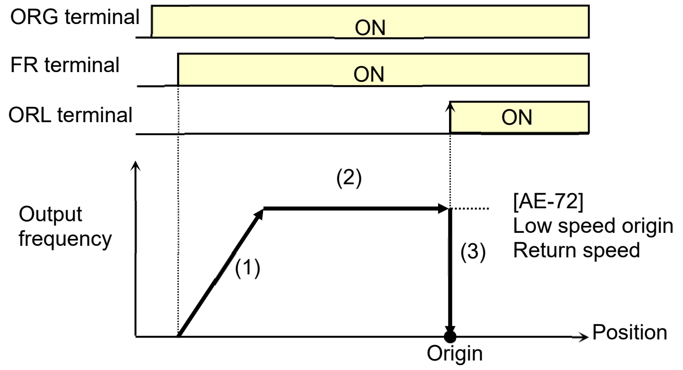
- If the power supply of the inverter control circuit (r1, t1) is input, the teaching is allowed.
  Since operating the work with an external unit, etc. also enables the current position counter to work, the teaching is allowed even if the operation is performed without an inverter.

- However, make sure that the power supply of the inverter power circuit (R, S, T) is shut off.
  Or make sure that the connection between the output of the inverter (U, V, W) and the motor is shut off.
  Otherwise, you run the risk of injury and damage.

■Zero Return Function

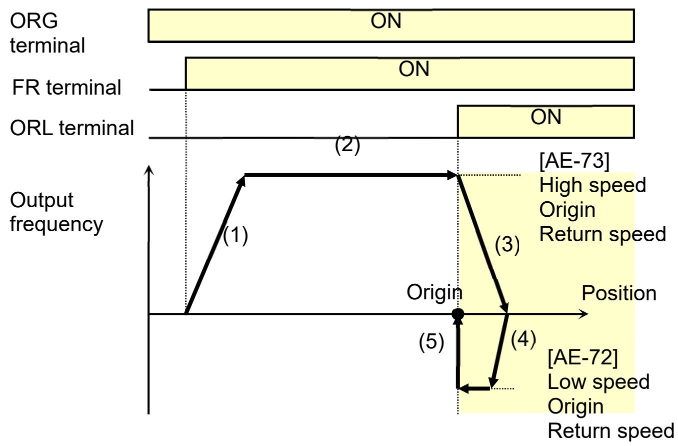
- With the [AE-70] zero return mode selection, three types of zero return operations are performed. Once the zero return completes, the current position is cleared (= 0).
- The direction of the [AE-71] zero return is selected with the zero return direction selection.
- When the zero return is not performed, the position at power-on follows the [AE-61] current position memory at power-off and the position control is performed.

■Low Speed Zero Return ([AE-70] = 00)



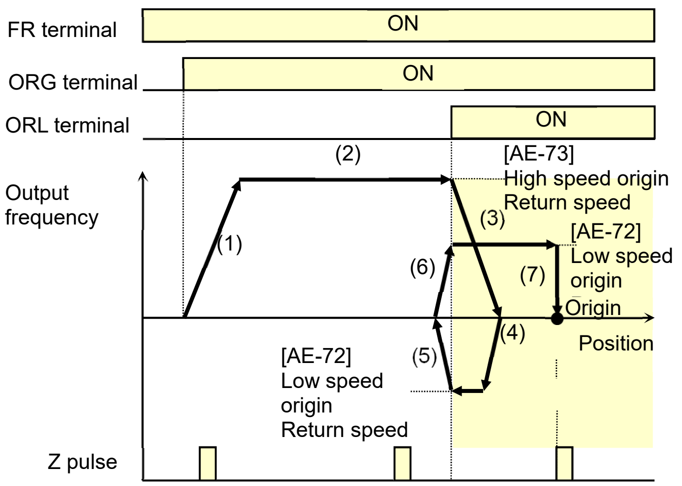
(1) Follows the acceleration time to accelerate to the low speed zero return speed.
(2) Operates at the low speed zero return speed.
(3) Positioning when the ORL signal is input.

■High Speed Zero Return 1 ([AE-70] = 01)



(1) Follows the acceleration time to accelerate to the high speed zero return speed.
(2) Operates at the high speed zero return speed.
(3) Starts the deceleration when the ORL signal is turned on.
(4) Operates in the reverse rotation direction at the low speed zero return speed.
(5) Positioning when the ORL signal is turned off.

■High Speed Zero Return 2 ([AE-70] = 02)



(1) Follows the acceleration time to accelerate to the high speed zero return speed.
(2) Operates at the high speed zero return speed.
(3) Starts the deceleration when the ORL signal is turned on.
(4) Operates in the reverse rotation direction at the low speed zero return speed.
(5) Starts the deceleration when the ORL signal is turned off.
(6) Operates in the forward rotation direction at the low speed zero return speed.
(7) Positioning at the first Z pulse after the ORL signal is turned on.

■Forward/Reverse Drive Stop Function (FOT/ROT)

- Function to prevent the operation range from being deviated using the signal from the control range limit switch.
- The torque limit is restricted to 10% on the forward rotation side when the 082[FOT] terminal is input and on the reverse rotation side when the 083[ROT] terminal is input. This is applicable as the limit switch at the edge of the machine.

■Position Range Designation Function

- Specify the position control range at the [AE-52] position range designation (forward rotation side) /[AE-54] position range designation (reverse rotation side).
- When the current position counter exceeds this setting, there is a trip with the position control range error (E104) and the inverter becomes the free-running status.

■Position Memory at Power-Off

- By setting the [AE-61] current position memory at power-off to 01, the current position data at power-off can be stored.
- Use this for the application where the shaft of the motor is locked at power-off.

- For the machine of which the shaft idles at power-off, there is likely to be a gap between the stored position and the current position when the power is turned on again.

■Position Data Preset

- When the 085[PSET] terminal is turned on, the current position counter (can be monitored with [dA-20]) is overwritten with the value set to the [AE-62] preset position data.
- Available for restarting in the middle of the positioning process, etc. (Data is overwritten at the ON edge of the [PSET] terminal.)

■Position Control Related Parameters

Item	Function Code	Data/Data Range	Description
Control Method	[AA121]	10	Vector control with sensor
Vector control mode selection	[AA123]	02	Absolute position control
		03	High resolution absolute position control
Multistage position command 0	[AE-20]	[AE-54]~[AE-52]	Set the position command for the multistage speed command to each.
Multistage position command 1	[AE-22]	[AE-54]~[AE-52]	
Multistage position command 2	[AE-24]	[AE-54]~[AE-52]	
Multistage position command 3	[AE-26]	[AE-54]~[AE-52]	
Multistage position command 4	[AE-28]	[AE-54]~[AE-52]	
Multistage position command 5	[AE-30]	[AE-54]~[AE-52]	
Multistage position command 6	[AE-32]	[AE-54]~[AE-52]	
Multistage position command 7	[AE-34]	[AE-54]~[AE-52]	
Multistage position command 8	[AE-36]	[AE-54]~[AE-52]	
Multistage position command 9	[AE-38]	[AE-54]~AE-52]	
Multistage position command 10	[AE-40]	[AE-54]~[AE-52]	
Multistage position command 11	[AE-42]	[AE-54]~[AE-52]	
Multistage position command 12	[AE-44]	[AE-54]~[AE-52]	
Multistage position command 13	[AE-46]	[AE-54]~[AE-52]	
Multistage position command 14	[AE-48]	[AE-54]~[AE-52]	
Multistage position command 15	[AE-50]	[AE-54]~[AE-52]	
Position range designation (forward rotation side)	[AE-52]	Condition 1: 0 to +268435455 Condition 2: 0 to +1073741823	Condition 1: Except for the condition 2 Condition 2: [AA121] = 10, [AA123] = 03
Position range designation (reverse rotation side)	[AE-54]	Condition 1: -268435455 to 0 Condition 2: -1073741823 to 0	Condition 1: Except for the condition 2 Condition 2: [AA121] = 10, [AA123] = 03
Position command monitor	[FA-20]	Condition 1: -268435455 to +268435455 Condition 2: -1073741823 to +1073741823	Condition 1: Except for the condition 2 Condition 2: [AA121] = 10, [AA123] = 03

■Position Control Related Parameters

Item	Function Code	Data/Data Range	Description
Positioning mode selection	[AE-56]	00	With limit
		01	Without limit
Teaching selection	[AE-60]	00	Multistage position command 0 (AE-20)
		01	Multistage position command 1 (AE-22)
		02	Multistage position command 2 (AE-24)
		03	Multistage position command 3 (AE-26)
		04	Multistage position command 4 (AE-28)
		05	Multistage position command 5 (AE-30)
		06	Multistage position command 6 (AE-32)
		07	Multistage position command 7 (AE-34)
		08	Multistage position command 8 (AE-36)
		09	Multistage position command 9 (AE-38)
		10	Multistage position command 10 (AE-40)
		11	Multistage position command 11 (AE-42)
		12	Multistage position command 12 (AE-44)
		13	Multistage position command 13 (AE-46)
		14	Multistage position command 14 (AE-48)
		15	Multistage position command 15 (AE-50)
Current position at power-off memory	[AE-61]	00	Disabled
		01	Enabled
Preset position data	[AE-62]	Condition 1: -268435455 ~+268435455 Condition 2: -1073741823 ~+1073741823	Condition 1: Except for the condition 2 Condition 2: [AA121] = 10, [AA123] = 03
Reset selection	[CA-72]	02	Enabled Only at Trip (On to Release)
		03	Enabled Only at Trip (Off to Release)
Input terminal function	[CA-01]~[CA-11]	072	PCLR: Position deviation clear
		076	CP1: Position command selection 1
		077	CP2: Position command selection 2
		078	CP3: Position command selection 3
		079	CP4: Position command selection 4

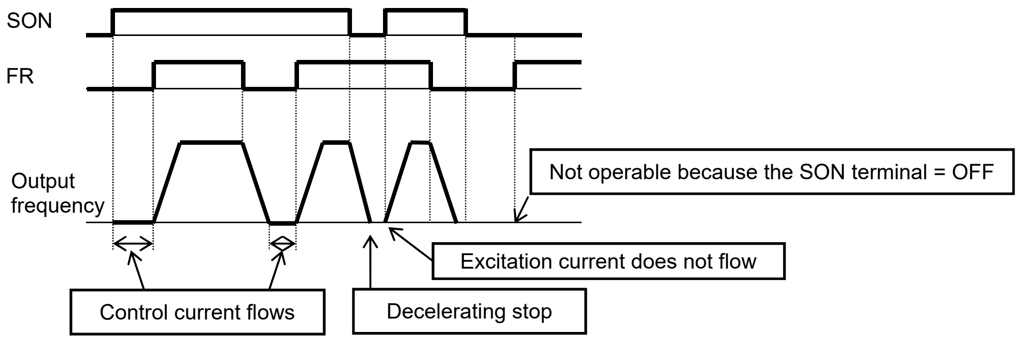
■Zero Return Related Parameters

Item	Function Code	Data/Data Range	Description
Zero return mode selection	[AE-70]	00	Low speed zero return
		01	High speed zero return 1
		02	High speed zero return 2
Zero return direction selection	[AE-71]	00	Forward rotation
		01	Reverse rotation
Low speed zero return speed	[AE-72]	0.00~10.00(Hz)	Speed in the low speed zero return mode.
High speed zero return speed	[AE-73]	0.00~590.00(Hz)	Speed in the high speed zero return mode.
Input terminal function	[CA-01]~[CA-11]	072	PCLR: Position deviation clear
		076	CP1: Position command selection 1
		077	CP2: Position command selection 2
		078	CP3: Position command selection 3
		079	CP4: Position command selection 4
		080	ORL: Origin limit signal
		081	ORG: Zero return start signal
		082	FOT: Forward rotation drive stop
		083	ROT: Reverse rotation drive stop
		084	SPD: Speed/position switching
		085	PSET: Position data preset
		110	TCH: Teaching

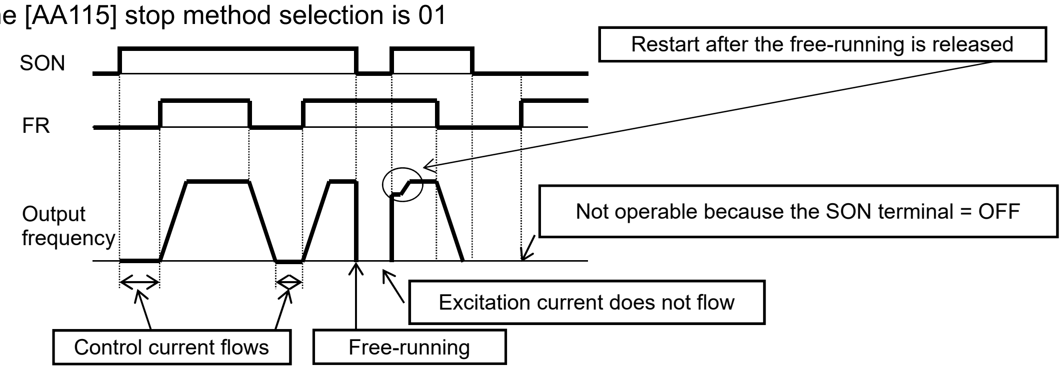
12.17.10 Servo Lock

- This function makes a motor the servo lock status with the servo lock terminal [SON] command.
- Assigning the input terminal function 054[SON] triggers this function.
- This is valid when the control method [AA121] is 09: IM 0 Hz range sensor less vector control or 10: IM vector control with sensor.
- When [SON] is assigned to the input terminal function, the operation is not accepted unless [SON] is turned on.
- During the operation, when [SON] is turned off, there is an operation according to the [AA115] stop method selection. If the free-running occurs, the settings for the restart after releasing the free-running is followed at the time of restart.
- When the backup excitation function [FOC] is assigned to the input terminal, the servo lock function [SON] does not operate.

- For the [AA115] stop method selection is 00



- For the [AA115] stop method selection is 01



■Parameters

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	054	Servo lock function [SON]
Stop method selection	[AA115]	00	Perform the deceleration stop when the operation command is off.
		01	Perform the free-running when the operation command is off.
Restart after the free-running is released	[bb-40]	00	Perform the 0 Hz restart.
		01	Perform the frequency matching restart. 1)
		02	Perform the frequency pull-in restart. 2)
Instantaneous power failure/under voltage retry waiting time	[bb-26]	0.3~100.0(s)	Set the waiting time after an operation command.

*1) Refer to "12.14.3 Starting by picking up frequency".
*2) Refer to "12.14.4 Starting with frequency pull-in".

- If the torque at the time of start is insufficient, it may be improved by adjusting the starting boost amount [HC111][HC112] or speed response [HA115].
  Refer to "12.9 Select motor control method in accordance with motor and load".
- If the torque at the time of start is insufficient, it may be improved by using the torque bias function.
  Refer to "12.11.6 Operate by Adding Torque Command".

12.18 Controlling the Cooling Fan

12.18.1 Selecting the Operation of the Cooling Fan

- [bA-70] Setting the selection of the cooling fan operation allows you to set the operation of the cooling fan.
- For [bA-70] =00, the cooling fan runs all the time.
- For [bA-70] =01, the cooling fan runs when the inverter becomes the output status.
  The fan runs for three minutes after the operation stops.
- For [bA-70] =02, the cooling fan runs depending on the temperature of the heat sink detected by the inverter.

- When the instantaneous power failure or power-off occurs while the cooling fan is running, it is suspended regardless of the [bA-70] cooling fan operation, and automatically resumes after the restoration of power.

■Parameters

Item	Parameter	Data	Description
Selection of the Cooling Fan Operation	[bA-70]	00	Running all the time: The fan runs all the time.
		01	Running in operation: The fan runs automatically when the inverter becomes the operating status. The fan continuously runs for three minutes after the operation stops and then automatically stops. * The cooling fan runs when the head sink temperature of the inverter exceeds 60°C. If the head sink temperature is under 50°C for more than three minutes, the cooling fan is allowed to be stopped.
		02	Running depending on the temperature: The cooling fan runs when the head sink temperature of the inverter exceeds 40°C. If the head sink temperature is under 40°C for more than three minutes, the cooling fan automatically stops.

- For checking the heat sink temperature, see "13.9.1 Checking the Head Sink Temperature"
- For the replacement timing of the cooling fan, see "13.11.1 Checking the Life Cycle Monitor".

12.19 Warning Signal

12.19.1 Outputting an alarm signal

- Assign the output terminal function 017 [AL] alarm signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The [AL] function is assigned in the initial state to the contact c relay [CC-07] of FA-FC and FB-FC.

- If the system recognizes an interruption of the inverter power supply as an error, this symptom may be alleviated by changing the wiring and the selection of contacts.
- You can set the output specifications of contacts a and b to output terminals UPF-X3, relay output terminals RL and FL individually.

■Alarm relay FL

- The operations of FA-FC and FB-FC are as follows.

[CC-17]	Control power	Inverter error output	Output terminal state	
			FB-FC	FA-FC
00	On	Abnormal	Close	Open
		Normal	Open	Close
	Off	-	Open	Close
01	On	Abnormal	Open	Close
		Normal	Close	Open
	Off	-	Open	Close

- The specifications of the relay contacts FA-FC and FB-FC are as follows.

		Resistive load	Inductive load
FA-FC	Maximum contact capacity	AC250V,2A DC30V,3A	AC250V,0.2A DC30V,0.6A
	Minimum contact capacity	AC100V,10mA DC5V,100mA	
FB-FC	Maximum contact capacity	AC250V,1A DC30V,1A	AC250V,0.2A DC30V,0.2A
	Minimum contact capacity	AC100V,10mA DC5V,100mA	

■Relay output RL

- The operations of RL are as follows.

[CC-16]	Control power	Functional operation	Output terminal state
00	On	ON	Close
		OFF	Open
	Off	-	Open
01	On	ON	Open
		OFF	Close
	Off	-	Open

- The specifications of the relay contact RL are as follows.

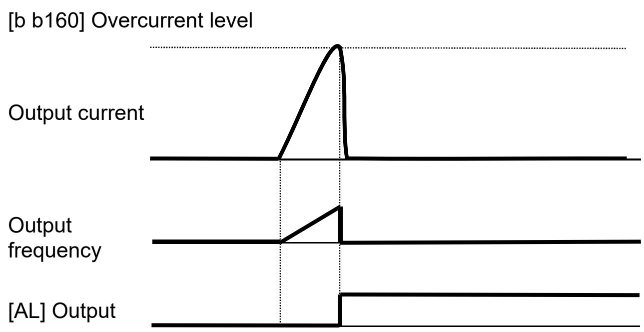
		Resistive load	Inductive load
RY-RC	Maximum contact capacity	AC250V,2A	AC250V,1A
	Minimum contact capacity	AC250V,1mA	

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	017	An alarm signal is output to the output terminal to which 017 [AL] has been assigned. ON: When an alarm has occurred OFF: When no alarm has occurred
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Output terminal function selection	[CC-11]~[CC-15]	00	Operates as contact a (NO).
		01	Operates as contact b (NC).
1a relay output terminal function selection a/b (NO/NC) selection	[CC-16]	00	Operates as contact a (NO).
		01	Operates as contact b (NC).
1c relay output terminal function selection a/b (NO/NC) selection	[CC-17]	00	See the table at the upper left.
		01	

- Contact a:
  The contact closes when the functional operation is ON and opens when OFF.
- Contact b:
  The contact closes when the functional operation functional operation is OFF and opens when ON.

Example: [E001] occurred when the current reached the overcurrent level.



12.19.2 Outputting a serious fault signal

- Assign the output terminal function 018 [MJA] serious fault signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- Trips that are evaluated as serious faults are as follows.
- The inverter hardware may have a fault when this signal is output. Check the error history and deal with the situation appropriately.

Error code	Name	Description
E008	Memory element error	The memory element of the inverter is under an abnormal condition.
E010	Current detector error	The current detector of the inverter is under an abnormal condition.
E011	CPU error	The drive CPU of the inverter is under an abnormal condition.
E014	Ground fault error	The inverter has a ground fault.
E019	Temperature detector error	The temperature detector of the inverter is under an abnormal condition.
E020	Cooling fan rotation speed reduction error	The cooling fan rotation speed of the inverter has reduced, preventing the inverter from dissipating heat.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	018	The signal will be output when a serious fault error occurs in the output terminal to which 018 [AL] has been assigned. OFF: No serious fault has occurred. ON: A serious fault has occurred.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

12.19.3 Outputting the trip type

- Assign the output terminal functions 084 [AC0] to 087 [AC3] alarm code to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- Assign 084 [AC0] to 087 [AC3] to the output terminal functions [CC-01] to [CC-07].
- The 4-bit output mode is selected when 087 [AC3] is assigned to the output terminal function, whereas the 3-bit output mode is selected when it is not assigned.
- The table below shows the alarm codes to be output.

- The output state switches depending on whether 087 [AC3] has been set to [CC-01] to [CC-07]. The 4-bit output mode is selected when 087 [AC3] has been set, and the signals 084 [AC0], 085 [AC1], 086 [AC2], and 087[AC3] will be output in accordance with the table below even when all of them have not been set.
- The signals will be output in the 3-bit mode when one of or any pair from 084 [AC0], 085 [AC1], and 086 [AC2] have been set. The signals 084 [AC0], 085 [AC1], and 086 [AC2] will be output in accordance with the table below even when all of them have not been set.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	084~087	084: [AC0] alarm code 0 085: [AC1] alarm code 1 086: [AC2] alarm code 2 087: [AC3] alarm code 3 The signal is output when a trip occurs at the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

■Trip code

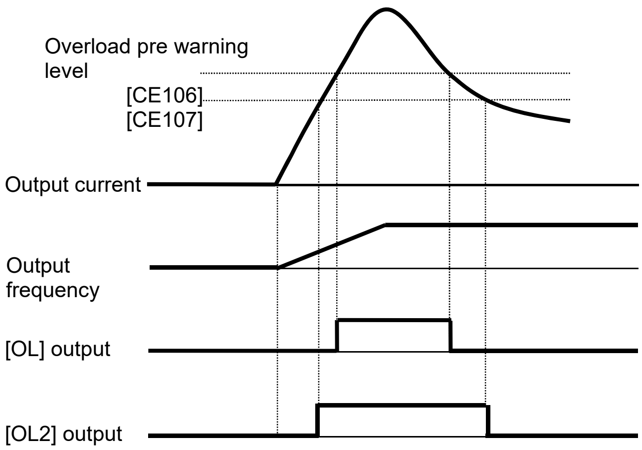
Output terminal function				When a 4-bit code is selected (with [AC3])		When a 3-bit code is selected (without [AC3])	
AC3	AC2	AC1	AC0	Cause code	Trip description	Cause code	Trip description
0	0	0	0	Normal	Normal	Normal	Normal
0	0	0	1	E001	Overcurrent error	E001	Overcurrent error
0	0	1	0	E005 E038 E039	Motor overload error Low-speed range overload error Inverter overload error	E005 E038 E039	Motor overload error Low-speed range overload error Inverter overload error
0	0	1	1	E007 E015	Overvoltage Incoming overvoltage error	E007 E015	Overvoltage Incoming overvoltage error
0	1	0	0	E009	Under voltage error	E009	Under voltage error
0	1	0	1	E016	Momentary interruption error	E016	Momentary interruption error
0	1	1	0	E030	IGBT error	E030	IGBT error
0	1	1	1	E006	Braking resistor overload error	-	Other than above
1	0	0	0	E008 E011	Memory element error CPU error		-
1	0	0	1	E010	Detector error		
1	0	1	0	E012 E013 E035 E036	External error USP error Thermistor error, break fault		
1	0	1	1	E014	Ground fault protection		
1	1	0	0	E040 E041 E042 E043 E044 E045	Operation panel communication error RS485 communication error RTC error		
1	1	0	1	E020 E021	Abnormal temperature error caused by reduced rotation speed of the cooling fan Abnormal temperature error		
1	1	1	0	E024 E034	Input open-phase error Output open-phase error		
1	1	1	1	Other than above	-		

12.19.4 Outputting a warning when an overload occurs

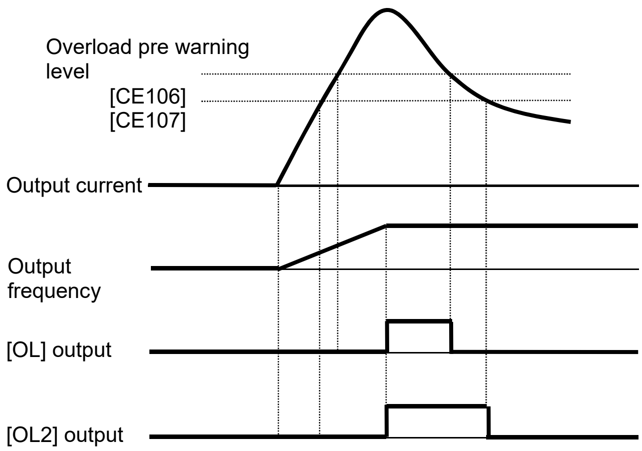
- Assign the output terminal functions 035 [OL] and 036 [OL2] overload pre-warning signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The overload prewarning signals [OL] and [OL2] will be output when the output currents exceed the corresponding overload prewarning level.
- You can output the signal in accordance with the operating state by changing the overload pre-warning signal output mode selection [CE105].
- This function is effective, especially for conveyors, to prevent machine failure that may occur when the load increases because an excessive number of packages are loaded, or to prevent carrier lines from stopping because of an overload error of the inverter.

- An overcurrent error may occur before the signal is output when the overload pre warning level has been set to an excessively high value. In this case, reduce the overload pre warning level.
- Small fluctuations in the frequency input may hinder the speed from being determined as constant when an analog input is used as the frequency command. In this case, change the overload pre warning signal output mode selection [CE105] to 00 (valid in operation).

- When [CE105] = 00



- When [CE105] = 01



■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	035 036	035 [OL]: Overload pre warning signal 1 is output. 036 [OL2]: Overload pre warning signal 2 is output. OFF: Less than or equal to the overload pre warning signal level ON: More than or equal to the overload pre warning signal level
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Overload pre warning signal output mode selection	[CE105]	00	Valid in operation
		01	Valid only in constant speed operation
Overload pre warning signal level 1	[CE106]	(0.0 to 2.00)x inverter rated current	Specify the current level at which the overload pre warning signal is output. The signal will be output when the current exceeds the overload pre warning signal level.
Overload pre warning signal level 2	[CE107]		

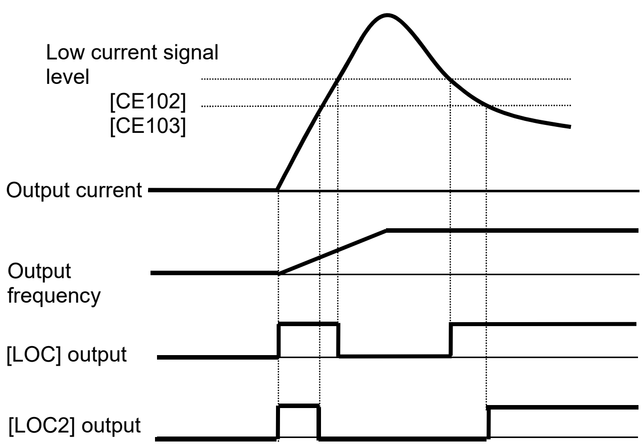
12.19.5 Outputting a warning when the current is low

- Assign the output terminal functions 033 [LOC] and 034 [LOC2] low current signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The low current detection signal can be output when the load has reduced.

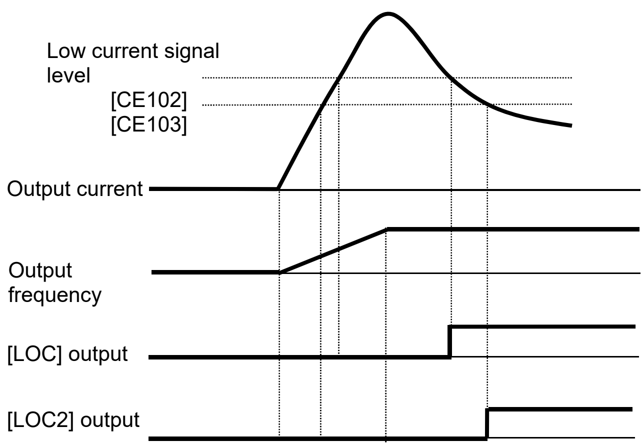
- Small fluctuations in the frequency input may hinder the speed from being determined as constant when an analog input is used as the frequency command. In this case, change the low current signal output mode selection [CE101] to 00 (valid in operation).

- The low current signals 033 [LOC] and 034 [LOC2] will be output when the output currents becomes lower than the low current detection levels [CE102] and [CE103], respectively.
- You can output the signal in accordance with the operating state by changing the low current signal output mode selection [CE101].

- When [CE101] = 00



- When [CE101] = 01



■Parameters

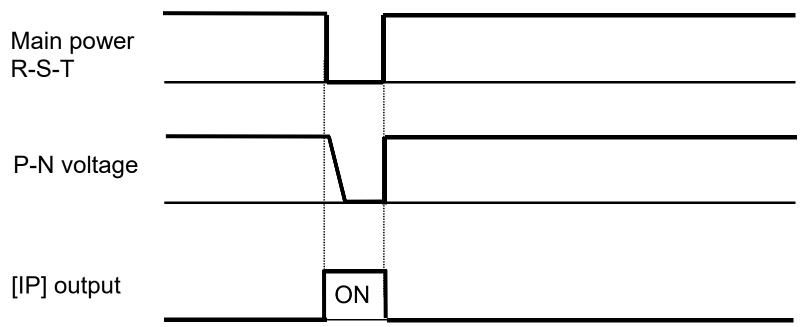
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	033 034	033 [LOC]: Low current signal 1 is output. 034 [LOC2]: Low current signal 2 is output. OFF: Less than or equal to the low current signal level ON: More than or equal to the low current signal level
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Low current signal output mode selection	[CE101]	00	Valid in operation
		01	Valid only in constant speed operation
Low current detection level 1	[CE102]	(0.00 to 2.00) x inverter rated current	Specify the current level at which the low current pre warning signal is output. The signal will be output when the current becomes lower than the low current pre warning detection level.
Low current detection level 2	[CE103]		

12.19.6 Outputting a warning when a momentary interruption occurs

- Assign the output terminal function 020 [IP] under momentary interruption signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The momentary interruption signal can be output when a momentary interruption occurs in the inverter main power.
- An interruption in the main power can be output as a signal when the control power is supplied via a separate line.

- The momentary interruption signal [IP] is valid when the main power is input from R-S-T.
- The momentary interruption signal [IP] is output while the control power of the inverter remains (including when a 24-V power supply is used).
- To set errors that will be generated when a momentary interruption occurs, refer to 12.16.6 “Generating a momentary interruption/under voltage trip.”
- To perform retry restart operation without generating errors when a momentary interruption occurs, refer to 12.13.7 “Restarting the inverter after recovering from a momentary interruption.”

- Example of a momentary interruption



■Parameters

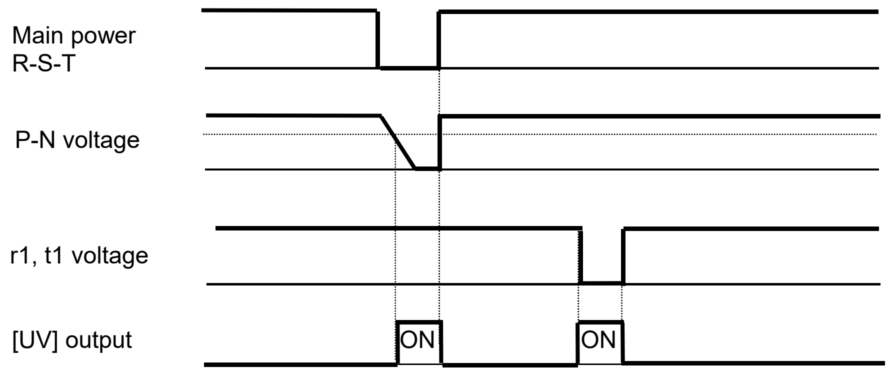
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	020	The momentary interruption signal [IP] is output. OFF: Input power to R-S-T has been established. ON: Input power to R-S-T was established and then interrupted.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

12.19.7 Outputting a warning while an under voltage occurs

- Assign the output terminal function 021 [UV] under voltage signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The undervoltage signal can be output when a power failure occurs in the main power and control power.
- You can output the signal by assigning the under voltage signal 021 [UV] to the output terminal selection.

- The under voltage signal [UV] is output while the control power of the inverter remains (including when a 24-V power supply is used).
- To set errors that will be generated when an under voltage occurs, refer to 12.16.6 "Generating a momentary interruption/under voltage trip."
- To perform retry restart operation without generating errors when an under voltage occurs, refer to 12.13.6 "Restarting the inverter after recovering from an under voltage."
- The [UV] signal is output under an under voltage state irrespective of the occurrence of a trip.

- Example of an under voltage (r1 and t1/24V are supplied from a separate power)



■Parameters

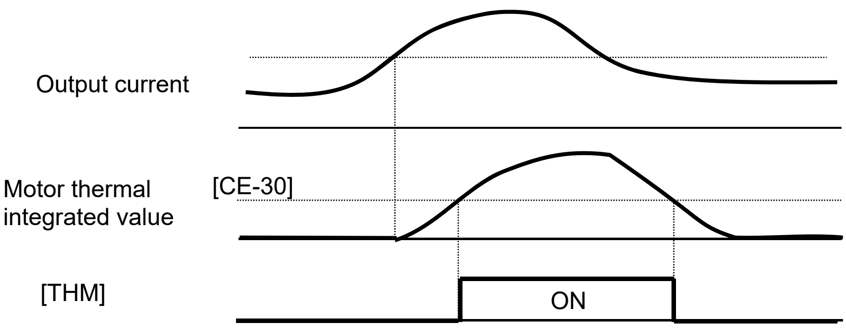
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	021	The under voltage signal [UV] is output. OFF: Internal PN voltage and control power have been established. ON: Internal PN voltage or control power is insufficient.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

12.19.8 Outputting a warning before thermal protection of the motor

- Assign the output terminal function 026 [THM] motor thermal warning signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can understand the state from the signal before the motor overload error [E005] is generated by the electronic thermal function.

- The motor overload error [E005] will be generated when the motor thermal integrated value reaches 100.00%.
- For the settings of motor electronic thermal, refer to 12.7.1 “Setting the electronic thermal of the motor.”

■Example operation (when thermal subtractions enabled)



■Parameters

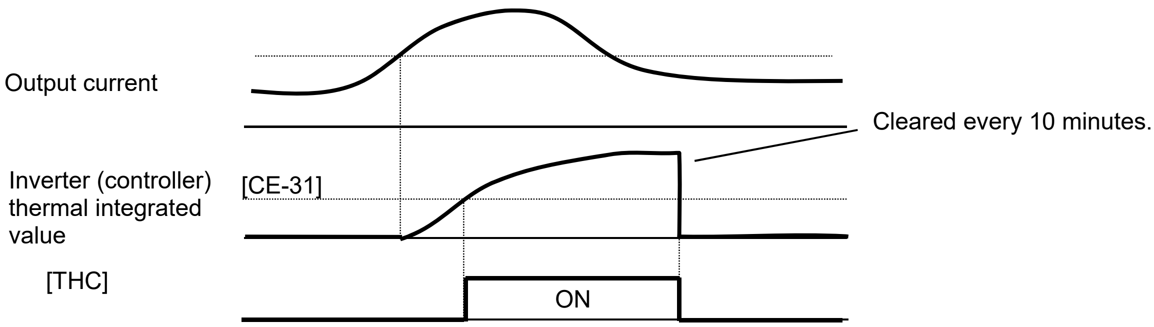
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	026	The thermal warning signal [THM] of the motor is output. OFF: The motor thermal integrated value is smaller than the level. ON: The motor thermal integrated value is equal to or larger than the level.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Electronic thermal warning level (motor)	[CE-30]	0.00~100.00(%)	The signal [THM] is turned on when the thermal integrated value of the motor is equal to or larger than the set level. This function does not work when this level has been set to 0.00.

12.19.9 Outputting a warning before thermal protection of the inverter

- Assign the output terminal function 027 [THC] controller (inverter) thermal warning signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can understand the state from the signal before the controller overload error [E039] is generated by the electronic thermal function.

- The controller overload error [E039] will be generated when the inverter thermal integrated value reaches 100.00%.
- For the protection of inverters, electronic thermal characteristics of inverters are fixed and specific to the type.
- Inverter thermal values are cleared every 10 minutes. However, integration is processed in a dual-redundant system, so that the value may not be cleared when the current is high and the integrated value increases.

■Operation example



■Parameters

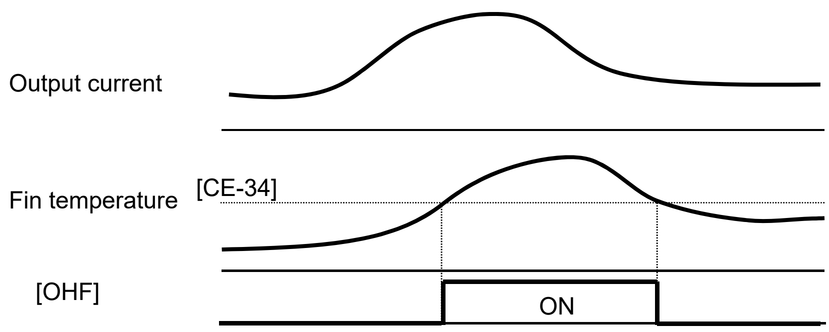
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	027	The thermal warning signal [THC] of the inverter is output. OFF: The inverter thermal integrated value is smaller than the level. ON: The inverter thermal integrated value is equal to or larger than the level.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Electronic thermal warning level (Inverter)	[CE-31]	0.00~100.00(%)	The signal [THC] is turned on when the thermal integrated value of the inverter is equal to or larger than the set level.

12.19.10 Outputting a warning when the temperature of the cooling fin increases

- Assign the output terminal function 032 [OHF] cooling fin overheating pre-warning signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can understand the state from the signal before the temperature error [E021] is generated by the cooling fin heating pre-warning level function.

- The temperature error [E021] is generated when the cooling fin temperature exceeds 120°C.

■Operation example



■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	032	The cooling fin heating pre-warning signal [OHF] is output. OFF: Fin temperature is lower than the pre-warning level. ON: Fin temperature is equal to or higher than the pre-warning level.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Cooling fin heating pre-warning level	[CE-34]	0~200(°C)	The signal [OHF] is turned on when the cooling fin temperature is equal to or higher than the set level.

12.19.11 Outputting a warning about the lives of the capacitors on the control circuit board

- Assign the output terminal function 029 [WAC] capacitor life pre-warning signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The life spans of the capacitors on the circuit board are diagnosed from the temperature inside the inverter and the energized time.
- The state of this signal can be monitored by using the life diagnostic monitor. Refer to 13.11.1 “Checking the life monitor.”
- A warning will also be displayed in the display icons on the operating panel.

- You are recommended to replace the main circuit board and the logic board when a warning about capacitor lives is generated.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	029	The capacitor life pre-warning signal (on board) [WAC] is output. OFF: No warning ON: Time to replace the circuit board because the capacitors has reached their life spans
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Life diagnostic monitor	[dC-16]	LL~HH	The monitors become H at the end of the life spans. The monitor on the right indicates the lives of the capacitors on the circuit board, whereas that on the left indicates the life of the cooling fan.

12.19.12 Outputting a warning about the life of the cooling fan

- Assign the output terminal function 030 [WAF] cooling fan rotation speed reduction signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The signal is output when it is detected that the rotation speed of the cooling fan incorporated in the inverter has decreased to 75% or less.
- The state of this signal can be monitored by using the life diagnostic monitor. Refer to 13.11.1 “Checking the life monitor.”
- A warning will also be displayed in the display icons on the operating panel.

- Check the cooling fan for clogging when this signal is output.
- This signal will not be output when the fan is stopped by selecting the cooling fan operation.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	030	The cooling fan rotation speed reduction signal [WAF] is output. OFF: No warning ON: Fan rotation speed has decreased
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Life diagnostic monitor	[dC-16]	LL~HH	The monitors become H at the end of the life spans. The monitor on the right indicates the lives of the capacitors on the circuit board, whereas that on the left indicates the life of the cooling fan.

12.19.13 Outputting a warning based on the number of operating hours

- Assign the output terminal function 024 [RNT] RUN time over signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- Specify the RUN time/power-on time level [CE-36].
- The RUN time over signal [RNT] will be output when the cumulative total of inverter operating hours exceeds the time specified with the RUN time/power-on time level [CE-36].

- When specifying the time level as a guideline for replacement, use a number with an adequate margin.

- Setting example
  First time:
  When you want to generate a warning after an operation of (250 days × 8 hours × 5 years =) 10,000 hours, set [CE-36] to 10,000.
  Second time onward:
  When you want to generate a warning after an operation of (250 days × 8 hours × 5 years =) 10,000 hours, set [CE-36] to [dC-22] + 10,000.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	024	The RUN time over signal [RNT] is output. OFF: Less than or equal to the RUN time level ON: More than the RUN time level
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
RUN time/power-on time level	[CE-36]	0~100000[hour]	This function does not work when this level has been set to 0. Specify 1 to 100,000 hours.
Cumulative operating hours monitor during RUN	[dC-22]	0~65535[hour]	The number of hours when the inverter outputs is stored for monitoring.

12.19.14 Outputting a warning based on the amount of power-on hours

- Assign the output terminal function 025 [ONT] power-on time over signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- Assign 025 (ONT) to the output terminal.
- Specify the power-on time level [CE-36].
- The power-on time over signal [ONT] will be output when the cumulative total of inverter operating hours exceeds the time specified with the RUN time/power-on time level [CE-36].

- When specifying the time level as a guideline for replacement, use a number with an adequate margin.

- Setting example
  When you want to generate a warning after the inverter has been turned on for (300 days × 24 hours × 3 years =) 21,600 hours, set [CE-36] to 21,600.
  Second time onward:
  When you want to generate a warning after an operation of (250 days × 8 hours × 5 years =) 10,000 hours, set [CE-36] to [dC-24] + 10,000.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	025	The power-on time over [ONT] is output. OFF: Less than or equal to the power-on time level ON: More than the power-on time level
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
RUN time/power-on time level	[CE-36]	0~100000[hour]	This function does not work when this level has been set to 0. Specify 1 to 100,000 hours.
Cumulative power-on time monitor	[dC-24]	0~65535[hour]	The number of hours when the inverter has been turned on is stored for monitoring.

12.19.15 Outputting a warning when the incoming voltage is high

- Assign the output terminal function 081 [OVS] incoming overvoltage signal to one of [CC-01] to [CC-17] that corresponds to the output terminal and output the signal.
- The incoming overvoltage signal [OVS] turns on when the PN voltage of the main circuit exceeds the voltage level specified with the incoming overvoltage level selection [bb-62] for 100 s continuously.
- When incoming overvoltage level [bb-61] is set to 00, the signal [OVS] will be output.
- When incoming overvoltage level [bb-61] is set to 01, the signal [OVS] will be output, while a trip being made due to incoming overvoltage error [E015].

- This function performs detection only when the inverter is stopped. This function does not work while the inverter is in operation.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	081	The signal [OVS] is output when the incoming voltage is high. OFF: Less than or equal to the incoming overvoltage level ON: More than the incoming overvoltage level
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Incoming overvoltage selection	[bb-61]	00	The signal [OVS] will be output.
		01	The signal [OVS] will be output, while a trip being made due to incoming overvoltage error [E015].
Incoming overvoltage level selection	[bb-62]	(200-V class) 300.0Vdc~400.0Vdc (400-V class) 600.0Vdc~800.0Vdc	The number of hours when the inverter has been turned on is stored for monitoring.

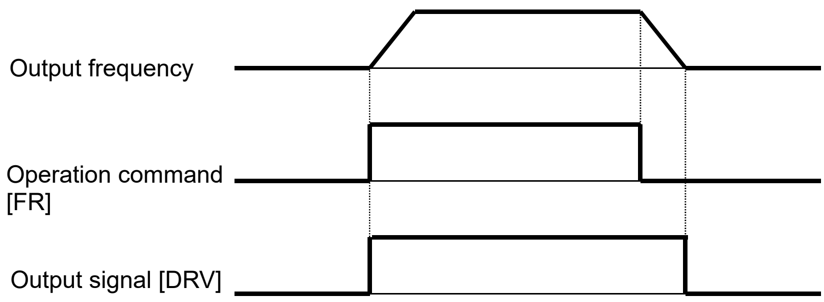
12.20 Operating Status

12.20.1 Outputting a signal during operation (output)

- Assign the output terminal function 001 [DRV] running signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.

- The signal becomes ON not only when the motor is operating at normal rotation but also when a voltage is output to the motor as a function such as DC braking.
- The signal [DRV] will not be output when the inverter is waiting for a retry or DC braking.

- The timing chart is as follows.

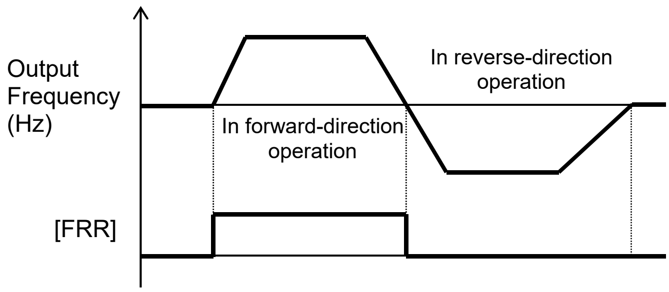


■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	001	The signal [DRV] is output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

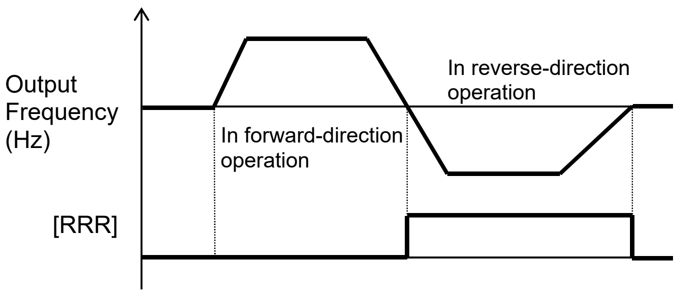
12.20.2 Outputting a signal during forward- or reverse-direction operation

- Assign the output terminal function 008 [FRR] forward-direction operating signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can output the signal only when the inverter is operating in the forward direction by assigning 008 [FRR] to the output terminal function selection.
- The timing chart is as follows.

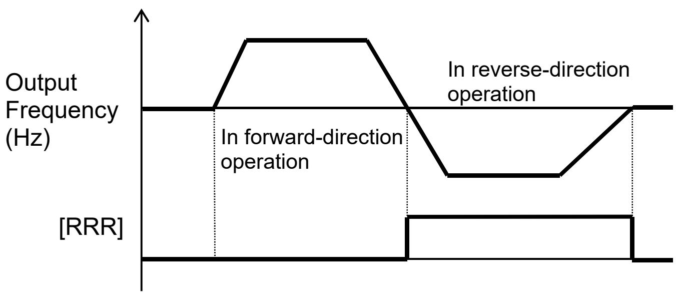


- [FRR] and [RRR] will not be output during DC breaking or when the servo is on.

- Assign the output terminal function 009 [RRR] reverse-direction operating signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can output the signal only when the inverter is operating in the reverse direction by assigning 009 [RRR] to the output terminal function selection.
- The timing chart is as follows.



- Assign the output terminal function 009 [RRR] reverse-direction operating signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- You can output the signal only when the inverter is operating in the reverse direction by assigning 009 [RRR] to the output terminal function selection.
- The timing chart is as follows.



■Parameters

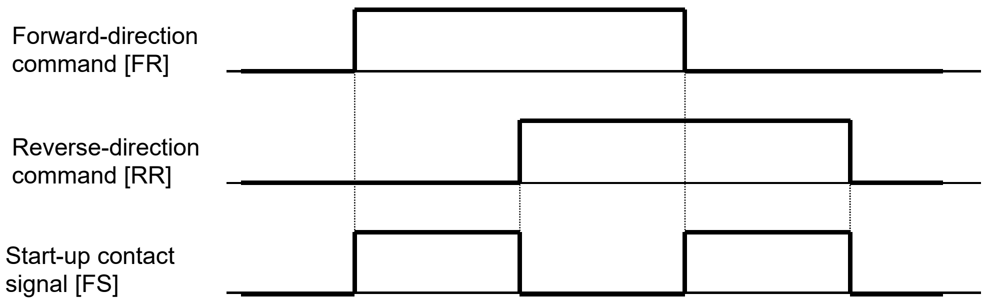
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	008	[FRR]: The forward-direction operation signal is output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]	009	[RRR]: The reverse-direction operation signal is output to the output terminal assigned.
Relay output terminal function selection FL	[CC-07]		

12.20.3 Outputting a signal when an operation command exists

- Assign the output terminal function 031 [FS] start-up contact signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The start-up contact signal 031 [FS] is output while the inverter accepts operation commands.
- The start-up contact signal [FS] is output in accordance with the state how the operation command is accepted even when the destination of the operation command is not a contact.

- When the inverter is operated by using terminal commands, simultaneous inputs of the forward-direction command [FR] and the reverse-direction command [RR] will cause a command mismatch, which is interpreted as the stop command. •In this case, the [FR] signal will not be output.
- The signal becomes ON not only when the motor is operating at normal rotation but also when a voltage is output to the motor as a function such as DC breaking.
- When the operation enable signal 101 [REN] has been assigned and set to OFF, the signal [FS] becomes OFF because the inverter cannot be operated

- The timing chart is as follows.
  (Example) In the case of a terminal command



■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	031	[FS]: The start-up contact signal is output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

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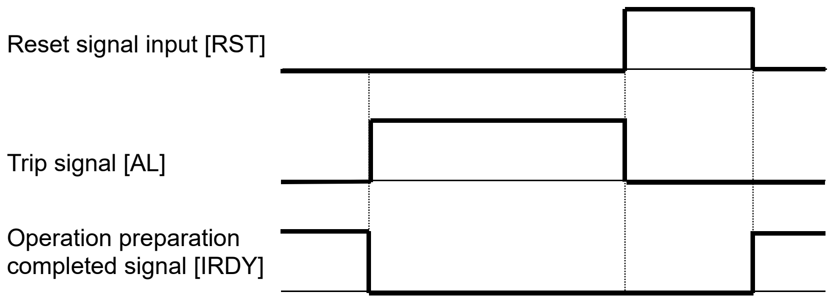
12.20.4 Outputting a signal when the preparations for operation have been completed

- Assign the output terminal function 007 [IRDY] operation preparation completed signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The operation preparation completed signal 007 [IRDY] is output when the inverter can accept operation commands.

- When this signal is not output, the inverter cannot be operated even if operation commands are input.
- This signal becomes OFF when output operation is disabled, such as during start-up preparation at power-up, when under-voltage of the R-S-T input voltage occurs, while the inverter has been tripped, and under a free run stop command.

- The timing chart is as follows.
  (Example) In the case of a terminal command



■Parameters

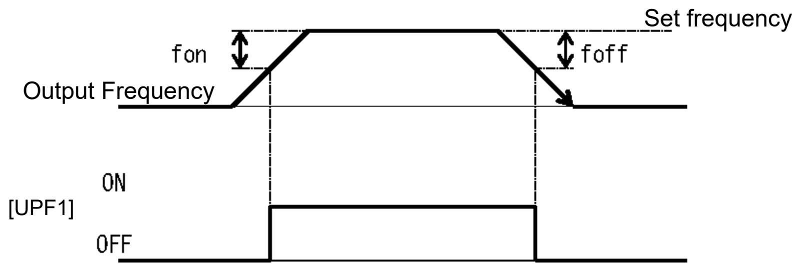
Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	007	[IRDY]: The operation preparation completed signal is output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		

12.21 Frequency Reached Signal

12.21.1 Outputting a signal when the frequency reaches the target

- Assign the output terminal function 002 [UPF1]constant-speed reaching output signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- The signal will be output when the frequency has reached the enabled frequency command.

- The signal [UPF1] may not be output stably when the frequency command fluctuates because an analog input command is used. In this case, the symptom may be alleviated by using the ON/OFF delay function of the output terminal.



fon: 1% of the maximum frequency
foff: 2% of the maximum frequency

(Operation example)
Maximum frequency: 60 Hz
Set frequency: 50 Hz
- fon=60×0.01=0.6Hz
- foff=60×0.02=1.2Hz
- In acceleration: On at 50 - 0.6 = 49.4 Hz
- In deceleration: On at 50 - 1.2 = 48.8 Hz

■Parameters

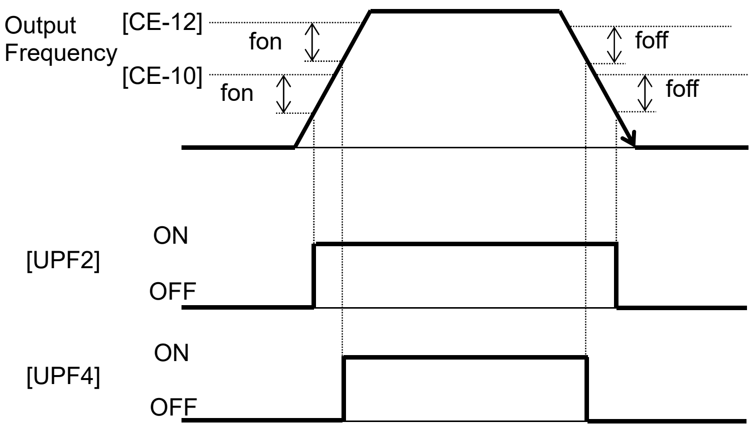
Item	Parameter	Data	Description
Output terminal function selection	[CC-01]~[CC-05]	002	[UPF1]: The constant-speed reaching output will be output as a signal to the output terminal assigned.
Relay output terminal function selection	[CC-06]		
Relay output terminal function selection	[CC-07]		

12.21.2 Outputting a signal when the frequency reaches the target

- Assign the output terminal functions 003 [UPF2] and 005 [UPF4] exceeding set frequency signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signals.
- The signals [UPF2] and [UPF4] can be output to output terminal functions individually as the exceeding set frequency output signal.
- The signals [UPF2] and [UPF4] will be output when the enabled output frequency exceeds the setting.

- The operation of [UPF2] can be set through [CE-10] and [CE-11].
- The operation of [UPF4] can be set through [CE-12] and [CE-13].

- Operation example



fon: 1% of the maximum frequency
foff: 2% of the maximum frequency

(Operation example)
Maximum frequency: 60 Hz
When [CE-10] = [CE-11] = 50 Hz
• fon=60×0.01=0.6Hz
• foff=60×0.02=1.2Hz
• In acceleration: On at 50 - 0.6 = 49.4 Hz
• In deceleration: On at 50 - 1.2 = 48.8 Hz

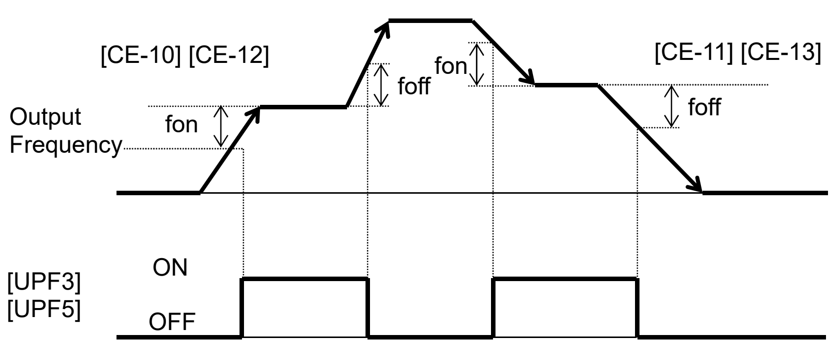
■Parameters

Item	Parameter	Data	Description
Output terminal function selection	[CC-01]~[CC-05]	003 005	003 [UPF2]: The exceeding set frequency signal will be output to the output terminal assigned. 005 [UPF4]: The exceeding set frequency signal 2 will be output to the output terminal assigned.
Relay output terminal function selection	[CC-06]		
Relay output terminal function selection	[CC-07]		
Acceleration reaching frequency 1	[CE-10]	0.00~590.00(Hz)	The frequency to judge that the frequency has been reached in acceleration and output the signal [UPF2].
Deceleration reaching frequency 1	[CE-11]		The frequency to judge that the frequency has been reached in deceleration and output the signal [UPF2].
Acceleration reaching frequency 2	[CE-12]		The frequency to judge that the frequency has been reached in acceleration and output the signal [UPF4].
Deceleration reaching frequency 2	[CE-13]		The frequency to judge that the frequency has been reached in deceleration and output the signal [UPF4].

12.21.3 Outputting a signal when the frequency reaches the set value

- Assign the output terminal functions 004 [UPF3] and 006 [UPF5] set frequency only output signals to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signals.
- The signals [UPF3] and [UPF5] can be output individually.
- The signals [UPF3] and [UPF5] will be output when the enabled output frequency reaches around the setting value.

- The operation of [UPF3] can be set through [CE-10] and [CE-11].
- The operation of [UPF5] can be set through [CE-12] and [CE-13].



fon: 1% of the maximum frequency
foff: 2% of the maximum frequency

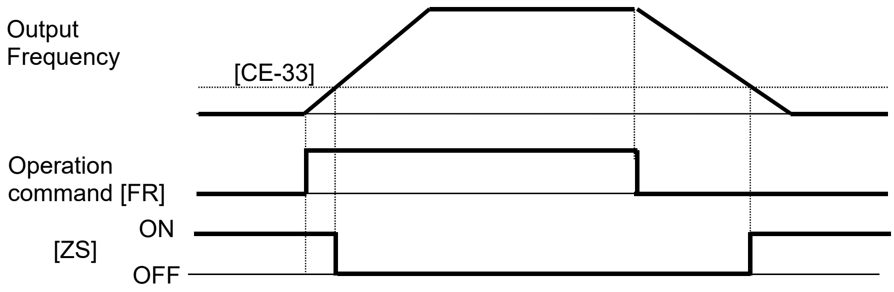
(Operation example)
Maximum frequency: 60 Hz
When [CE-10] = [CE-11] = 50 Hz
- fon=60×0.01=0.6Hz
- foff=60×0.02=1.2Hz
- In acceleration: On at 50 - 0.6 = 49.4 Hz
  Off at 50 + 1.2 = 51.2 Hz
- In deceleration: On at 50 + 0.6 = 50.6 Hz
  Off at 50 - 1.2 = 48.8 Hz

■Parameters

Item	Parameter	Data	Description
Output terminal function selection	[CC-01]~[CC-05]	004 006	[UPF3]: The set frequency only reaching signal will be output to the output terminal assigned. [UPF5]: The set frequency only reaching signal 2 will be output to the output terminal assigned.
Relay output terminal function selection	[CC-06]		
Relay output terminal function selection	[CC-07]		
Acceleration reaching frequency 1	[CE-10]	0.00~590.00(Hz)	The frequency to judge that the frequency has been reached in acceleration and output the signal [UPF3].
Deceleration reaching frequency 1	[CE-11]		The frequency to judge that the frequency has been reached in deceleration and output the signal [UPF3].
Acceleration reaching frequency 2	[CE-12]		The frequency to judge that the frequency has been reached in acceleration and output the signal [UPF5].
Deceleration reaching frequency 2	[CE-13]		The frequency to judge that the frequency has been reached in deceleration and output the signal [UPF5].

12.21.4 Outputting a signal when the frequency reaches around 0 Hz

- Assign the output terminal function 040 [ZS] 0-Hz detection signal to one of [CC-01] to [CC-07] that corresponds to the output terminal and output the signal.
- This function is to output a signal when the output frequency of the inverter becomes lower than the level specified with the 0-Hz detection value level [CE-33].
- When the feedback circuit board is used, the actual frequency of the motor is evaluated for outputting the signal.



■Parameters

Item	Parameter	Data	Description
Output terminal function selection	[CC-01]~[CC-05]	040	[ZS]: The 0-Hz signal is output to the output terminal assigned.
Relay output terminal function selection	[CC-06]		
Relay output terminal function selection	[CC-07]		
0-Hz detection value level	[CE-33]	0.00~100.00(Hz)	The frequency setting value to estimate 0-Hz state when [ZS] is output.

12.22 Detecting disconnection or out-of-range of Analogue Input

12.22.1 Detecting disconnection and out-of-range errors at terminals

- Assign the output terminal functions 050 [VRFDc], 051 [IRFDc], and 052 [VF2Dc] analog break signals to one of [CC-01] to [CC-17] that corresponds to the output terminal and output the signals.
- The signals will be output when the input values of the analog inputs [VRF], [IRF], and [VF2] are within the range from the lower limit level to the upper limit level of the window comparators. The analog inputs can be monitored at any value, so that this function can be used for detecting breaks, for example.

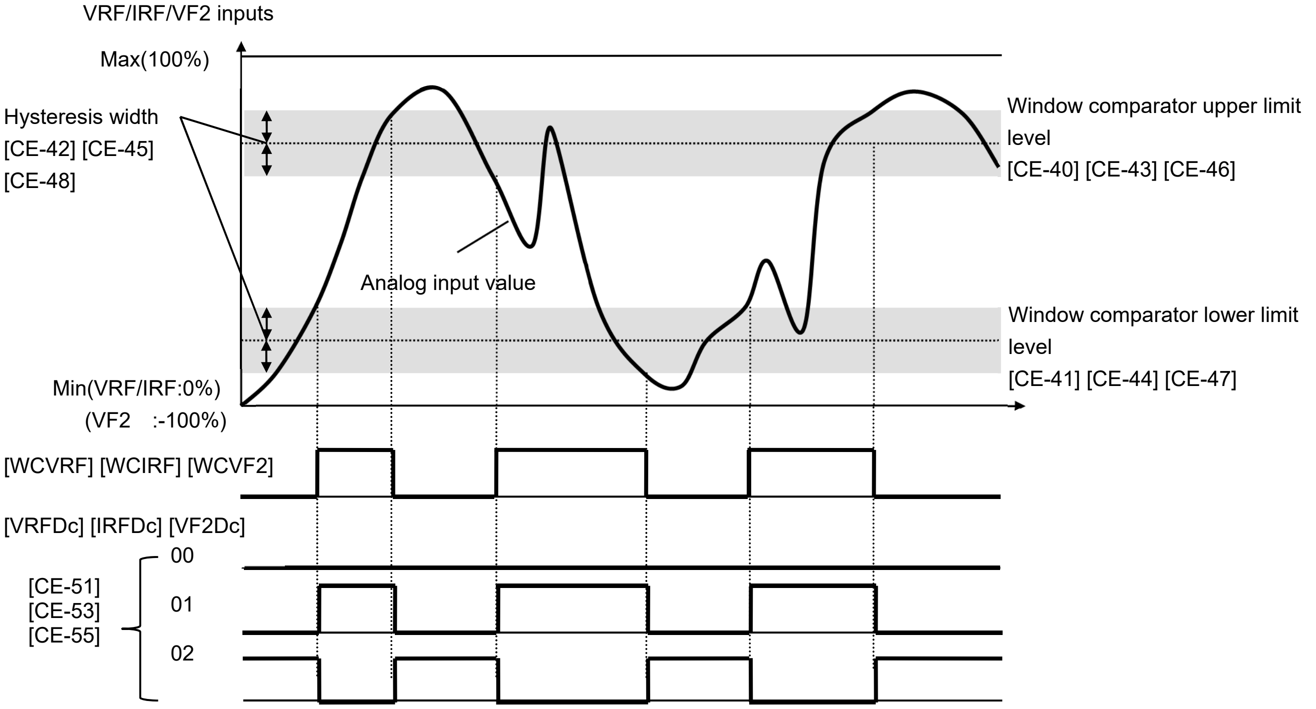
- When the signal [WCVRF], [WCIRF], or [WCVF2] is output, the value adopted to the analog input can be fixed to any value. Specify the value using the break operation level [VRF], [IRF], or [VF2].
- When the analog hold function [AHD] is enabled, the input being held has higher priority.

- A hysteresis width can be specified to the upper and lower limit levels of the window comparator.
- A level and a hysteresis width can be specified to each of the analog inputs [VRF], [IRF], and [VF2] individually.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	050 051 052	The signals 050 [VRFDc], 051 [IRFDc], and 052 [VF2Dc] will be output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	056 057 058	The signals 056 [WCVRF], 057 [WCIRF], and 058 [WCVF2] will be output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Window comparator VRF/IRF/VF2 upper limit level	VRF:[CE-40] IRF:[CE-43]	0~100(%)	Specify the upper limits of the analog inputs. The setting ranges are limited to the lower limits or greater.
	VF2:[CE-46]	-100~100(%)	
Window comparator VRF/IRF/VF2 lower limit level	VRF:[CE-41] IRF:[CE-44]	0~100(%)	Specify the lower limits of the analog inputs. The setting ranges are limited to the upper limits or smaller.
	VF2:[CE-47]	-100~100(%)	
Window comparator VRF/IRF/VF2 hysteresis width	VRF:[CE-42] IRF:[CE-45] VF2:[CE-48]	0~10(%)	The maxim hysteresis widths are limited to (upper limit level - lower limit level)/2.
VRF/IRF/VF2 abnormal condition analog operation level	VRF:[CE-50] IRF:[CE-52]	0~100(%)	Specify the input values when the input become within the ranges according to their operation level selection.
	VF2:[CE-54]	-100~100(%)	
VRF/IRF/VF2 abnormal condition analog operation level selection	VRF:[CE-51] IRF:[CE-53] VF2:[CE-55]	00	Disabled
		01	When the enabled WC signal is in operation (within the range)
		02	When the enabled WC signal is out of operation (beyond the range)

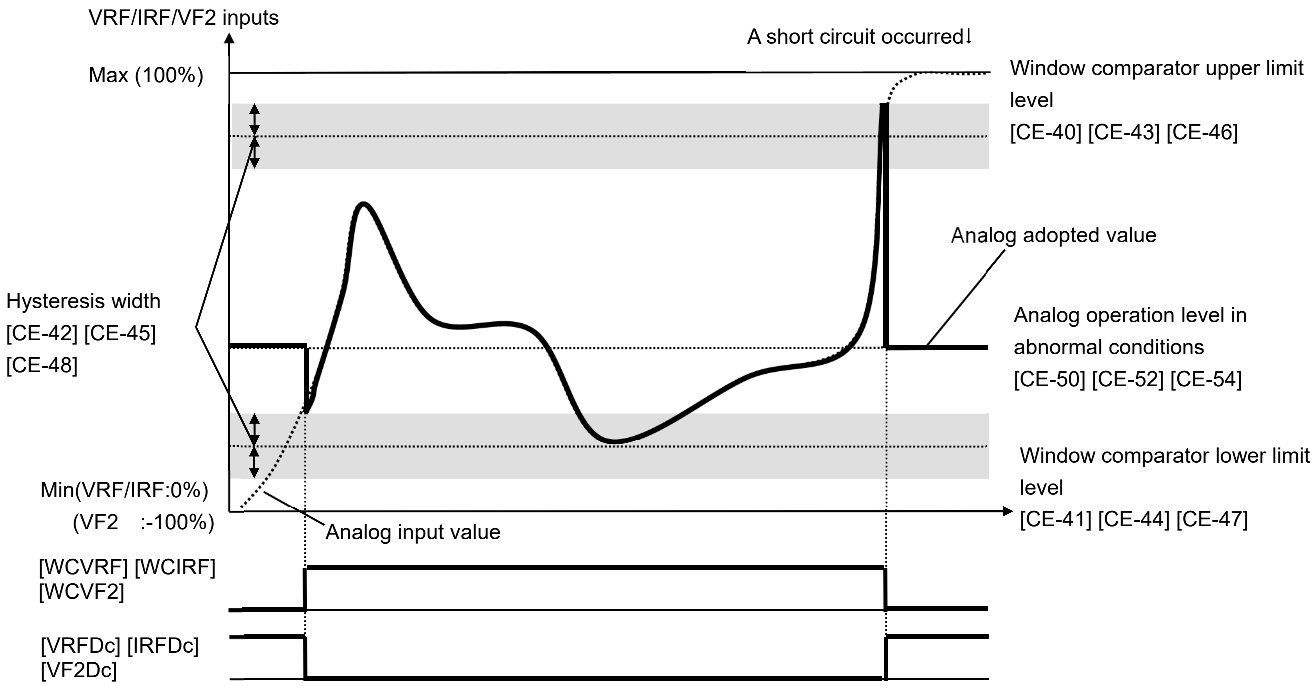
■Window comparator operation



- In the window comparator function, the signal will be output when the input level is within the specified range.
- In the break detection function, the signal will be output when the input level is out of the specified range.
- The logical values of the output signals can be modified through [CC-11] to [CC-17].
- Specify the analog operation level to maintain the output level when the analog input becomes the maximum value because of a short circuit or when the analog input becomes 0 V because of a break.
- To prevent the signal from being output at power-on, specify the on delay times [CC-20], [CC-22], [CC-24], [CC-26], [CC-28], [CC-30], and [CC-32] of the output terminals.

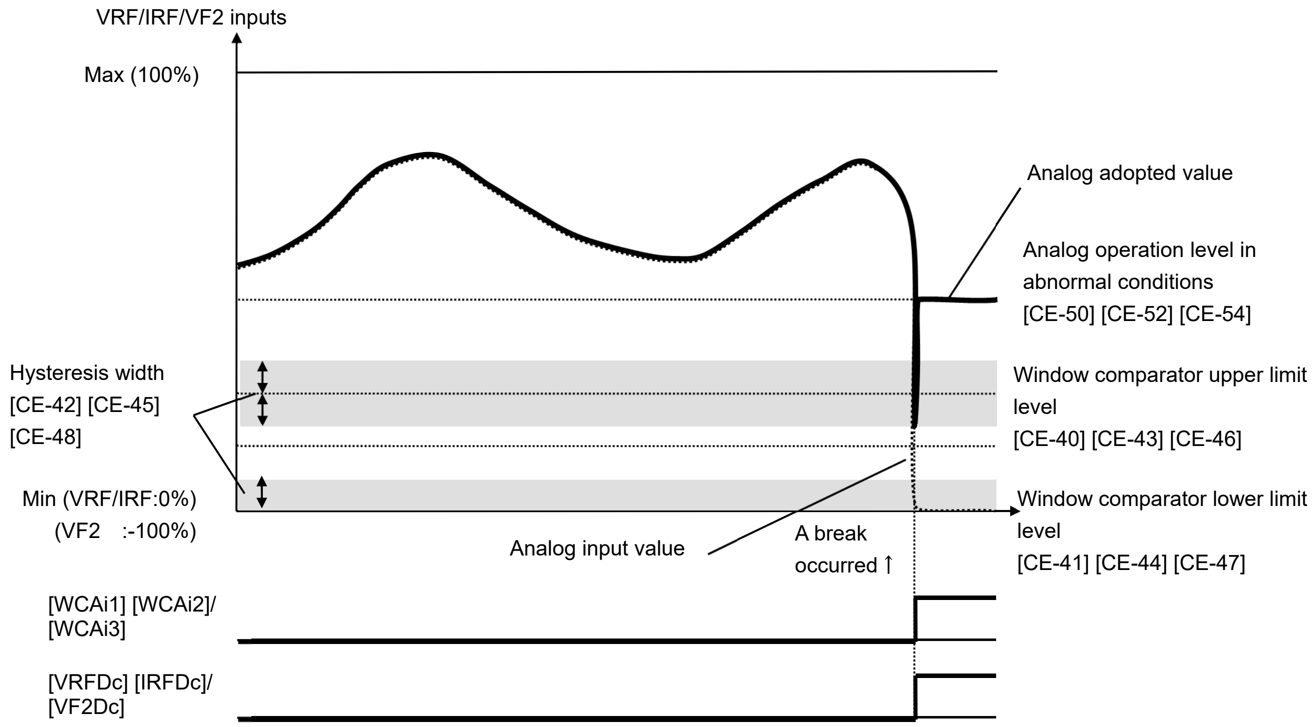
■Output operation in abnormal conditions

Example when [CE-51] [CE-53] [CE-55] = 02

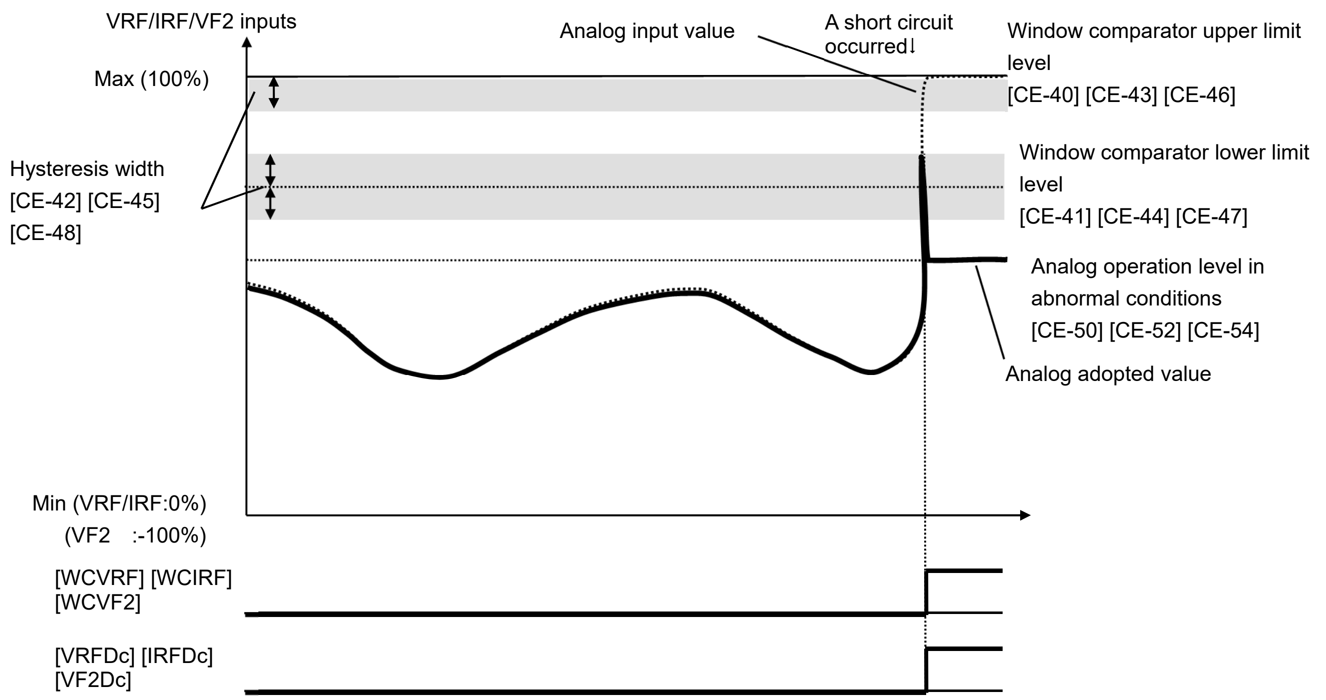


■Output operation in abnormal conditions
Example when [CE-51] [CE-53] [CE-55] = 01

- When the analog input becomes the minimum value (Min) because of a break in the input wire



- When the analog input becomes the maximum value (Max) because of a short circuit in the input wire



12.22.2 Detecting break and out-of-range errors at expansion option terminals

- Assign the output terminal functions 053 [Ai4Dc], 054 [Ai5Dc], and 055 [Ai6Dc] analog break signals to one of [CC-01] to [CC-17] that corresponds to the output terminal and output the signals.
- The signals will be output when the input values of the analog inputs [Ai4] (Vi4, Ii4), [Ai5] (Vi5, Ii5), and [Ai6] (Vi6, Ii6) are within the range from the lower limit level to the upper limit level of the window comparators. The analog inputs can be monitored at any value, so that this function can be used for detecting breaks, for example.

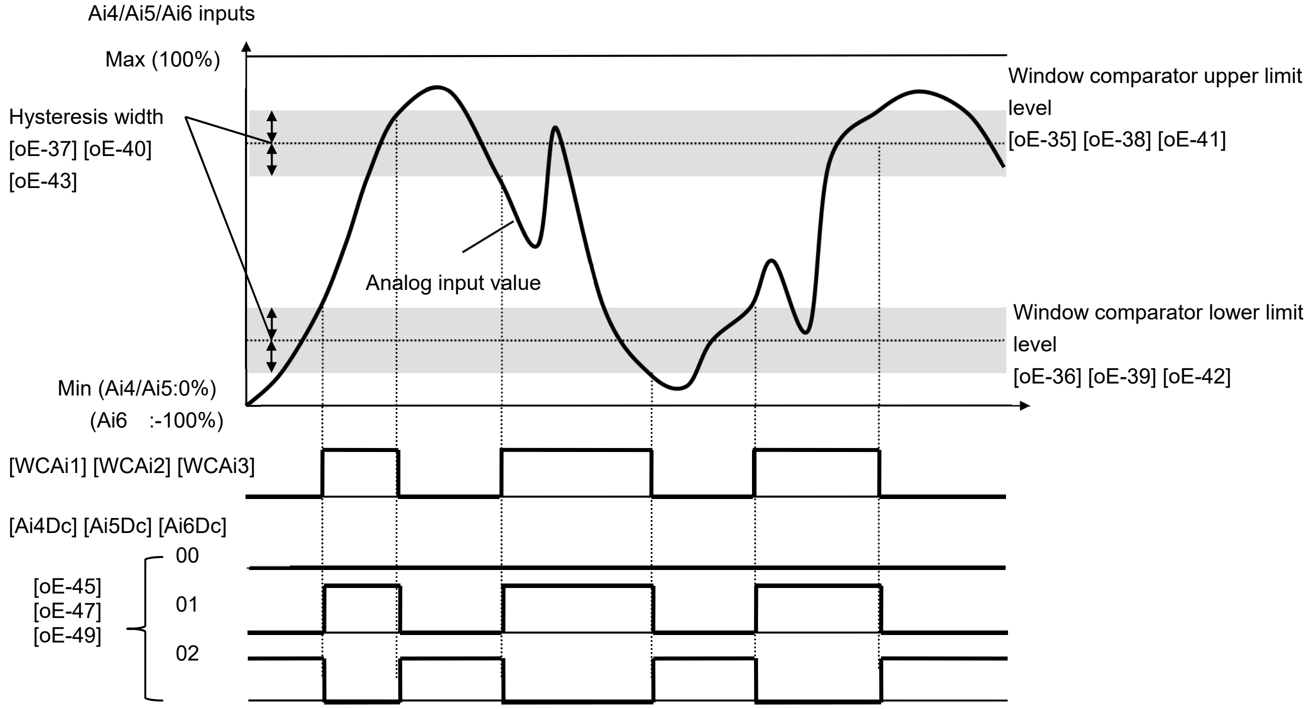
- When the signal [WCAi4], [WCAi5], or [WCAi6] is output, the value adopted to the analog input can be fixed to any value. Specify the value using the break operation level [Ai4], [Ai5], or [Ai6].
- When the analog hold function [AHD] is enabled, the input being held has higher priority.

- A hysteresis width can be specified to the upper and lower limit levels of the window comparator.
- A level and a hysteresis width can be specified to each of the analog inputs [Ai4] (Vi4, Ii4), [Ai5] (Vi5, Ii5), and [Ai6] (Vi6, Ii6) individually.
- For details, refer to the instruction manual provided together with the optional device.

■Parameters

Item	Parameter	Data	Description
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	053 054 055	The signals 053 [Ai4Dc], 054 [Ai5Dc], and 055 [Ai6Dc] will be output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Output terminal function selection UPF-X3	[CC-01]~[CC-05]	059 060 061	The signals 059 [WCAi4], 060 [WCAi5], and 061 [WCAi6] will be output to the output terminal assigned.
Relay output terminal function selection RL	[CC-06]		
Relay output terminal function selection FL	[CC-07]		
Window comparator Ai4/Ai5/Ai6 upper limit level	Ai4:[oE-35] Ai5:[oE-38]	0~100(%)	Specify the upper limits of the analog inputs. The setting ranges are limited to the lower limits or greater.
	Ai6:[oE-41]	-100~100(%)	
Window comparator Ai4/Ai5/Ai6 lower limit level	Ai4:[oE-36] Ai5:[oE-39]	0~100(%)	Specify the lower limits of the analog inputs. The setting ranges are limited to the upper limits or smaller.
	Ai6:[oE-42]	-100~100(%)	
Window comparator Ai4/Ai5/Ai6 hysteresis width	Ai4:[oE-37] Ai5:[oE-40] Ai6:[oE-43]	0~10(%)	The maxim hysteresis widths are limited to (upper limit level - lower limit level)/2.
Ai4/Ai5/Ai6 abnormal condition analog operation level	Ai4:[oE-44] Ai5:[oE-46]	0~100(%)	Specify the input values when the input become within the ranges according to their operation level selection.
	Ai6:[oE-48]	-100~100(%)	
Ai4/Ai5/Ai6 abnormal condition analog operation level selection	Ai4:[oE-45] Ai5:[oE-47] Ai6:[oE-49]	00	Disabled
		01	When the enabled WC signal is in operation (within the range)
		02	When the enabled WC signal is out of operation (beyond the range)

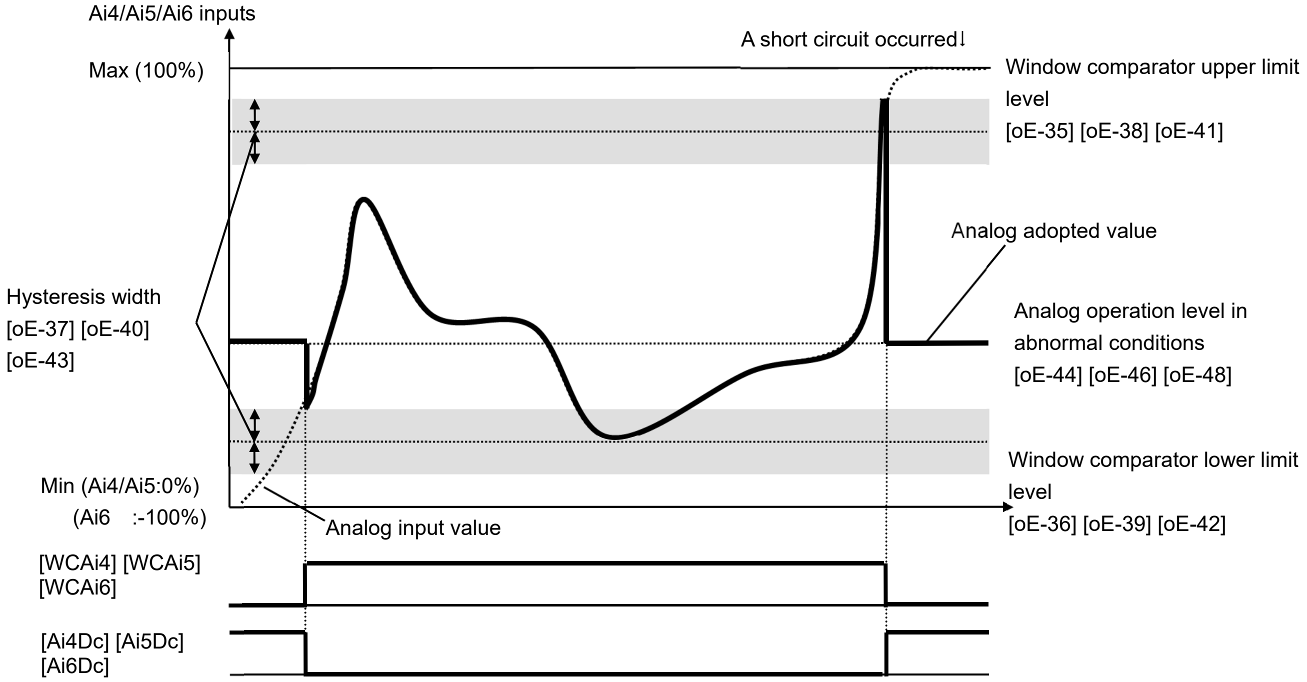
■Window comparator operation



- In the window comparator function, the signal will be output when the input level is within the specified range.
- In the break detection function, the signal will be output when the input level is out of the specified range.
- The logical values of the output signals can be modified through [CC-11] to [CC-17].

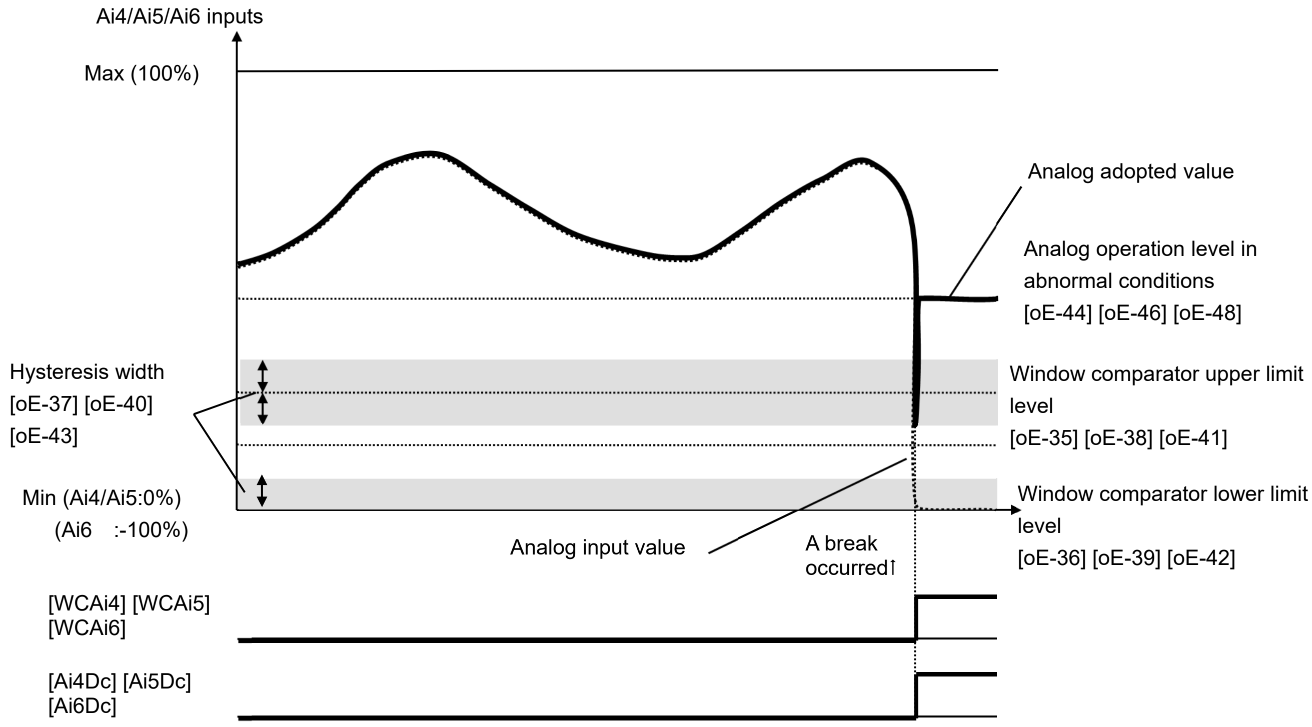
- Specify the analog operation level to maintain the output level when the analog input becomes the maximum value because of a short circuit or when the analog input becomes 0 V because of a break.
- To prevent the signal from being output at power-on, specify the on delay times [CC-20], [CC-22], [CC-24], [CC-26], [CC-28], [CC-30], and [CC-32] of the output terminals.

■Output operation in abnormal conditions
Example when [oE-45] [oE-47] [oE-49] = 02

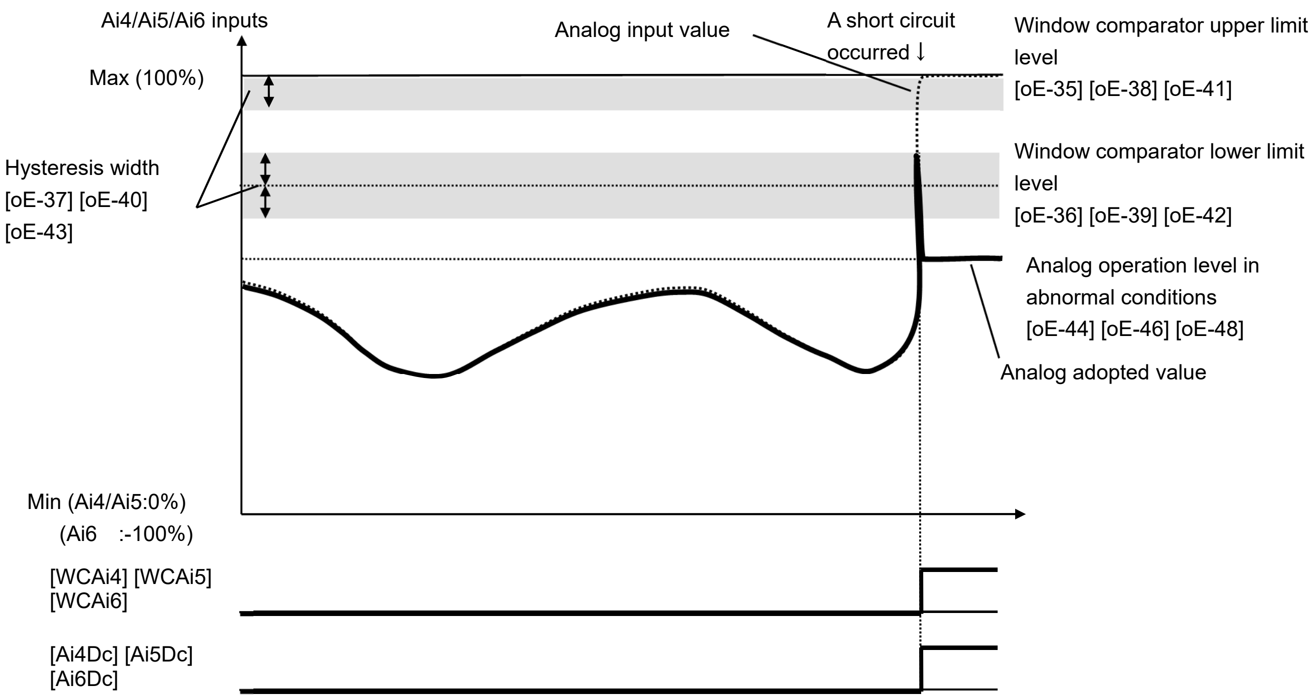


■Output operation in abnormal conditions Example when [oE-45]/[oE-47]/[oE-49] = 01

- When the analog input becomes the minimum value (Min) because of a break in the input wire



- When the analog input becomes the maximum value (Max) because of a short circuit in the input wire



12.23 Combining Output Signals

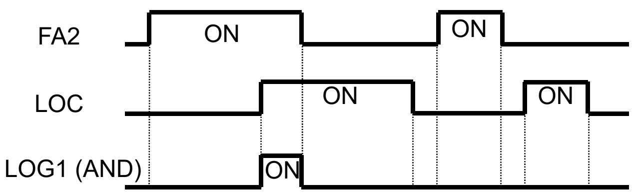
- You can combine the operation of the output terminal function to perform a logical operation for output signals in the inverter to output various signals.
- You can select three types of operators: AND, OR, and XOR.

- All output signals are subject to operation. However, you are not able to include the results of logical operations [LOG1] to [LOG7] into the targets of arithmetic operation.

Selected signal	Arithmetic operation target 1 selection	Arithmetic operation target 2 selection	Operator selection
068: Logical output signal 1 (LOG1)	[CC-40]	[CC-41]	[CC-42]
069: Logical output signal 2 (LOG2)	[CC-43]	[CC-44]	[CC-45]
070: Logical output signal 3 (LOG3)	[CC-46]	[CC-47]	[CC-48]
071: Logical output signal 4 (LOG4)	[CC-49]	[CC-50]	[CC-51]
072: Logical output signal 5 (LOG5)	[CC-52]	[CC-53]	[CC-54]
073: Logical output signal 6 (LOG6)	[CC-55]	[CC-56]	[CC-57]
074: Logical output signal 7 (LOG7)	[CC-58]	[CC-59]	[CC-60]

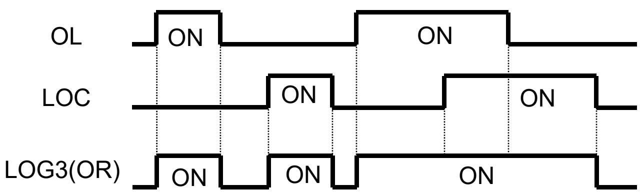
Example 1)
Use a signal for which an AND operation has been performed with a frequency equal to or above the set frequency (003: FA2) and a low current signal (033: LOC), and, when a current lowers after the frequency has been determined, output the signal as Logical output 1 (LOG1) to Output terminal function 1.

- Output terminal function 1 [CC-01]: 062 (LOG1)
- Logical output signal 1 selection 1 [CC-40]: 003 (FA2)
- Logical output signal 1 selection 2 [CC-41]: 033 (LOC)
- Logical output signal 1 operator [CC-42]: 00 (AND)



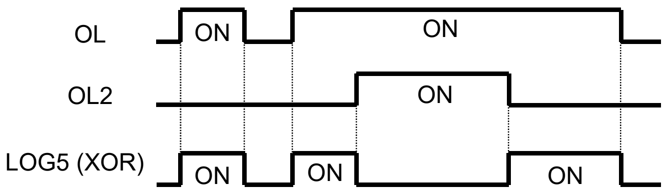
Example 2)
Use a signal for which an OR operation has been performed with an overload advance notice signal (035: OL) and a thermal warning signal (026: THM), and, when a current falls outside the range, output the signal as Logical output 3 (LOG3) to Output terminal function 2.

- Output terminal function 2 [CC-02]: 063 (LOG3)
- Logical output signal 3 selection 1 [CC-43]: 035 (OL)
- Logical output signal 3 selection 2 [CC-44]: 026 (THM)
- Logical output signal 3 operator [CC-45]: 01 (OR)



Example 3)
Use a signal for which an XOR operation has been performed with an overload advance notice signal (035: OL) and an overload advance notice signal 2 (036: OL2), and, when a current falls within a certain range, output the signal as Logical output 5 (LOG5) to Output terminal function 3.

- Output terminal function 3 [CC-03]: 066 (LOG5)
- Logical output signal 5 selection 1 [CC-46]: 035 (OL)
- Logical output signal 5 selection 2 [CC-47]: 036 (OL2)
- Logical output signal 5 operator [CC-48]: 02 (XOR)



■Parameters

Item	Parameter	Data	Description
Output terminal function selection Relay output terminal function selection	[CC-01]~[CC-05]	062 063 064 065 066 067 068	LOG1: Result of logical operation 1 LOG2: Result of logical operation 2 LOG3: Result of logical operation 3 LOG4: Result of logical operation 4 LOG5: Result of logical operation 5 LOG6: Result of logical operation 6 LOG7: Result of logical operation 7
16C relay output terminal function selection	[CC-06]		
AL relay output terminal function selection	[CC-07]		
Logical output signal selection 1	[CC-40] [CC-43] [CC-46] [CC-49] [CC-52] [CC-55] [CC-58]	Select from the output terminal function selection data (excluding LOG1 to LOG7)	Select Arithmetic operation target 1
Logical output signal selection 2	[CC-41] [CC-44] [CC-47] [CC-50] [CC-53] [CC-56] [CC-59]	Select from the output terminal function selection data (excluding LOG1 to LOG7)	Select Arithmetic operation target 2
Logical output signal operator selection	[CC-42] [CC-45] [CC-48] [CC-51] [CC-54] [CC-57] [CC-60]	00	AND
		01	OR
		02	XOR

12.24 Input Signal

12.24.1 Using the input signal function externally

- Input terminals FR to RST, DFH, and DHH are open collector inputs.
  Pulse inputting is possible for Terminals DFH and DHH.

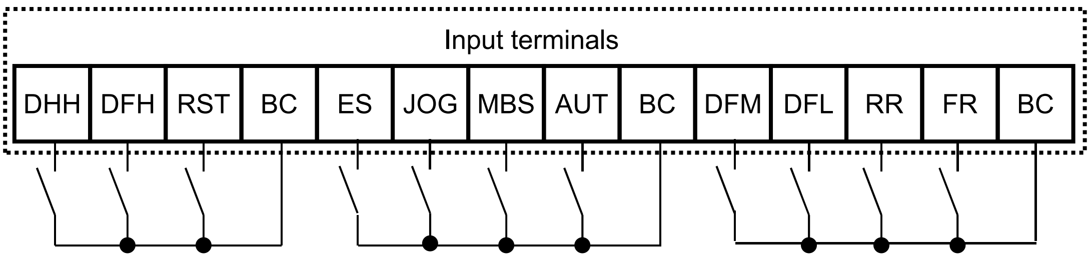
- For the content of an input signal, by allocating the functions that you want to operate to [CA-01] to [CA-11], you will be able to operate the functions with a corresponding input terminal operation.
- You can switch a contact for an input signal with the Contacts a/b selection functions of [CA-21] to [CA-31].
- When a function is selected for many targets, the targets will be set to 00 [without allocation], excluding the finally set function selection.

■Parameters

Item	Parameter	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	Next item: Table of input terminal selections	Outputs the allocated function to the corresponding input terminal.
Selection of Input terminals a/b (NO/NC)	[CA-21]~[CA-31]	00	Operates as Contact a (NO).
		01	Operates as Contact b (NC).

■Terminals corresponding to parameters

Terminal block symbol	Function setting destination parameter
FR	[CA-01]
RR	[CA-02]
DFL	[CA-03]
DFM	[CA-04]
AUT	[CA-05]
MBS	[CA-06]
JOG	[CA-07]
ES	[CA-08]
RST	[CA-09]
DFH	[CA-10]
DHH	[CA-11]



■Table of input terminal selections

Function No.	Abbreviation	Function name	Page
000	no	Without allocation	-
001	FR	Normal rotation	12-5-2
002	RR	Reverse rotation	12-5-2
003	DFL	Multistage speed 1	12-4-12
004	DFM	Multistage speed 2	12-4-12
005	DFH	Multistage speed 3	12-4-12
006	DHH	Multistage speed 4	12-4-12
007	SF1	Multistage speed bit 1	12-4-13
008	SF2	Multistage speed bit 2	12-4-13
009	SF3	Multistage speed bit 3	12-4-13
010	SF4	Multistage speed bit 4	12-4-13
011	SF5	Multistage speed bit 5	12-4-13
012	SF6	Multistage speed bit 6	12-4-13
013	SF7	Multistage speed bit 7	12-4-13
014	ADD	Addition of frequency	12-4-14
015	AUT	Switching of instruction	12-4-10
016	STA	3-wire starting up	12-5-3
017	STP	3-wire stopping	12-5-3
018	F/R	3-wire normal and reverse	12-5-3
019	AHD	Retention of analog instruction	12-4-15
020	UP	Acceleration through remote operation	12-4-14
021	DWN	Deceleration through remote operation	12-4-14
022	UDC	Clearing of remote operation data	12-4-14
023	F-OP	Forced switching of instruction	12-5-5
024	SET	Second control	12-17-1
028	RST	Reset	12-24-6
029	JOG	Jogging	12-17-3
030	DB	Braking with external direct current	12-15-2
031	AD2	2-step acceleration/deceleration	12-8-4
032	MBS	Stopping of free running	12-15-1
033	ES	External abnormality	12-16-2
034	USP	Prevention of power restoration restarting	12-16-2
035	CS	Commercial switch	12-17-2
036	SFT	Soft-lock	9-26
037	BOK	Brake check	12-17-4
038	OLR	Switching of stall prevention	12-13-2
039	KHC	Clearing of integrated input power	13-7
040	OKHC	Clearing of integrated output power	13-7
041	PID	PID1 invalidation	12-10-13
042	PIDC	Resetting of PID1 integration	12-10-13
043	PID2	PID2 invalidation	12-10-26
044	PIDC2	Resetting of PID2 integration	12-10-26
045	PID3	PID3 invalidation	12-10-26
046	PIDC3	Resetting of PID3 integration	12-10-26
047	PID4	PID4 invalidation	12-10-26
048	PIDC4	Resetting of PID4 integration	12-10-26
051	SVC1	PID1 multistage target value 1	12-10-9
052	SVC2	PID1 multistage target value 2	12-10-9
053	SVC3	PID1 multistage target value 3	12-10-9
054	SVC4	PID1 multistage target value 4	12-10-9
055	PRO	Switching of PID gain	12-10-14
056	PIO	Switching of PID output	12-10-22
058	SLEP	Satisfaction of SLEEP condition	12-10-17
059	WAKE	Satisfaction of WAKE condition	12-10-17
060	TL	Validation of torque limit	12-11-5
061	TRQ1	Torque limit switchover 1	12-11-6
062	TRQ2	Torque limit switchover 2	12-11-6
063	PPI	Switching of PPI control	12-11-1
064	CAS	Switching of control gain	12-11-1
066	FOC	Auxiliary excitation	12-14-13
067	ATR	Validation of torque control	12-11-12
068	TBS	Validation of torque bias	12-11-9

Function No.	Abbreviation	Function name	Page
069	ORT	Orientation	12-17-21
071	LAC	Cancellation of LAD	12-8-11
072	PCLR	Clearing of positional deviation	12-17-24
073	STAT	Permission to inputting of pulse string position instruction	12-17-19
074	PUP	Addition of positional bias	12-17-20
075	PDN	Subtraction of positional bias	12-17-20
076	CP1	Positional instruction selection 1	12-17-26
077	CP2	Positional instruction selection 2	12-17-26
078	CP3	Positional instruction selection 3	12-17-26
079	CP4	Positional instruction selection 4	12-17-26
080	ORL	Origin limit signal	12-17-28
081	ORG	Return-to-origin start up signal	12-17-28
082	FOT	Stopping of normal rotation driving	12-17-29
083	ROT	Stopping of reverse rotation driving	12-17-29
084	SPD	Switching of speed position	12-17-26
085	PSET	Presetting of positional data	12-17-29
086～096	-	Reserved	-
097	PCC	Clearing of pulse counter	12-24-13
098	ECOM	Starting up of EzCOM	14-17
099	-	Reserved	-
100	HLD	Stopping of acceleration/deceleration	12-8-8
101	REN	Operation permission signal	12-6-3
102	DISP	Fixation of display	12-5-4
103	PLA	Pulse string input DFH	12-24-13
104	PLB	Pulse string input DHH	12-24-13
105	EMF	Emergency forced operation	12-17-12
107	COK	Contactor check signal	12-17-9
108	DTR	Data trace starting signal	16-2
109	PLZ	Pulse string input Z	12-17-21
110	TCH	Teaching signal	12-17-27

12.24.2 Reversing the logical level of input signals

- You can set input specifications for Contact a or Contact b separately for Input terminals FR to RST, DFH, and DHH.

- Even when the "Selection of Input terminals a/b" is used, a terminal allocated with a "028 [RST] signal" always operates as Contact a (NO).

■Parameters

Item	Parameter	Data	Description
Input terminal function selection	[CA-01]~[CA-11]	Next item: Table of input terminal selections	Outputs the allocated function to the corresponding input terminal.
Selection of Input terminals a/b (NO/NC)	[CA-21]~[CA-31]	00	Operates as Contact a (NO).
		01	Operates as Contact b (NC).

- Contact a: Closes with "ON," and opens with "OFF."
- Contact b: Closes with "OFF," and opens with "ON."

Input terminal	Switching between Contact a and Contact b
FR	[CA-21]
RR	[CA-22]
DFL	[CA-23]
DFM	[CA-24]
AUT	[CA-25]
MBS	[CA-26]
JOG	[CA-27]
ES	[CA-28]
RST	[CA-29]
DFH	[CA-30]
DHH	[CA-31]

12.24.3 Adjusting the response to input signals

- You can set a response time per input terminal.
- For the correspondence between input terminals and parameters, please refer to the table shown on the right.

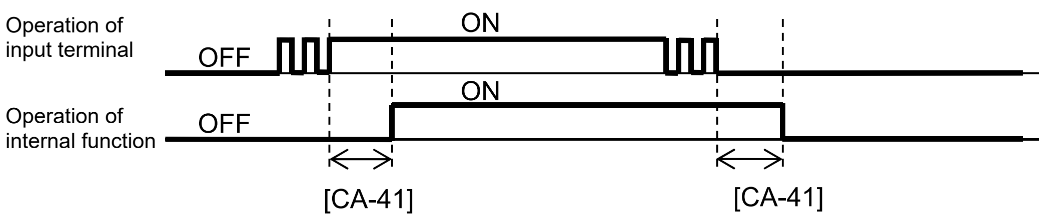
- All input signals immediately turn ON/OFF upon a condition is satisfied.
  Chattering could occur depending on a selected signal.
  This function is available for retaining/delaying such a signal.

Input terminal	Response time
FR	[CA-41]
RR	[CA-42]
DFL	[CA-43]
DFM	[CA-44]
AUT	[CA-45]
MBS	[CA-46]
JOG	[CA-47]
ES	[CA-48]
RST	[CA-49]
DFH	[CA-50]
DHH	[CA-51]

■Parameters

Item	Parameter	Data	Description
Input terminal response time	[CA-41] [CA-42] [CA-43] [CA-44] [CA-45] [CA-46] [CC-47] [CA-48] [CA-49] [CA-50] [CA-51]	0~400(ms)	Sets a response time.

Example) Operation of Input terminal FR



12.24.4 Alarm resetting

- You can release the trip of inverter.
- For resetting, press the Stop/Reset key on the operation panel or turn on the [RST] reset terminal.
- To use the reset terminal, allocate the "028 [RST] reset" to the input terminal function.
- Regardless of the settings, the reset terminal is set to serve as Contact a (NO).
- With the "Reset selection [CA-72]," you can select a timing for releasing the trip with the RST terminal. You can make the "[RST] terminal" valid only at a timing for releasing the trip in the event of an abnormality.

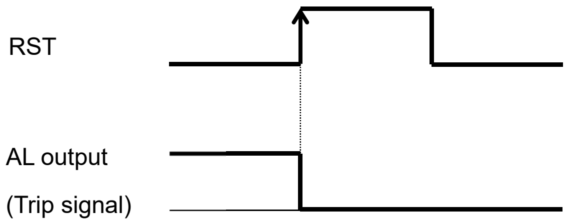
- Do not use the "[RST] reset terminal" in order to interrupt the output of the inverter. To interrupt the output of the inverter with a signal input, use the "[MBS] free run stopping terminal" of the input terminal function.
- You are not able to clear the internal data even when a reset signal is input.
- When a reset signal is input during retry stand-by, the operation starts with the frequency at the time of interruption kept un-cleared.

■Parameters

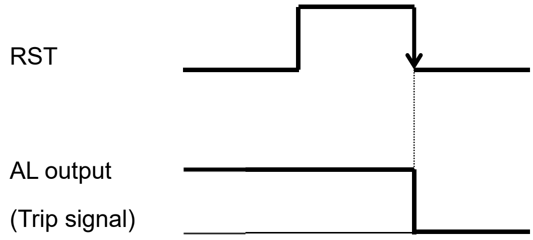
Item	Parameter	Data	Description
Reset selection	[CA-72]	00	At ON, cancels the trip (Example 1 and 3). At normal: Interrupts the output. At abnormal: Cancels the trip.
		01	At OFF, cancels the trip (Example 2 and 3). At normal: Interrupts the output. At abnormal: Cancels the trip.
		02	At ON, cancels the trip (Examples1 and 4). At normal: Invalid At abnormal: Cancels the trip.
		03	At OFF, cancels the trip (Examples 2 and 4). At normal: Invalid At abnormal: Cancels the trip.
Reset restarting selection	[bb-41]	00	Starts with 0 Hz
		01	Starts frequency adjustment
		02	Restarts frequency acquisition
Input terminals FR to RST, DFH, and DHH	[CA-01]~[CA-11]	028	RS: Reset function
Retry stand-by time for instantaneous power failure and insufficient voltage	[bb-26]	0.3~100.0(s)	A stand-by time for restarting after resetting, and after an operation instruction has been given
Lower limit setting for frequency adjustment	[bb-42]	0.00~590.00(Hz)	The lower limit frequency setting for restarting
Restarting level of frequency acquisition	[bb-43]	(0.20 to 2.50) × Inverter rated current	The current limit level when restarting frequency acquisition
Constant (frequency) for frequency acquisition restarting	[bb-44]	0.10~30.00 (sec)	The deceleration rate at the time of frequency acquisition
Constant (voltage) for frequency acquisition restarting	[bb-45]		The start time of frequency acquisition
Excessive current prevention level at the time of frequency acquisition	[bb-46]	(0.00 to 2.50) × Inverter rated current	The limit current value setting for the excessive current prevention level at the time of frequency acquisition
Start frequency selection at the time of frequency acquisition	[bb-47]	00	Frequency at the time of interruption
		01	Maximum frequency
		02	Set frequency

■Examples of resetting operations

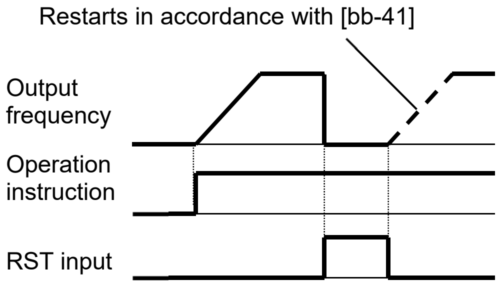
Example 1)
Cancelling the trip at ON ([CA-72] =00, 02)



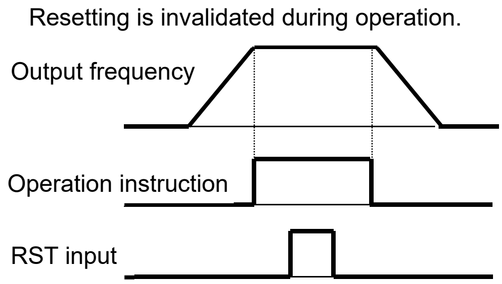
Example 2)
Cancelling the trip at OFF ([CA-72]=01,03)



Example 3)
Validating resetting at normal ([CA-72] =00, 01)

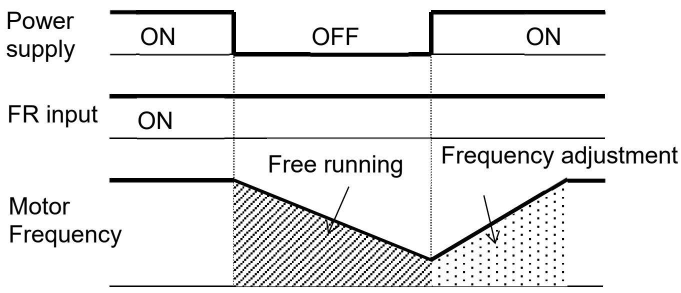


Example 4)
Invalidating resetting at normal ([CA-72]=02,03)

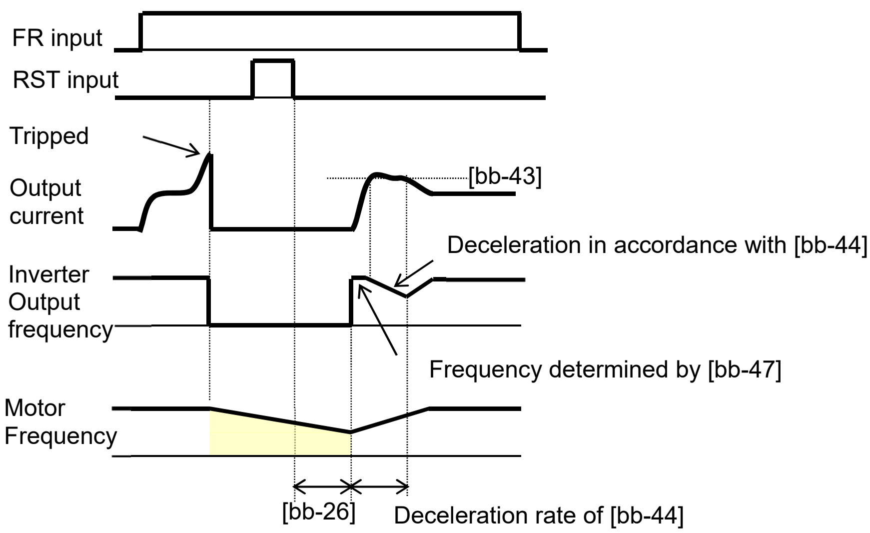


■Examples of restarting when resetting

Example 5) When frequency adjustment restarting is selected ([bb-41] =01)



Example 6) When frequency acquisition restarting is selected ([bb-41] =02)



- In the "Reset restarting selection [bb-41]," selecting "01 (frequency adjustment restarting)" allows you to perform the frequency adjustment restarting when turning on the power supply again.
  When "00 (Restarting with 0 Hz)" is set, the operation starts from 0 Hz without waiting for the "Retry stand-by time for instantaneous power failure and insufficient voltage [bb-26]."

- Even when the frequency adjustment restarting is selected, the "Restarting with 0 Hz" occurs in the cases shown below.
  - When an output frequency is 1/2 of a base frequency or below
  - When the induced voltage of the motor quickly attenuates
  - When the "Lower limit setting for frequency adjustment [bb-42]" is set, and a frequency equal to or below this set frequency is detected

  - After the "Retry stand-by time for instantaneous power failure and insufficient voltage [bb-26]" has elapsed, the output starts at a frequency conforming to the "Constant (frequency) for frequency acquisition restarting [bb-44]."
    After that, during a time of the "Constant (voltage) for restarting [bb-45]," the motor speed is acquired. At that time, to reduce the output current with the "Restarting level of acquisition [bb-43]," deceleration occurs in accordance with the "Constant (frequency) for restarting [bb-44]."
  - When the output current lowers below the "Restarting level of acquisition [bb-43]," acceleration starts.
    If a trip occurs due to an excessive current even in this method, lower the "Restarting level of acquisition [bb-43]" or the "Excessive current prevention level [bb-46]."

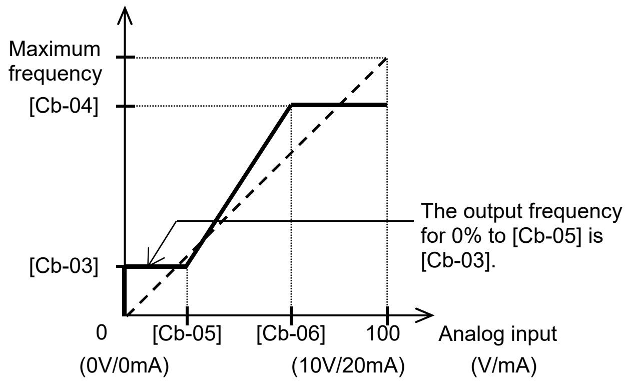
  - When the "Start frequency selection [bb-47]" is set to "00 (Frequency at the time of interruption)," the operation starts at a frequency at the time of the previous interruption even when a reset signal is input during retry stand-by.

12.24.5 Adjusting analog input

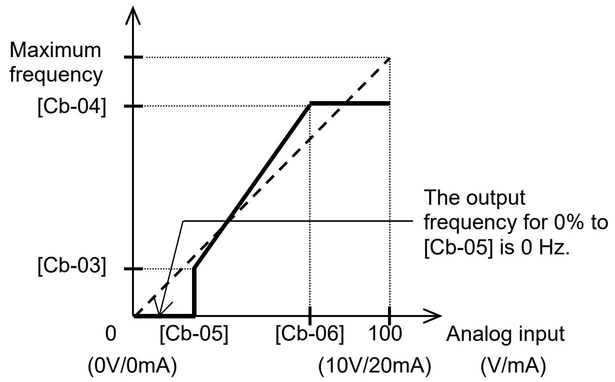
■Adjusting the relationship between Analog input VRF and frequency instruction

Item	Parameter	Data	Description
[VRF terminal input filter time constant	[Cb-01]	1~500(ms)	Filters the input.
[VRF] terminal start amount	[Cb-03]	0.00 ~100.00(%)	Sets a frequency instruction ratio when setting a start ratio for analog input.
[VRF] terminal end amount	[Cb-04]		Sets a frequency instruction ratio when setting an end ratio for analog input.
[VRF] terminal start ratio	[Cb-05]	0.0 ~[Cb-06](%)	With respect to a minimum ratio for analog input for 0 to 10 V/0 to 20 mA, sets a start ratio.
[VRF] terminal end ratio	[Cb-06]	[Cb-05] ~100.0(%)	With respect to an external frequency instruction for 0 to 10 V, 0 to 20 mA, sets an end ratio.
[VRF] terminal start selection	[Cb-07]	00	For an instruction for a value of one of 0.00% to the "Start amount [Cb-03]" and to the "End amount [Cb-04]," whichever is lower, one of the values of the "Start amount [Cb-03]" and the "End amount [Cb-04]," whichever is lower, is output.
		01	For an instruction for a value of one of 0.00% to the "Start amount [Cb-03]" and to the "End amount [Cb-04]," whichever is lower, a value of 0.00% is output.

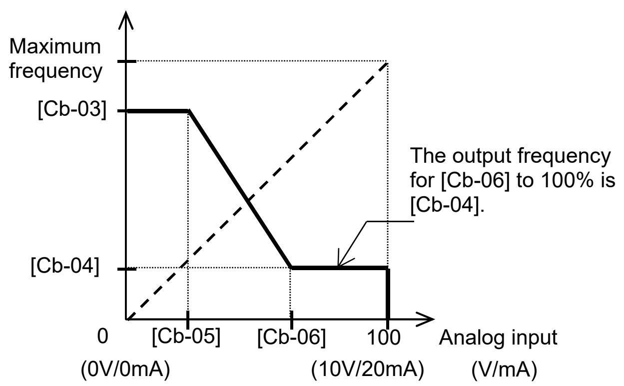
(Example 1-1) [Cb-07]=00



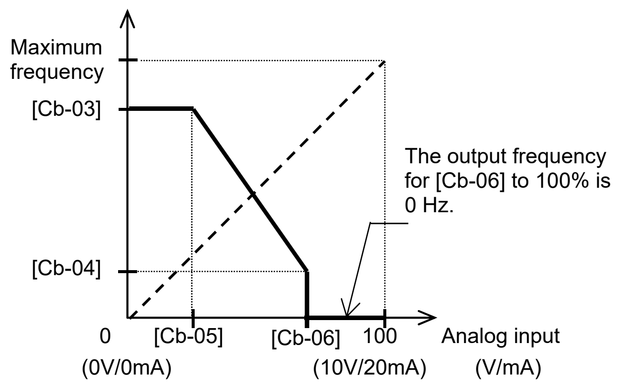
(Example 2-1) [Cb-07]=01



(Example 1-2) [Cb-07]=00



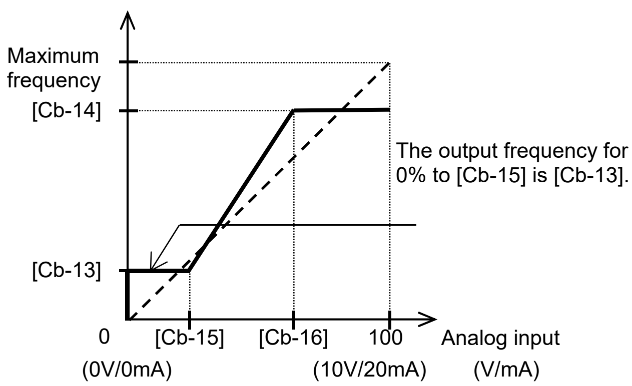
(Example 2-2) [Cb-07]=01



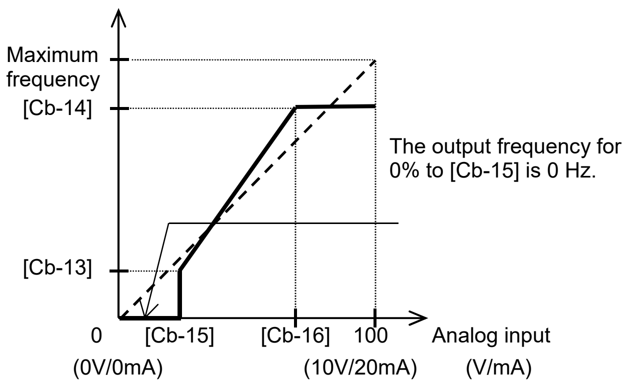
■Adjusting the relationship between Analog input IRF and frequency instruction

Item	Parameter	Data	Description
[IRF] terminal input filter time constant	[Cb-11]	1~500(ms)	Filters the input.
[IRF] terminal start amount	[Cb-13]	0.00 ~100.00(%)	Sets a frequency instruction ratio when setting a start ratio for analog input.
[IRF] terminal end amount	[Cb-14]		Sets a frequency instruction ratio when setting an end ratio for analog input.
[IRF] terminal start ratio	[Cb-15]	0.0 ~[Cb-16](%)	With respect to a minimum ratio for analog input for 0 to 10 V/0 to 20 mA, sets a start ratio.
[IRF] terminal end ratio	[Cb-16]	[Cb-17] ~100.0(%)	With respect to an external frequency instruction for 0 to 10 V, 0 to 20 mA, sets an end ratio.
[IRF] terminal start selection	[Cb-17]	00	For an instruction for a value of one of 0.00% to the "Start amount [Cb-13]" and to the "End amount [Cb-14]," whichever is lower, one of the values of the "Start amount [Cb-13]" and the "End amount [Cb-14]," whichever is lower, is output.
		01	For an instruction for a value of one of 0.00% to the "Start amount [Cb-14]" and to the "End amount [Cb-15]," whichever is lower, a value of 0.00% is output.

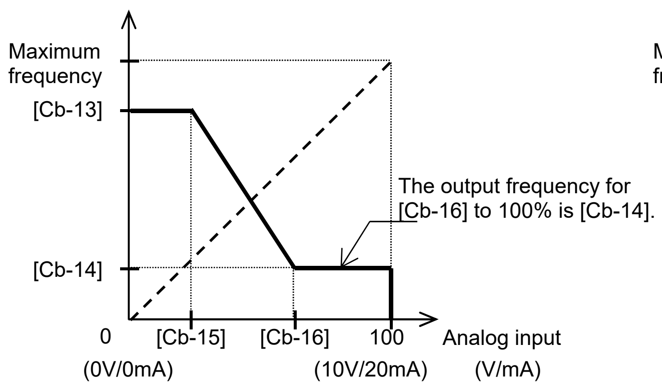
(Example 1-1) [Cb-17]=00



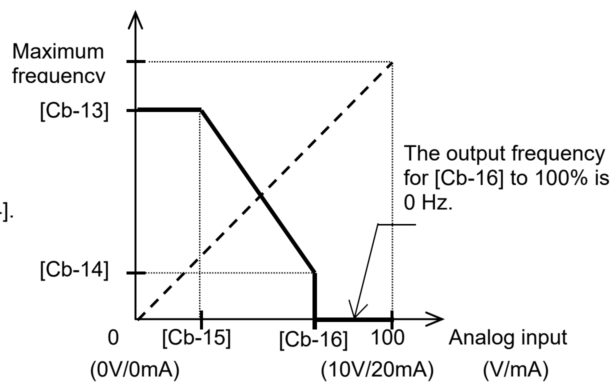
(Example 2-1) [Cb-18]=01



(Example 1-2) [Cb-17]=00



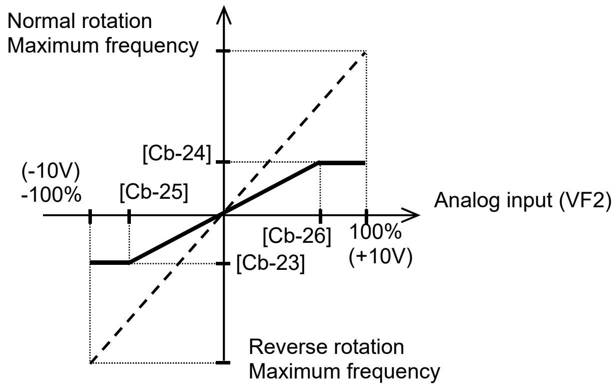
(Example 2-2) [Cb-17]=01



■Adjusting the relationship between Analog input VF2 and frequency instruction

Item	Parameter	Data	Description
[VF2] terminal input filter time constant	[Cb-21]	1~500(ms)	Filters the input.
[VF2] terminal selection	[Cb-22]	00	Individual
		01	Added to [VRF]/[IRF], with reversibility
		02	Added to [VRF]/[IRF], without reversibility
[VF2] terminal start amount	[Cb-23]	-100.00~100.00(%)	Sets a frequency instruction ratio when setting a start ratio for analog input.
[VF2] terminal end amount	[Cb-24]		Sets a frequency instruction ratio when setting an end ratio for analog input.
[VF2] terminal start ratio	[Cb-25]	-100.0~[Cb-26](%)	With respect to a minimum ratio for analog input for -10 to 10V, sets a start ratio.
[VF2] terminal end ratio	[Cb-26]	[Cb-25]~100.0(%)	With respect to an external frequency instruction for -10 to 10 V, sets an end ratio.

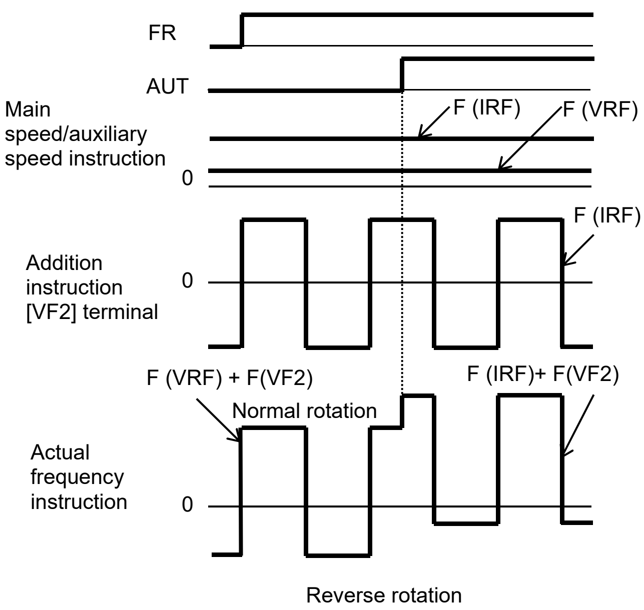
(Example 3)



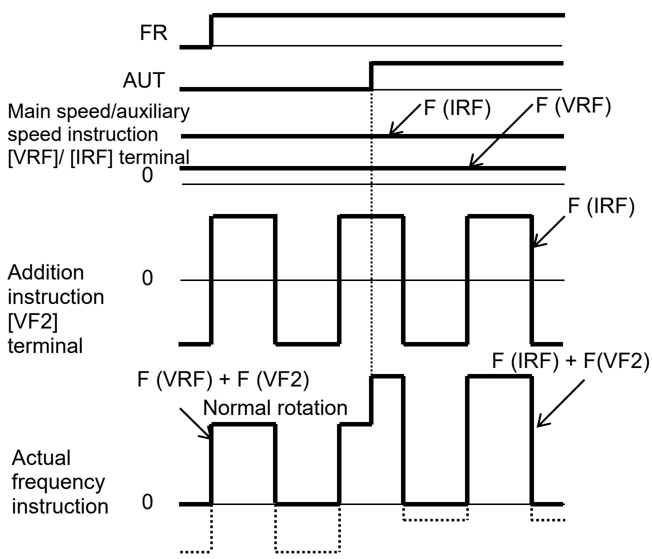
■Adding analog input [VF2] to [VRF] and [IRF]

- You can forcibly add an input of the [VF2] terminal to [VRF]/ [IRF].
- You are able to make an input of ±10 V to the [Ai3] terminal. Use [Cb-22] to select whether the output of reversibility for normal rotation or reverse rotation is possible after making an addition.

(Example 4-1) [Cb-22]=01 (with reversibility)



(Example 4-2) [Cb-22]=02 (without reversibility)



■Stabilizing signals of analog inputs

- To give a frequency instruction with an external analog signal, you can set a sampling time for voltage input or current input.
- This feature is effective for removing noise from the frequency setting circuit.

- Increase the set value if noise negatively affects a stable operation.
  Note that the greater the set value, the lower the responsiveness.
  When this feature is used for a PID instruction, and a filter is set, the filter would affect the feedback, and therefore a fine operation would not be achieved.

Item	Parameter	Data	Description
[VRF] terminal input filter time constant	[Cb-01]	1.~500.(ms)	Sets a time constant for the input filter.
[IRF] terminal input filter time constant	[Cb-11]		
[VF2] terminal input filter time constant	[Cb-21]		

12.24.6 Checking the number of input pulses

- For the pulse counting function, the terminal input monitoring mode and the phase coefficient monitoring mode are available.
- When the "Selection of targets for pulse string input detection [CA-90]" ranges from 00 to 02, the terminal input monitoring mode becomes valid. When [CA-90] is set to "03 (pulse count)," the phase coefficient monitoring mode becomes valid.
- You can monitor the acquired pulses with the pulse counter monitor served as an accumulation counter.
- By turning on [PCC] (Clearing of pulse counter), you can clear the accumulated counter value.

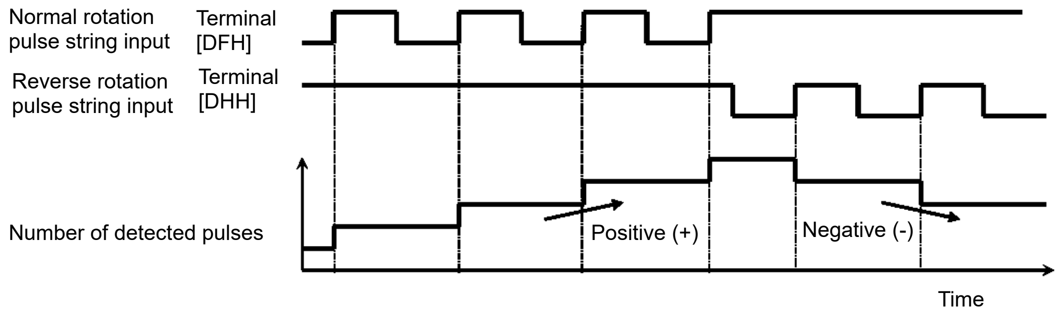
- The maximum input pulse in the phase coefficient monitoring mode becomes a maximum of 32 kpps. (When the duty ratio is approximately 50%)
- An accumulation counter value cannot be stored. After the power supply is turned on, the value becomes zero.
- The maximum input pulse in the terminal input monitoring mode depends on the settings of the input terminal response functions [CA-41] to [CA-51].

■Parameters

Item	Parameter	Data	Description
Input terminal function	[CA-01]~[CA-11]	103	[PLA]: Accepts a pulse input.
		104	[PLB]: Accepts a pulse input.
		097	[PCC]: Clears the integrated value.
Output terminal function	[CC-01]~[CC-07]	091	[PCMP]: Outputs pulse compare-match signals.
Selection of targets for pulse string input detection	[CA-90]	00	PCNT function
		01	Instruction
		02	Speed feedback
		03	Pulse count
Pulse count compare-match output ON level	[CA-97]	0~65535	When the number of pulses reaches this set value, Turn on [PCMP].
Pulse count compare-match output OFF level	[CA-98]		When the number of pulses reaches this set value, Turn off [PCMP].
Maximum value for pulse count compare-match output	[CA-99]		A one-shot pulse can be achieved when the value is 0. When the number of pulses reaches the set value, the internal counter is cleared.
Pulse counter monitor	[dA-28]	0~2147483647	Displays the counter integrated value.

■Terminal input monitoring mode

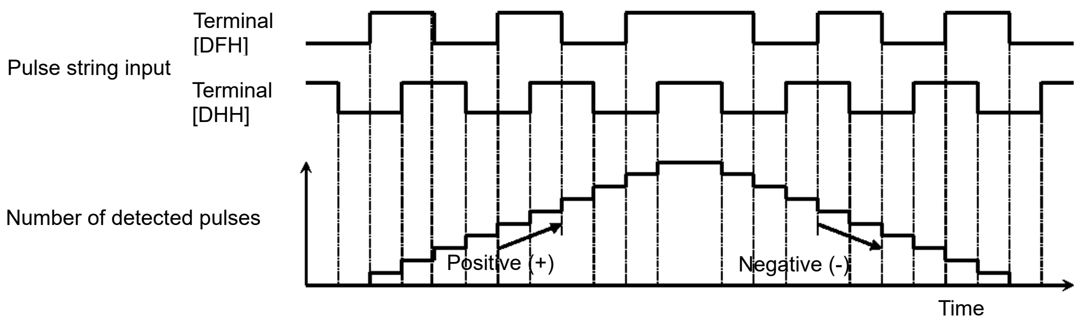
- Monitors whether the input terminal functions [PLA] and [PLB] are turned on.



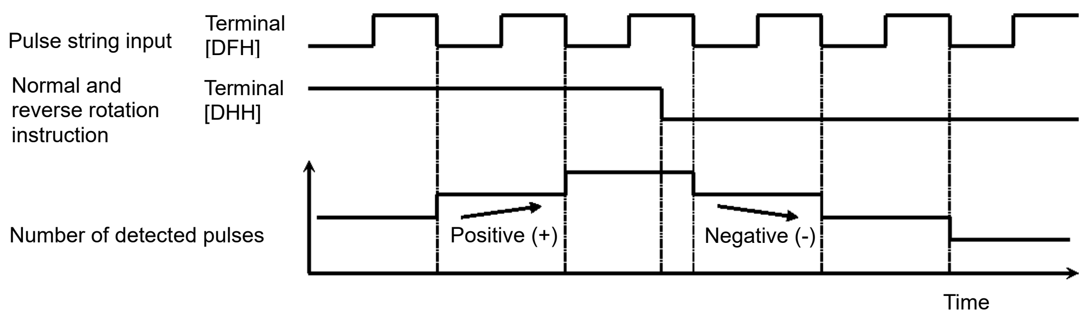
■Phase coefficient monitoring mode

- Input terminals [DFH] and [DHH] become available for pulse string inputs.

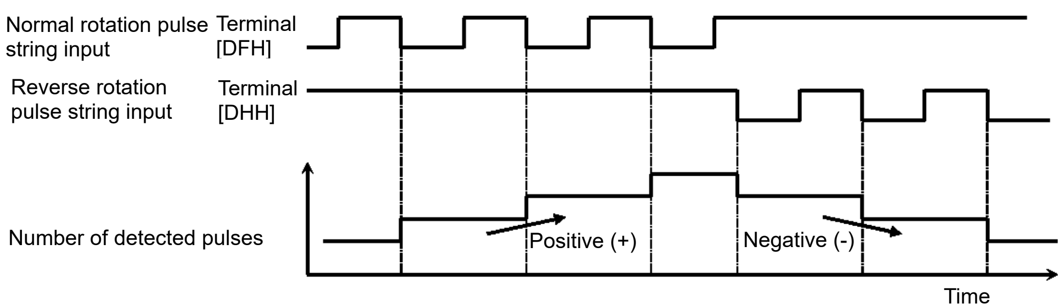
(1) Mode 0: [CA-91]=00 90° Phase difference pulse string



(2) Mode 1: [CA-91]=01 Normal and reverse rotation instruction + Pulse string

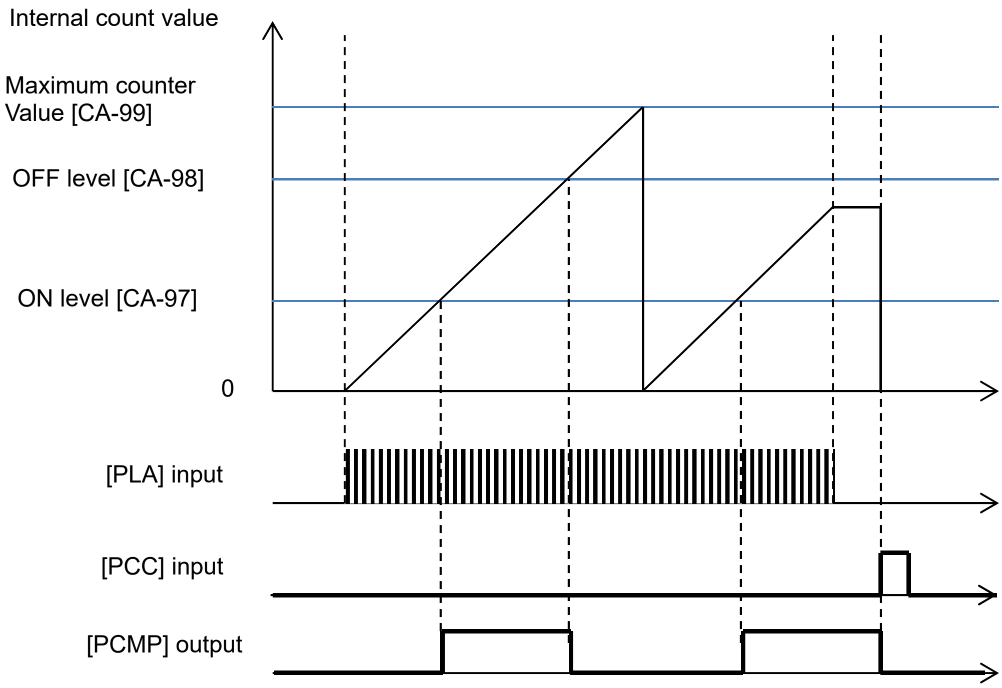


(3) Mode 2: [CA-91]=02 Normal rotation pulse string + Reverse rotation pulse string



■Example of pulse counter operation

- The following shows how the pulse counter operates.
- You can monitor the acquired pulses with the pulse counter monitor [dA-28] served as an accumulation counter.



12.24.7 Performing resetting automatically

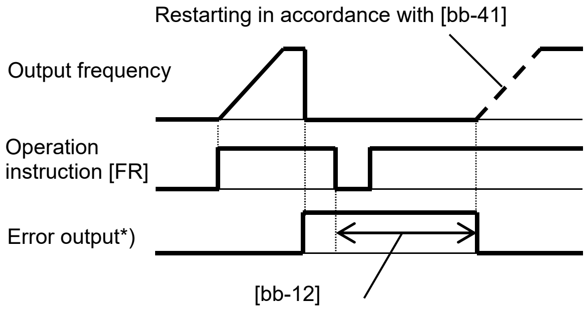
- When the "[bb-10] automatic reset selection" is set to 01, resetting is performed after the "[bb-12] automatic resetting stand-by time" has elapsed from when an operation instruction has been turned off.
- When the "[bb-10] automatic reset selection" is set to 02, resetting is performed after the "[bb-12] automatic resetting stand-by time" has elapsed from when an error has occurred.

- When the "[bb-10] automatic reset selection" is set to 01, resetting starts when the STOP/RESET key is pressed as long as an instruction is given through the operation panel.
- When resetting is performed manually, and a control power supply is turned on again, the number of automatic resetting counted in internal is cleared.

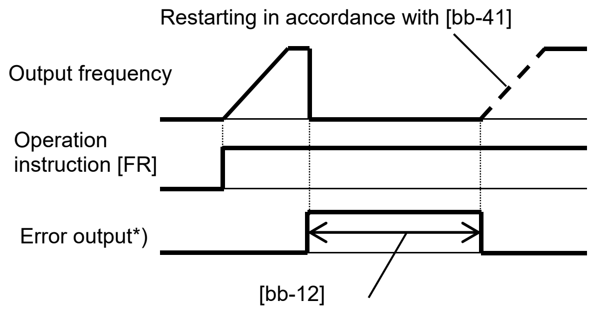
- By setting the "Alarm output selection [bb-11]" to 01 while automatic resetting is valid, you can invalidate the output of the "Alarm [AL]" during automatic resetting operation.
- Upon automatic resetting has been performed for the number of times set with the "[bb-13] automatic resetting count setting," no error will be released, but a trip occurs.

■Example operation of automatic resetting

Example 1) When [bb-10]=01



Example 2) When [bb-10]=02



*) When [bb-11] =00, the error output becomes the "[AL] output."

■Parameters

Item	Parameter	Data	Description
Automatic reset selection	[bb-10]	00	Invalid
		01	Resetting starts when the operation instruction is turned off.
		02	Resetting starts after the set time has elapsed.
Alarm output selection when the automatic resetting is valid	[bb-11]	00	Outputting is available.
		01	Outputting is not available.
Automatic resetting stand-by time	[bb-12]	0~600(s)	Sets a stand-by time from when resetting starts to when actual resetting starts.
Automatic resetting count setting	[bb-13]	0 to 10 (times)	Sets the number of automatic resetting.

12.25 Output Signal

12.25.1 Using the output signal function externally

- Output terminals UPF to X3 are used for open collector output, and Relay output terminals RL and FL are used for relay output. Relay output RL serves as a contact a relay, and Relay output FL serves as a contact c relay.

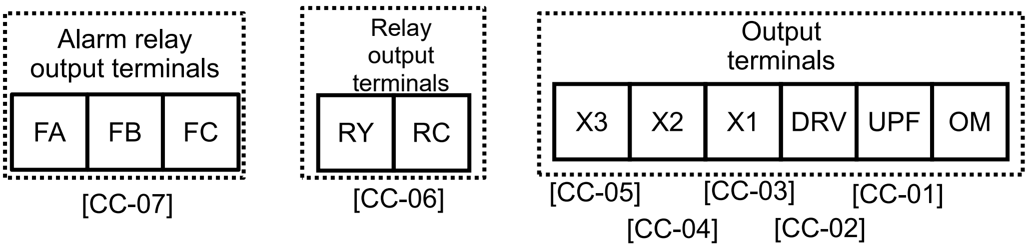
- To use the contact c relay, please check the control circuit power supply and the relay output terminals whether they are turned on or off.

- For the content of an output signal, by allocating the functions that you want to output to [CC-01] to [CC-07], you will be able to allow the corresponding output terminal contacts to operate.
- You can switch an output signal level with the Contacts a/b selection functions of [CC-11] to [CC-17].

■Parameters

Item	Parameter	Data	Description
Output terminal function selection	[CC-01]~[CC-05]	Next item: Table of output terminal selections	Outputs the allocated function to the corresponding output terminal.
Relay output terminal function selection	[CC-06]		
Relay output terminal function selection	[CC-07]		
Output terminal function selection	[CC-11]~CC-15]	00	Operates as Contact a (NO).
Relay output terminal function selection a/b (NO/NC) selection	[CC-16]		
Relay output terminal function selection a/b (NO/NC) selection	[CC-17]	01	Operates as Contact b (NC).

■Terminals corresponding to parameters



■Table of output terminal selections

Function No.	Abbreviation	Function name	Page
000	No	Without allocation	-
001	DRV	During operation	12-20-1
002	UPF1	When the constant speed is attained	12-21-1
003	UPF2	Equal to or above the set frequency	12-21-2
004	UPF3	Set frequency only	12-21-3
005	UPF4	Equal to or above the set frequency 2	12-21-2
006	UPF5	Set frequency only 2	12-21-3
007	IRDY	Operation ready completion	12-20-4
008	FRR	During normal rotation operation	12-20-2
009	RRR	During reverse rotation operation	12-20-2
010	FREF	Frequency command panel	12-4-2
011	REF	Operation command panel	12-5-1
012	SETM	Second control under selection	12-17-1
016	OPO	Optional output	14-30
017	AL	Alarm signal	12-19-1
018	MJA	Severe failure signal	12-19-2
019	OTQ	Excessive torque	12-11-7
020	IP	During instantaneous power failure	12-19-6
021	UV	Under insufficient voltage	12-19-7
022	TRQ	During torque limitation	12-11-6
023	IPS	During power failure deceleration	12-13-16
024	RNT	RUN time elapsed	12-19-11
025	ONT	Power supply ON time elapsed	12-19-12
026	THM	Electronic thermal warning (motor)	12-19-10
027	THC	Electronic thermal warning (inverter)	12-19-9
029	WAC	Capacitor life advance notice	12-19-10
030	WAF	Fan life advance notice	12-19-11
031	FS	Operation command signal	12-20-3
032	OHF	Cooling fin heating advance notice	12-19-10
033	LOC	Low current signal	12-19-5
034	LOC2	Low current signal 2	12-19-5
035	OL	Overload advance notice	12-19-4
036	OL2	Overload advance notice 2	12-19-4
037	BRK	Brake release	12-17-4
038	BER	Brake abnormality	12-17-4
039	CON	Contactor control	12-17-9
040	ZS	0 Hz detection signal	12-21-4
041	DSE	Excessive speed deviation	12-16-8
042	PDD	Excessive positional deviation	12-17-20
043	POK	Positioning completed	12-17-21
044	PCMP	Pulse count compare-match	12-24-13
045	OD	PID excessive deviation	12-10-27
046	FBV	PID feedback comparison	12-10-28
047	OD2	PID2 excessive deviation	12-10-27
048	FBV2	PID2 feedback comparison	12-10-28
049	NDc	Communication disconnection	14-3
050	VRFDc	Analog disconnection VRF	12-22-1
051	IRFDc	Analog disconnection IRF	12-22-1
052	VF2Dc	Analog disconnection VF2	12-22-1
053	Ai4Dc	Analog disconnection Ai4	12-22-4
054	Ai5Dc	Analog disconnection Ai5	12-22-4
055	Ai6Dc	Analog disconnection Ai6	12-22-4
056	WCVRF	Window comparator Ai1	12-22-1
057	WCIRF	Window comparator Ai2	12-22-1
058	WCVF2	Window comparator Ai3	12-22-1
059	WCAi4	Window comparator Ai4	12-22-4
060	WCAi5	Window comparator Ai5	12-22-4
061	WCAi6	Window comparator Ai6	12-22-4
062	LOG1	Result of logical operation 1	12-23-1
063	LOG2	Result of logical operation 2	
064	LOG3	Result of logical operation 3	
065	LOG4	Result of logical operation 4	
066	LOG5	Result of logical operation 5	
067	LOG6	Result of logical operation 6	
068	LOG7	Result of logical operation 7	
06 to 075	-	Reserved	-
076	EMFC	During-Em-Force signal	12-17-12
077	EMBP	During-bypass-mode signal	12-17-14
078	WFT	Trace function trigger stand-by signal	16-2

Function No.	Abbreviation	Function name	Page
079	TRA	Trace function during-tracing signal	16-2
080	LBK	Operation panel battery insufficient	9-37
081	OVS	Excessive voltage of accepted power	12-19-12
084	AC0	Alarm code bit 0	12-19-3
085	AC1	Alarm code bit 1	
086	AC2	Alarm code bit 2	
087	AC3	Alarm code bit 3	
089	OD3	PID3 excessive deviation	12-10-27
090	FBV3	PID3 feedback comparison	12-10-28
091	OD4	PID4 excessive deviation	12-10-27
092	FBV4	PID4 feedback comparison	12-10-28
093	SSE	PID soft start abnormality	12-10-16

12.25.2 Reversing the output level of output signals

- You can set output specifications for Contact a or Contact b separately for Output terminals UPF to X3 and Relay output terminals RL and FL.

■Parameters

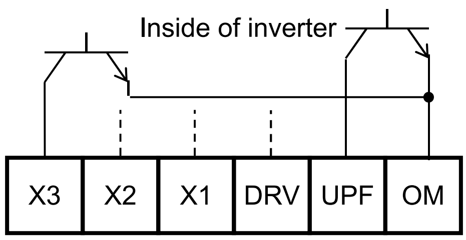
Item	Parameter	Data	Description
Output terminal function selection	[CC-11] ~ [CC-15]	00、01	00: Contact a (normally open) operation 01: Contact b (normally closed) operation
Relay output terminal function selection a/b (NO/NC) selection	[CC-16]		
Relay output terminal function selection a/b (NO/NC) selection	[CC-17]		

- Contact a: Closes with "ON," and opens with "OFF."
- Contact b: Closes with "OFF," and opens with "ON."

■Open collector output terminals

- The specifications of Output terminals UPF to X3 are as shown below. The same specifications are applied.

	Electrical characteristics
Terminals (UPF to X3)-OM	Voltage drop at ON: 4 V or below Allowable maximum voltage: DC 27 V Allowable maximum current: 50 mA

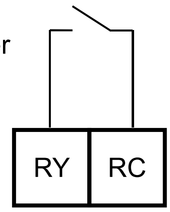


- The open collector output operation is as shown below.

[CC-11]~ [CC-15]	Control power supply	Output of inverter function	Open collector operation
00 (Contact a)	On	ON	Close
		OFF	Open
	Off	-	-
01 (Contact b)	On	ON	Open
		OFF	Close
	Off	-	-

■Relay 1a output terminals
- The specifications of Relay 1a output terminals RY to RC are as shown below.

Inside of inverter



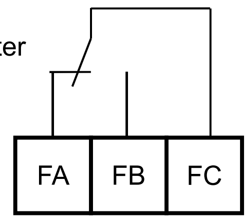
	Electrical characteristics
RY-RC	Voltage drop at ON: 4 V or below Allowable maximum voltage: DC 27 V Allowable maximum current: 50 mA

- The operations of RY to RC are as shown below.

[CC-16]	Control power supply	Output of inverter function	Relay operation
00 (Contact a)	On	ON	Close
		OFF	Open
	Off	-	Open
01 (Contact b)	On	ON	Open
		OFF	Close
	Off	-	Open

■Relay 1c output terminals
- The specification of Relay 1c output terminals FA to FC / FB to FC are as shown below.

Inside of inverter



		Resistance load	Induced load
FB-FC	Maximum contact capacity	AC250V, 2A DC30V, 3A	AC250V, 0.2A DC30V, 0.6A
	Minimum contact capacity	AC100V, 10mA DC5V, 100mA	
FA-FC	Maximum contact capacity	AC250V, 1A DC30V, 1A	AC250V, 0.2A DC30V, 0.2A
	Minimum contact capacity	AC100V, 10mA DC5V, 100mA	

- The operations of FA to FC / FB to FC are as shown below.

[CC-17]	Control power supply	Output of inverter function	Output terminal state	
			FB-FC	FA-FC
00	On	ON	Close	Open
		OFF	Open	Close
	Off	-	Open	Close
01 (Initial value)	On	ON	Open	Close
		OFF	Close	Open
	Off	-	Open	Close

12.25.3 Delaying and retaining output signals

- You can set an on-delay/off-delay time per output terminal.
- You can make a setting per output terminal. For the correspondence between output terminals and parameters, please refer to the table shown on the right.

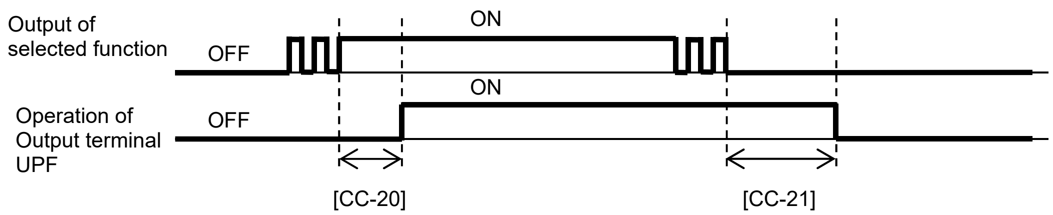
- All output signals immediately turn ON/OFF upon a condition is satisfied. Chattering could occur depending on a selected signal. This function is available for retaining/delaying such a signal.

Output terminals	On-delay time	Off-delay time
UPF	[CC-20]	[CC-21]
DRV	[CC-22]	[CC-23]
X1	[CC-24]	[CC-25]
X2	[CC-26]	[CC-27]
X3	[CC-28]	[CC-29]
RY-RC	[CC-30]	[CC-31]
FB-FC / FA-FC	[CC-32]	[CC-33]

■Parameters

Item	Parameter	Data	Description
Output on-delay time	[CC-20] [CC-22] [CC-24] [CC-26] [CC-28] [CC-30] [CC-32]	0.00~100.00(s)	Sets an on-delay time.
Output off-delay time	[CC-21] [CC-23] [CC-25] [CC-27] [CC-29] [CC-31] [CC-33]		Sets an off-delay time.

Example) Operation of Output terminal UPF



12.25.4 Selecting data to be output

■Selectable parameter codes

- The below table shows selectable parameter codes.
- The output scale ranges are specified when bias settings are each set to 0.0%, and gain settings are each set to 100.0%.

- You can select, using some parameter codes, data to be output to the Analog output AMV-COM and AMI-COM terminals and the Digital pulse output FRQ-P- terminal.

- You can adjust the output scale ranges with bias settings and gain settings.
- Using the bias function, you can output, from data that can output "(±) data," "(-) data" in a range from which outputting is available.

<table>
<tr><th>Code</th><th>Name</th><th>Output scale range (Corresponding to 0 to 10 V / 0 to 20 mA / 0 to 100%)</th><th>Remarks</th></tr>
<tr><td>dA-01</td><td>Output frequency monitor</td><td>0.00 to Maximum speed (Hz)</td><td rowspan="7">Outputting is possible with (±).</td></tr>
<tr><td>dA-02</td><td>Output current monitor</td><td>(0.00 to 2.00) × Inverter rated current (A)</td></tr>
<tr><td>dA-04</td><td>Frequency command</td><td rowspan="2">0.00 to Maximum speed (Hz)</td></tr>
<tr><td>dA-10</td><td>Estimated speed value monitor</td></tr>
<tr><td>dA-15</td><td>Torque command monitor</td><td rowspan="3">0 to Motor rated torque × 500% (Nm)</td></tr>
<tr><td>dA-16</td><td>Torque limit monitor</td></tr>
<tr><td>dA-17</td><td>Output torque monitor</td></tr>
<tr><td>dA-18</td><td>Output voltage monitor</td><td>0 to Rated voltage × 133% (V)</td><td rowspan="9">-</td></tr>
<tr><td>dA-30</td><td>Input power monitor</td><td rowspan="2">0.00 to Rated power × 200% (kW)</td></tr>
<tr><td>dA-34</td><td>Output power monitor</td></tr>
<tr><td>dA-40</td><td>DC voltage monitor</td><td>(200 V class) 0.0 to 400.0 (Vdc)
(400 V class) 0.0 to 800.0 (Vdc)</td></tr>
<tr><td>dA-41</td><td>Braking circuit (DBTR) duty ratio monitor</td><td rowspan="5">0.00~100.00(%)</td></tr>
<tr><td>dA-42</td><td>Electronic thermal duty ratio monitor (motor)</td></tr>
<tr><td>dA-43</td><td>Electronic thermal duty ratio monitor (inverter)</td></tr>
<tr><td>dA-61</td><td>Analog input [VRF] monitor</td></tr>
<tr><td>dA-62</td><td>Analog input [IRF] monitor</td></tr>
<tr><td>dA-63</td><td>Analog input [VF2] monitor</td><td rowspan="2">-100.00~100.00(%)</td><td rowspan="2">Outputting is possible with (±).</td></tr>
<tr><td>dA-70</td><td>Pulse string input monitor (main body)</td></tr>
</table>

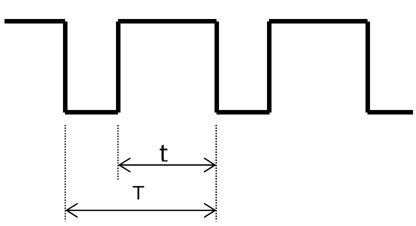
<table>
<tr><th>Code</th><th>Name</th><th>Output scale range (Corresponding to 0 to 10 V / 0 to 20 mA / 0 to 100%)</th><th>Remarks</th></tr>
<tr><td>db-30</td><td>PID1 feedback data 1 monitor</td><td rowspan="11">-100.00~100.00(%)</td><td rowspan="11">Outputting is possible with (±).</td></tr>
<tr><td>db-32</td><td>PID1 feedback data 2 monitor</td></tr>
<tr><td>db-36</td><td>PID2 feedback data monitor</td></tr>
<tr><td>db-42</td><td>PID1 target value monitor</td></tr>
<tr><td>db-44</td><td>PID1 feedback data monitor</td></tr>
<tr><td>db-50</td><td>PID1 output monitor</td></tr>
<tr><td>db-51</td><td>PID1 deviation monitor</td></tr>
<tr><td>db-52</td><td>PID1 deviation 1 monitor</td></tr>
<tr><td>db-53</td><td>PID1 deviation 2 monitor</td></tr>
<tr><td>db-55</td><td>PID2 output monitor</td></tr>
<tr><td>db-56</td><td>PID2 deviation monitor</td></tr>
<tr><td>db-64</td><td>PID feedforward monitor</td><td>0.00~100.00(%)</td><td rowspan="4">-</td></tr>
<tr><td>dC-15</td><td>Cooling fin temperature monitor</td><td>-20.0~200.0(°C)</td></tr>
<tr><td>FA-01</td><td>Main speed command monitor</td><td rowspan="2">0.00~590.00(Hz)</td></tr>
<tr><td>FA-02</td><td>Auxiliary speed command monitor</td></tr>
<tr><td>FA-15</td><td>Torque command monitor</td><td rowspan="2">Motor rated torque × (-500.0 to 500.0(%))</td><td rowspan="2">Outputting is possible with (±).</td></tr>
<tr><td>FA-16</td><td>Torque bias command monitor</td></tr>
<tr><td>FA-30</td><td>PID1 target value 1</td><td rowspan="3">0.00~100.00(%)</td><td>-</td></tr>
<tr><td>FA-32</td><td>PID1 target value 2</td><td rowspan="2">Outputting is possible with (±).</td></tr>
<tr><td>FA-36</td><td>PID2 target value</td></tr>
</table>

12.25.5 Pulse-outputting data

- With the FRQ output function, you can make selections from the PWM output in which a duty ratio changes and the digital frequency output in which a frequency changes.

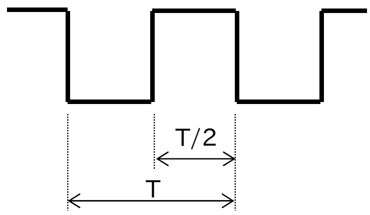
- The finally determined output does not exceed an output range of the [FRQ] output terminal.
- When [Cd-10] =01 is set, [FRQ], [AMV], and [AMI] respectively perform outputs in accordance with the values of [Cd-15], [Cd-25], and [Cd-35].

(Example 1) [Cd-01]=00 PWM output



Frequency T: Constant (6.4 ms)
Duty ratio t/T: Changes

(Example 2) [Cd-01]=01 Digital frequency output



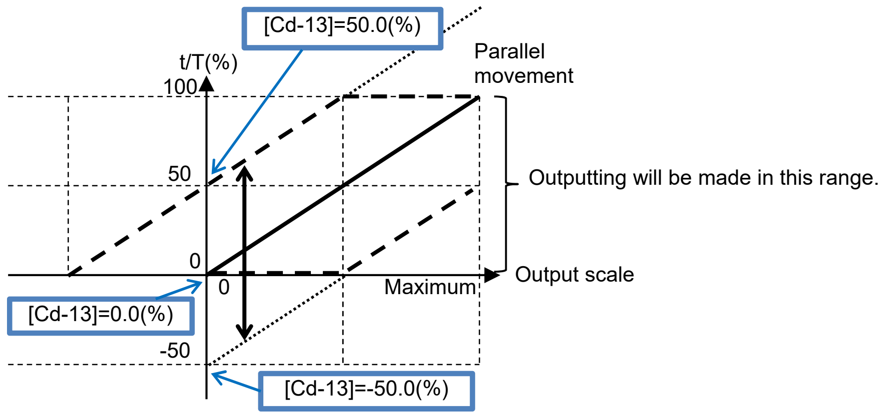
Frequency T: Changes
Duty ratio (approximately 1/2): Fixed

■Parameters

Item	Parameter	Data	Description
[FRQ] terminal output form selection	[Cd-01]	00	PWM output (Frequency: 6.4 ms)
		01	Digital frequency output
[FRQ] terminal standard frequency (during digital frequency output)	[Cd-02]	0~3600[Hz]	[FRQ] terminal output frequency in the full scale.
[FRQ] terminal output selection	[Cd-03]	Parameter number for "12.25.4 Selecting data to be output"	Sets a parameter number.
Analog monitor adjustment mode selection	[Cd-10]	00	Invalid.
		01	Valid. Outputs to terminals output levels in the adjustment mode.
[FRQ] output filter time constant	[Cd-11]	1~500[ms]	Filters FRQ output data.
[FRQ] output data type selection	[Cd-12]	00	Outputs the absolute value of data.
		01	Outputs data with a symbol.
[FRQ] Bias	[Cd-13]	-100.0~100.0[%]	Biases data to adjust Point 0 of data.
[FRQ] gain	[Cd-14]	-1000.0~1000.0[%]	Apply a gain to data to adjust an inclination in data.
[FRQ] output level in the adjustment mode	[Cd-15]	-100.0~100.0[%]	Sets output in the adjustment mode. It selects the maximum output (at 100.0%), the minimum output (at 0.0%) ([Cd-12]=00), or the minimum output (at -100.0%) ([Cd-12]=01).

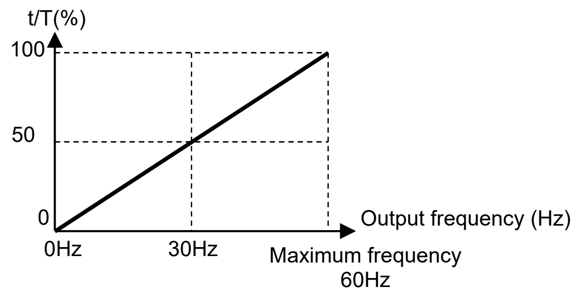
■[Cd-01] [FRQ] terminal output form selection is set to 00

- With the "Bias adjustment [Cd-13]" of the "PWM output," you can bias Point 0 as shown in the below figure.



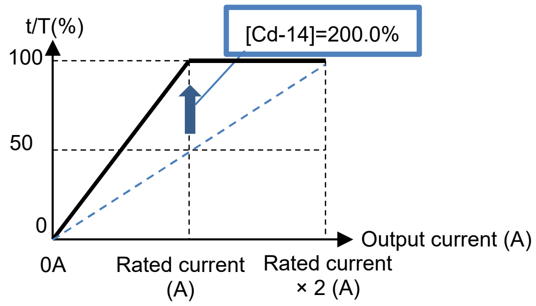
(Example) PWM-outputting [dA-01] output frequency monitor

- I want to perform outputting until a frequency reaches the maximum frequency when the PWM output is 100%.
  [Cd-13]=0.0%,[Cd-14]=100.0%

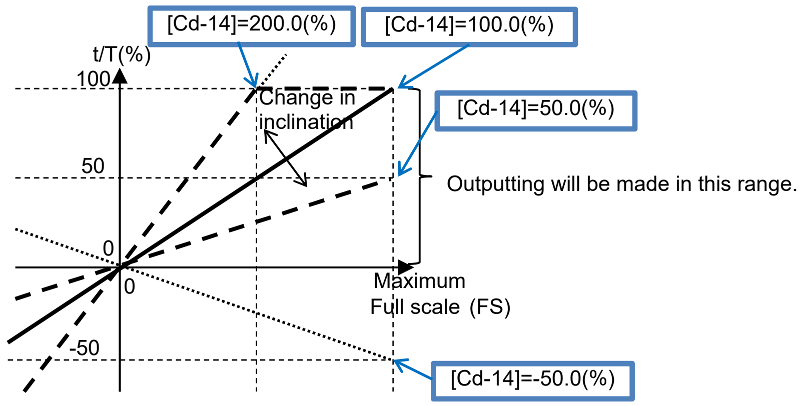


(Example) PWM-outputting [dA-02] output current monitor

- I want to perform outputting until a current reaches the inverter rated current when the PWM output is 100%.
  [Cd-13]=0.0%、[Cd-14]=200.0%

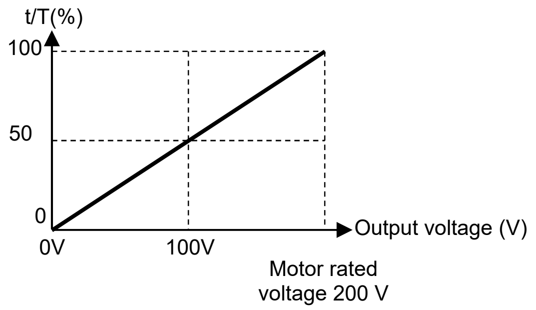


- With the "Gain adjustment [Cd-14]" of the "PWM output," you can change an inclination as shown in the below figure.



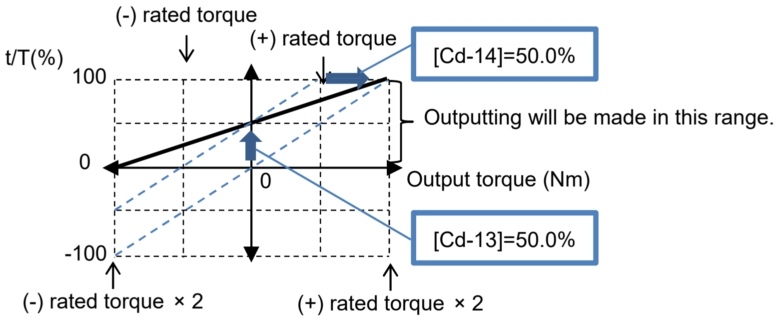
(Example) PWM-outputting [dA-18] output voltage monitor

- I want to monitor the output voltage.
  [Cd-13]=0.0%,[Cd-14]=133.0%



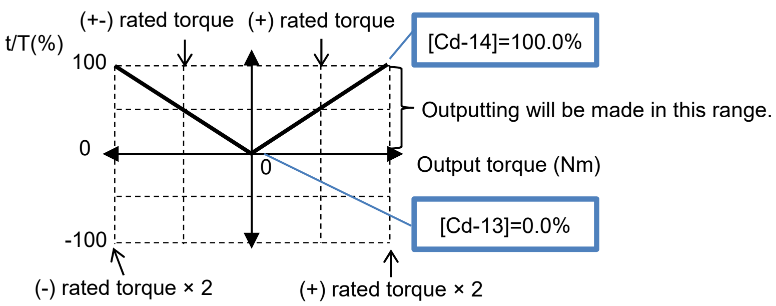
(Example) PWM-outputting [dA-17] output torque monitor

- I want to apply a PWM output range from 0 to 100% in a torque range from -200 to 200%.
  [Cd-12]=01、[Cd-13]=50.0%、[Cd-14]=50.0%



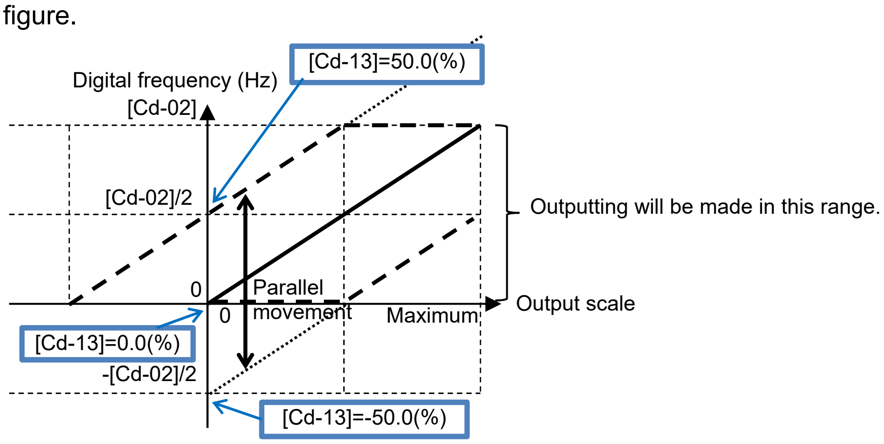
(Example) PWM-outputting [dA-17] output torque monitor

- I want to apply a PWM output range from 0 to 100% in a torque range from 0% to ±200%.
  [Cd-12]=00、[Cd-13]=0.0%、[Cd-14]=100.0%



■[Cd-01] [FRQ] terminal output form selection is set to 01

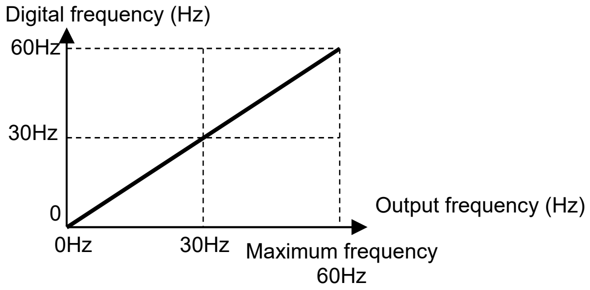
- With the "Bias adjustment [Cd-13]" of the "Digital frequency output," you can bias Point 0 as shown in the below figure.



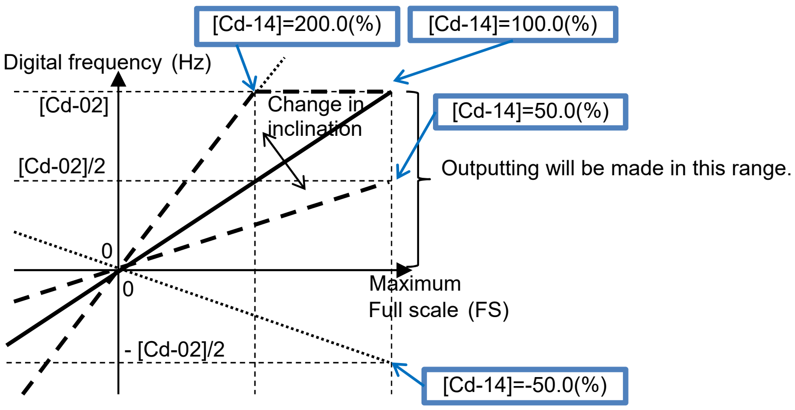
(Example) Digital-frequency-outputting information on [dA-01] output frequency monitor

- I want to perform outputting so that the maximum value of the "Digital frequency output" corresponds to the maximum frequency.

  When the maximum frequency is 60 Hz, set [Cd-02] =60Hz.
  [Cd-13]=0.0% [Cd-14]=100.0%

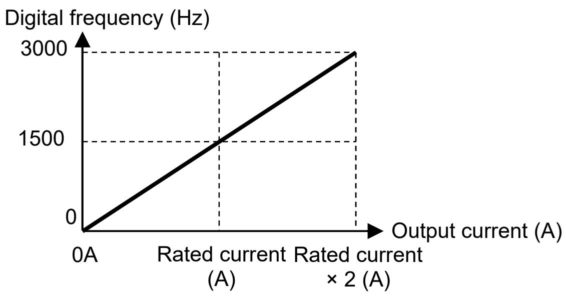


- With the "Gain adjustment [Cd-14]" of the "Digital frequency output," you can change an inclination as shown in the below figure.

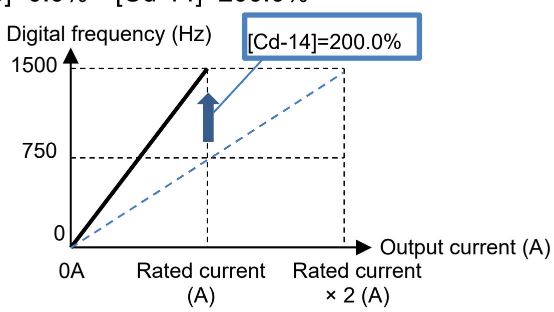


(Example) Digital-frequency-outputting information on [dA-02] output current monitor

- I want to perform outputting at a frequency of 1500 Hz when a current corresponding to the inverter rated current flows.
  Set [Cd-02] =3000Hz.
  [Cd-13]=0.0% [Cd-14]=100.0%



  Set [Cd-02] =1500Hz.
  [Cd-13]=0.0% [Cd-14]=200.0%



■Analog monitor adjustment mode: [FRQ] output

- Setting the analog monitor adjustment mode [Cd-10] to 01 fixes the output of the [FRQ] output terminal.

(Example) Outputting the output current monitor with the PWM output

- I want to perform outputting with a PWM output of 100% when a current corresponding to the inverter rated current flows.

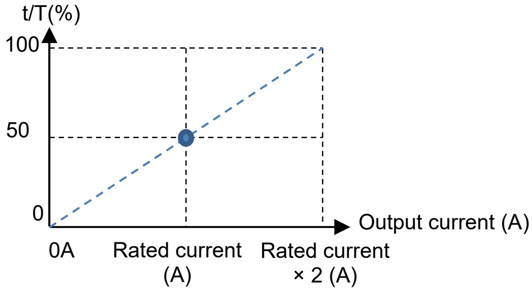
(The standard point is the inverter rated current.)

Code	Name	Output scale range (Corresponding to 0 to 10 V / 0 to 20 mA)
dA-02	Output current monitor	(0.00 to 2.00) × Inverter rated current (A)

1 Set [Cd-01]=00 and [Cd-03]=(dA-02). Setting [Cd-10] to 01 outputs PWM from the [FRQ] terminal in accordance with [Cd-12].

2 When the standard point at which you want to perform outputs is the rated current value, since the rated current has a maximum scale of Rated current × 2.00, set a point that is half of it.
First set [Cd-12] to 50.0% (corresponding to the inverter rated current).

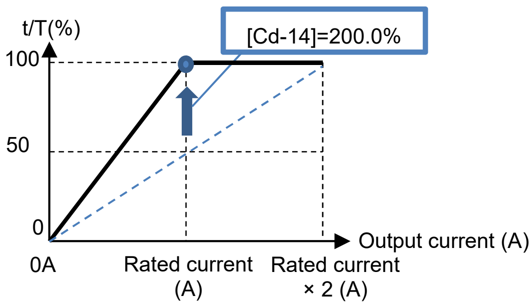
In this state, since the full scale of the output current monitor is Rated current × 2.00, the [FRQ] terminal outputs PWM of 50% duty, which is an output at the rated current (= Rated current × 2.00 × 50.0%).



- With the fixed output, an output set with [Cd-12] is made for the full-scale value of the monitor selected with [Cd-03].

3 Adjust the inclination with [Cd-14]. Change [Cd-14] to make an adjustment toward the point from which PWM of 100% duty is output.
(For example, see and wait with a range from 190.0% to 210.0%.)

[Cd-13]=0.0%、[Cd-14]=200.0%



4 Returning [Cd-10] to 00 starts the PWM output of [FM] that is adjusted.

12.25.6 Outputting data with voltage/current

- With Analog output terminals AMV and AMI, you can select voltage output or current output by operating Switches SW3 and SW4 on the substrate.

- For outputs of [AMV] and [AMI], voltage output has an initial value in a range from 0 to 10 V, and current output has an initial value in a range from 4 to 20 mA.
- Operate the switches on the substrate while the inverter power supply is turned off.
- When [Cd-10] =01 is set, [FRQ], [AMV], and [AMI] respectively perform outputs in accordance with values of [Cd-15], [Cd-25], and [Cd-35].

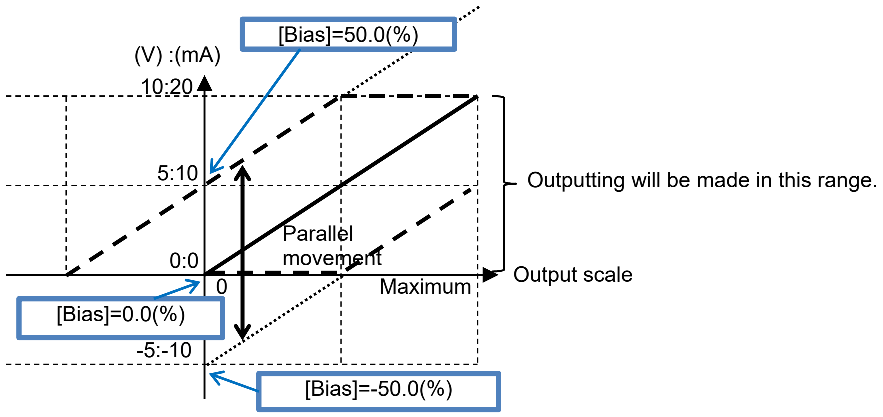
■Parameters

Item	Parameter	Data	Description
[AMV] terminal output selection	[Cd-04]	Parameter number for "12.25.4 Selecting data to be output"	Sets a parameter number.
[AMI] terminal output selection	[Cd-05]		
Analog monitor adjustment mode selection	[Cd-10]	00	Invalid.
		01	Valid. Outputs to terminals output levels in the adjustment mode.
[AMV] output filter time constant	[Cd-21]	1~500[ms]	Filters and outputs the selected data.
[AMV] output data type selection	[Cd-22]	00	Outputs the absolute value of data.
		01	Outputs data with a symbol as is.
[AMV] bias adjustment (Common to voltage/current)	[Cd-23]	-100.0~100.0[%]	Biases data to adjust Point 0 of data.
[AMV] gain adjustment (Common to voltage/current)	[Cd-24]	-1000.0~1000.0[%]	Apply a gain to data to adjust an inclination in data.
[AMV] output level in the adjustment mode	[Cd-25]	-100.0~100.0[%]	Sets output in the adjustment mode. It selects the maximum output (at 100.0%), the minimum output (at 0.0%) ([Cd-22]=00), or the minimum output (at -100.0%) ([Cd-22]=01).
[AMI] output filter time constant	[Cd-31]	1~500[ms]	Filters and outputs the selected data.
[AMI] output data type selection	[Cd-32]	00	Outputs the absolute value of data.
		01	Outputs data with a symbol as is.
[AMI] bias adjustment (Common to voltage/current)	[Cd-33]	-100.0~100.0[%]	Biases data to adjust Point 0 of data.
[AMI] gain adjustment (Common to voltage/current)	[Cd-34]	-1000.0~1000.0[%]	Apply a gain to data to adjust an inclination in data.
[AMI] output level in the adjustment mode	[Cd-35]	-100.0~100.0[%]	Sets output in the adjustment mode. It selects the maximum output (at 100.0%), the minimum output (at 0.0%) ([Cd-32]=00), or the minimum output (at -100.0%) ([Cd-32]=01).

■Bias adjustment of analog output

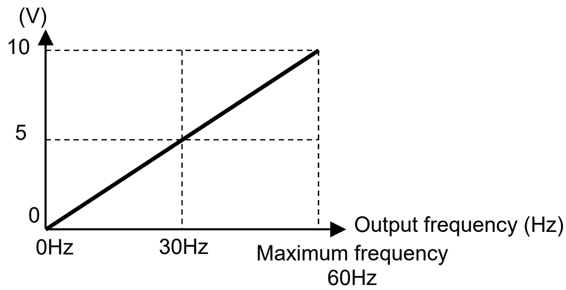
Terminal	Current/voltage	Bias parameter
AMV	Common to voltage/current	[Cd-23]
AMI	Common to voltage/current	[Cd-33]

- You can bias Point 0 as shown in the below figure.



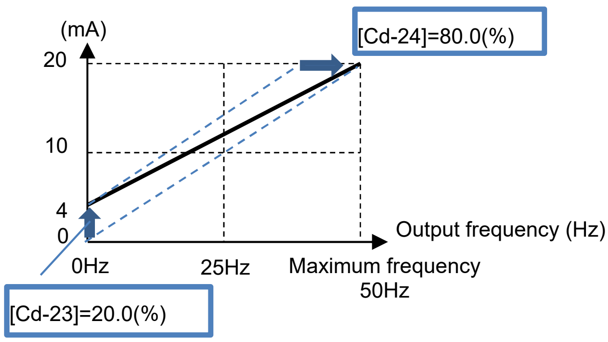
(Example) Outputting information on the "[dA-01] output frequency monitor" to [AMV] in a voltage range from 0 to 10 V

- I want to perform outputting in a range from 0 Hz to the maximum frequency (60 Hz).
  [Cd-23]=0.0%, [Cd-24]=100.0%



(Example) Outputting information on the output frequency monitor to [AMV] in a current range from 4 to 20 mA

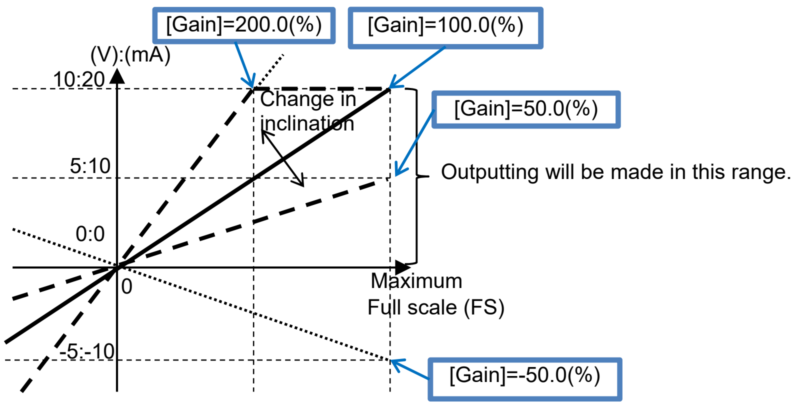
- I want to perform outputting in a range from 0 Hz to the maximum frequency (50Hz).
  [Cd-23]=20.0%, [Cd-24]=80.0%



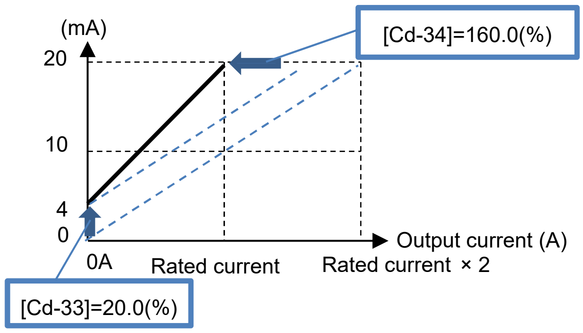
■Gain adjustment of analog output

Terminal	Current/voltage	Gain parameter
AMV	Common to voltage/current	[Cd-24]
AMI	Common to voltage/current	[Cd-34]

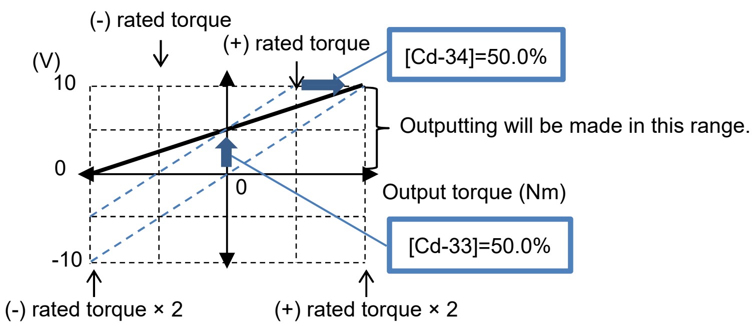
• You can change an inclination as shown in the below figure.



(Example) Outputting information on the output current monitor to [AMI] in a current range from 4 to 20 mA
• I want to monitor the current in a range from 0 A to the inverter rated current.
[Cd-33]=20.0%, [Cd-34]=160.0%



(Example) Outputting information on the output torque monitor to [AMI] in a voltage range from 0 to 10 V
• I want to apply a voltage output range from 0 to 10 V in a torque range from -200 to 200%.
[Cd-32]=01, [Cd-33]=50.0%, [Cd-34]=50.0%



*) When [Cd-32]=00 is set in the above described example, corresponding values in a range from 5 to 10 V will be output for a range from 0 to -200% on the "(-) rated torque" side.

■Analog monitor adjustment mode: [AMV] and [AMI] output

- Setting the analog monitor adjustment mode [Cd-10] to 01 fixes the outputs of the [Ao1] and [Ao2] output terminals.

(Example) Outputting from [AMV] information on the output current monitor in a range from 4 to 20 mA

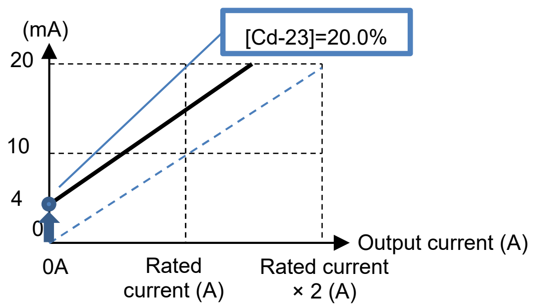
- I want to perform outputting in a range from 4 to 20 mA when a current ranging from 0 A to a current value of Inverter rated current × 2 flows.

(The standard points are a current in a range from 0 A to a current value of Inverter rated current × 2)

Code	Name	Output scale range (Corresponding to 0 to 10 V / 0 to 20 mA)
dA-02	Output current monitor	(0.00 to 2.00) × Inverter rated current (A)

1 Check that [SW3] on the substrate is set to a current of 20 mA, and then turn on the power supply.
Set [Cd-04] = (dA-02). Setting [Cd-10] to 01 and [Cd-25] to 0.0% sets the output from the [Ao1] terminal to 0 mA.

2 When the standard point you want to output is 0 A, and when you want to output 4 mA from [Ao1], adjust [Cd-23] to approximately 20.0%, and check if 4 mA is output.
(For example, see and wait with a range from 15.0% to 25.0%.)

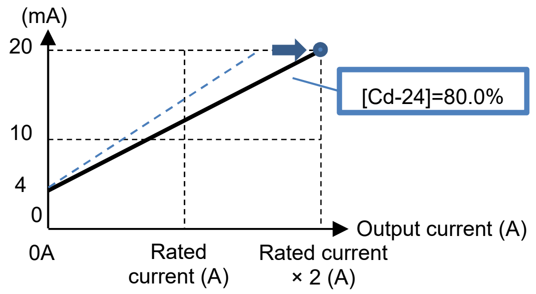


3 Setting [Cd-25] to 100.0% sets the output from the [AMI] terminal to approximately 20 mA.

- With the output fixed with [AMV], an output set with [Cd-25] is made for the full-scale value of the monitor selected with [Cd-04].
- With the output fixed with [AMI], an output set with [Cd-35] is made for the full-scale value of the monitor selected with [Cd-05].

4 Adjust the inclination with [Cd-24]. Change [Cd-24] to make an adjustment immediately before the point at which [AMI] begins lowering from 20 mA.
(For example, see and wait with a range from 75.0 to 85.0%.)

[Cd-23]=20.0%, [Cd-24]=80.0%



5 Returning [Cd-10] to 00 starts current output of [AMV] that is adjusted.

Chapter 13 Monitor Functions

13

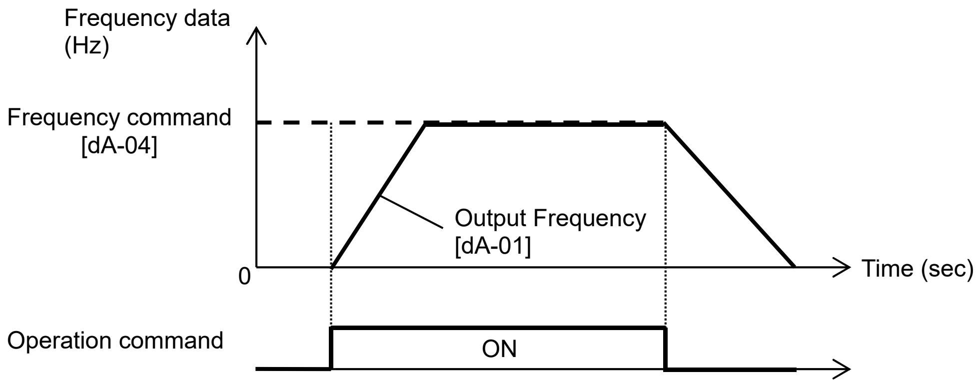
13.1 What This Chapter Explains

This chapter describes various monitor functions of the inverter.
Select a monitor function that you want to use and configure it.
Make sure to carefully read “Chapter 1Risks” for safety work.

13.2 Checking the Frequency Data

13.2.1 Monitoring output frequency

- Output frequency operates in such a way that the inverter starts running and follows the frequency command according to the setting of the acceleration/deceleration time.



■Parameters

Item	Parameter	Data	Description
Output frequency monitor	[dA-01]	0.00~590.00 (Hz)	Displays output frequency.
Frequency command	[dA-04]	-590.00~590.00 (Hz)	Displays frequency command.
Output frequency monitor	[dA-12]		Displays output frequency with sign. A forward revolution is indicated with + sign, and a reverse revolution with -.

13.2.2 Monitoring frequency command

- Frequency command [dA-04] monitors the state of command which is input ultimately at the moment.
- As for the main speed command monitor [FA-01], frequency command setting value can be changed by using UP/DOWN keys on the monitor, if the main speed command selection [AA101] is set to 07 (Operator keypad setting).
- As for the auxiliary speed command monitor [FA-02], frequency command setting value can be changed by using UP/DOWN keys on the monitor, if the auxiliary speed command selection [AA102] is set to 07 (Operator keypad setting).

- If the frequency command monitor does not change when frequency command is changed, a command destination not intended by the frequency command may have taken a priority.

- The frequency command is influenced by the following functions:
  - Main speed command selection [AA101]
  - Auxiliary speed command selection [AA102]
  - Jogging command [JOG]
  - Multi-speed command [DFL/DFM]
  - Operation switching [AUT]
  - Frequency operator [AA105]
  - Forced operation [F-OP]
  - Addition [ADD]
- See “12.4 Select a frequency command.” for details.

■Parameters

Item	Parameter	Data	Description
Frequency command	[dA-04]	-590.00~590.00 (Hz)	Displays frequency command. Displays a result of function such as jogging, multi speed, and forced operation.
Main speed command monitor	[FA-01]	0.00~590.00 (Hz)	Displays the command frequency selected for the main speed command [AA101].
Auxiliary speed command monitor	[FA-02]	Monitor: 0.00 to 590.00 (Hz) Setting: -590.00 to 590.00 (Hz)	Displays the command frequency selected for the auxiliary speed command [AA102].

13.2.3 Monitoring converted frequency

- On the frequency conversion monitor, the frequency value obtained by multiplying the coefficient which is set in the frequency conversion coefficient [Ab-01] can be shown. Use this method when you want to change the displayed value of data such as motor rotation speed, etc.
- Example of conversion of displayed frequency
  “Value displayed on frequency conversion monitor [dA-06]” = “Frequency command (Hz)” x “ Frequency conversion coefficient [Ab-01]”

(Example) Displaying the motor rotation speed
The relationship of rotation speed and frequency is as shown below:
Rotation speed N (min^{-1}) = (120 x f (Hz))/P (poles)
When the motor frequency is 60Hz and the number of poles is 4, the coefficient is 30; hence at 60Hz, where [Ab-01]=30.00, “60×30.0=1800 (min^{-1})” will be displayed on the monitor.

- In this monitor, gain is applied to the output frequency monitor [dA-01].

Table of sample conversions

Motor frequency (Hz)	Number of motor poles (P)	Coefficient [Ab-01]	Synchronous rotation [min-1]
50	2	60	3000
50	4	30	1500
50	6	15	750
50	8	7.5	375
60	2	60	3600
60	4	30	1800
60	6	15	900
60	8	7.5	450

■Parameters

Item	Parameter	Data	Description
Frequency conversion monitor	[dA-06]	0.00~59000.00 (Hz)	Converted output frequency is displayed.
Frequency conversion coefficient	[Ab-01]	0.01~100.00	Set the gain of frequency conversion monitor.

13.2.4 Monitoring the motor speed

- If the motor is controlled with the feedback option, the feedback rotation speed data can be shown as frequency.
- Frequency will not be displayed if the feedback function is not used.
- Frequency will not be correctly displayed if the number of pulses of encoder and the number of motor poles are not set accurately.

■Parameters

Item	Parameter	Data	Description
Speed detection monitor	[dA-08]	-590.00~590.00 (Hz)	Displays the feedback speed detection value.
Encoder constant set-up	[CA-81]	32~65535 (pulse)	Enabled when the “pulse train input (inverter) detection target [CA-90]” is set to 2.
Pulse train input (inverter) detection target selection	[CA-90]	00	Pulse count (PCNT) function is enabled.
		01	Pulse train input frequency command is enabled.
		02	Speed feedback
		03	Pulse count
Encoder constant set-up (HF-FB)	[ob-01]	32~65535 (pulse)	Set the number of pulses of encoder which is input from HF-FB. It is enabled when [CA-90] is set to other than 02.
Selection of number of motor poles	[Hb103]	2 to 48 (poles)	Set the number of motor poles.

13.3 Checking the Acceleration Time or Deceleration Time

13.3.1 Monitoring the acceleration time or deceleration time

- The time of acceleration or deceleration currently underway can be shown, when, with 2-step acceleration/deceleration function or multi-speed function, the acceleration or deceleration time is switched or when you are using the inverter while changing the acceleration/deceleration time setting.
- The time that it takes to rise from 0 Hz to the maximum frequency will be displayed as the acceleration time.
- The time that it takes to fall from the maximum frequency to 0 Hz will be displayed as the deceleration time.

- The acceleration time and deceleration time monitors are affected by the following functions:
  - Acceleration/deceleration function
  - 2-step acceleration/deceleration function
  - Multi-speed function
  - PID soft-start function
  - Acceleration/deceleration cancellation [LAC] function
  - Second setting [SET] function
- The acceleration time and deceleration time monitors are enabled only under the frequency control. A correct value may not be displayed when the acceleration or deceleration time fluctuates depending on the torque under the torque control.
- When the frequency is accelerated or decelerated after the acceleration or deceleration pattern is changed, the time to change between 0 Hz and maximum value will be displayed.

■Parameters

Item	Parameter	Data	Description
Acceleration time monitor	[FA-10]	0.00~3600.00 (s)	Monitors the enabled acceleration time.
Deceleration time monitor	[FA-12]		Monitors the enabled deceleration time.

13.4 Checking the Rotational Direction

13.4.1 Monitoring the rotational direction

- The rotational direction is determined by methods of operation command and signs of frequency command.
- In the zero-speed output mode, it is likely that the converter is outputting under 0Hz command due to the direct current function, forcing function, or 0Hz range sensor less vector control, etc.
- The inverter is stopped when an output is not made.

■Parameter

Item	Parameter	Data	Description
Operation direction monitor	[dA-03]	00: Stop	Inverter is stopped.
		01: Zero-speed out	Inverter is outputting 0 Hz.
		02: Forward run	Inverter is running under forward rotation command.
		03: Reverse run	Inverter is running under reverse rotation command.

13.5 Checking the Input or Output of Terminals

13.5.1 Checking the input of input terminals

- The input terminal monitor displays the physical ON (H)/OFF (L) status of terminals.
- A reaction of the input terminal monitor delays according to input terminal response time.
- The input terminal monitor is not affected by setting of a/b contact.

- If the monitor status doesn't change when a terminal is turned ON and OFF, the input wires may be disconnected.
- When the [RST] terminal is turned ON, the inverter enters a reset mode; hence the state of input terminal cannot be checked on the input terminal monitor. However, from the fact the inverter enters the reset mode, you know that the terminal is working.

(Example) The state where terminals 4 and 8 are ON.

Monitor	L	L	L	H	L	L	L	H	L	L	L
Terminal No.	(DHH)	(DFH)	(RST)	(ES)	(JOG)	(MBS)	(AUT)	(DFM)	(DFL)	(RR)	(FR)

■Parameter

Item	Parameter	Data	Description
Input terminal monitor	[dA-51]	LLLLLLLLLLL~HHHHHHHHHHH	Displays the ON/OFF status of input terminals (H: ON; L: OFF).

13.5.2 Checking the output of output terminals

- The output terminal monitor displays the state of internal functions.
- The output terminal monitor behaves as set for on-delay/off-delay of output terminals.

- If the output terminal status doesn't change when the monitor status changes, the output wires may be disconnected.
- The output terminal monitor is not affected by setting of a/b contact.

(Example) The state where terminals 15 and AL are ON.

Monitor	H	L	H	L	L	L	L
Terminal No.	(FL)	(RL)	(X3)	(X2)	(X1)	(DRV)	(UPF)

■Parameter

Item	Parameter	Data	Description
Output terminal monitor	[dA-54]	LLLLLLL~HHHHHHH	Displays the ON/OFF status of output terminals (H: ON; L: OFF).

13.6 Monitoring Output Currents

- Displays the output current flowing in the motor.
- The lower the carrier frequency, the more the value of current of monitor may fluctuate, depending on the PWM output system of the inverter.

■Parameter

Item	Parameter	Data	Description
Output current monitor	[dA-02]	0.00~655.35 (A)	Displays the effective value of output current flowing in the motor.

13.7 Monitoring Output Voltage

- Displays the output voltage which is output to the motor.
- A correct value may not be displayed when the input voltage is low.

■Parameter

Item	Parameter	Data	Description
Output voltage monitor	[dA-18]	0.0~800.0 (V)	Displays the voltage which is output to the motor.

13.8 Checking P-N Voltage (Internal DC Voltage)

- P-N voltage charged in the main circuit capacitor of inverter can be monitored.
- P-N voltage is DC voltage. The overvoltage error [E007] is generated when P-N voltage exceeds approx. 405Vdc in the case of 200V class inverters, and if P-N voltage exceeds approx. 810Vdc in the case of 400V class inverters.

■Parameter

Item	Parameter	Data	Description
DC voltage monitor	[dA-40]	0.0~1000.0 (V)	Displays the P-N voltage of inverter.

13.9 Checking the Inverter's Operating Time and Operation Count

13.9.1 Checking the cumulative operating hours

- The cumulative operating hours monitor monitors the duration of time that the inverter outputs when a command is input to the inverter.
- The cumulative operating hours monitor during RUN cannot be cleared by initialization or the similar method.

■Parameter

Item	Parameter	Data	Description
Cumulative operating hours monitor during RUN	[dC-22]	0~100000 [hr]	Data of period that the inverter outputs is stored for monitoring.

13.9.2 Checking the cumulative power-on time

- The cumulative power-on time monitor monitors the duration of time that the inverter has been ON.
- The cumulative power-on time monitor cannot be cleared by initialization or the like.

■Parameter

Item	Parameter	Data	Description
Cumulative power-on time monitor	[dC-24]	0~100000 [hr]	Data of period that the inverter is ON is stored for monitoring.

13.9.3 Checking the total start-up count

- The total start-up count monitor monitors the number of times the inverter started outputting from a condition it was stopped.
- Total start-up count monitor cannot be cleared by initialization or the like.

■Parameter

Item	Parameter	Data	Description
Total start-up count monitor	[dC-20]	0 - 65535 (Counts)	Checks the number of times the inverter entered an operation condition from a power-off condition.

13.9.4 Checking the total start-up count

- The cumulative power-on time monitor monitors the number of times the inverter was turned ON.
- Power-on count monitor cannot be cleared by initialization or the like.
- Retry restarts due to instantaneous power failures are not counted.

■Parameter

Item	Parameter	Data	Description
Cumulative power-on count monitor	[dC-21]	0 - 65535 (Counts)	Checks the number of times the power supply for control circuit was turned ON.

13.10 Checking the Inverter Temperature

13.10.1 Checking the cooling fin temperature

- Cooling fin temperature monitor monitors the temperature of inverter's fin.
- The temperature error [E021] is generated when the cooling fin temperature exceeds 120°C.

■Parameter

Item	Parameter	Data	Description
Cooling fin temperature monitor	[dC-15]	-20.0 ~ 200.0 (°C)	Displays the cooling fin temperature

13.11 Checking the Inverter Power Consumption

13.11.1 Checking the input power

- On the input power monitor [dA-30], the power which is currently input to the inverter can be monitored.
- On the integrated input power monitor [dA-32], the integrated data of input power to the inverter can be monitored.
- In the integrated input power display gain [UA-13] mode, the displayed contents can be converted with gain.
  [dA-32]= "Calculated input power value (kWh)"/[UA-13]
  ([UA-13] can be set from 1. to 1000. by an unit.)
- By setting the clearing of integrated input power [UA-12] to "01" and then determining it, you can clear an integrated power value.
- Also, if 039 [KHC] (clearing of integrated power) has been assigned to one the input terminals, integrated input power value can be cleared via that terminal

■Parameters

Item	Parameter	Data	Description
Input power monitor	[dA-30]	0.00~75.00 (kW)	Displays the input power. Changes according to input power factors.
Integrated input power monitor	[dA-32]	0.0~100000.0 (kWh)	Displays the integrated value of input power. Changes according to input power factors.
Clearing of integrated input power	[UA-12]	00	Disable
		01	Clear
Integrated input power display gain	[UA-13]	1~1000	Displays the value obtained by multiplying by gain
Input terminal function	[CA-01]~[CA-11]	039	[KHC] Input power clearance terminal

13.11.2 Checking the output power

- On the output power monitor [dA-34], the power which is currently being output to the motor can be monitored.
- On the integrated output power monitor [dA-36], the integrated data of output power to the motor can be monitored.

- In the integrated output power display gain [UA-15] mode, the displayed contents can be converted with gain.
  Value indicated on [dA-36] = "Calculated output power value (kWh)"/[UA-15]
  ([UA-15] can be set from 1. to 1000. by an unit.)
- By setting the clearing of integrated output power [UA-14] to "01" and then determining it, you can clear an integrated power value.
- Also, if 40 (OKHC: clearing of integrated output power) has been assigned to one of the input terminals, integrated input power value can be cleared via that terminal.

■Parameters

Item	Parameter	Data	Description
Output power monitor	[dA-34]	0.00~75.00 (kW)	Displays the output power.
Integrated output power monitor	[dA-36]	0.0~100000.0 (kWh)	Displays the integrated value of output power.
Clearing of integrated output power	[UA-14]	00	Disable
		01	Clear
Integrated output power display gain	[UA-15]	1~1000	Displays the value by multiplying by gain.
Input terminal function	[CA-01]~[CA-11]	040	Output power clearance terminal

13.12 Checking the Result of Life Diagnosis

13.12.1 Checking the life monitor

- The life diagnostic monitor monitors the status of following two items.
  1: The lives of capacitors on the main circuit board
  2: Reduced rotation speed of the cooling fan.

- As for signals, a capacitor life pre-warning signal (029 [WAC]) and a fan life advance notice signal (030 [WAF]) can be output.

- The lives of capacitors are calculated once a ten minutes. If the power supply is repeatedly turned ON and OFF faster than this cycle, the inverter will be incapable of diagnosing the lives of capacitors normally.
- If the selection of the cooling fan operation is set to other than 00, the fan will stop automatically depending on the condition. The life diagnosis isn't carried out while the fan is in the automatic stop mode.

■Parameters

Item	Parameter	Data	Description
Life diagnostic monitor	[dC-16]	LL~HH	The monitors shows H at the end of the life spans. The monitor on the right indicates the lives of the capacitors on the circuit board, whereas that on the left indicates the life of the cooling fan.
Capacitor life advance notice	[CC-01]~[CC-07]	029	[WAC]: This signal is output when the lives of the capacitors on the circuit board are neared.
Fan life advance notice	[CC-01]~[CC-07]	030	[WAF]: This signal is output when the cooling fan rotation speed is decreased.
Selection of the cooling fan operation	[bA-70]	00	Always ON
		01	The fan is turned ON during operation and continues rotating after the operation is stopped.
		02	Running depending on the temperature. The fan runs as the fin temperature rises.

- For operation of cooling fan, see "12.18 Controlling the Cooling Fan of the Inverter".

13.12.2 Checking the cumulative operating time of cooling fan

- The cumulative cooling fan operating time monitor checks the time the cooling fan have operated.
- The cumulative cooling fan operating time monitor can be used as a guild for a replacement of the cooling fan.
- The cooling fan life monitor can be cleared by setting the parameter.

■Parameters

Item	Parameter	Data	Description
Cooling fan life monitor	[dC-26]	0~1000000 (hr)	Measures and displays the duration of time that the cooling fan has been operated.
Selection of cumulative cooling fan operating time clearance	[bA-71]	00	Not operated.
		01	Carries out clearance at the set time.

13.13 Checking Electric Thermal Load Ratio

13.13.1 Checking thermal load ratio of the motor

- Display the electric thermal load ratio of the motor.
  The overload protection error [E005] is generated when the displayed thermal load ratio is about to exceed 100%.
- Appropriately perform the basic settings of motor and electric thermal function settings.

■Parameter

Item	Parameter	Data	Description
Electronic thermal load ratio monitor (Motor)	[dA-42]	0.00~100.00 (%)	Displays the thermal load ratio of the motor.

13.13.2 Checking thermal load ratio of the inverter

- Display the electric thermal load ratio of the inverter.
  The inverter overload protection error [E038] is generated when the displayed thermal load ratio is about to exceed 100%.
- The heat characteristics of the inverter has been predetermined.

■Parameter

Item	Parameter	Data	Description
Electronic thermal load ratio monitor (Inverter)	[dA-43]	0.00~100.00 (%)	Displays the thermal load ratio of the inverter.

13.14 Checking Load Ratio of Braking Resistor

- Display the use rate of braking resistor circuit (DBTR).
- A setting is required for a braking resistor circuit (DBTR) to operate.
  For details, see “12.13.5 Suppressing overvoltage with braking resistor”.
- The braking resistor overload error [E006] is generated when the displayed use rate is about to exceed the value which has been set in the DBTR use rate [bA-60].

■Parameters

Item	Parameter	Data	Description
Braking resistor (DBTR) load ratio monitor	[dA-41]	0.00~100.00 (%)	Displays the load ratio of braking resistor.
Braking resistor circuit (DBTR) use rate	[bA-60]	0.0~100.0 (%)	Sets the maximum use rate of braking resistor.

13.15 Checking the State of Mounted Option Slot

- On the monitor, you can check which optional cassette is mounted and where it is mounted.
- Recognition of an optional cassette is performed in the condition the power supply of the optional cassette has been established.
- If the optional cassette is poorly connected or damaged, it is regarded as in unconnected state.

■Parameters

Item	Parameter	Data	Description
Option slot 1 mounted	[dA-81]	Option ID	Displays the ID of optional cassette mounted in the option slot 1.
Option slot 2 mounted	[dA-82]		Displays the ID of optional cassette mounted in the option slot 2.
Option slot 3 mounted	[dA-83]		Displays the ID of optional cassette mounted in the option slot 3.

■Option ID

ID	Cassette option type	Description
00	No	-
01	P1-EN	Ethernet communication
02	-	Reserved
03	P1-PN	PROFINET communication
06	P1-PB	PROFIBUS communication
07	P1-CCL	CC-Link communication
18	P1-AG	Analog Input/Output option
33	HF-FB	Line driver feedback

13.16 Checking the State of Analog Switch

- You can check the state of analog input/output changeover switches.
- Note that the data cannot be obtained appropriately if the analog input switch selection differs from the actual input, which results in a damage.
- The data cannot be output appropriately if an analog output switch selection differs from the actual output.
- If the data on analog switch monitor does not switch after the switch is switched, check the switch because the switch may not be fully switched or may be damaged.

(Example) For terminals on the inverter, current is enabled only at [IRF], and voltage is enabled at the other terminals.
For options, current terminal is enabled only at [Ii4] of [Ai4], and other voltage terminals are enabled.

Monitor	V	V	A	V	V	V	A	V
Terminal No.	(Ao4)	(Ao3)	(Ai4)	(VF2)	(AMI)	(AMV)	(IRF)	(VRF)

*) For options, current terminals and voltage terminals are separated. Each terminal is numbered in the order corresponding to “terminal (current terminal/voltage terminal)” as follows: Ao4 (Io4/Vo4), terminal Ao3 (Io3/Vo3), terminal Ai4 (Ii4/Vi4), and terminal VF2 (Ii3/Vi3).

■Parameter

Item	Parameter	Data	Description
Analog I/O selection monitor	[dA-60]	VVVVVVVV~ AAAAAAAA	Displays whether an analog input/output terminal is a voltage input/output terminal or a current input/out terminal. [Left side] (terminal Ao4 (Io4/Vo4)) (terminal Ao3 (Io3/Vo3)) (terminal Ai4 (Ii4/Vi4)) (terminal VF2 (Ii3/Vi3)) (terminal AMI) (terminal AMV) (terminal IRF) (terminal VRF) [Right side] V: voltage/A: current

13.17 Checking the Load Type of Inverter

- You can check the adopted load rating of inverter.
- You should also check the rated current and current derating characteristics because they vary depending on load type selections.

■Parameter

<table>
<tr><th>Item</th><th>Parameter</th><th>Data</th><th>Description</th></tr>
<tr><td rowspan="3">Monitor for checking selection of inverter load type</td><td rowspan="3">[dC-01]</td><td>00</td><td>VLD: Very low duty</td></tr>
<tr><td>01</td><td>LD: Low duty</td></tr>
<tr><td>02</td><td>ND: Normal duty</td></tr>
</table>

13.18 Checking the Rated Current of Inverter

- You can check the adopted rated current of inverter.
- You should also check not only the rated current but also the current derating characteristics because they vary depending on load type selections.

■Parameter

Item	Parameter	Data	Description
Inverter rated current monitor	[dC-02]	0.0~6553.5 [A]	Displays the rated current adopted to the inverter.

13.19 Checking the Operation and Frequency Command Destinations

- You can check the operation command destinations and the frequency command destinations that are currently enabled.
- Command destinations vary according to the state of terminal functions as well as to the settings. Commands not input from the currently enabled command destinations will be ignored.

■Parameters

<table>
<tr><th>Item</th><th>Parameter</th><th>Data</th><th>Description</th></tr>
<tr><td>Main speed command destination monitor</td><td>[dC-07]</td><td>01~07
09~34</td><td rowspan="2">00 (disabled)
01 (VRF)
02 (IRF)
03 (VF2)
07 (Multistage speed 0[Ab110]/[Ab210])
08 (auxiliary speed[AA104]/[AA204])
09 (Multistage speed 1[Ab-11])
10 (Multistage speed 2[Ab-12])
11 (Multistage speed 3[Ab-13])
12 (Multistage speed 4[Ab-14])
13 (Multistage speed 5[Ab-15])
14 (Multistage speed 6[Ab-16])
15 (Multistage speed 7[Ab-17])
16 (Multistage speed 8[Ab-18])
17 (Multistage speed 9[Ab-19])
18 (Multistage speed 10[Ab-20])
19 (Multistage speed 11[Ab-21])
20 (Multistage speed 12[Ab-22])
21 (Multistage speed 13[Ab-23])
22 (Multistage speed 14[Ab-24])
23 (Multistage speed 15[Ab-25])
24 (JOG[AG-20])
25 (RS485), 29 (Pulse array (inverter))
31 (Reserved), 32 (PID)
34 (AHD retention speed)</td></tr>
<tr><td>Auxiliary speed command destination monitor</td><td>[dC-08]</td><td>00~34</td></tr>
<tr><td>Operation command destination monitor</td><td>[dC-10]</td><td>00~06</td><td>00 ([FR]/[RR] terminal)
01 (3 wire)
02 (RUN key on operator keypad)
03 (RS485 setting)
04 (Option 1)/05 (Option 2)/06 (Option 3)</td></tr>
</table>

13.20 Checking the State of Inverter

13.20.1 Iconized monitors

- Check the current condition of inverter.
- Commnad destinations vary according to the state of terminal functions as well as to the settings. Commands not input from the currently enabled command destinations will be ignored.

■Parameters

Item	Parameter	Data	Description
Detailed monitor for icon 2 LIM	[dC-37]	00~06	Refer to “18.5.1 Checking the warning display”.
Detailed monitor for icon 2 ALT	[dC-38]	00~04	
Detailed monitor for icon 2 RETRY	[dC-39]	00~02	
Detailed monitor for icon 2 NRDY	[dC-40]	00~05	

■Detailed monitor for icon 2 LIM [dC-37]

Data	Status	Description
01	The overcurrent suppression function is applied due to increased current.	Under overcurrent suppression.
02	The stall prevention function is applied due to increased current.	Under stall prevention.
03	The overvoltage suppression function is applied due to increased P-N voltage.	Under overvoltage suppression.
04	The torque limiting function is applied due to increased current.	Under torque limit.
05	The frequency is within the upper/lower limit or jump frequency limit.	Within upper limit. Within lower limit. Within jump frequency limit.
06	The frequency command at below the minimum frequency has been given.	Under minimum frequency limit.
00	A state other than those above.	A state other than those above.

■Detailed monitor for icon 2 ALT [dC-38]

Data	Status	Description
01	Current is increased.	Overload advance notice in effect.
02	The motor thermal load is increased.	Motor thermal advance notice in effect.
03	The inverter thermal load is increased.	Inverter thermal advance notice in effect.
00	A state other than those above.	A state other than those above.

■Detailed monitor for icon 2 RETRY [dC-39]

Data	Status	Description
01	Waiting to retry after a trip.	Retry Standby.
02	Waiting to restart.	Waiting to restart.
00	A state other than those above.	A state other than those above.

■Detailed monitor for icon 2 NRDY [dC-40]

Data	Status	Description
01	Tripped.	A trip has occurred.
02	Power supply abnormality.	Power failure or under voltage state.
03	Being reset.	Being reset or waiting to cancel reset.
04	STO	STO is enabled.
05	Waiting.	Waiting for inverter’s internal circuit or internal condition to be stable.
06	Data inconsistency.	A setting inconsistency exists (warning).
07	Sequence abnormality.	Abnormality during a sequence operation.
08	Free-run.	Free-run is enabled (free-run operation).
09	Forced stop state.	Operation command isn’t permitted. Or forced stop is being issued. (Deceleration stop behavior)
00	A state other than those above.	A state other than those above.

13.21 Monitoring Analog Input Information

- You can monitor the input values for VRF/IRF/VF2 that are currently being input to the inverter's terminal block.
- You can monitor the input values for Ai4/Ai5/Ai6 that are input to the terminal block of an analog extension option.

■Parameters

Item	Parameter	Data	Description
Analog input [VRF] monitor	[dA-61]	0.00~100.00 (%)	Monitors analog input values. [VRF][IRF]: 0~10V/0~20mA [VF2]: Equivalent to -10 to 10V
Analog input [IRF] monitor	[dA-62]		
Analog input [VF2] monitor	[dA-63]	-100.00~100.00 (%)	
Extended analog input [Ai4] monitor	[dA-64]	0.00~100.00 (%)	Monitors analog input values for an analog extension option. [Ai4(Vi4/Ii4)][Ai5(Vi5/Ii5)]: 0~10V/0~20mA [Ai6(Vi6)]: Equivalent to -10 to 10V
Extended analog input [Ai5] monitor	[dA-65]		
Extended analog input [Ai6] monitor	[dA-66]	-100.00~100.00 (%)	

13.22 Monitoring Terminal Block Mounting Status

- You can monitor a terminal block option which is currently mounted to the inverter.

■Parameter

Item	Parameter	Data	Description
Terminal block option mounting status	[dA-50]	00 (standard) 02 (terminal block with round screws) 15 (not connected)	Displays terminal block option types.

13.23 Functions Described in Other Chapters

- The information shown below is provided in the pages shown for reference. Please also read the pages.

■Parameters

Parameter	Description	Reference item	Page
See the right column.	Trip history monitor	Troubleshooting	18-2
	Retry history monitor		18-3
	Warning monitor		18-21
[dA-16]	Torque limit monitor	Operates under a limited torque.	12-11-7
[dA-17]	Output torque monitor		
[dA-15]	Torque command monitor (after calculation)	Carries out torque control.	12-11-12
[dA-17]	Output torque monitor		
[FA-15]	Torque command monitor		
[dA-38]	Motor temperature monitor	Monitoring of motor temperature	12-7-6
[dA-28]	Pulse counter	Checks the number of input pulses.	12-24-13
[dA-70]	Pulse train input monitor (inverter)	Makes command from pulse train input.	12-4-5
[dA-71]	Pulse train input monitor (HF-FB)	Makes command from pulse train input.	12-4-7

Chapter 14 RS485 Communication

14

14.1 What This Chapter Explains

This chapter describes the communication methods operable using RS485 communication.
HF-430NEO main units correspond to Modbus-RTU mode in which RS485 is used as the physical layer.
EzCOM (communication between inverters) function with Modbus protocol is also available.
Select a communication function that you want to use and configure it.
See “RS485 Communication Guide” for details of functions such as message codes, function codes, registers, and coils.
Make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

14.2 Modbus-RTU

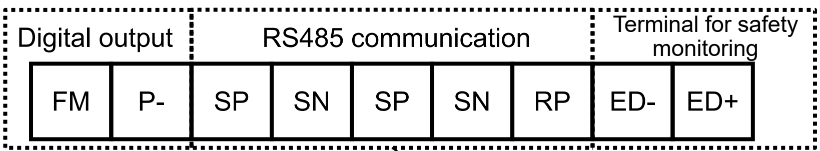
14.2.1 Communication specification

• Modbus-RTU is used as communication method.

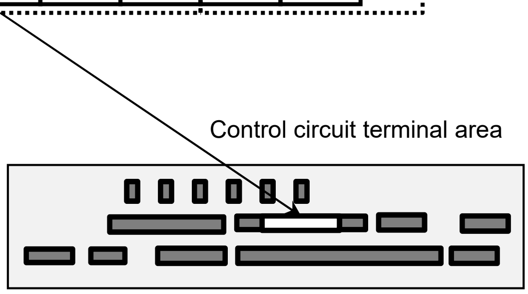
Item	Modbus-RTU Mode	Remarks
Transmission speed	2400/4800/9600/19.2k/38.4k/57.6k/76.8k/115.2k bps	Sets using a parameter.
Communication method	Half duplex communication method	-
Synchronous mode	Non-synchronous mode	
Transmission code	Binary	
Transmission method	Transmission from a low-order bit	
Applicable interface	RS-485	
Data bit length	8 bits	
Parity	No / Even / Odd	Sets using a parameter.
Stop bit length	1/2 bits	
Start mode	Half side start mode by host side command	-
Waiting time	0~1000[ms]	Sets using a parameter.
Connection form	1:N (N=Maximum 32)	
Error check	Overrun / Framing / CRC-16 / Horizontal parity	-

14.2.2 Wiring and Connection

■Wiring location
Connect communication lines to the control circuit terminal block.



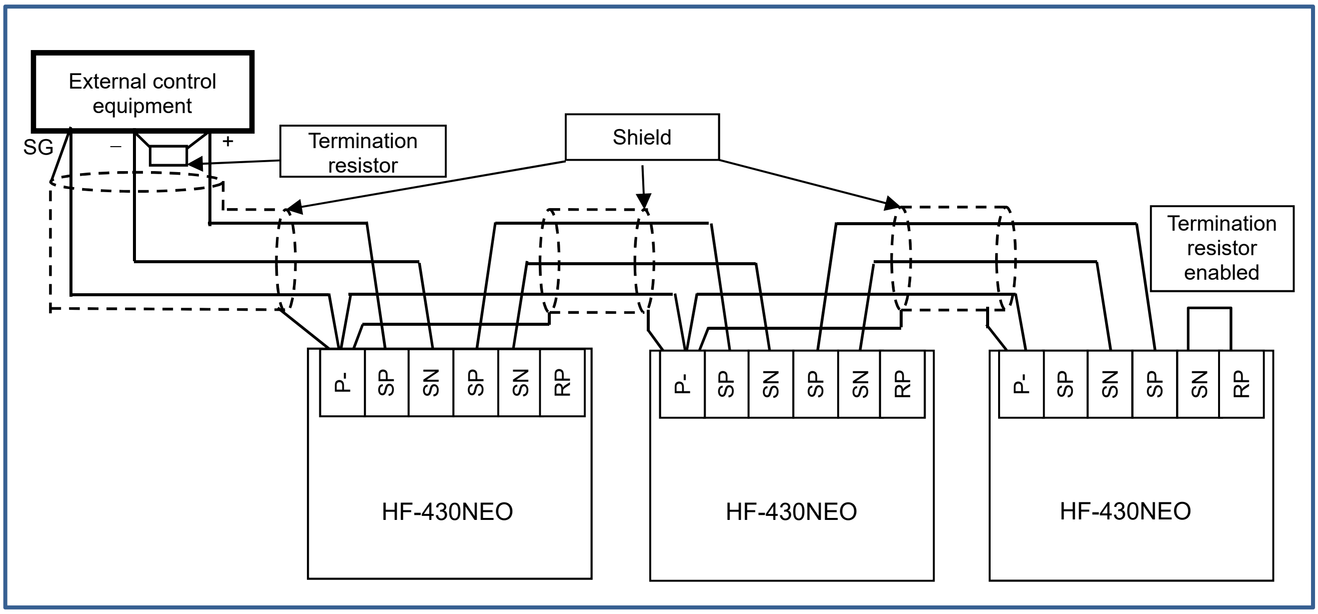
Abbreviated Terminal Name	Description
SP	Sending/receiving + side
SN	Sending/receiving - side
RP	Enable termination resistor terminal
(SN)	Enable termination resistor terminal
(CM1)	Signal ground



■Connection

- When performing a connection, connect each inverter in parallel as shown below. For the terminating inverter, short-circuit between terminals RP and SN.
  (When you execute RS485 communication on one inverter, short-circuit between RP and SN likewise.) With the RP-SN short-circuited, the termination resistor within the control terminal block board becomes enabled, which prevents reflection of signals.

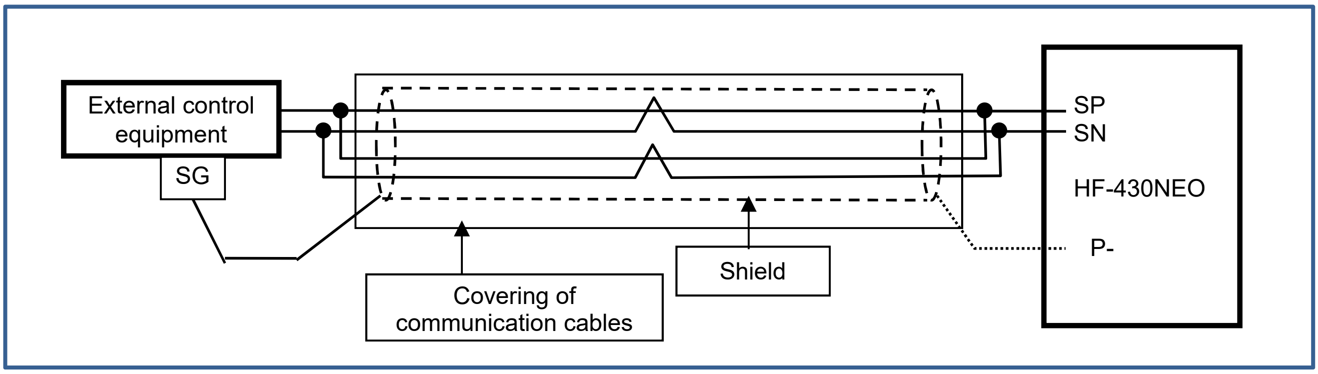
- For communication cables, use shielded cables.
- As for shields, it is recommended that a signal ground (SG) of external control equipment is connected to P- of an inverter as shown below.



- As for a cable to connect to TM2, use a shielded twisted pair cable (0.5mm^2). If the above mentioned cable is not available, use the following:
- Single cable of 0.14 mm^2 to 1.5 mm^2
  (0.14 mm^2 to 0.5 mm^2 to connect two same size cables to one pole)
- Stranded cable 0.14 mm^2 to 1.0 mm^2
  (0.14 mm^2 to 0.2 mm^2 to connect two same size cables to one pole)
- Stranded cable with rod terminal
  0.25 mm^2 to 0.5 mm^2
  (e.g. 1.25=3AF manufactured by J.S.T. Mfg. Co., Ltd.)

Cable stripping length 5 mm
Tightening torque 0.22·N･m to 0.25·N･m (screw size M2)

- Connect a signal ground (SG) of external control equipment to P- of an inverter main body.
- Communication of a shielded cable may be improved by disconnecting the cable from P-.
  Change the connection depending on the situation.
- Separate communication cables from power lines and alarm high voltage circuits. Communication cables must not be laid in parallel with power lines and alarm high voltage circuits.
- When using more than a pair of cables, connect all of them to signal wires as shown below. In doing so, connect each pair to SP and SN.



14.2.3 Parameters

■ Parameter settings

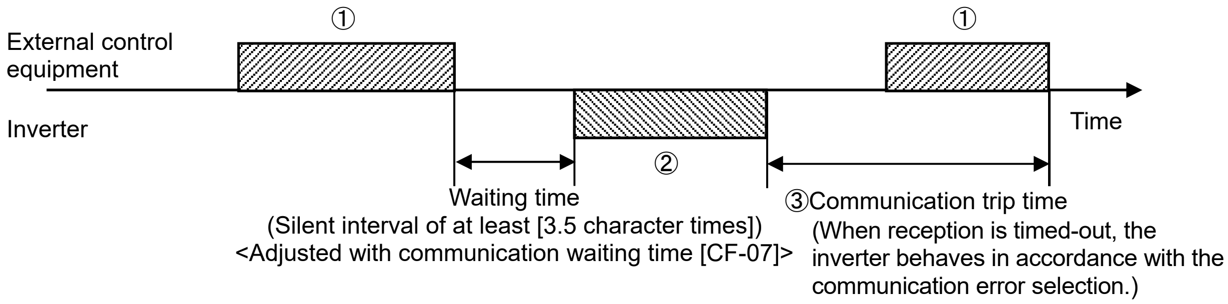
RS485 communication requires the following settings.

Item	Parameter	Data	Description
Communication transmission speed selection	[CF-01]	03	2400bps
		04	4800bps
		05	9600bps
		06	19200bps
		07	38400bps
		08	57600bps
		09	76800bps
		10	115200bps
Communication station number selection	[CF-02]	1~247	Assigns inverter station numbers. This is to be set in controlling multiple inverters simultaneously.
Communication parity selection	[CF-03]	00	No Parity
		01	Even number parity
		02	Odd number parity
Communication stop bit selection	[CF-04]	1	1 bit
		2	2 bits
Communication error selection	[CF-05]	00	Trip
		01	Trips after decelerating and stopping
		02	Ignore
		03	Free-run stop
		04	Deceleration stop
Communication timeout time	[CF-06]	0.00~100.00 (s)	Determination time for communication disconnection. When communication is lost longer than the determination time, the RS485 error [E041] will be generated.
Communication waiting time	[CF-07]	0~1000(ms)	The time until the inverter replies.
Communication method selection	[CF-08]	00	Modbus-RTU mode
		01	Communication between inverters (EzCOM)
		02	Communication between inverters (EzCOM administrator)
Output terminal functions and relay output terminal functions	[CC-01]~[CC-07]	049	When a communication disconnection occurs, [NDc] signal is turned ON. As the error is released, the signal will be OFF.

14.2.4 Communication process

■Communication process

Communication between external control equipment and the inverter is carried out in the following process:



①Frame sent from external control equipment to the inverter (query)

②Frame returned from the inverter to external control equipment (response)

③After the inverter sends a response, if a query from the hose is not completely received within the time set in [CF-06] (communication timeout time), the inverter will be in the condition of receiving the head data again. During this, the inverter will be in a no response condition and will behave as set in the communication error selection. For more details, see the following.

Monitoring of reception timeout begins following the completion of first transmission after the power supply is turned ON or reset. A reception timeout does not occur until a transmission is performed.
A response from the inverter (frame ②) is output as a reply after the inverter receives a query (frame ①) and hence is not output actively.

■Parameters

Item	Parameter	Data	Description
Communication error selection	[CF-05]	00:Trip	Trip with error [E041] after reception timeout.
		01:Trip after stopping	Deceleration stop after reception timeout. Trip with error [E041] after stopping.
		02:Ignore	No trip, nor alarm output.
		03:Free-run stop	No free-run stop trip, nor alarm output after reception timeout.
		04:Deceleration stop	No deceleration stop, nor alarm output after reception timeout.
Communication timeout time	[CF-06]	0.00~100.00(s)	The time until reception timeout.
Communication waiting time	[CF-07]	0~1000(ms)	Waiting time until a reply starts after completion of receiving (excluding silent interval).

14.3 Message Structure

14.3.1 Queries and responses

- A command message sent from the master to a slave is called a “query”, and an answering message from a slave is called “response”.
  Transmission formats of queries and responses are as shown below:

Query
Slave address
Function code
Query data
Error check (CRC-16)

Response
Slave address for checking
Function code for checking
Answering data
Error check (CRC-16)

14.3.2 Slave addresses (communication station numbers)

- A slave address is a number from 1 to 247 which is set in each inverter (slave) in advance. (Only the inverter having the address matching the query’s slave address will take the query.)
- If you designate “0” to the slave address of transmission destination in the master inverter, you can activate a broadcasting to all stations (simultaneous broadcasting). Under the broadcasting mode, all slaves receive data but do not return responses.

- Under the broadcasting mode, data readout and loopback cannot be executed.
- Although in the Modbus specification, slave addresses from 1 to 247 are used, if you use slave addresses from 250 to 254 on the master side, you can execute a simultaneous broadcasting only to the specific slave addresses. (The slaves do not return responses. This function is valid only for writing commands (05h, 06h, 0Fh, 10h).)

Slave Address	Transmission Destination
250 (Fah)	Simultaneous broadcasting to slave addresses 01 to 09.
251 (FBh)	Simultaneous broadcasting to slave addresses 10 to 19.
252 (FCh)	Simultaneous broadcasting to slave addresses 20 to 29.
253 (FDh)	Simultaneous broadcasting to slave addresses 30 to 39.
254 (FEh)	Simultaneous broadcasting to slave addresses 40 to 247.

14.3.3 Function codes

- Specify functions the inverter executes using function codes.
  Corresponding function codes are shown below:

Function code

Function Code	Function	Max. Data Bytes Handled by 1 Message	Max. Number of Data Handled by 1 Message
01h	Reads out the state of coil.	4	32 coils (bitwise)
03h	Reads out the content of retention register.	32	16 registers (in bytes)
05h	Writes to coil.	2	1 coil (bitwise)
06h	Writes to retention register.	2	1 register (in bytes)
08h	Loopback test	-	-
0Fh	Writes to multiple coils.	4	32 coils (bitwise)
10h	Writes to multiple retention registers.	32	16 registers (in bytes)
17h	Writes / reads out to multiple retention registers.	32 / 32	16 / 16 registers (in bytes)

14.3.4 Data

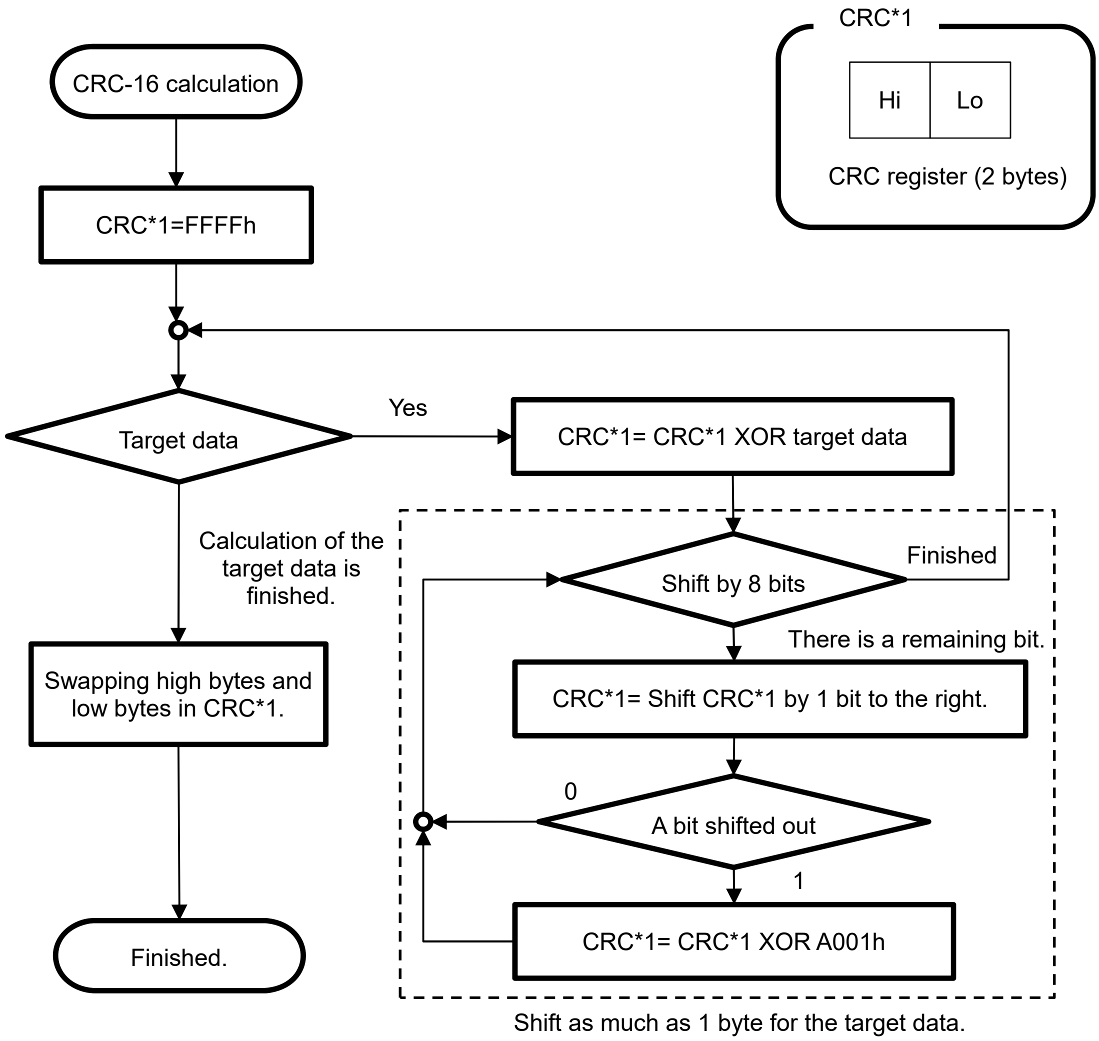
- Transmit the data related to function codes.
- The inverter corresponds to the data formats shown below among data used in Modbus.
- Transmission formats of data vary depending on function codes.

Data Name	Description
Coil	Writable/readable binary data (1 bit long)
Retention register	Writable/readable 16 bits long data

14.3.5 Error check

- To check errors in Modbus-RTU, use CRC (Cyclic Redundancy Check).
- To generate a CRC code, use the generating polynomial for CRC-16 ($X^{16}+X^{15}+X^2+1$).
- CRC codes are16 bits data generated for a block with arbitrary data length in 8-bit unit.

Example of procedure for calculating CRC-16.



14.3.6 Time required for communication

- The inverter's response after it receives a query is equal to [CF-07] (communication waiting time) setting value plus processing time for creating response.
- When transmitting the next query to the inverter after receiving a response from the inverter, make sure to provide an interval equal to the silent interval of [at least 3.5 characters] or more.

14.3.7 Responses in the normal condition

- A response is returned in accordance with the format for each query defined in "3. Description of Each Function code".

14.3.8 Responses in the abnormal condition

- When there is a failure (excluding communication error) in the content of a query, the inverter returns an exceptional response without executing any action requested by the query.
- For error determination, check the function code of the response. The function code of the exceptional response is the value obtained by adding 80h to the function code of the query.

- Field composition for exceptional response

Slave address
Function code
Exception code
CRC-16

- For more details of errors, see "14.3.9 Exceptional Responses".

14.3.9 No response

- The inverter ignores a query and returns no response in the following conditions:
  (1) A broadcast (query with slave address "0") is received.
  (2) A communication error is detected during a query reception processing.
  (3) The query's slave address doesn't match the slave address set in the inverter.
  (4) The time interval between data constituting a message is 3.5 characters or less.
  (5) The data of query is in the wrong length.
  (6) The reception interval within frame exceeds 1.5 character.
  (7) An error check code of query does not match (CRC error).
  (8) A simultaneous broadcasting by group (query with slave address from 250 to 254) is received.

- Provide the master with a timer for monitoring responses, then if a response is not returned within the time, transmit the same query again.

14.4 Description of Each Function code

14.4.1 Reading out the state of coil [01h]

- Read out the state of coil (ON/OFF).

(Example)
To read out the input terminal functions from 1 to 6 of the inverter with slave address 8, the state of input terminals are as shown in the right table.
- Coils 13 and 14 are OFF.

Input terminal No.	1	2	3	4	5	6
Coil No.	7	8	9	10	11	12
Terminal state	ON	ON	ON	OFF	ON	OFF

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	08
2	Function code	01
3	Coil starting No. (high) *2)	00
4	Coil starting No. (low) *2)	06
5	Number of coils (high) *3)	00
6	Number of coils (low) *3)	06
7	CRC-16 (high)	5C
8	CRC-16 (low)	90

Response

No.	Field Name	Example (HEX)
1	Slave address	08
2	Function code	01
3	Data bytes	01
4	Coil data *4)	17
5	CRC-16 (high)	12
6	CRC-16 (low)	1A

*1) A broadcasting cannot be executed.
*2) Note that the value of starting number is one less than the actual number.
Specify the value of “(Coil No.) -1”.
*3) Where the number of readout coils is specified to value 0 or value exceeding 32, error code “03h” is returned.
*4) Data as much as the number of data bytes is transferred.

- Data received as a response indicates the state of coils 7 to 14. The data “17h = 00010111b” received here is read as shown below, letting coil 7 be the LSB.
When the coil state readout command cannot be executed normally, see “3.9 Exceptional Responses”.

Coil	14	13	12	11	10	9	8	7
Coil state	OFF	OFF	OFF	ON	OFF	ON	ON	ON
17h	0	0	0	1	0	1	1	1

In the last coil data, if the readout coil data extends to the outside the range of defined coil, the coil data beyond the range is transmitted as “0”.

14.4.2 Reading out the content of retention register [03h]

- Read out the contents of consecutive retention registers as much as specified, from the specified retention register addresses.

(Example)
To read out a past trip history from the inverter with slave address 5.
(To read out the factors and output frequency of trip monitor 1.)

	Trip monitor 1 (factor)	Trip monitor 1 (output frequency)
Retention register No.	03E9h	03EAh, 03EBh
Data	Overvoltage (E007) (0007h)	60.00Hz (0000h, 1770h)

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	05
2	Function code	03
3	Register starting No. (high) *2)	03
4	Register starting No. (low) *2)	E8
5	The number of retention registers (high)	00
6	The number of retention registers (low)	03
7	CRC-16 (high)	84
8	CRC-16 (low)	3F

Response

No.	Field Name	Example (HEX)
1	Slave address	05
2	Function code	03
3	Data bytes *3)	06
4	Register starting No. (high)	00
5	Register starting No. (low)	07
6	Register starting No. +1 (high)	00
7	Register starting No. +1 (low)	00
8	Register starting No. +2 (high)	17
9	Register starting No. +2 (low)	70
10	CRC-16 (high)	A8
11	CRC-16 (low)	61

*1) A broadcasting cannot be executed.
*2) Note that the value of starting number is one less than the actual number. Specify the value of “(Register No.) -1”.
*3) Data as much as the number of data bytes is transferred. In this example, two retention registers are returned; hence 4 bytes.

- The data received as a response is read as shown below.

Response buffer	4	5	6	7	8	9
Retention register starting No.	+0 (hi)	+0 (lo)	+1 (hi)	+1 (lo)	+2 (hi)	+2 (lo)
Response data	00h	07h	00h	00h	17h	70h
Trip description	Overvoltage trip (0007h)		Trip frequency 60.00Hz (00001770h)			

- When a readout of retention register contents cannot be executed normally, see “3.9 Exceptional Responses”.

14.4.3 Writing to coil [05h]

- Perform writing to a coil.
  Coil states change as shown in the table at the right.

(Example)
To give an operation command to the inverter with slave address 10.

- You need to set the operation command selection [AA111] to 03 in advance to operate using a Modbus command.
- Coil No. for operation command is "1".

	Coil state	
	OFF→ON	**ON→OFF**
Data to be changed (high)	FFh	00h
Data to be changed (low)	00h	00h

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	0A
2	Function code	05
3	Coil starting No. (high) *2)	00
4	Coil starting No. (low) *2)	00
5	Data to be changed (high)	FF
6	Data to be changed (low)	00
7	CRC-16 (high)	8D
8	CRC-16 (low)	41

Response

No.	Field Name	Example (HEX)
1	Field Name	0A
2	Slave address	05
3	Coil starting No. (high)	00
4	Coil starting No. (low)	00
5	Data to be changed (high)	FF
6	Data to be changed (low)	00
7	CRC-16 (high)	8D
8	CRC-16 (low)	41

*1) When a broadcasting is performed, a response is not returned.
*2) Note that the shown value is one less than starting number. For coil No. 0001, specify 0000(=0001-1).

- When a writing to a coil cannot be executed normally, see "3.9 Exceptional Responses".

14.4.4 Writing to retention register [06h]

- Perform a writing to the specified retention register.

(Example)
To write 50Hz as the 0 speed command [Ab110] to the inverter with slave address 1.
- In order to set 50Hz, set the data to be changed to "5000 (1388h) because the data resolution of retention register "2F4Eh" for 0 speed command [Ab110] is 0.01Hz.

Query

No.	Field Name	Example (HEX)
1	Slave address*1)	01
2	Function code	06
3	Register starting No. (high)	2F
4	Register starting No. (low)	4D
5	Data to be changed (high)	13
6	Data to be changed (low)	88
7	CRC-16 (high)	1C
8	CRC-16 (low)	5F

Response

No.	Field Name	Example (HEX)
1	Slave address	01
2	Function code	06
3	Register starting No. (high)	2F
4	Register starting No. (low)	4D
5	Data to be changed (high)	13
6	Data to be changed (low)	88
7	CRC-16 (high)	1C
8	CRC-16 (low)	5F

*1) When a broadcasting is performed, a response is not returned.
*3) Note that the starting address of [Ab110] retention register is "2F4Dh", which is one less than the register No. "2F4Eh". The value obtained by subtracting one from the register No. is the register address.

- When a writing to a retention register cannot be executed normally, see "3.9 Exceptional Responses"

14.4.5 Loopback test [08h]

- Use this test for a communication check between the master and slaves. For test data, arbitrary values can be used.

(Example)
To perform a loopback test on the inverter with slave address 1.

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	01
2	Function code	08
3	Diagnostic sub code (high)	00
4	Diagnostic sub code (low)	00
5	Data (high)	Arbitrary
6	Data (low)	Arbitrary
7	CRC-16 (high)	CRC
8	CRC-16 (low)	CRC

Response

No.	Field Name	Example (HEX)
1	Slave address	01
2	Function code	08
3	Diagnostic sub code (high)	00
4	Diagnostic sub code (low)	00
5	Data (high)	Arbitrary
6	Data (low)	Arbitrary
7	CRC-16 (high)	CRC
8	CRC-16 (low)	CRC

*1) A broadcasting cannot be executed.

- Diagnostic sub codes correspond to query data echo (00h, 00h) only and not to other commands.

14.4.6 Writing to multiple coils [0Fh]

- Rewrite consecutive multiple coils.

(Example)
To change the state of input terminal functions from 1 to 6 of the inverter with slave address 5.
The state of input terminals are as shown below.

Input terminal No.	1	2	3	4	5	6
Coil No.	7	8	9	10	11	12
Terminal state	ON	ON	ON	OFF	ON	OFF

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	05
2	Function code	0F
3	Coil starting No. (high) *2)	00
4	Coil starting No. (low) *2)	06
5	Number of coils (high)	00
6	Number of coils (low)	06
7	Bytes *3)	02
8	Data to be changed (high) *3)	17
9	Data to be changed (low) *3)	00
10	CRC-16 (high)	DB
11	CRC-16 (low)	3E

Response

No.	Field Name	Example (HEX)
1	Slave address	05
2	Function code	0F
3	Coil starting No. (high)	00
4	Coil starting No. (low)	06
5	Number of coils (high)	00
6	Number of coils (low)	06
7	CRC-16 (high)	34
8	CRC-16 (low)	4C

*1) When a broadcasting is performed, a response is not returned.
*2) Note that the value of starting number is one less than the No.
*3) Even when the number of bytes required to be changed is odd, add 1 to the number to make it even because the data to be changed will consist of higher order and lower order bytes as a set.

- When a writing to multiple coils cannot be executed normally, see “3.9 Exceptional Responses”.

14.4.7 Writing to multiple registers [10h]

- Rewrite consecutive multiple registers.

(Example)
To set acceleration time [FA-10] for the inverter with slave address 1 to 3,000 seconds.

- In order to set 3,000 seconds, set the data to be changed to “300,000 (493E0h)” because the data resolution of retention registers “2B02h, 2B03h” for acceleration time [FA-10] is 0.01 seconds.

Query

No.	Field Name	Example (HEX)
1	Slave address *1)	01
2	Function code	10
3	Starting address (high) *2)	2B
4	Starting address (low) *2)	01
5	The number of retention registers (high)	00
6	The number of retention registers (low)	02
7	Bytes *3)	04
8	Data to be changed 1 (high)	00
9	Data to be changed 1 (low)	04
10	Data to be changed 2 (high)	93
11	Data to be changed 2 (low)	E0
12	CRC-16 (high)	9E
13	CRC-16 (low)	9F

Response

No.	Field Name	Example (HEX)
1	Slave address	01
2	Function code	10
3	Starting address (high)	2B
4	Starting address (low)	01
5	The number of retention registers (high)	00
6	The number of retention registers (low)	02
7	CRC-16 (high)	E5
8	CRC-16 (low)	34

*1) When a broadcasting is performed, a response is not returned.
*2) Note that the value of starting address is one less than the actual address.
*3) Specify the number of bytes to be actually changed instead of the number of retention registers.

- When a writing to multiple coils cannot be executed normally, see “14.3.9 Exceptional Responses”.

14.4.8 Writing and reading out to multiple registers [17h]

- Write and read out to consecutive multiple registers.

(Example) To the inverter with slave address “1”, to write 50.00Hz for the output frequency setting [FA-01] and read out output frequency monitor value [dA-01].

Query

No.	Field Name	Example (Hex)	
1	Slave address	01	
2	Function code	17	
3	Readout register starting address (high) *1)	27	(Register address) = (register No.) - 1
4	Readout register starting address (low) *1)	10	
5	The number of readout registers (high)	00	
6	The number of readout registers (low)	02	
7	Writing register starting address (high) *1)	2A	(Register address) = (register No.) - 1
8	Writing register starting address (low) *1)	F8	
9	The number of writing registers (high)	00	
10	The number of writing registers (low)	02	
11	Writing data bytes n	04	
12	Writing data 1 (high)	00	0000 1388h → 5000d → 50.00Hz
13	Writing data 1 (low)	00	
14	Writing data 2 (high)	13	
15	Writing data 2 (low)	88	
16	CRC-16 (high)	F4	
17	CRC-16 (low)	86	

Response

No.	Field Name	Example (Hex)	
1	Slave address	01	
2	Function code	17	
3	Readout data bytes n	04	
4	Readout data 1 (high)	00	0000 1388h → 5000d → 50.00Hz
5	Readout data 1 (low)	00	
6	Readout data 2 (high)	13	
7	Readout data 2 (low)	88	
8	CRC-16 (high)	F4	
9	CRC-16 (low)	71	

*1) Note that the starting address of retention register is one less than the register No.
The value obtained by subtracting one from the register No. is the register address.

- When a writing and reading out to multiple registers cannot be executed normally, see “3.9 Exceptional Responses”.

14.4.9 Exceptional Responses

- The master inverter requires a response to a query transmitted not by a broadcasting.
  Inverters have to return responses corresponding to queries, but when there is an error in queries, inverters return an exceptional response.

- Details of field composition are showed. The value of function code is obtained by adding 80h to a query subjected to an exceptional response. An exception code indicates a factor of exceptional response.

Function code

Query	Exception Response
01h	81h
03h	83h
05h	85h
06h	86h
0Fh	8Fh
10h	90h
17h	97h

- Field composition for exceptional response is as shown below.

Field composition

Slave address
Function code
Exception code
CRC-16

Exception code

Code	Description
01h	An unsupported function was specified.
02h	The specified address does not exist.
03h	The specified data is in an unacceptable format.
21h	In writing to a retention register, the data is beyond the range of the inverter.
22h	The inverter is in the state that it doesn’t permit functions to be executed as following: • a register for which changes are inhibited during running was about to be changed; • data was written to a register to which soft-lock has been applied; • an ENTER instruction was executed during running; • an ENTER instruction was executed during undervoltage; • data was about to be written to a register when auto-tuning is enable; and so on.
23h	A function code for writing was used to the parameter specialized for readout.
26h	Data was written during data writing or execution of data initialization.
27h	There was an access to only the higher side register of 2 register long parameter.

14.4.10 Storing a change made to retention register

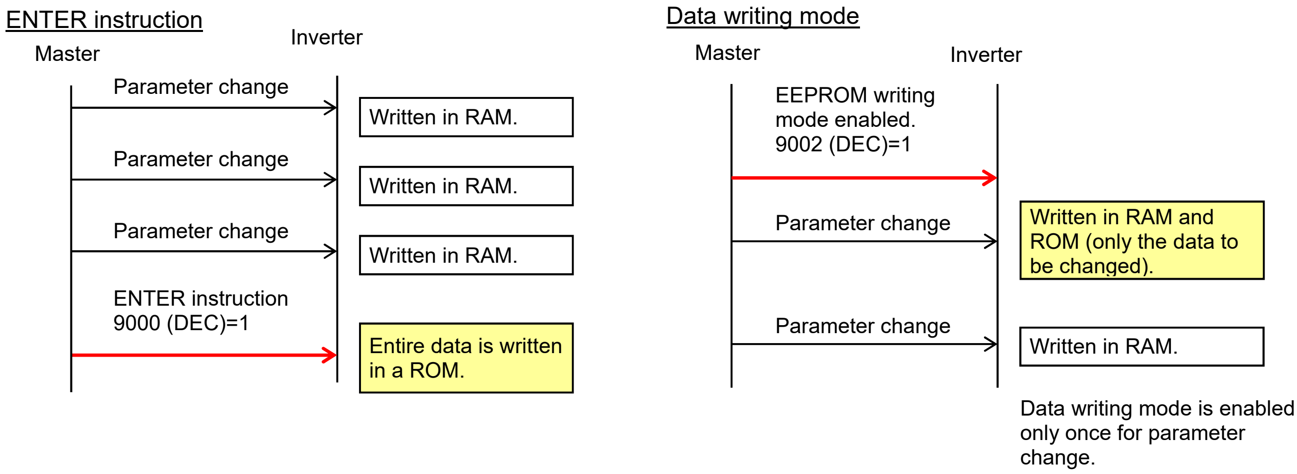
- The inverter doesn't store the data of changes even when the writing command to a retention register (06h) and the writing command to multiple registers (10h) are used.
- If the power of inverter is shut off without storying the data, the data will be restored to the condition before the retention register is changed.

■ENTER instruction issuing method

- The writing of entire memory is performed when 1 is written to a retention register (9000(DEC)) using the writing command to a retention register (06h).

Cautions

- Do not turn OFF the power during data writing by an ENTER instruction. If the power is turned OFF, the data is not stored properly. Monitor the signal (coil No. 0049h) during data wring to determine whether the data is being written or not.
- Frequent use of ENTER instruction may shorten the life of converter because the inverter's memory element has the limit of the number of rewriting times. Use of ENTER instruction must be kept minimized, and especially periodic and/or successive issuance of this instruction must be completely avoided.



- To store in the inverter a change made to retention register, you need to issue ENTER instruction in the procedure shown below.
- To change control constants such as a motor constant, you need to use ENTER instruction and recalculate control processing internal variables.

■Data writing mode

- The inverter enters the data writing mode when 1 is written to a retention register (9002 (DEC)) using the writing command to a retention register (06h).
- The data changed by the writing command to a retention register (06h) after the inverter enters the data writing mode will be written both in the RAM area for temporary saving and in the ROM area for storying in the event of power-off. Then simultaneously the data writing mode will be released.
- If the inverter receives commands other than the writing command to a retention register (06h) after entering the data writing mode, the data writing mode will be released.
- Frequent use of data writing mode may shorten the life of converter because the inverter's memory element has the limit of the number of rewriting times. Use of data writing mode must be kept minimized, and especially periodic and/or successive issuance of this mode must be completely avoided.

■Recalculation of control processing internal variables

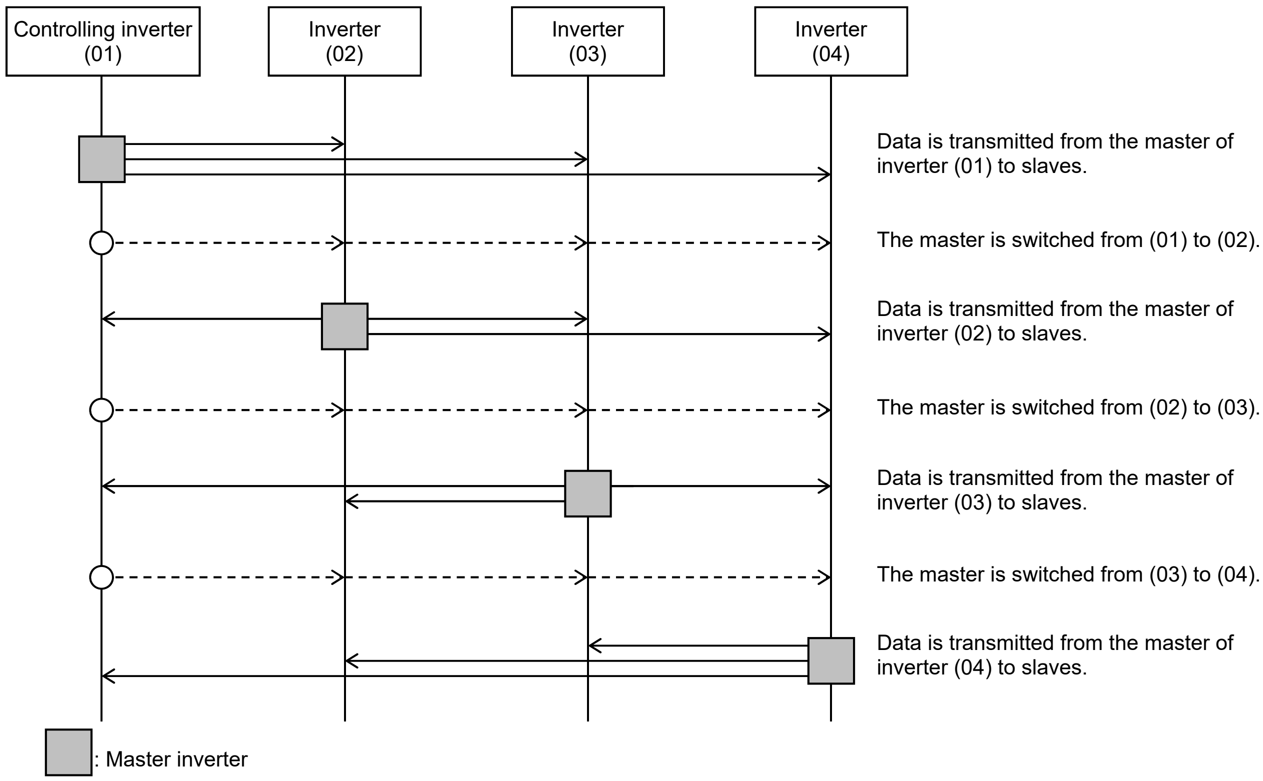
- Recalculation of control processing internal variables is performed when 1 is written to a retention register (9010 (DEC)) using the writing command to a retention register (06h).

14.5 EzCOM Function

14.5.1 What is EzCOM?

- EzCOM is a function to allow multiple inverters to communicate each other without a master inverter such as PC and PLC, aside from normal Modbus-RTU communication (slave).
- Rolls of inverters within the network of EzCOM are allocated to:
  - "Controlling inverter"
  - "Master inverter"
  - "Slave inverter"
- In the EzCOM network, the "controlling inverter" designates an inverter within the network as a "master inverter", and the "master inverter" gives commands sequentially.
- As in the normal Modbus communication (RS-485), connect SP and SN terminals of respective inverters used in EzCOM communication.

- A master inverter is able to write 5 different commands to retention registers of arbitrary slave inverters.
- Once a data transmission between a master and slaves is completed, the controlling inverter shifts a master inverter sequentially and repeats a data transmission in accordance with the settings of respective master inverters.
- "Controlling inverter" is always fixed whereas "master inverter" is shifted sequentially. For this reason, the "controlling inverter" can be a "master inverter" or "slave inverter".
- Up to 8 inverters can function as a "master inverter".



14.5.2 EzCOM Settings

- Set a station number for [CF-02] to each inverter of the EzCOM network, avoiding overlapping a station number. While doing so, make sure to assign a station number 01. The inverter with the station number 01 will be the "controlling inverter".
- Set the communication selection of controlling inverter to EzCOM communication's "controlling inverter" [CF-09] =02. Set the communication selection of other inverters to EzCOM communication [CF-09] =01.

- Set the EzCOM communication start method [CF-22] to the controlling inverter.
  If you selected the input terminal start [CF-22] =00, assign 098 [485:EzCOM start] to any of input terminals.
- To a master inverter, set the number of transmitting data, the station number of transmission destination, register of transmission destination, and register of transmission source that are required for the master inverter to write the data (see the following table).

Item	Parameter	Data	Set-up Destination	Description
Communication station number selection *1)	[CF-02]	1~247	ALL	Station number setting
Communication error operation selection	[CF-06]	00	ALL	Trip
		01	ALL	Trips after decelerating and stopping
		02	ALL	Ignore
		03	ALL	Free-run
		04	ALL	Deceleration stop
Communication timeout time	[CF-07]	0.00	ALL	Communication timeout disabled
		0.01~100.00	ALL	Unit [s]
Communication waiting time	[CF-08]	0~1000	ALL	Unit [ms]
Communication selection	[CF-09]	00	–	Modbus-RTU communication
		01	B	EzCOM communication
		02	A	EzCOM communication <controlling inverter>
EzCOM master start station number *2)	[CF-20]	01~08	A	Setting required for controlling inverter only.
EzCOM master end station number *2)	[CF-21]	01~08	A	Setting required for controlling inverter only.
EzCOM start selection	[CF-22]	00	A	Start-up by input terminal
		01	A	Always communication
Input terminal selection	[CA-01]~[CA-11]	098	A	[ECOM]: Starting up of EzCOM

■Set-up destinations
ALL: Set to all inverters used for EzCOM.
A: Set to only an inverter for controlling (station number 01).
B: Set to inverters other than an inverter for controlling (station number 01).

*1) When you provide multiple master inverters, set consecutive station numbers (01, 02, 03 ...) to them.
If the numbers are not consecutive, the inverters cannot perform communication.
*2) Note that the relationship between the master start/end station number settings must be [CF-20] ≤ [CF-21].

■Command settings for assigning master inverters

Item	Parameter	Data	Set-up Destination	Description
Number of EzCOM transmitting data	[CF-23]	01~05	M	Sets how many of the registers 1 to 5 shown below need to be transferred in EzCOM communication.
EzCOM transmission destination station number 1	[CF-24]	1~247	M	Station number for transmission destination 1.
EzCOM transmission destination register *3)	[CF-25]	0000h~FFFFh	M	Sets the high-order register of transmission destination 1.
EzCOM transmission source 1 register *3)	[CF-26]	0000h~FFFFh	M	Sets the low-order register of transmission destination 1.
EzCOM transmission destination station number 2	[CF-27]	1~247	M	Station number for transmission destination 2.
EzCOM transmission destination 2 register *3)	[CF-28]	0000h~FFFFh	M	Sets the high-order register of transmission destination 2.
EzCOM transmission source 2 register *3)	[CF-29]	0000h~FFFFh	M	Sets the low-order register of transmission destination 2.
EzCOM transmission destination station number 3	[CF-30]	1~247	M	Station number for transmission destination 3.
EzCOM transmission destination 3 register *3)	[CF-31]	0000h~FFFFh	M	Sets the high-order register of transmission destination 3.
EzCOM transmission source 3 register *3)	[CF-32]	0000h~FFFFh	M	Sets the low-order register of transmission destination 3.
EzCOM transmission destination station number 4	[CF-33]	1~247	M	Station number for transmission destination 4.
EzCOM transmission destination 4 register *3)	[CF-34]	0000h~FFFFh	M	Sets the high-order register of transmission destination 4.
EzCOM transmission source 4 register *3)	[CF-35]	0000h~FFFFh	M	Sets the low-order register of transmission destination 4.
EzCOM transmission destination station number 5	[CF-36]	1~247	M	Station number for transmission destination 5.
EzCOM transmission destination 5 register *3)	[CF-37]	0000h~FFFFh	M	Sets the high-order register of transmission destination 5.
EzCOM transmission source 5 register *3)	[CF-38]	0000h~FFFFh	M	Sets the low-order register of transmission destination 5.

*3) As for the transmission destination register and the transmission source register, specify the register address obtained by subtracting one from the register No. For information on register address, please contact the sales officer of our company shown on the back cover.

■Set-up destinations

M: Perform the setting to inverters having station numbers designated in [CF-20] and [CF-21] (= master inverters).

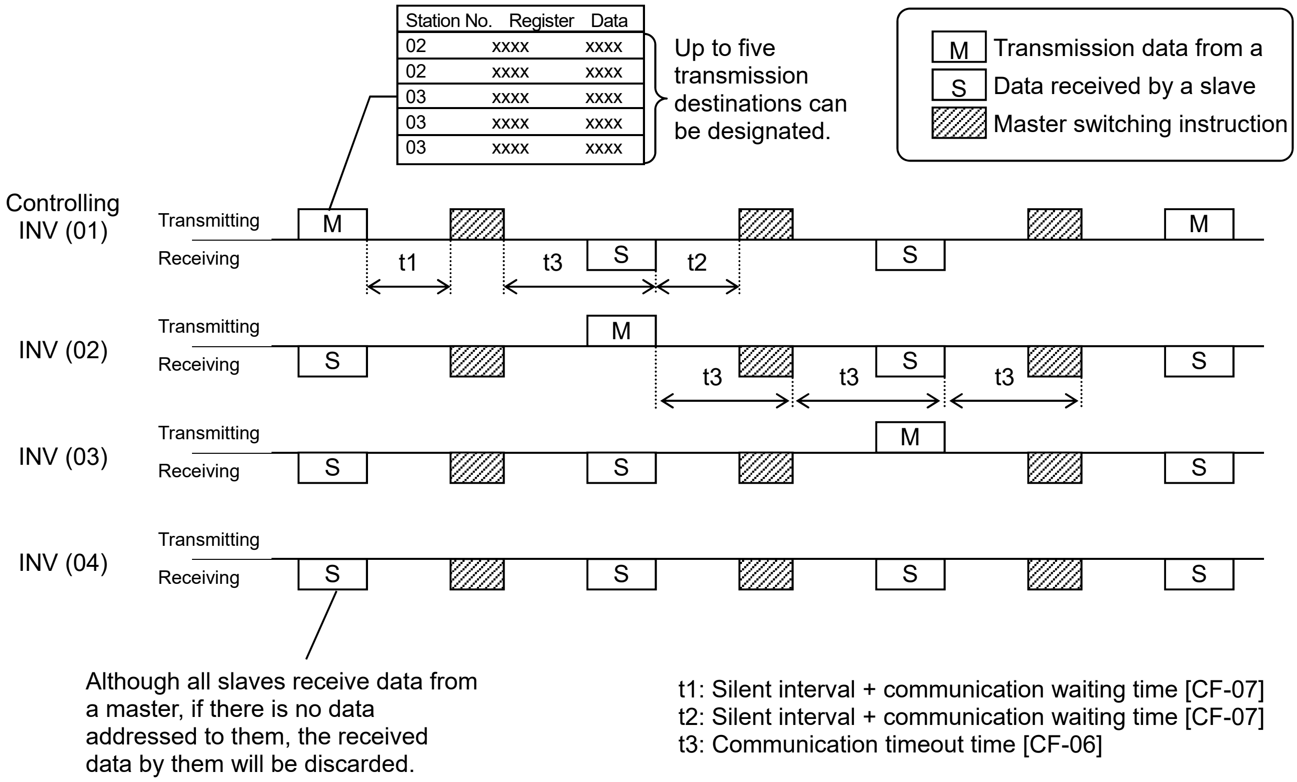
14.5.3 EzCOM Operation

(1) A master inverter transmits data to slave inverters according to the settings made to the master inverter.
(2) The controlling inverter transmits a master switching command, and then a master inverter is switched.
(3) The next master inverter transmits data to slave inverters as described in (1).
(4) Processes of (2) and (3) will follow, and the whole processes will be repeated likewise.

- Entire communication data is transmitted to all stations because EzCOM communication is performed by broadcast communication. As a result, a slave not designated as transmission destinations on the master side receives data once, but internally discards the data which is not addressed to it.

14.5.4 Examples of EzCOM communication

- Shown below is communication sequences of inverters with station numbers 01 to 04 (four inverters in total), where the inverters 01 to 03 are designated as master inverters.



- Communication timeout time [CF-06] for the controlling inverter, make sure to set value other than 0 (1 second or longer is recommended). Otherwise, the EzCOM function will stop when the communication is timed-out and data from a master inverter cannot be received. When the EzCOM function is stopped, reset the controlling inverter by turning on the power again or by resetting with the [RST] terminal.
- If the controlling inverter is a master inverter, a master switching instruction is transmitted after the master inverter transmits data followed by a silent interval + communication waiting time [CF-07] (aforementioned t1).

- If an inverter other than the controlling inverter is a master inverter, a master switching instruction is transmitted after the data from the master inverter is received followed by a silent interval + communication waiting time [CF-07] (aforementioned t2).
- The timer of communication timeout starts counting from the start of reception waiting. If data reception isn't completed within a set time, the communication will be timed-out (aforementioned t3), and the the inverter behaves in accordance with the communication error selection [CF-05].

- When continuous communication [CF-22]=01 is selected in EzCOM start selection, the controlling inverter starts a transmission as soon as the power is turned ON. If the other inverters are turned ON late, a normal communication cannot be performed and the controlling inverter issues a communication timeout. Where always communication is selected, turn ON the controlling inverter after confirming that the other inverters have been turned ON.

- Do not set 08FFh (data writing) or 0901h (data writing mode selection) to transmission destination registers.
- If you changed settings of [CF-09] and [CF-20] - [CF-22], you can reflect the changes by turning on the power again or by resetting with the [RS] terminal.

14.6 Lists of Coils and Communication Registers

14.6.1 Precautions at setting registers and coils

- R or W shown in the lists indicates whether a coil or retention register can be used for readout or writing.
  - R: only readout
  - W: only writing
  - R/W: both readout and writing

- The setting ranges shown in the lists are values in the condition where the parameter [CF-11] resister data selection (A, V⇔% conversion function) is set to “00:(A, V)”.
  Note that where the parameter selection is set to “01:(%)”, monitor and setting range for a current/voltage related parameter is shown in percentage to the rated value.

14.6.2 List of coil numbers

Coil No.	Coil No. (hexadecimal)	Item name	R/W	Setting description
0	0000h	Reserved	-	-
1	0001h	Operation command	R/W	1: Run / 0: Stop (enabled when AA111/AA211=03)
2	0002h	Rotation direction command	R/W	1: Reverse / 0: Forward (enabled when AA111/AA211=03)
3	0003h	External trip [ES]	R/W	1: Trip / 0: Not trip
4	0004h	Trip reset [RST]	R/W	1: Reset / 0: Not reset
5	0005h	Input terminal FR	R/W	1: ON/0: OFF
6	0006h	Input terminal RR	R/W	
7	0007h	Input terminal DFL	R/W	
8	0008h	Input terminal DFM	R/W	
9	0009h	Input terminal AUT	R/W	
10	000Ah	Input terminal MBS	R/W	
11	000Bh	Input terminal JOG	R/W	
12	000Ch	Input terminal ES	R/W	
13	000Dh	Input terminal RST	R/W	
14	000Eh	Input terminal DFH	R/W	
15	000Fh	Input terminal DHH	R/W	
16 to 20	0010h to 0014h	Reserved	-	-
21	0015h	Operating status	R	1: Rotating in forward direction,rotating in reverse direction 0: Other than rotating in forward/reverse rotation (linked with dA-03)
22	0016h	Rotation direction	R	1: Rotating in reverse direction 0: Rotating in forward direction (linked with dA-03)
23	0017h	Inverter operation ready completion	R	1: Ready / 0: Not ready
24	0018h	Reserved	-	-
25	0019h	Output terminal UPF	R	1: ON / 0: OFF
26	001Ah	Output terminal DRV	R	
27	001Bh	Output terminal X1	R	
28	001Ch	Output terminal X2	R	
29	001Dh	Output terminal X3	R	
30	001Eh	Output terminal RL	R	
31	001Fh	Output terminal FL	R	
32 to 72	0020h to 0048h	Reserved	-	-
73	0049h	Data being written	R	1: Being written / 0: Forward state
74	004Ah	CRC error	R	1: With error / 0: No error
75	004Bh	Overrun error	R	
76	004Ch	Framing error	R	
77	004Dh	Parity error	R	
78	004Eh	Sum check error	R	
79~	004Fh~	Reserved	-	-

14.6.3 List of retention register numbers

■Monitor (Code-d))

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
dA-01	10001	2711h	Output frequency monitor	R	0 ~ 59000	0.01Hz
dA-02	10002	2712h	Output current monitor	R	0 ~ 65535	0.01A
dA-03	10003	2713h	Operation direction monitor	R	0 ~ 3	1
dA-04	10004	2714h	Frequency command (High)	R	-59000 ~ 59000	0.01Hz
(dA-05)	10005	2715h	(after calculation) (Low)			
dA-06	10006	2716h	Output frequency conversion (High)	R	0 ~ 5900000	0.01
(dA-07)	10007	2717h	monitor (Low)			
dA-08	10008	2718h	Speed detection value monitor (High)	R	-59000 ~ 59000	0.01Hz
(dA-09)	10009	2719h	(Low)			
dA-12	10012	271Ch	Output frequency monitor (High)	R		
(dA-13)	10013	271Dh	(with sign) (Low)			
dA-14	10014	271Eh	Frequency upper limit monitor	R	0 ~ 59000	
dA-15	10015	271Fh	Torque command monitor (after calculation)	R	-10000 ~ 10000	0.1%
dA-16	10016	2720h	Torque limit monitor	R	0 ~ 5000	
dA-17	10017	2721h	Output torque monitor	R	-10000 ~ 10000	
dA-18	10018	2722h	Output voltage monitor	R	0 ~ 8000	0.1V
dA-20	10020	2724h	Current position monitor (High)	R	-268435455 ~ 268435455 In high resolution mode: -1073741823 to 1073741823	1pls
(dA-21)	10021	2725h	(Low)			
dA-26	10026	272Ah	Pulse train position deviation (High)	R	-2147483647 ~ 2147483647	
(dA-27)	10027	272Bh	monitor (Low)			
dA-28	10028	272Ch	Pulse counter monitor (High)	R	0 ~ 2147483647	
(dA-29)	10029	272Dh	(Low)			
dA-30	10030	272Eh	Input power monitor	R	0 ~ 60000	0.01kWh
dA-32	10032	2730h	Integrated input power monitor (High)	R	0 ~ 10000000	0.1kWh
(dA-33)	10033	2731h	(Low)			
dA-34	10034	2732h	Output power monitor	R	0 ~ 60000	0.01kWh
dA-36	10036	2734h	Integrated output power monitor (High)	R	0 ~ 10000000	0.1kWh
(dA-37)	10037	2735h	(Low)			
dA-38	10038	2736h	Motor temperature monitor	R	-200 ~ 2000	0.1°C
dA-40	10040	2738h	DC voltage monitor	R	0 ~ 10000	0.1Vdc
dA-41	10041	2739h	DBTR load factor monitor	R	0 ~ 10000	0.01%
dA-42	10042	273Ah	Electronic thermal load factor monitor (Motor)	R		
dA-43	10043	273Bh	Electronic thermal load factor monitor (Inverter)	R		
dA-45	10045	273Dh	Safety STO monitor	R	0 ~ 7	1
dA-46	10046	273Eh	Safety option hardware monitor	R	0 ~ 0xFFFF	
dA-47	10047	273Fh	Reserved	R	-	-
dA-50	10050	2742h		R		
dA-51	10051	2743h	Input terminal monitor	R	0 ~ 0xFFFF	1
dA-54	10054	2746h	Output terminal monitor	R	0 ~ 0xFF	
dA-60	10060	274Ch	Analog I/O selection monitor	R		
dA-61	10061	274Dh	Analog input [VRF] monitor	R	0 ~ 10000	0.01%
dA-62	10062	274Eh	Analog input [IRF] monitor	R		
dA-63	10063	274Fh	Analog input [VF2] monitor	R	-10000 ~ 10000	
dA-64	10064	2750h	Extended analog input [Ai4] monitor	R	0 ~ 10000	
dA-65	10065	2751h	Extended analog input [Ai5] monitor	R		
dA-66	10066	2752h	Extended analog input [Ai6] monitor	R	-10000 ~ 10000	
dA-70	10070	2756h	Pulse train input monitor (inverter)	R		
dA-71	10071	2757h	Pulse train input monitor (option)	R		
dA-81	10081	2761h	Option slot 1 mounted state	R	0 ~ 48	1
dA-82	10082	2762h	Option slot 2 mounted state	R		
dA-83	10083	2763h	Option slot 3 mounted state	R		
db-01 to db-23	10101 to 10123	2775h to 278Bh	Reserved	R	-	-

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
db-30 (db-31)	10130 10131	2792h 2793h	PID1 feedback data 1 monitor (High) (Low)	R	-10000 ~ 10000	Per AJ-06 setting
db-32 (db-33)	10132 10133	2794h 2795h	PID1 feedback data 2 monitor (High) (Low)	R		
db-34 (db-35)	10134 10135	2796h 2797h	PID1 feedback data 3 monitor (High) (Low)	R		
db-36 (db-37)	10136 10137	2798h 2799h	PID2 feedback data monitor (High) (Low)	R		
db-38 (db-39)	10138 10139	279Ah 279Bh	PID3 feedback data monitor (High) (Low)	R		Per AJ-26 setting
db-40 (db-41)	10140 10141	279Ch 279Dh	PID4 feedback data monitor (High) (Low)	R		Per AJ-46 setting
db-42 (db-43)	10142 10143	279Eh 279Fh	PID1 target value monitor (High) (after calculation) (Low)	R		Per AH-06 setting
db-44 (db-45)	10144 10145	27A0h 27A1h	PID1 feedback data monitor (High) (after calculation) (Low)	R		
db-50	10150	27A6h	PID1 output monitor	R	-10000 ~ 10000	0.01%
db-51	10151	27A7h	PID1 deviation monitor	R		
db-52	10152	27A8h	PID1 deviation 1 monitor	R		
db-53	10153	27A9h	PID1 deviation 2 monitor	R		
db-54	10154	27AAh	PID1 deviation 3 monitor	R		
db-55	10155	27ABh	PID2 output monitor	R		
db-56	10156	27ACh	PID2 deviation monitor	R		
db-57	10157	27ADh	PID3 output monitor	R		
db-58	10158	27AEh	PID3 deviation monitor	R		
db-59	10159	27AFh	PID4 output monitor	R		
db-60	10160	27B0h	PID4 deviation monitor	R		
db-61	10161	27B1h	PID current P gain monitor	R	0 ~ 1000	0.1 x
db-62	10162	27B2h	PID current I gain monitor	R	0 ~ 36000	0.1s
db-63	10163	27B3h	PID current D gain monitor	R	0 ~ 10000	0.01s
db-64	10164	27B4h	PID feed forward monitor	R		0.01%
dC-01	10201	27D9h	Inverter load type selection monitor	R	0 ~ 2	1
dC-02	10202	27DAh	Rated current monitor	R	0 ~ 65535	0.1A
dC-07	10207	27DFh	Speed command destination monitor (main)	R	0 ~ 34	1
dC-08	10208	27E0h	Speed command destination monitor (auxiliary)	R		
dC-10	10210	27E2h	Operation command destination monitor	R	0 ~ 6	
dC-15	10215	27E7h	Cooling fin temperature monitor	R	-200 ~ 2000	0.1°C
dC-16	10216	27E8h	Life diagnostic monitor	R	0 ~ 0xFF	1
dC-20	10220	27ECh	Total start-up count	R	1 ~ 65535	
dC-21	10221	27EDh	Power-on count	R		
dC-22 (dC-23)	10222 10223	27EEh 27EFh	Cumulative operating hours monitor (High) during RUN (Low)	R	0 ~ 1000000	1hr
dC-24 (dC-25)	10224 10225	27F0h 27F1h	Cumulative power-on time (High) (Low)	R		
dC-26 (dC-27)	10226 10227	27F2h 27F3h	Cumulative operating time of cooling fan (High) (Low)	R		
dC-37	10237	27FDh	Detailed monitor for icon 2 LIM	R	0 ~ 6	1
dC-38	10238	27FEh	Detailed monitor for icon 2 LIM	R	0 ~ 4	
dC-39	10239	27FFh	Detailed monitor for icon 2 RETRY	R	0 ~ 2	
dC-40	10240	2800h	Detailed monitor for icon 2 NRDY	R	0 ~ 9	
dC-45	10245	2805h	IM/SM monitor	R	0 ~ 1	
dC-50	10250	280Ah	Firmware Ver. monitor	R	0 ~ 0xFFFF Higher 1 byte: Major Lower 1 byte: Minor 1	
dC-53	10253	280Dh	Firmware Gr. monitor	R	0 ~ 1	

■Trip monitor

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Trip monitor (dE-01)	1000	03E8h	Trip count monitor	R	0 ~ 65535	1
Trip monitor (dE-11)	1001	03E9h	Trip monitor 1 Factor	R	1 ~ 255	
	1002	03EAh	Trip monitor 1 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1003	03EBh	(Low)			
	1004	03ECh	Trip monitor 1 Output current	R	0 ~ 65535	0.01A
	1005	03EDh	Trip monitor 1 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1006	03EEh	Trip monitor 1 Inverter state	R	0 ~ 8	1
	1007	03EFh	Trip monitor 1 LAD state	R	0 ~ 5	
	1008	03F0h	Trip monitor 1 INV control mode	R	0 ~ 11	
	1009	03F1h	Trip monitor 1 Limit state	R	0 ~ 6	
	1010	03F2h	Trip monitor 1 Special state	R		
	1012	03F4h	Trip monitor 1 RUN time (High)	R	0 ~ 1000000	1hr
	1013	03F5h	(Low)			
	1014	03F6h	Trip monitor 1 Power ON time (High)	R		
	1015	03F7h	(Low)			
	1016	03F8h	Trip monitor 1 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1017	03F9h	Trip monitor 1 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1018	03FAh	Trip monitor 1 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-12)	1021	03FDh	Trip monitor 2 Factor	R	1 ~ 255	
	1022	03FEh	Trip monitor 2 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1023	03FFh	(Low)			
	1024	0400h	Trip monitor 2 Output current	R	0 ~ 65535	0.01A
	1025	0401h	Trip monitor 2 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1026	0402h	Trip monitor 2 Inverter state	R	0 ~ 8	1
	1027	0403h	Trip monitor 2 LAD state	R	0 ~ 5	
	1028	0404h	Trip monitor 2 INV control mode	R	0 ~ 11	
	1029	0405h	Trip monitor 2 Limit state	R	0 ~ 6	
	1030	0406h	Trip monitor 2 Special state	R		
	1032	0408h	Trip monitor 2 RUN time (High)	R	0 ~ 1000000	1hr
	1033	0409h	(Low)			
	1034	040Ah	Trip monitor 2 Power ON time (High)	R		
	1035	040Bh	(Low)			
	1036	040Ch	Trip monitor 2 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1037	040Dh	Trip monitor 2 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1038	040Eh	Trip monitor 2 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-13)	1041	0411h	Trip monitor 3 Factor	R	1 ~ 255	
	1042	0412h	Trip monitor 3 Output frequency(with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1043	0413h	(Low)			
	1044	0414h	Trip monitor 3 Output current	R	0 ~ 65535	0.01A
	1045	0415h	Trip monitor 3 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1046	0416h	Trip monitor 3 Inverter state	R	0 ~ 8	1
	1047	0417h	Trip monitor 3 LAD state	R	0 ~ 5	
	1048	0418h	Trip monitor 3 INV control mode	R	0 ~ 11	
	1049	0419h	Trip monitor 3 Limit state	R	0 ~ 6	
	1050	041Ah	Trip monitor 3 Special state	R		
	1052	041Ch	Trip monitor 3 RUN time (High)	R	0 ~ 1000000	1hr
	1053	041Dh	(Low)			
	1054	041Eh	Trip monitor 3 Power ON time (High)			
	1055	041Fh	(Low)			
	1056	0420h	Trip monitor 3 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1057	0421h	Trip monitor 3 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1058	0422h	Trip monitor 3 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Trip monitor (dE-14)	1061	0425h	Trip monitor 4 Factor	R	1 ~ 255	1
	1062	0426h	Trip monitor 4 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1063	0427h	(Low)			
	1064	0428h	Trip monitor 4 Output current	R	0 ~ 65535	0.01A
	1065	0429h	Trip monitor 4 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1066	042Ah	Trip monitor 4 Inverter state	R	0 ~ 8	1
	1067	042Bh	Trip monitor 4 LAD state	R	0 ~ 5	
	1068	042Ch	Trip monitor 4 INV control mode	R	0 ~ 11	
	1069	042Dh	Trip monitor 4 Limit state	R	0 ~ 6	
	1070	042Eh	Trip monitor 4 Special state	R		
	1072	0430h	Trip monitor 4 RUN time (High)	R	0 ~ 1000000	1hr
	1073	0431h	(Low)			
	1074	0432h	Trip monitor 4 Power ON time (High)	R		
	1075	0433h	(Low)			
	1076	0434h	Trip monitor 4 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1077	0435h	Trip monitor 4 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1078	0436h	Trip monitor 4 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-15)	1081	0439h	Trip monitor 5 Factor	R	1 ~ 255	
	1082	043Ah	Trip monitor 5 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1083	043Bh	(Low)			
	1084	043Ch	Trip monitor 5 Output current	R	0 ~ 65535	0.01A
	1085	043Dh	Trip monitor 5 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1086	043Eh	Trip monitor 5 Inverter state	R	0 ~ 8	1
	1087	043Fh	Trip monitor 5 LAD state	R	0 ~ 5	
	1088	0440h	Trip monitor 5 INV control mode	R	0 ~ 11	
	1089	0441h	Trip monitor 5 Limit state	R	0 ~ 6	
	1090	0442h	Trip monitor 5 Special state	R		
	1092	0444h	Trip monitor 5 RUN time (High)	R	0 ~ 1000000	1hr
	1093	0445h	(Low)			
	1094	0446h	Trip monitor 5 Power ON time (High)	R		
	1095	0447h	(Low)			
	1096	0448h	Trip monitor 5 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1097	0449h	Trip monitor 5 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1098	044Ah	Trip monitor 5 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-16)	1101	044Dh	Trip monitor 6 Factor	R	1 ~ 255	
	1102	044Eh	Trip monitor 6 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1103	044Fh	(Low)			
	1104	0450h	Trip monitor 6 Output current	R	0 ~ 65535	0.01A
	1105	0451h	Trip monitor 6 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1106	0452h	Trip monitor 6 Inverter state	R	0 ~ 8	1
	1107	0453h	Trip monitor 6 LAD state	R	0 ~ 5	
	1108	0454h	Trip monitor 6 INV control mode	R	0 ~ 11	
	1109	0455h	Trip monitor 6 Limit state	R	0 ~ 6	
	1110	0456h	Trip monitor 6 Special state	R		
	1112	0458h	Trip monitor 6 RUN time (High)	R	0 ~ 1000000	1hr
	1113	0459h	(Low)			
	1114	045Ah	Trip monitor 6 Power ON time (High)	R		
	1115	045Bh	(Low)			
	1116	045Ch	Trip monitor 6 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1117	045Dh	Trip monitor 6 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1118	045Eh	Trip monitor 6 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Trip monitor (dE-17)	1121	0461h	Trip monitor 7 Factor	R	1 ~ 255	1
	1122	0462h	Trip monitor 7 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1123	0463h	(Low)			
	1124	0464h	Trip monitor 7 Output current	R	0 ~ 65535	0.01A
	1125	0465h	Trip monitor 7 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1126	0466h	Trip monitor 7 Inverter state	R	0 ~ 8	1
	1127	0467h	Trip monitor 7 LAD state	R	0 ~ 5	
	1128	0468h	Trip monitor 7 INV control mode	R	0 ~ 11	
	1129	0469h	Trip monitor 7 Limit state	R	0 ~ 6	
	1130	046Ah	Trip monitor 7 Special state	R		
	1132	046Ch	Trip monitor 7 RUN time (High)	R	0 ~ 1000000	1hr
	1133	046Dh	(Low)			
	1134	046Eh	Trip monitor 7 Power ON time (High)	R		
	1135	046Fh	(Low)			
	1136	0470h	Trip monitor 7 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1137	0471h	Trip monitor 7 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1138	0472h	Trip monitor 7 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-18)	1141	0475h	Trip monitor 8 Factor	R	1 ~ 255	
	1142	0476h	Trip monitor 8 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1143	0477h	(Low)			
	1144	0478h	Trip monitor 8 Output current	R	0 ~ 65535	0.01A
	1145	0479h	Trip monitor 8 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1146	047Ah	Trip monitor 8 Inverter state	R	0 ~ 8	1
	1147	047Bh	Trip monitor 8 LAD state	R	0 ~ 5	
	1148	047Ch	Trip monitor 8 INV control mode	R	0 ~ 11	
	1149	047Dh	Trip monitor 8 Limit state	R	0 ~ 6	
	1150	047Eh	Trip monitor 8 Special state	R		
	1152	0480h	Trip monitor 8 RUN time (High)	R	0 ~ 1000000	1hr
	1153	0481h	(Low)			
	1154	0482h	Trip monitor 8 Power ON time (High)	R		
	1155	0483h	(Low)			
	1156	0484h	Trip monitor 8 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1157	0485h	Trip monitor 8 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1158	0486h	Trip monitor 8 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Trip monitor (dE-19)	1161	0489h	Trip monitor 9 Factor	R	1 ~ 255	1
	1162	048Ah	Trip monitor 9 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1163	048Bh	(Low)			
	1164	048Ch	Trip monitor 9 Output current	R	0 ~ 65535	0.01A
	1165	048Dh	Trip monitor 9 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1166	048Eh	Trip monitor 9 Inverter state	R	0 ~ 8	1
	1167	048Fh	Trip monitor 9 LAD state	R	0 ~ 5	
	1168	0490h	Trip monitor 9 INV control mode	R	0 ~ 11	
	1169	0491h	Trip monitor 9 Limit state	R	0 ~ 6	
	1170	0492h	Trip monitor 9 Special state	R		
	1172	0494h	Trip monitor 9 RUN time (High)	R	0 ~ 1000000	1hr
	1173	0495h	(Low)			
	1174	0496h	Trip monitor 9 Power ON time (High)			
	1175	0497h	(Low)			
	1176	0498h	Trip monitor 9 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1177	0499h	Trip monitor 9 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1178	049Ah	Trip monitor 9 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Trip monitor (dE-20)	1181	049Dh	Trip monitor 10 Factor	R	1 ~ 255	1
	1182	049Eh	Trip monitor 10 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1183	049Fh	(Low)			
	1184	04A0h	Trip monitor 10 Output current	R	0 ~ 65535	0.01A
	1185	04A1h	Trip monitor 10 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1186	04A2h	Trip monitor 10 Inverter state	R	0 ~ 8	1
	1187	04A3h	Trip monitor 10 LAD state	R	0 ~ 5	
	1188	04A4h	Trip monitor 10 INV control mode	R	0 ~ 11	
	1189	04A5h	Trip monitor 10 Limit state	R	0 ~ 6	
	1190	04A6h	Trip monitor 10 Special state	R		
	1192	04A8h	Trip monitor 10 RUN time (High)	R	0 ~ 1000000	1hr
	1193	04A9h	(Low)			
	1194	04AAh	Trip monitor 10 Power ON time (High)	R		
	1195	04ABh	(Low)			
	1196	04ACh	Trip monitor 10 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1197	04ADh	Trip monitor 10 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1198	04AEh	Trip monitor 10 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

■Retry monitor

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Retry monitor (dE-31)	1201	04B1h	Retry monitor 1 Factor	R	1 ~ 255	1
	1202	04B2h	Retry monitor 1 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1203	04B3h	(Low)			
	1204	04B4h	Retry monitor 1 Output current	R	0 ~ 65535	0.01A
	1205	04B5h	Retry monitor 1 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1206	04B6h	Retry monitor 1 Inverter state	R	0 ~ 8	1
	1207	04B7h	Retry monitor 1 LAD state	R	0 ~ 5	
	1208	04B8h	Retry monitor 1 INV control mode	R	0 ~ 11	
	1209	04B9h	Retry monitor 1 Limit state	R	0 ~ 6	
	1210	04BAh	Retry monitor 1 Special state	R		
	1212	04BCh	Retry monitor 1 RUN time (High)	R	0 ~ 1000000	1hr
	1213	04BDh	(Low)			
	1214	04BEh	Retry monitor 1 Power ON time (High)	R		
	1215	04BFh	(Low)			
	1216	04C0h	Retry monitor 1 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1217	04C1h	Retry monitor 1 Absolute time(day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1218	04C2h	Retry monitor 1 Absolute time(hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-32)	1221	04C5h	Retry monitor 2 Factor	R	1 ~ 255	
	1222	04C6h	Retry monitor 2 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1223	04C7h	(Low)			
	1224	04C8h	Retry monitor 2 Output current	R	0 ~ 65535	0.01A
	1225	04C9h	Retry monitor 2 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1226	04CAh	Retry monitor 2 Inverter state	R	0 ~ 8	1
	1227	04CBh	Retry monitor 2 LAD state	R	0 ~ 5	
	1228	04CCh	Retry monitor 2 INV control mode	R	0 ~ 11	
	1229	04CDh	Retry monitor 2 Limit state	R	0 ~ 6	
	1230	04CEh	Retry monitor 2 Special state	R		
	1232	04D0h	Retry monitor 2 RUN time (High)	R	0 ~ 1000000	1hr
	1233	04D1h	(Low)			
	1234	04D2h	Retry monitor 2 Power ON time (High)	R		
	1235	04D3h	(Low)			
	1236	04D4h	Retry monitor 2 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1237	04D5h	Retry monitor 2 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1238	04D6h	Retry monitor 2 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Retry monitor (dE-33)	1241	04D9h	Retry monitor 3 Factor	R	1 ~ 255	1
	1242	04DAh	Retry monitor 3 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1243	04DBh	(Low)			
	1244	04DCh	Retry monitor 3 Output current	R	0 ~ 65535	0.01A
	1245	04DDh	Retry monitor 3 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1246	04DEh	Retry monitor 3 Inverter state	R	0 ~ 8	1
	1247	04DFh	Retry monitor 3 LAD state	R	0 ~ 5	
	1248	04E0h	Retry monitor 3 INV control mode	R	0 ~ 11	
	1249	04E1h	Retry monitor 3 Limit state	R	0 ~ 6	
	1250	04E2h	Retry monitor 3 Special state	R		
	1252	04E4h	Retry monitor 3 RUN time (High)	R	0 ~ 1000000	1hr
	1253	04E5h	(Low)			
	1254	04E6h	Retry monitor 3 Power ON time (High)	R		
	1255	04E7h	(Low)			
	1256	04E8h	Retry monitor 3 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1257	04E9h	Retry monitor 3 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1258	04EAh	Retry monitor 3 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-34)	1261	04EDh	Retry monitor 4 Factor	R	1 ~ 255	
	1262	04EEh	Retry monitor 4 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1263	04EFh	(Low)			
	1264	04F0h	Retry monitor 4 Output current	R	0 ~ 65535	0.01A
	1265	04F1h	Retry monitor 4 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1266	04F2h	Retry monitor 4 Inverter state	R	0 ~ 8	1
	1267	04F3h	Retry monitor 4 LAD state	R	0 ~ 5	
	1268	04F4h	Retry monitor 4 INV control mode	R	0 ~ 11	
	1269	04F5h	Retry monitor 4 Limit state	R	0 ~ 6	
	1270	04F6h	Retry monitor 4 Special state	R		
	1272	04F8h	Retry monitor 4 RUN time (High)	R	0 ~ 1000000	1hr
	1273	04F9h	(Low)			
	1274	04FAh	Retry monitor 4 Power ON time (High)	R		
	1275	04FBh	(Low)			
	1276	04FCh	Retry monitor 4 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1277	04FDh	Retry monitor 4 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1278	04FEh	Retry monitor 4 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-35)	1281	0501h	Retry monitor 5 Factor	R	1 ~ 255	1
	1282	0502h	Retry monitor 5 Output frequency(with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1283	0503h	(Low)			
	1284	0504h	Retry monitor 5 Output current	R	0 ~ 65535	0.01A
	1285	0505h	Retry monitor 5 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1286	0506h	Retry monitor 5 Inverter state	R	0 ~ 8	1
	1287	0507h	Retry monitor 5 LAD state	R	0 ~ 5	
	1288	0508h	Retry monitor 5 INV control mode	R	0 ~ 11	
	1289	0509h	Retry monitor 5 Limit state	R	0 ~ 6	
	1290	050Ah	Retry monitor 5 Special state	R		
	1292	050Ch	Retry monitor 5 RUN time (High)	R	0 ~ 1000000	1hr
	1293	050Dh	(Low)			
	1294	050Eh	Retry monitor 5 Power ON time (High)	R		
	1295	050Fh	(Low)			
	1296	0510h	Retry monitor 5 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1297	0511h	Retry monitor 5 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1298	0512h	Retry monitor 5 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Retry monitor (dE-36)	1301	0515h	Retry monitor 6 Factor	R	1 ~ 255	1
	1302	0516h	Retry monitor 6 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1303	0517h	(Low)			
	1304	0518h	Retry monitor 6 Output current	R	0 ~ 65535	0.01A
	1305	0519h	Retry monitor 6 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1306	051Ah	Retry monitor 6 Inverter state	R	0 ~ 8	1
	1307	051Bh	Retry monitor 6 LAD state	R	0 ~ 5	
	1308	051Ch	Retry monitor 6 INV control mode	R	0 ~ 11	
	1309	051Dh	Retry monitor 6 Limit state	R	0 ~ 6	
	1310	051Eh	Retry monitor 6 Special state	R		
	1312	0520h	Retry monitor 6 RUN time (High)	R	0 ~ 1000000	1hr
	1313	0521h	(Low)			
	1314	0522h	Retry monitor 6 Power ON time (High)	R		
	1315	0523h	(Low)			
	1316	0524h	Retry monitor 6 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1317	0525h	Retry monitor 6 Absolute time(day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1318	0526h	Retry monitor 6 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-37)	1321	0529h	Retry monitor 7 Factor	R	1 ~ 255	
	1322	052Ah	Retry monitor 7 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1323	052Bh	(Low)			
	1324	052Ch	Retry monitor 7 Output current	R	0 ~ 65535	0.01A
	1325	052Dh	Retry monitor 7 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1326	052Eh	Retry monitor 7 Inverter state	R	0 ~ 8	1
	1327	052Fh	Retry monitor 7 LAD state	R	0 ~ 5	
	1328	0530h	Retry monitor 7 INV control mode	R	0 ~ 11	
	1329	0531h	Retry monitor 7 Limit state	R	0 ~ 6	
	1330	0532h	Retry monitor 7 Special state	R		
	1332	0534h	Retry monitor 7 RUN time (High)	R	0 ~ 1000000	1hr
	1333	0535h	(Low)			
	1334	0536h	Retry monitor 7 Power ON time (High)	R		
	1335	0537h	(Low)			
	1336	0538h	Retry monitor 7 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1337	0539h	Retry monitor 7 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1338	053Ah	Retry monitor 7 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-38)	1341	053Dh	Retry monitor 8 Factor	R	1 ~ 255	
	1342	053Eh	Retry monitor 8 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1343	053Fh	(Low)			
	1344	0540h	Retry monitor 8 Output current	R	0 ~ 65535	0.01A
	1345	0541h	Retry monitor 8 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1346	0542h	Retry monitor 8 Inverter state	R	0 ~ 8	1
	1347	0543h	Retry monitor 8 LAD state	R	0 ~ 5	
	1348	0544h	Retry monitor 8 INV control mode	R	0 ~ 11	
	1349	0545h	Retry monitor 8 Limit state	R	0 ~ 6	
	1350	0546h	Retry monitor 8 Special state	R		
	1352	0548h	Retry monitor 8 RUN time (High)	R	0 ~ 1000000	1hr
	1353	0549h	(Low)			
	1354	054Ah	Retry monitor 8 Power ON time (High)	R		
	1355	054Bh	(Low)			
	1356	054Ch	Retry monitor 8 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1357	054Dh	Retry monitor 8 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1358	054Eh	Retry monitor 8 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Retry monitor (dE-39)	1361	0551h	Retry monitor 9 Factor	R	1 ~ 255	1
	1362	0552h	Retry monitor 9 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1363	0553h	(Low)			
	1364	0554h	Retry monitor 9 Output current	R	0 ~ 65535	0.01A
	1365	0555h	Retry monitor 9 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1366	0556h	Retry monitor 9 Inverter state	R	0 ~ 8	1
	1367	0557h	Retry monitor 9 LAD state	R	0 ~ 5	
	1368	0558h	Retry monitor 9 INV control mode	R	0 ~ 11	
	1369	0559h	Retry monitor 9 Limit state	R	0 ~ 6	
	1370	055Ah	Retry monitor 9 Special state	R		
	1372	055Ch	Retry monitor 9 RUN time (High)	R	0 ~ 1000000	1hr
	1373	055Dh	(Low)			
	1374	055Eh	Retry monitor 9 Power ON time (High)	R		
	1375	055Fh	(Low)			
	1376	0560h	Retry monitor 9 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1377	0561h	Retry monitor 9 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1378	0562h	Retry monitor 9 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	
Retry monitor (dE-40)	1381	0565h	Retry monitor 10 Factor	R	1 ~ 255	
	1382	0566h	Retry monitor 10 Output frequency (with sign) (High)	R	-59000 ~ 59000	0.01Hz
	1383	0567h	(Low)			
	1384	0568h	Retry monitor 10 Output current	R	0 ~ 65535	0.01A
	1385	0569h	Retry monitor 10 P-N DC voltage	R	0 ~ 10000	0.1Vdc
	1386	056Ah	Retry monitor 10 Inverter state	R	0 ~ 8	1
	1387	056Bh	Retry monitor 10 LAD state	R	0 ~ 5	
	1388	056Ch	Retry monitor 10 INV control mode	R	0 ~ 11	
	1389	056Dh	Retry monitor 10 Limit state	R	0 ~ 6	
	1390	056Eh	Retry monitor 10 Special state	R		
	1392	0570h	Retry monitor 10 RUN time (High)	R	0 ~ 1000000	1hr
	1393	0571h	(Low)			
	1394	0572h	Retry monitor 10 Power ON time (High)	R		
	1395	0573h	(Low)			
	1396	0574h	Retry monitor 10 Absolute time (year, month)	R	00 - 99 (BCD code) 01 - 12 (BCD code)	1
	1397	0575h	Retry monitor 10 Absolute time (day, day of the week)	R	01 - 31 (BCD code) 00 - 06 (BCD code)	
	1398	0576h	Retry monitor 10 Absolute time (hour, minute)	R	00 - 23 (BCD code) 00 - 59 (BCD code)	

■Warning

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
dE-50	1500	05DCh	Warning monitor	R	0 ~ 65535	1

■Writing, recalculation register

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
-	9000	2328h	ENTER instruction (Writing to Data Flash)	W	01: writing all parameters	1
	9002	232Ah	1 register writing mode	W	01: enabled	
	9010	2332h	Motor constant recalculation (motor constant standard data not to be developed)	W	01: enabled	

■Items other than parameter

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
-	10502	2906h	RS485 Set frequency (Signed) (High)	R/W	-59000～59000	0.01Hz
	10503	2907h	(Common to main speed and auxiliary speed) (Low)			
	10526	291Eh	RS485 Torque command	R/W	-5000 ~ 5000	0.1%
	10530	2922h	RS485 Torque bias	R/W		
	10534	2926h	RS485 Torque control speed limit value (Forward)	R/W	0 ~ 59000	0.01Hz
	10535	2927h	RS485 Torque control speed limit value (Reverse)	R/W		
	10546	2932h	RS485 PID target value (High)	R/W	-10000 ~ 10000	0.01%
	10547	2933h	(Low)			
	10554	293Ah	RS485 PID feedback data (High)	R/W		
	10555	293Bh	(Low)			
	10566	2946h	RS485 Torque limit	R/W	0 ~ 5000	0.1%
	16053	3EB5h	Output terminal function option output (OPO output)	R/W	0 ~ 0x7F	1
	16060	3EBCh	Coil data 0 (coil No. 0001h - 000Fh)	R/W	0 ~ 0xFFFF	
	16061	3EBDh	Coil data 1 (coil No. 0010h - 001Fh)	R		
	16062	3EBEh	Coil data 2 (coil No. 0020h - 002Fh)	R		
	16063	3EBFh	Coil data 3 (coil No. 0030h - 003Fh)	R		
	16064	3EC0h	Coil data 4 (coil No. 0040h - 004Fh)	R		

■Monitor + setting parameter (Code-F)

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
FA-01	11001	2AF9h	Main speed command (monitor + setting)	R/W	0 ~ 59000	0.01Hz
FA-02	11002	2AFAh	Auxiliary speed command (High)	R/W	-59000～59000 (monitor) 0～59000 (setting)	
(FA-03)	11003	2AFBh	(monitor + setting) (Low)			
FA-10	11010	2B02h	Acceleration time (monitor + setting) (High)	R/W	0 ~ 360000	0.01s
(FA-11)	11011	2B03h	(Low)			
FA-12	11012	2B04h	Deceleration time (monitor + setting) (High)	R/W		
(FA-13)	11013	2B05h	(Low)			
FA-15	11015	2B07h	Torque command monitor (monitor + setting)	R/W	-5000 ~ 5000	0.1%
FA-16	11016	2B08h	Torque bias monitor (monitor + setting)	R/W		
FA-20	11020	2B0Ch	Position command monitor (High)	R/W	-268435455 ~ 268435455 In high resolution mode: -1073741823 to 1073741823	1
(FA-21)	11021	2B0Dh	(monitor + setting) (Low)			
FA-30	11030	2B16h	PID1 target value 1 (High)	R/W	-10000 ~ 10000	Per AH-06 setting
(FA-31)	11031	2B17h	(monitor + setting) (Low)			
FA-32	11032	2B18h	PID1 target value 2 (High)	R/W		
(FA-33)	11033	2B19h	(monitor + setting) (Low)			
FA-34	11034	2B1Ah	PID1 target value 3 (High)	R/W		
(FA-35)	11035	2B1Bh	(monitor + setting) (Low)			
FA-36	11036	2B1Ch	PID2 target value (monitor + setting) (High)	R/W		Per AJ-06 setting
(FA-37)	11037	2B1Dh	(Low)			
FA-38	11038	2B1Eh	PID3 target value (monitor + setting) (High)	R/W		Per AJ-26 setting
(FA-39)	11039	2B1Fh	(Low)			
FA-40	11040	2B20h	PID4 target value (monitor + setting) (High)	R/W		Per AJ-46 setting
(FA-41)	11041	2B21h	(Low)			

■Setting parameter (Code-A, b, C, H, o, P, U)

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AA101	12001	2EE1h	First main speed command selection	R/W	1 ~ 16	1
AA102	12002	2EE2h	First auxiliary speed command selection	R/W	0 ~ 16	
AA104	12004	2EE4h	First auxiliary speed setting	R/W	0 ~ 59000	0.01Hz
AA105	12005	2EE5h	First operator selection	R/W	0 ~ 3	1
AA106	12006	2EE6h	First additional frequency setting (High)	R/W	-59000 ~ 59000	0.01Hz
(AA107)	12007	2EE7h	(SET-POINT) (Low)			
AA111	12011	2EEBh	First operation command selection	R/W	0 ~ 6	1
AA-12	12012	2EECh	RUN key direction selection	R/W	0 ~ 1	
AA-13	12013	2EEDh	STOP key selection	R/W	0 ~ 2	
AA114	12014	2EEEh	First operation direction limit selection	R/W	0 ~ 2	
AA115	12015	2EEFh	First stop mode selection	R/W	0 ~ 1	
AA121	12021	2EF5h	First control mode	R/W	0 ~ 12	
AA123	12023	2EF7h	First vector control mode selection	R/W	0 ~ 3	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AA201	22001	55F1h	Second main speed command selection	R/W	1 ~ 16	1
AA202	22002	55F2h	Second auxiliary speed command selection	R/W	0 ~ 16	
AA204	22004	55F4h	Second auxiliary speed setting	R/W	0 ~ 59000	0.01Hz
AA205	22005	55F5h	Second operator selection	R/W	0 ~ 3	1
AA206	22006	55F6h	Second additional frequency setting (High)	R/W	-59000 ~ 59000	0.01Hz
(AA207)	22007	55F7h	(SET-POINT) (Low)			
AA211	22011	55FBh	Second operation command selection	R/W	0 ~ 6	1
AA214	22014	55FEh	Second operation direction limit selection	R/W	0 ~ 2	
AA215	22015	55FFh	Second stop mode selection	R/W	0 ~ 1	
AA221	22021	5605h	Second control mode	R/W	0 ~ 11	
AA223	22023	5607h	Second vector control mode selection	R/W	0 ~ 3	
Ab-01	12101	2F45h	Frequency conversion coefficient	R/W	1 ~ 10000	0.01
Ab-03	12103	2F47h	Multi-step speed selection	R/W	0 ~ 1	1
Ab110	12110	2F4Eh	0th speed of the 1st multi-step speed	R/W	0 ~ 59000	0.01Hz
Ab-11	12111	2F4Fh	1st speed of the multi-step speed	R/W		
Ab-12	12112	2F50h	2nd speed of the multi-step speed	R/W		
Ab-13	12113	2F51h	3rd speed of the multi-step speed	R/W		
Ab-14	12114	2F52h	4th speed of the multi-step speed	R/W		
Ab-15	12115	2F53h	5th speed of the multi-step speed	R/W		
Ab-16	12116	2F54h	6th speed of the multi-step speed	R/W		
Ab-17	12117	2F55h	7th speed of the multi-step speed	R/W		
Ab-18	12118	2F56h	8th speed of the multi-step speed	R/W		
Ab-19	12119	2F57h	9th speed of the multi-step speed	R/W		
Ab-20	12120	2F58h	10th speed of the multi-step speed	R/W		
Ab-21	12121	2F59h	11th speed of the multi-step speed	R/W		
Ab-22	12122	2F5Ah	12th speed of the multi-step speed	R/W		
Ab-23	12123	2F5Bh	13th speed of the multi-step speed	R/W		
Ab-24	12124	2F5Ch	14th speed of the multi-step speed	R/W		
Ab-25	12125	2F5Dh	15th speed of the multi-step speed	R/W		
Ab210	22110	565Eh	0th speed of the 2nd multi-step speed	R/W		
AC-01	12201	2FA9h	Acceleration or deceleration time input type selection	R/W	0 ~ 4	1
AC-02	12202	2FAAh	Multi-stage acceleration or deceleration selection	R/W	0 ~ 1	
AC-03	12203	2FABh	Acceleration pattern selection	R/W	0 ~ 4	
AC-04	12204	2FACh	Deceleration pattern selection	R/W		
AC-05	12205	2FADh	Acceleration curve constant (S, U, reverse U)	R/W	1 ~ 10	
AC-06	12206	2FAEh	Deceleration curve constant (S, U, reverse U)	R/W		
AC-08	12208	2FB0h	Curvature 1 for EL-S-shaped acceleration	R/W	0 ~ 100	1%
AC-09	12209	2FB1h	Curvature 2 for EL-S-shaped acceleration	R/W		
AC-10	12210	2FB2h	Curvature 1 for EL-S-shaped deceleration	R/W		
AC-11	12211	2FB3h	Curvature 2 for EL-S-shaped deceleration	R/W		
AC115	12215	2FB7h	First 2-stage acceleration or deceleration selection	R/W	0 ~ 2	1
AC116	12216	2FB8h	First 2-stage acceleration frequency	R/W	0 ~ 59000	0.01Hz
AC117	12217	2FB9h	First 2-stage deceleration frequency	R/W		
AC120	12220	2FBCh	First acceleration time 1 (High)	R/W	0 ~ 360000	0.01s
(AC121)	12221	2FBDh	(Low)	R/W		
AC122	12222	2FBEh	First deceleration time 1 (High)	R/W		
(AC123)	12223	2FBFh	(Low)	R/W		
AC124	12224	2FC0h	First acceleration time 2 (High)	R/W		
(AC125)	12225	2FC1h	(Low)	R/W		
AC126	12226	2FC2h	First deceleration time 2 (High)	R/W		
(AC127)	12227	2FC3h	(Low)	R/W		
AC-30	12230	2FC6h	Acceleration time for multi-speed 1st speed (High)	R/W		
(AC-31)	12231	2FC7h	(Low)	R/W		
AC-32	12232	2FC8h	Deceleration time for multi-speed 1st speed (High)	R/W		
(AC-33)	12233	2FC9h	(Low)	R/W		
AC-34	12234	2FCAh	Acceleration time for multi-speed 2nd speed (High)	R/W		
(AC-35)	12235	2FCBh	(Low)	R/W		
AC-36	12236	2FCCh	Deceleration time for multi-speed 2nd speed (High)	R/W		
(AC-37)	12237	2FCDh	(Low)	R/W		
AC-38	12238	2FCEh	Acceleration time for multi-speed 3rd speed (High)	R/W		
(AC-39)	12239	2FCFh	(Low)	R/W		
AC-40	12240	2FD0h	Deceleration time for multi-speed 3rd speed (High)	R/W		
(AC-41)	12241	2FD1h	(Low)	R/W		
AC-42	12242	2FD2h	Acceleration time for multi-speed 4th speed (High)	R/W		
(AC-43)	12243	2FD3h	(Low)	R/W		
AC-44	12244	2FD4h	Deceleration time for multi-speed 4th speed (High)	R/W		
(AC-45)	12245	2FD5h	(Low)	R/W		
AC-46	12246	2FD6h	Acceleration time for multi-speed 5th speed (High)	R/W		
(AC-47)	12247	2FD7h	(Low)	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AC-48 (AC-49)	12248 12249	2FD8h 2FD9h	Deceleration time for multi-speed 5th speed (High) (Low)	R/W		
AC-50 (AC-51)	12250 12251	2FDAh 2FDBh	Acceleration time for multi-speed 6th speed (High) (Low)			
AC-52 (AC-53)	12252 12253	2FDCh 2FDDh	Deceleration time for multi-speed 6th speed (High) (Low)	R/W		
AC-54 (AC-55)	12254 12255	2FDEh 2FDFh	Acceleration time for multi-speed 7th speed (High) (High)	R/W		
AC-56 (AC-57)	12256 12257	2FE0h 2FE1h	Deceleration time for multi-speed 7th speed (High) (Low)	R/W		
AC-58 (AC-59)	12258 12259	2FE2h 2FE3h	Acceleration time for multi-speed 8th speed (High) (Low)	R/W		
AC-60 (AC-61)	12260 12261	2FE4h 2FE5h	Deceleration time for multi-speed 8th speed (High) (Low)	R/W		
AC-62 (AC-63)	12262 12263	2FE6h 2FE7h	Acceleration time for multi-speed 9th speed (High) (Low)	R/W		
AC-64 (AC-65)	12264 12265	2FE8h 2FE9h	Deceleration time for multi-speed 9th speed (High) (Low)	R/W		
AC-66 (AC-67)	12266 12267	2FEAh 2FEBh	Acceleration time for multi-speed 10th speed (High) (Low)	R/W		
AC-68 (AC-69)	12268 12269	2FECh 2FEDh	Deceleration time for multi-speed 10th speed (High) (Low)	R/W	0 ~ 360000	0.01s
AC-70 (AC-71)	12270 12271	2FEEh 2FEFh	Acceleration time for multi-speed 11th speed (High) (Low)	R/W		
AC-72 (AC-73)	12272 12273	2FF0h 2FF1h	Deceleration time for multi-speed 11th speed (High) (Low)	R/W		
AC-74 (AC-75)	12274 12275	2FF2h 2FF3h	Acceleration time for multi-speed 12th speed (High) (Low)	R/W		
AC-76 (AC-77)	12276 12277	2FF4h 2FF5h	Deceleration time for multi-speed 12th speed (High) (Low)	R/W		
AC-78 (AC-79)	12278 12279	2FF6h 2FF7h	Acceleration time for multi-speed 13th speed (High) (Low)	R/W		
AC-80 (AC-81)	12280 12281	2FF8h 2FF9h	Deceleration time for multi-speed 13th speed (High) (Low)	R/W		
AC-82 (AC-83)	12282 12283	2FFAh 2FFBh	Acceleration time for multi-speed 14th speed (High) (Low)	R/W		
AC-84 (AC-85)	12284 12285	2FFCh 2FFDh	Deceleration time for multi-speed 14th speed (High) (Low)	R/W		
AC-86 (AC-87)	12286 12287	2FFEh 2FFFh	Acceleration time for multi-speed 15th speed (High) (Low)	R/W		
AC-88 (AC-89)	12288 12289	3000h 3001h	Deceleration time for multi-speed 15th speed (High) (Low)	R/W		
AC215	22215	56C7h	Second 2-stage acceleration or deceleration selection	R/W	0 ~ 2	1
AC216	22216	56C8h	Second 2-stage acceleration frequency	R/W	0 ~ 59000	0.01H
AC217	22217	56C9h	Second 2-stage deceleration frequency	R/W		
AC220 (AC221)	22220 22221	56CCh 56CDh	Second acceleration time 1 (High) (Low)	R/W		
AC222 (AC223)	22222 22223	56Ceh 56CFh	Second deceleration time 1 (High) (Low)	R/W	0 ~ 360000	0.01s
AC224 (AC225)	22224 22225	56D0h 56D1h	Second acceleration time 2 (High) (Low)	R/W		
AC226 (AC227)	22226 22227	56D2h 56D3h	Second deceleration time 2 (High) (Low)	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Ad-01	12301	300Dh	Torque command input selection	R/W	1 ~ 15	1
Ad-02	12302	300Eh	Torque command setting	R/W	-5000 ~ 5000	0.1%
Ad-03	12303	300Fh	Torque command polarity selection	R/W	0 ~ 1	1
Ad-04	12304	3010h	Speed/torque control switch time	R/W	0 ~ 1000	1ms
Ad-11	12311	3017h	Torque bias input selection	R/W	0 ~ 15	1
Ad-12	12312	3018h	Torque bias setting	R/W	-5000 ~ 5000	0.1%
Ad-13	12313	3019h	Torque bias polarity selection	R/W	0 ~ 1	
Ad-14	12314	301Ah	Enable torque bias terminal [TBS] selection	R/W		1
Ad-40	12340	3034h	Torque control speed limit value input selection	R/W	1 ~ 13	
Ad-41	12341	3035h	Torque control speed limit value (forward)	R/W	0 ~ 59000	0.01Hz
Ad-42	12342	3036h	Torque control speed limit value (reverse)	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AE-01	12401	3071h	Electronic gear installation position selection	R/W	0 ~ 1	1
AE-02	12402	3072h	Electronic gear ratio's numerator	R/W	1 ~ 10000	
AE-03	12403	3073h	Electronic gear ratio's denominator	R/W		
AE-04	12404	3074h	Positioning completion range setting	R/W	0 ~ 10000	1pls
AE-05	12405	3075h	Positioning completion delay time setting	R/W	0 ~ 1000	0.01s
AE-06	12406	3076h	Position control feed forward	R/W	0 ~ 65535	0.01
AE-07	12407	3077h	Position loop gain	R/W	0 ~ 10000	
AE-08	12408	3078h	Position bias setting	R/W	-2048 ~ 2048	1pls
AE-10	12410	307Ah	Orientation stop position input destination selection	R/W	0 ~ 3	1
AE-11	12411	307Bh	Orientation stop position input destination selection	R/W	0 ~ 4095	
AE-12	12412	307Ch	Orientation speed setting	R/W	0 ~ 12000	0.01Hz
AE-13	12413	307Dh	Orientation direction setting	R/W	0 ~ 1	1
AE-20 (AE-21)	12420 12421	3084h 3085h	Position command 0 (High) (Low)	R/W	-268435455 ~ 268435455 In high resolution mode: -1073741823 to 1073741823	1pls
AE-22 (AE-23)	12422 12423	3086h 3087h	Position command 1 (High) (Low)	R/W		
AE-24 (AE-25)	12424 12425	3088h 3089h	Position command 2 (High) (Low)	R/W		
AE-26 (AE-27)	12426 12427	308Ah 308Bh	Position command 3 (High) (Low)	R/W		
AE-28 (AE-29)	12428 12429	308Ch 308Dh	Position command 4 (High) (Low)	R/W		
AE-30 AE-31	12430 12431	308Eh 308Fh	Position command 5 (High) (Low)	R/W		
(AE-32) AE-33	12432 12433	3090h 3091h	Position command 6 (High) (Low)	R/W		
(AE-34) AE-35	12434 12435	3092h 3093h	Position command 7 (High) (Low)	R/W		
(AE-36) AE-37	12436 12437	3094h 3095h	Position command 8 (High) (Low)	R/W		
AE-38 (AE-39)	12438 12439	3096h 3097h	Position command 9 (High) (Low)	R/W		
AE-40 (AE-41)	12440 12441	3098h 3099h	Position command 10 (High) (Low)	R/W		
AE-42 (AE-43)	12442 12443	309Ah 309Bh	Position command 11 (High) (Low)	R/W		
AE-44 (AE-45)	12444 12445	309Ch 309Dh	Position command 12 (High) (Low)	R/W		
AE-46 (AE-47)	12446 12447	309Eh 309Fh	Position command 13 (High) (Low)	R/W		
AE-48 (AE-49)	12448 12449	30A0h 30A1h	Position command 14 (High) (Low)	R/W		
AE-50 (AE-51)	12450 12451	30A2h 30A3h	Position command 15 (High) (Low)	R/W		
AE-52 (AE-53)	12452 12453	30A4h 30A5h	Position range designation (forward rotation side) (High) (Low)	R/W	0 ~ 268435455 In high resolution mode: 0～1073741823	
AE-54 (AE-55)	12454 12455	30A6h 30A7h	Position range designation (reverse rotation side) (High) (Low)	R/W	-268435455 ~ 0 In high resolution mode: -1073741823～0	
AE-56	12456	30A8h	Positioning mode selection	R/W	0 ~ 1	1
AE-60	12460	30Ach	Teaching selection	R/W	0 ~ 15	
AE-61	12461	30Adh	Memorization of current position at power-off	R/W	0 ~ 1	
AE-62 (AE-63)	12462 12463	30Aeh 30Afh	Preset position data (High) (Low)	R/W	-268435455 ~ 268435455 In high resolution mode: -1073741823～1073741823	1pls
AE-64	12464	30B0h	Gain for calculating the deceleration stop distance	R/W	5000 ~ 20000	0.01%
AE-65	12465	30B1h	Bias for calculating the deceleration stop distance	R/W	0 ~ 65535	
AE-66	12466	30B2h	APR control speed limit	R/W	0 ~ 10000	
AE-67	12467	30B3h	APR start speed	R/W		
AE-70	12470	30B6h	Zero return mode selection	R/W	0 ~ 2	1
AE-71	12471	30B7h	Zero return direction selection	R/W	0 ~ 1	
AE-72	12472	30B8h	Low speed zero return speed	R/W	0 ~ 1000	0.01Hz
AE-73	12473	30B9h	High speed zero return speed	R/W	0 ~ 59000	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AF101	12501	30D5h	First DC braking selection	R/W	0 ~ 2	1
AF102	12502	30D6h	First braking mode selection	R/W		
AF103	12503	30D7h	First DC braking frequency	R/W	0 ~ 59000	0.01Hz
AF104	12504	30D8h	First DC braking delay time	R/W	0 ~ 500	0.01s
AF105	12505	30D9h	First DC braking force at the time of the stop	R/W	0 ~ 100	1%
AF106	12506	30Dah	First DC braking time at the time of the stop	R/W	0 ~ 6000	0.01s
AF107	12507	30DBh	First DC braking trigger selection	R/W	0 ~ 1	1
AF108	12508	30DCh	First DC braking force at the start	R/W	0 ~ 100	1%
AF109	12509	30DDh	First DC braking time at the start	R/W	0 ~ 6000	0.01s
AF120	12520	30E8h	First contactor control selection	R/W	0 ~ 2	1
AF121	12521	30E9h	First start waiting time	R/W	0 ~ 200	0.01s
AF122	12522	30Eah	First contactor release delay time	R/W		
AF123	12523	30Ebh	First contactor check time	R/W	0 ~ 500	
AF130	12530	30F2h	First brake control selection	R/W	0 ~ 3	1
AF131	12531	30F3h	First brake release establishment waiting time (forward)	R/W	0 ~ 500	0.01s
AF132	12532	30F4h	First acceleration waiting time (forward)	R/W		
AF133	12533	30F5h	First stop waiting time (forward)	R/W		
AF134	12534	30F6h	First brake confirmation waiting time (forward)	R/W		
AF135	12535	30F7h	First brake release frequency (forward)	R/W	0 ~ 59000	0.01Hz
AF136	12536	30F8h	First brake release current (forward)	R/W	(0 to 2.0)×Inverter rated current	0.1A
AF137	12537	30F9h	First brake apply frequency (forward)	R/W	0 ~ 59000	0.01Hz
AF138	12538	30Fah	First brake release establishment waiting time (reverse)	R/W	0 ~ 500	0.01s
AF139	12539	30FBh	First acceleration waiting time (reverse)	R/W		
AF140	12540	30FCh	First stop waiting time (reverse)	R/W		
AF141	12541	30FDh	First brake confirmation waiting time (reverse)	R/W		
AF142	12542	30Feh	First brake release frequency (reverse)	R/W	0 ~ 59000	0.01Hz
AF143	12543	30FFh	First brake release current (reverse)	R/W	(0 to 2.0)×Inverter rated current	0.1A
AF144	12544	3100h	First brake apply frequency (reverse)	R/W	0 ~ 59000	0.01Hz
AF150	12550	3106h	First brake release delay time	R/W	0 ~ 200	0.01s
AF151	12551	3107h	First brake apply delay time	R/W		
AF152	12552	3108h	First brake check time	R/W	0 ~ 500	
AF153	12553	3109h	First servo lock time at start	R/W	0 ~ 1000	
AF154	12554	310Ah	First servo lock time at the time of the stop	R/W		
AF201	22501	57E5h	Second DC braking selection	R/W	0 ~ 2	1
AF202	22502	57E6h	Second braking mode selection	R/W		
AF203	22503	57E7h	Second DC braking frequency	R/W	0 ~ 59000	0.01Hz
AF204	22504	57E8h	Second DC braking delay time	R/W	0 ~ 500	0.01s
AF205	22505	57E9h	Second DC braking force at the time of the stop	R/W	0 ~ 100	1%
AF206	22506	57Eah	Second DC braking time at the time of the stop	R/W	0 ~ 6000	0.01s
AF207	22507	57Ebh	Second DC braking trigger selection	R/W	0 ~ 1	1
AF208	22508	57Ech	Second DC braking force at the start	R/W	0 ~ 100	1%
AF209	22509	57Edh	Second DC braking time at the start	R/W	0 ~ 6000	0.01s
AF220	22520	57F8h	Second contactor control selection	R/W	0 ~ 2	1
AF221	22521	57F9h	Second start waiting time	R/W	0 ~ 200	0.01s
AF222	22522	57Fah	Second contactor release delay time	R/W		
AF223	22523	57FBh	Second contactor check time	R/W	0 ~ 500	
AF230	22530	5802h	Second brake control selection	R/W	0 ~ 3	1
AF231	22531	5803h	Second brake release establishment waiting time (forward)	R/W	0 ~ 500	0.01s
AF232	22532	5804h	Second acceleration waiting time (forward)	R/W		
AF233	22533	5805h	Second stop waiting time (forward)	R/W		
AF234	22534	5806h	Second brake confirmation waiting time (forward)	R/W		
AF235	22535	5807h	Second brake release frequency (forward)	R/W	0 ~ 59000	0.01Hz
AF236	22536	5808h	Second brake release current (forward)	R/W	(0 to 2.0)×Inverete rated current	0.1A
AF237	22537	5809h	Second brake apply frequency (forward)	R/W	0 ~ 59000	0.01Hz
AF238	22538	580Ah	Second brake release establishment waiting time (reverse)	R/W	0 ~ 500	0.01s
AF239	22539	580Bh	Second acceleration waiting time (forward)	R/W		
AF240	22540	580Ch	Second stop waiting time (feverse)	R/W		
AF241	22541	580Dh	Second brake confirmation waiting time (reverse)	R/W		
AF242	22542	580Eh	Second brake release frequency (reverse)	R/W	0 ~ 59000	0.01Hz
AF243	22543	580Fh	Second brake release current (reverse)	R/W	(0 to 2.0)×Inverter rated current	0.1A
AF244	22544	5810h	Second brake apply frequency (reverse)	R/W	0 ~ 59000	0.01Hz

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AF250	22550	5816h	Second brake release delay time	R/W	0 ~ 200	0.01s
AF251	22551	5817h	Second brake apply delay time	R/W		
AF252	22552	5818h	Second brake check time	R/W	0 ~ 500	
AF253	22553	5819h	Second servo lock time at start	R/W	0 ~ 1000	
AF254	22554	581Ah	Second servo lock time at the time of the stop	R/W		
AG101	12601	3139h	First jump frequency 1	R/W	0 ~ 59000	0.01Hz
AG102	12602	313Ah	First jump frequency width 1	R/W	0 ~ 1000	
AG103	12603	313Bh	First jump frequency 2	R/W	0 ~ 59000	
AG104	12604	313Ch	First jump frequency width 2	R/W	0 ~ 1000	
AG105	12605	313Dh	First jump frequency 3	R/W	0 ~ 59000	
AG106	12606	313Eh	First jump frequency width 3	R/W	0 ~ 1000	
AG110	12610	3142h	First acceleration-stop frequency	R/W	0 ~ 59000	
AG111	12611	3143h	First acceleration-stop time	R/W	0 ~ 600	0.1s
AG112	12612	3144h	First deceleration-stop frequency	R/W	0 ~ 59000	0.01Hz
AG113	12613	3145h	First deceleration-stop time	R/W	0 ~ 600	0.1s
AG-20	12620	314Ch	Jogging frequency	R/W	0 ~ 1000	0.01Hz
AG-21	12621	314Dh	Jogging stop selection	R/W	0 ~ 5	1
AG201	22601	5849h	Second jump frequency 1	R/W	0 ~ 59000	0.01Hz
AG202	22602	584Ah	Second jump frequency width 1	R/W	0 ~ 1000	
AG203	22603	584Bh	Second jump frequency 2	R/W	0 ~ 59000	
AG204	22604	584Ch	Second jump frequency width 2	R/W	0 ~ 1000	
AG205	22605	584Dh	Second jump frequency 3	R/W	0 ~ 59000	
AG206	22606	584Eh	Second jump frequency width 3	R/W	0 ~ 1000	
AG210	22610	5852h	Second acceleration-stop frequency	R/W	0 ~ 59000	
AG211	22611	5853h	Second acceleration-stop time	R/W	0 ~ 600	0.1s
AG212	22612	5854h	Second deceleration-stop frequency	R/W	0 ~ 59000	0.01Hz
AG213	22613	5855h	Second deceleration-stop time	R/W	0 ~ 600	0.1s

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AH-01	12701	319Dh	PID1 selection	R/W	0 ~ 2	1
AH-02	12702	319Eh	PID1 deviation minus	R/W	0 ~ 1	
AH-03	12703	319Fh	PID1 unit selection (PID1)	R/W	0 ~ 58	
AH-04	12704	31A0h	PID1 scale adjustment (0%)	R/W	-10000 ~ 10000	
AH-05	12705	31A1h	PID1 scale adjustment (100%)	R/W		
AH-06	12706	31A2h	PID1 scale adjustment (decimal point)	R/W	0 ~ 4	
AH-07	12707	31A3h	PID1 target value 1 input destination selection	R/W	0 ~ 13	
AH-10	12710	31A6h	PID1 target value 1 set value (High)	R/W	-10000 ~ 10000	Per AH-06 setting
(AH-11)	12711	31A7h	(Low)			
AH-12	12712	31A8h	PID1 multistage target value 1 (High)	R/W		
(AH-13)	12713	31A9h	(Low)			
AH-14	12714	31Aah	PID1 multistage target value 2 (High)	R/W		
(AH-15)	12715	31Abh	(Low)			
AH-16	12716	31Ach	PID1 multistage target value 3 (High)	R/W		
(AH-17)	12717	31Adh	(Low)			
AH-18	12718	31Aeh	PID1 multistage target value 4 (High)	R/W		
(AH-19)	12719	31Afh	(Low)			
AH-20	12720	31B0h	PID1 multistage target value 5 (High)	R/W		
(AH-21)	12721	31B1h	(Low)			
AH-22	12722	31B2h	PID1 multistage target value 6 (High)	R/W		
(AH-23)	12723	31B3h	(Low)			
AH-24	12724	31B4h	PID1 multistage target value 7 (High)	R/W		
(AH-25)	12725	31B5h	(Low)			
AH-26	12726	31B6h	PID1 multistage target value 8 (High)	R/W		
(AH-27)	12727	31B7h	(Low)			
AH-28	12728	31B8h	PID1 multistage target value 9 (High)	R/W		
(AH-29)	12729	31B9h	(Low)			
AH-30	12730	31Bah	PID1 multistage target value 10 (High)	R/W		
(AH-31)	12731	31BBh	(Low)			
AH-32	12732	31BCh	PID1 multistage target value 11 (High)	R/W		
(AH-33)	12733	31BDh	(Low)			
AH-34	12734	31Beh	PID1 multistage target value 12 (High)	R/W		
(AH-35)	12735	31BFh	(Low)			
AH-36	12736	31C0h	PID1 multistage target value 13 (High)	R/W		
(AH-37)	12737	31C1h	(Low)			

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AH-38	12738	31C2h	PID1 multistage target value 14 (High)	R/W	-10000 ~ 10000	Per AH-06 setting
(AH-39)	12739	31C3h	(Low)			
AH-40	12740	31C4h	PID1 multistage target value 15 (High)	R/W		
(AH-41)	12741	31C5h	(Low)			
AH-42	12742	31C6h	PID1 target value 2 input destination selection	R/W	0 ~ 13	1
AH-44	12744	31C8h	PID1 target value 2 set value (High)	R/W	-10000 ~ 10000	Per AH-06 setting
(AH-45)	12745	31C9h	(Low)			
AH-46	12746	31Cah	PID1 target value 3 input destination selection	R/W	0 ~ 13	1
AH-48	12748	31CCh	PID1 target value 3 set value (High)	R/W	-10000 ~ 10000	Per AH-06 setting
(AH-49)	12749	31CDh	(Low)			
AH-50	12750	31Ceh	PID1 target value 1 operator selection	R/W	1 ~ 6	1
AH-51	12751	31CFh	PID1 feedback data 1 input destination selection	R/W	0 ~ 13	
AH-52	12752	31D0h	PID1 feedback data 2 input destination selection	R/W		
AH-53	12753	31D1h	PID1 feedback data 3 input destination selection	R/W		
AH-54	12754	31D2h	PID1 feedback data operator selection	R/W	1 ~ 10	
AH-60	12760	31D8h	PID1 gain switch method selection	R/W	0 ~ 1	
AH-61	12761	31D9h	PID1 proportional gain 1	R/W	0 ~ 1000	0.1
AH-62	12762	31Dah	PID1 integral gain 1	R/W	0 ~ 36000	0.1s
AH-63	12763	31DBh	PID1 differential gain 1	R/W	0 ~ 10000	0.01s
AH-64	12764	31DCh	PID1 proportional gain 2	R/W	0 ~ 1000	0.1
AH-65	12765	31DDh	PID1 integral gain 2	R/W	0 ~ 36000	0.1s
AH-66	12766	31Deh	PID1 differential gain 2	R/W	0 ~ 10000	0.01s
AH-67	12767	31DFh	PID1 gain switch time	R/W		1ms
AH-70	12770	31E2h	PID1 feed forward selection	R/W	0 ~ 6	1
AH-71	12771	31E3h	PID1 changeable range	R/W	0 ~ 10000	0.01%
AH-72	12772	31E4h	PID1 deviation excessive level	R/W		
AH-73	12773	31E5h	PID1 feedback comparison signal OFF level	R/W		
AH-74	12774	31E6h	PID1 feedback comparison signal ON level	R/W		
AH-75	12775	31E7h	PID soft-start function selection	R/W	0 ~ 1	1
AH-76	12776	31E8h	PID soft-start target level	R/W	0 ~ 10000	0.01%
AH-78	12778	31Eah	Acceleration time for PID soft-start (High)	R/W	0 ~ 360000	0.01s
(AH-79)	12779	31Ebh	(Low)			
AH-80	12780	31Ech	PID soft-start time	R/W	0 ~ 10000	
AH-81	12781	31Edh	PID start abnormal judgment implement selection	R/W	0 ~ 2	1
AH-82	12782	31Eeh	PID start abnormal judgment level	R/W	0 ~ 10000	0.01%
AH-85	12785	31F1h	PID sleep condition selection	R/W	0 ~ 2	1
AH-86	12786	31F2h	PID sleep start level	R/W	0 ~ 59000	0.01Hz
AH-87	12787	31F3h	PID sleep operation time	R/W	0 ~ 10000	0.01s
AH-88	12788	31F4h	Boost selection prior to PID sleep	R/W	0 ~ 1	1
AH-89	12789	31F5h	Boost time prior to PID sleep	R/W	0 ~ 10000	0.01s
AH-90	12790	31F6h	Boost amount prior to PID sleep	R/W		0.01%
AH-91	12791	31F7h	Minimum operation time prior to PID sleep	R/W		0.01s
AH-92	12792	31F8h	PID sleep status minimum retaining time	R/W		
AH-93	12793	31F9h	PID wake condition selection	R/W	1 ~ 3	1
AH-94	12794	31Fah	PID wake start level	R/W	0 ~ 10000	0.01%
AH-95	12795	31FBh	PID wake operation time	R/W		0.01s
AH-96	12796	31FCh	PID wake start deviation amount	R/W		0.01%
AJ-01	12801	3201h	PID2 selection	R/W	0 ~ 2	1
AJ-02	12802	3202h	PID2 deviation minus	R/W	0 ~ 1	
AJ-03	12803	3203h	PID2 unit selection (PID2)	R/W	0 ~ 58	
AJ-04	12804	3204h	PID2 scale adjustment (0%)	R/W	-10000 ~ 10000	
AJ-05	12805	3205h	PID2 scale adjustment (100%)	R/W		
AJ-06	12806	3206h	PID2 scale adjustment (decimal point)	R/W	0 ~ 4	
AJ-07	12807	3207h	PID2 target value input destination selection	R/W	0 ~ 15	
AJ-10	12810	320Ah	PID2 target value set value (High)	R/W	-10000 ~ 10000	Per AJ-06 setting
(AJ-11)	12811	320Bh	(Low)			
AJ-12	12812	320Ch	PID2 feedback data input destination selection	R/W	0 ~ 13	1
AJ-13	12813	320Dh	PID2 proportional gain	R/W	0 ~ 1000	0.1
AJ-14	12814	320Eh	PID2 integral gain	R/W	0 ~ 36000	0.1s
AJ-15	12815	320Fh	PID2 differential gain	R/W	0 ~ 10000	0.01s
AJ-16	12816	3210h	PID2 changeable range	R/W		0.01%
AJ-17	12817	3211h	PID2 deviation excessive level	R/W		
AJ-18	12818	3212h	PID2 feedback comparison signal OFF level	R/W		
AJ-19	12819	3213h	PID2 feedback comparison signal ON level	R/W		
AJ-21	12821	3215h	PID3 selection	R/W	0 ~ 2	1
AJ-22	12822	3216h	PID3 deviation minus	R/W	0 ~ 1	
AJ-23	12823	3217h	PID3 unit selection (PID3)	R/W	0 ~ 58	
AJ-24	12824	3218h	PID3 scale adjustment (0%)	R/W	-10000 ~ 10000	
AJ-25	12825	3219h	PID3 scale adjustment (100%)	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
AJ-26	12826	321Ah	PID3 scale adjustment (decimal point)	R/W	0 ~ 4	1
AJ-27	12827	321Bh	PID3 target value input destination selection	R/W	0 ~ 13	
AJ-30	12830	321Eh	PID3 target value setting (High)	R/W	-10000 ~ 10000	Per AJ-26 setting
(AJ-31)	12831	321Fh	(Low)			
AJ-32	12832	3220h	PID3 feedback data input destination selection	R/W	0 ~ 13	1
AJ-33	12833	3221h	PID3 proportional gain	R/W	0 ~ 1000	0.1
AJ-34	12834	3222h	PID3 integral gain	R/W	0 ~ 36000	0.1s
AJ-35	12835	3223h	PID3 differential gain	R/W	0 ~ 10000	0.01s
AJ-36	12836	3224h	PID3 changeable range	R/W		0.01%
AJ-37	12837	3225h	PID3 deviation excessive level	R/W		
AJ-38	12838	3226h	PID3 feedback comparison signal OFF level	R/W		
AJ-39	12839	3227h	PID3 feedback comparison signal ON level	R/W		
AJ-41	12841	3229h	PID4 selection	R/W	0 ~ 2	1
AJ-42	12842	322Ah	PID4 deviation minus	R/W	0 ~ 1	
AJ-43	12843	322Bh	PID4 unit selection (PID4)	R/W	0 ~ 58	
AJ-44	12844	322Ch	PID4 scale adjustment (0%)	R/W	-10000 ~ 10000	
AJ-45	12845	322Dh	PID4 scale adjustment (100%)	R/W		
AJ-46	12846	322Eh	PID4 scale adjustment (decimal point)	R/W	0 ~ 4	
AJ-47	12847	322Fh	PID4 target value input destination selection	R/W	0 ~ 13	
AJ-50	12850	3232h	PID4 target value setting (High)	R/W	-10000 ~ 10000	Per AJ-46 setting
(AJ-51)	12851	3233h	(Low)			
AJ-52	12852	3234h	PID4 feedback data input destination selection	R/W	0 ~ 13	1
AJ-53	12853	3235h	PID4 proportional gain	R/W	0 ~ 1000	0.1
AJ-54	12854	3236h	PID4 integral gain	R/W	0 ~ 36000	0.1s
AJ-55	12855	3237h	PID4 differential gain	R/W	0 ~ 10000	0.01s
AJ-56	12856	3238h	PID4 changeable range	R/W		0.01%
AJ-57	12857	3239h	PID4 deviation excessive level	R/W		
AJ-58	12858	323Ah	PID4 feedback comparison signal OFF level	R/W		
AJ-59	12859	323Bh	PID4 feedback comparison signal ON level	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
bA101	13001	32C9h	First frequency upper limit selection	R/W	0 ~ 13	1
bA102	13002	32Cah	First frequency upper limiter	R/W	0 ~ 59000	0.01Hz
bA103	13003	32CBh	First frequency lower limiter	R/W		
bA110	13010	32D2h	First torque limit selection	R/W	0 ~ 11	1
bA111	13011	32D3h	First torque limit parameter mode selection	R/W	0 ~ 1	
bA112	13012	32D4h	First torque limit 1 (Four quadrant forward powered)	R/W	0 ~ 5000	0.1%
bA113	13013	32D5h	First torque limit 2 (Four quadrant reverse regenerative)	R/W		
bA114	13014	32D6h	First torque limit 3 (Four quadrant reverse powered)	R/W		
bA115	13015	32D7h	First torque limit 4 (Four quadrant forward regenerative)	R/W		
bA116	13016	32D8h	First torque LAD stop selection	R/W	0 ~ 1	1
bA120	13020	32DCh	First overcurrent suppression selection	R/W		
bA121	13021	32DDh	First overcurrent suppression level	R/W	(0 to 2.5)×Inverter rated current	0.1A
bA122	13022	32Deh	First stall prevention 1 selection	R/W	0 ~ 3	1
bA123	13023	32DFh	First stall prevention 1 level	R/W	(0.2 to 2.5)× Inverter rated current	0.1A
bA124	13024	32E0h	First stall prevention 1 operation time (High)	R/W	10 ~ 360000	0.01s
(bA125)	13025	32E1h	(Low)			
bA126	13026	32E2h	First stall prevention 2 selection	R/W	0 ~ 3	1
bA127	13027	32E3h	First stall prevention 2 level	R/W	(0.2 to 2.5)× Inverter rated current	0.1A
bA128	13028	32E4h	First stall prevention 2 operation time (High)	R/W	10 ~ 360000	0.01s
(bA129)	13029	32E5h	(Low)			
bA-30	13030	32E6h	Instantaneous power failure non-stop selection	R/W	0 ~ 3	1
bA-31	13031	32E7h	Instantaneous power failure non-stop function starting voltage	R/W	200V class: 0 ~ 4100 400V class: 0 ~ 8200	0.1Vdc
bA-32	13032	32E8h	Instantaneous power failure non-stop target level	R/W		
bA-34	13034	32Eah	Instantaneous power failure non-stop deceleration time (High)	R/W	1 ~ 360000	0.01s
(bA-35)	13035	32Edh	(Low)			
bA-36	13036	32Ech	Instantaneous power failure non-stop deceleration starting range	R/W	0 ~ 1000	0.01Hz

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
bA-38	13038	32Eeh	Instantaneous power failure non-stop constant DC voltage control I gain	R/W	0 ~ 15000	0.01s
bA140	13040	32F0h	First overvoltage suppression function selection	R/W	0 ~ 3	1
bA141	13041	32F1h	First overvoltage suppression level setting	R/W	∗	0.1Vdc
bA142	13042	32F2h	First overvoltage suppression operating time (High)	R/W	0 ~ 360000	0.01s
(bA143)	13043	32F3h	(Low)			
bA144	13044	32F4h	First constant DC voltage control P gain	R/W	0 ~ 500	0.01
bA145	13045	32F5h	First constant DC voltage control I gain	R/W	0 ~ 15000	0.01s
bA146	13046	32F6h	First over-excitation function selection (V/f)	R/W	0 ~ 4	1
bA147	13047	32F7h	First over-excitation output filter time constant (V/f)	R/W	0 ~ 100	0.01s
bA148	13048	32F8h	First over-excitation voltage gain (V/f)	R/W	50 ~ 400	1%
bA149	13049	32F9h	First over-excitation suppression level setting (V/f)	R/W	∗	0.1Vdc
bA-60	13060	3304h	DBTR use rate	R/W	0 – 1000 (linked with bA-63)	0.1%
bA-61	13061	3305h	DBTR selection	R/W	0 ~ 2	1
bA-62	13062	3306h	DBTR ON level	R/W	∗	0.1Vdc
bA-63	13063	3307h	DBTR resistance	R/W	From the minimum resistance to 600.0	0.1Ω
bA-70	13070	330Eh	Cooling fan operation selection	R/W	0 ~ 2	
bA-71	13071	330Fh	Selection of cumulative cooling fan operating time clearance	R/W	0 ~ 1	1
bA201	23001	59D9h	Second frequency upper limit selection	R/W	0 ~ 13	
bA202	23002	59Dah	Second frequency upper limiter	R/W	0 ~ 59000	0.01Hz
bA203	23003	59DBh	Second frequency lower limiter	R/W		
bA210	23010	59E2h	Second torque limit selection	R/W	0 ~ 11	1
bA211	23011	59E3h	Second torque limit parameter mode selection	R/W	0 ~ 1	
bA212	23012	59E4h	Second torque limit 1 (Four quadrant forward powered)	R/W	0 ~ 5000	0.1%
bA213	23013	59E5h	Second torque limit 2 (Four quadrant reverse regenerative)	R/W		
bA214	23014	59E6h	Second torque limit 3 (Four quadrant reverse powered)	R/W		
bA215	23015	59E7h	Second torque limit 4 (Four quadrant forward regenerative)	R/W		
bA216	23016	59E8h	Second torque LAD stop selection	R/W	0 ~ 1	1
bA220	23020	59Ech	Second overcurrent suppression selection	R/W		
bA221	23021	59Edh	Second overcurrent suppression level	R/W	(0 to 2.5)×Inverter rated current	0.1A
bA222	23022	59Eeh	Second stall prevention 1 selection	R/W	0 ~ 3	1
bA223	23023	59Efh	Second stall prevention 1 level	R/W	(0.2 to 2.5)× Inverter rated current	0.1A
bA224	23024	59F0h	Second stall prevention 1 operation time (High)	R/W	10 ~ 360000	0.01s
(bA225)	23025	59F1h	(Low)			
bA226	23026	59F2h	Second stall prevention 2 selection	R/W	0 ~ 3	1
bA227	23027	59F3h	Second stall prevention 2 level	R/W	(0.2 to 2.5) Inverter rated current	0.1A
bA228	23028	59F4h	Second stall prevention 2 operation time (High)	R/W	10 ~ 360000	0.01s
(bA229)	23029	59F5h	(Low)			
bA240	23040	5A00h	Second overvoltage suppression function selection	R/W	0 ~ 3	1
bA241	23041	5A01h	Second overvoltage suppression level setting	R/W	∗	0.1Vdc
bA242	23042	5A02h	Second overvoltage suppression operating time (High)	R/W	0 ~ 360000	0.01s
(bA243)	23043	5A03h	(Low)			
bA244	23044	5A04h	Second constant DC voltage control P gain	R/W	0 ~ 500	0.01
bA245	23045	5A05h	Second constant DC voltage control I gain	R/W	0 ~ 15000	0.01s
bA246	23046	5A06h	Second over-excitation function selection (V/f)	R/W	0 ~ 4	1
bA247	23047	5A07h	Second over-excitation output filter time constant (V/f)	R/W	0 ~ 100	0.01s
bA248	23048	5A08h	Second over-excitation voltage gain (V/f)	R/W	50 ~ 400	1%
bA249	23049	5A09h	Second over-excitation suppression level setting (V/f)	R/W	∗	0.1Vdc

∗200V class : 3300 ~ 4000
400V class : 6600 ~ 8000

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
bb101	13101	332Dh	First carrier frequency	R/W	5 to 160 ∗	0.1kHz
bb102	13102	332Eh	First sprinkle carrier pattern selection	R/W	0 ~ 3	1
bb103	13103	332Fh	First automatic carrier frequency reduction selection	R/W	0 ~ 2	
bb-10	13110	3336h	Auto-reset selection	R/W		
bb-11	13111	3337h	Alarm output selection when the auto-reset is enabled	R/W	0 ~ 1	
bb-12	13112	3338h	Automatic resetting stand-by time	R/W	0 ~ 600	1s
bb-13	13113	3339h	Automatic resetting count setting	R/W	0 ~ 10	1
bb-20	13120	3340h	Instantaneous power failure retry count selection	R/W	0 ~ 16 / 255	
bb-21	13121	3341h	Undervoltage retry count selection	R/W		
bb-22	13122	3342h	Overcurrent retry count selection	R/W	0 ~ 5	
bb-23	13123	3343h	Overvoltage retry count selection	R/W		
bb-24	13124	3344h	Selection of instantaneous power failure/undervoltage retry	R/W	0 ~ 4	
bb-25	13125	3345h	Allowable instantaneous power failure time	R/W	3 ~ 250	0.1s
bb-26	13126	3346h	Retry wait time after instantaneous power failure/undervoltage	R/W	3 ~ 1000	
bb-27	13127	3347h	Instantaneous power failure/undervoltage tripping selection during stop	R/W	0 ~ 2	1
bb-28	13128	3348h	Overcurrent trip/retry selection	R/W	0 ~ 4	
bb-29	13129	3349h	Retry wait time after overcurrent	R/W	3 ~ 1000	0.1s
bb-30	13130	334Ah	Overvoltage trip/retry selection	R/W	0 ~ 4	1
bb-31	13131	334Bh	Retry wait time after overvoltage	R/W	3 ~ 1000	0.1s
bb-40	13140	3354h	Restart after free-run release	R/W	0 ~ 3	1
bb-41	13141	3355h	Restart after reset release	R/W		
bb-42	13142	3356h	Speed frequency matching lower limit frequency setting	R/W	0 ~ 59000	0.01Hz
bb-43	13143	3357h	Restarting level of frequency acquisition	R/W	(0.2 to 2.5)× Inverter rated current	0.1A
bb-44	13144	3358h	Constant (frequency) of frequency pull-in restart	R/W	10 ~ 3000	0.01s
bb-45	13145	3359h	Constant (voltage) of frequency pull-in restart	R/W		
bb-46	13146	335Ah	Overcurrent suppression level of frequency pull-in restart	R/W	(0 to 2.5)×Inverter rated current	0.1A
bb-47	13147	335Bh	Start frequency selection of frequency pull-in restart	R/W	0 ~ 2	1
bb-50	13150	335Eh	Frequency matching filter gain	R/W	0 ~ 1000	1%
bb160	13160	3368h	First overcurrent detection level	R/W	Depend on the Inverter model	0.1A
bb-61	13161	3369h	Incoming overvoltage selection	R/W	0 ~ 1	1
bb-62	13162	336Ah	Incoming overvoltage level selection	R/W	200V class: 3000 ~ 4100 400V class: 6000 ~ 8200	0.1Vdc
bb-64	13164	336Ch	Ground fault detection selection	R/W	0 ~ 1	1
bb-65	13165	336Dh	Input phase loss selection	R/W		
bb-66	13166	336Eh	Output phase loss selection	R/W		
bb-67	13167	336Fh	Output phase loss detection sensitivity	R/W	1 ~ 100	1%
bb-70	13170	3372h	Thermistor error level	R/W	0 ~ 10000	1Ω
bb-80	13180	337Ch	Over-speed error detection level	R/W	0 ~ 1500	0.1%
bb-81	13181	337Dh	Over-speed error detection time	R/W	0 ~ 50	0.1s
bb-82	13182	337Eh	Operation for speed deviation error	R/W	0 ~ 1	1
bb-83	13183	337Fh	Speed deviation error detection level	R/W	0 ~ 1000	0.1%
bb-84	13184	3380h	Speed deviation error detection time	R/W	0 ~ 50	0.1s
bb-85	13185	3381h	Behavior when the position deviation is abnormal	R/W	0 ~ 1	1
bb-86	13186	3382h	Abnormal position deviation detection level	R/W	0 ~ 65535 (×100pls)	1 (×100pls)
bb-87	13187	3383h	Abnormal position deviation time	R/W	0 ~ 50	0.1s
bb201	23101	5A3Dh	Second carrier frequency	R/W	5 to 160 ∗	0.1kHz
bb202	23102	5A3Eh	Second sprinkle carrier pattern selection	R/W	0 ~ 3	1
bb203	23103	5A3Fh	Second automatic carrier frequency reduction selection	R/W	0 ~ 2	
bb260	23160	5A78h	Second overcurrent detection level	R/W	Depend on the Inverter model	0.1A

∗varies depending on selection of capacity and load rating.

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
bC110	13210	339Ah	First electronic thermal level	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC111	13211	339Bh	First electronic thermal characteristics selection	R/W	0 ~ 2	1
bC112	13212	339Ch	First electronic thermal subtraction function selection	R/W	0 ~ 1	
bC113	13213	339Dh	First electronic thermal subtraction time	R/W	1 ~ 1000	1s
bC114	13214	339Eh	Electronic thermal counter memory at power-off	R/W	0 ~ 1	1
bC120	13220	33A4h	First free electronic thermal frequency 1	R/W	0 ~ 59000 (bC122)	0.01Hz
bC121	13221	33A5h	First free electronic thermal current 1	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC122	13222	33A6h	First free electronic thermal frequency 2	R/W	0 ~ 59000 (bC120 ~ bC124)	0.01Hz
bC123	13223	33A7h	First free electronic thermal current 2	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC124	13224	33A8h	First free electronic thermal frequency 3	R/W	0 (bC122)~ 59000	0.01Hz
bC125	13225	33A9h	First free electronic thermal current 3	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC210	23210	5AAAh	Second electronic thermal level	R/W		
bC211	23211	5AABh	Second electronic thermal characteristics selection	R/W	0 ~ 2	1
bC212	23212	5AACh	Second electronic thermal subtraction function selection	R/W	0 ~ 1	
bC213	23213	5AADh	Second electronic thermal subtraction time	R/W	1 ~ 1000	1s
bC220	23220	5AB4h	Second free electronic thermal frequency 1	R/W	0 ~ 59000 (bC222)	0.01Hz
bC221	23221	5AB5h	Second free electronic thermal current 1	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC222	23222	5AB6h	Second free electronic thermal frequency 2	R/W	0 ~ 59000 (bC220 ~ bC224)	0.01Hz
bC223	23223	5AB7h	Second free electronic thermal current 2	R/W	(0 to 3.0)×Inverter rated current	0.1A
bC224	23224	5AB8h	Second free electronic thermal frequency 3	R/W	0 (bC222) ~ 59000	0.01Hz
bC225	23225	5AB9h	Second free electronic thermal current 3	R/W	(0 to 3.0)×Inverter rated current	0.1A
bd-01	13301	33F5h	STO input indication selection	R/W	0 ~ 2	1
bd-02	13302	33F6h	STO allowable input switch time	R/W	0 ~ 6000	0.01s
bd-03	13303	33F7h	STO indication selection within allowable input time	R/W	0 ~ 1	1
bd-04	13304	33F8h	STO operation selection after allowable input time	R/W	0 ~ 2	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
CA-01	14001	36B1h	Selection of input terminal [FR]	R/W	0 ~ 110	1
CA-02	14002	36B2h	Selection of input terminal [RR]	R/W		
CA-03	14003	36B3h	Selection of input terminal [DFL]	R/W		
CA-04	14004	36B4h	Selection of input terminal [DFM]	R/W		
CA-05	14005	36B5h	Selection of input terminal [AUT]	R/W		
CA-06	14006	36B6h	Selection of input terminal [MBS]	R/W		
CA-07	14007	36B7h	Selection of input terminal [JOG]	R/W		
CA-08	14008	36B8h	Selection of input terminal [ES]	R/W		
CA-09	14009	36B9h	Selection of input terminal [RST]	R/W		
CA-10	14010	36Bah	Selection of input terminal [DFH]	R/W		
CA-11	14011	36BBh	Selection of input terminal [DHH]	R/W		
CA-21	14021	36C5h	Selection of Input terminal [FR] a/b (NO/NC)	R/W	0 ~ 1	
CA-22	14022	36C6h	Selection of Input terminal [RR] a/b (NO/NC)	R/W		
CA-23	14023	36C7h	Selection of Input terminal [DFL] a/b (NO/NC)	R/W		
CA-24	14024	36C8h	Selection of Input terminal [DFM] a/b (NO/NC)	R/W		
CA-25	14025	36C9h	Selection of Input terminal [AUT] a/b (NO/NC)	R/W		
CA-26	14026	36Cah	Selection of Input terminal [MBS] a/b (NO/NC)	R/W		
CA-27	14027	36CBh	Selection of Input terminal [JOG] a/b (NO/NC)	R/W		
CA-28	14028	36CCh	Selection of Input terminal [ES] a/b (NO/NC)	R/W		
CA-29	14029	36CDh	Selection of Input terminal [RST] a/b (NO/NC)	R/W		
CA-30	14030	36Ceh	Selection of Input terminal [DFH] a/b (NO/NC)	R/W		
CA-31	14031	36CFh	Selection of Input terminal [DHH] a/b (NO/NC)	R/W		
CA-41	14041	36D9h	Input terminal [FR] response time	R/W	0 ~ 400	1ms
CA-42	14042	36Dah	Input terminal [RR] response time	R/W		
CA-43	14043	36DBh	Input terminal [DFL] response time	R/W		
CA-44	14044	36DCh	Input terminal [DFM] response time	R/W		
CA-45	14045	36DDh	Input terminal [AUT] response time	R/W		
CA-46	14046	36Deh	Input terminal [MBS] response time	R/W		
CA-47	14047	36DFh	Input terminal [JOG] response time	R/W		
CA-48	14048	36E0h	Input terminal [ES] response time	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
CA-49	14049	36E1h	Input terminal [RST] response time	R/W	0 ~ 400	1ms
CA-50	14050	36E2h	Input terminal [DFH] response time	R/W		
CA-51	14051	36E3h	Input terminal [DHH] response time	R/W		
CA-55	14055	36E7h	Multi-step input determination time	R/W	0 ~ 2000	
CA-60	14060	36Ech	UP/DWN overwriting target selection	R/W	0 ~ 1	1
CA-61	14061	36Edh	UP/DWN memory selection	R/W		
CA-62	14062	36Eeh	UP/DWN UDC terminal mode selection	R/W		
CA-64	14064	36F0h	Acceleration time for UP/DWN functions (High)	R/W	0 ~ 360000	0.01s
(CA-65)	14065	36F1h	(Low)			
CA-66	14066	36F2h	Deceleration time for UP/DWN functions (High)	R/W		
(CA-67)	14067	36F3h	(Low)			
CA-70	14070	36F6h	Speed command selection with [F-OP] enabled.	R/W	1 ~ 16	1
CA-71	14071	36F7h	Operation command selection with [F-OP] enabled.	R/W	0 ~ 6	
CA-72	14072	36F8h	Reset selection	R/W	0 ~ 3	
CA-81	14081	3701h	Encoder constant set-up	R/W	32 ~ 65535	1pls
CA-82	14082	3702h	Encoder phase sequence selection	R/W	0 ~ 1	1
CA-83	14083	3703h	Motor gear ratio's numerator	R/W	1 ~ 10000	
CA-84	14084	3704h	Motor gear ratio's denominator	R/W		
CA-90	14090	370Ah	Pulse train input (internal) detection target selection	R/W	0 ~ 3	
CA-91	14091	370Bh	Pulse train input (internal) mode selection	R/W	0 ~ 2	
CA-92	14092	370Ch	Pulse train frequency scale	R/W	5 ~ 3200	0.01kHz
CA-93	14093	370Dh	Pulse train frequency filter time constant	R/W	1 ~ 200	0.01s
CA-94	14094	370Eh	Pulse train frequency bias amount	R/W	-1000 ~ 1000	0.1%
CA-95	14095	370Fh	Pulse train frequency detection upper limit	R/W	0 ~ 1000	
CA-96	14096	3710h	Pulse train frequency detection lower level	R/W		
CA-97	14097	3711h	Pulse count compare-match output ON level	R/W	0 ~ 65535	1
CA-98	14098	3712h	Pulse count compare-match output OFF level	R/W		
CA-99	14099	3713h	Maximum value for pulse count compare-match output	R/W		
Cb-01	14101	3715h	[VRF] terminal input filter time constant	R/W	1 ~ 500	1ms
Cb-03	14103	3717h	[VRF] terminal start amount	R/W	0 ~ 10000	0.01%
Cb-04	14104	3718h	[VRF] terminal end amount	R/W		
Cb-05	14105	3719h	[VRF] terminal start ratio	R/W	0 ~ 1000 (Cb-06)	0.1%
Cb-06	14106	371Ah	[VRF] terminal end ratio	R/W	(Cb-05) 0 ~ 1000	
Cb-07	14107	371Bh	[VRF] terminal start selection	R/W	0 ~ 1	1
Cb-11	14111	371Fh	[IRF] terminal input filter time constant	R/W	1 ~ 500	1ms
Cb-13	14113	3721h	[IRF] terminal start amount	R/W	0 ~ 10000	0.01%
Cb-14	14114	3722h	[IRF] terminal end amount	R/W		
Cb-15	14115	3723h	[IRF] terminal start ratio	R/W	0 ~ 1000 (Cb-16)	0.1%
Cb-16	14116	3724h	[IRF] terminal end ratio	R/W	(Cb-15) 0 ~ 1000	
Cb-17	14117	3725h	[IRF] terminal start selection	R/W	0 ~ 1	1
Cb-21	14121	3729h	[VF2] terminal input filter time constant	R/W	1 ~ 500	1ms
Cb-22	14122	372Ah	[VF2] terminal selection	R/W	0 ~ 2	1
Cb-23	14123	372Bh	[VF2] terminal start amount	R/W	-10000 ~ 10000	0.01%
Cb-24	14124	372Ch	[VF2] terminal end amount	R/W		
Cb-25	14125	372Dh	[VF2] terminal start ratio	R/W	-1000 ~ 1000 (Cb-26)	0.1%
Cb-26	14126	372Eh	[VF2] terminal end ratio	R/W	-1000 ~ 1000 (Cb-25)	
Cb-30	14130	3732h	[VRF] voltage/current bias adjustment	R/W	-10000 ~ 10000	0.01%
Cb-31	14131	3733h	[VRF] voltage/current adjustment gain	R/W	0 ~ 20000	
Cb-32	14132	3734h	[IRF] voltage/current bias adjustment	R/W	-10000 ~ 10000	
Cb-33	14133	3735h	[IRF] voltage/current adjustment gain	R/W	0 ~ 20000	
Cb-34	14134	3736h	[VF2] voltage bias adjustment	R/W	-10000 ~ 10000	
Cb-35	14135	3737h	[VF2] voltage adjustment gain	R/W	0 ~ 20000	
Cb-40	14140	373Ch	Thermistor selection	R/W	0 ~ 2	1
Cb-41	14141	373Dh	Thermistor [TH+/TH-] adjustment	R/W	0 ~ 10000	0.1

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
CC-01	14201	3779h	Selection of output terminal [UPF]	R/W	0 ~ 93	1
CC-02	14202	377Ah	Selection of output terminal [DRV]	R/W		
CC-03	14203	377Bh	Selection of output terminal [X1]	R/W		
CC-04	14204	377Ch	Selection of output terminal [X2]	R/W		
CC-05	14205	377Dh	Selection of output terminal [X3]	R/W		
CC-06	14206	377Eh	Selection of relay output terminal [RL]	R/W		
CC-07	14207	377Fh	Selection of relay output terminal [FL]	R/W		
CC-11	14211	3783h	Selection of output terminal [UPF] a/b (NO/NC)	R/W	0 ~ 1	
CC-12	14212	3784h	Selection of output terminal [DRV] a/b (NO/NC)	R/W		
CC-13	14213	3785h	Selection of output terminal [X1] a/b (NO/NC)	R/W		
CC-14	14214	3786h	Selection of output terminal [X2] a/b (NO/NC)	R/W		
CC-15	14215	3787h	Selection of output terminal [X3] a/b (NO/NC)	R/W		
CC-16	14216	3788h	Selection of output terminal [RL] a/b (NO/NC)	R/W		
CC-17	14217	3789h	Selection of output terminal [FL] a/b (NO/NC)	R/W		
CC-20	14220	378Ch	Output terminal [UPF] on-delay time	R/W	0 ~ 10000	0.01s
CC-21	14221	378Dh	Output terminal [UPF] off-delay time	R/W		
CC-22	14222	378Eh	Output terminal [DRV] on-delay time	R/W		
CC-23	14223	378Fh	Output terminal [DRV] off-delay time	R/W		
CC-24	14224	3790h	Output terminal [X1] on-delay time	R/W		
CC-25	14225	3791h	Output terminal [X1] off-delay time	R/W		
CC-26	14226	3792h	Output terminal [X2] on-delay time	R/W		
CC-27	14227	3793h	Output terminal [X2] off-delay time	R/W		
CC-28	14228	3794h	Output terminal [X3] on-delay time	R/W		
CC-29	14229	3795h	Output terminal [X3] off-delay time	R/W		
CC-30	14230	3796h	Output terminal [RL] on-delay time	R/W		
CC-31	14231	3797h	Output terminal [RL] off-delay time	R/W		
CC-32	14232	3798h	Output terminal [FL] on-delay time	R/W		
CC-33	14233	3799h	Output terminal [FL] off-delay time	R/W		
CC-40	14240	37A0h	Logical calculation output signal LOG1 selection 1	R/W	0 ~ 93	1
CC-41	14241	37A1h	Logical calculation output signal LOG1 selection 2	R/W		
CC-42	14242	37A2h	Logical calculation output signal LOG1 operator selection	R/W	0 ~ 2	
CC-43	14243	37A3h	Logical calculation output signal LOG2 selection 1	R/W	0 ~ 93	
CC-44	14244	37A4h	Logical calculation output signal LOG2 selection 2	R/W		
CC-45	14245	37A5h	Logical calculation output signal LOG2 operator selection	R/W	0 ~ 2	
CC-46	14246	37A6h	Logical calculation output signal LOG3 selection 1	R/W	0 ~ 93	
CC-47	14247	37A7h	Logical calculation output signal LOG3 selection 2	R/W		
CC-48	14248	37A8h	Logical calculation output signal LOG3 operator selection	R/W	0 ~ 2	
CC-49	14249	37A9h	Logical calculation output signal LOG4 selection 1	R/W	0 ~ 93	
CC-50	14250	37Aah	Logical calculation output signal LOG4 selection 2	R/W		
CC-51	14251	37Abh	Logical calculation output signal LOG4 operator selection	R/W	0 ~ 2	
CC-52	14252	37Ach	Logical calculation output signal LOG5 selection 1	R/W	0 ~ 93	
CC-53	14253	37Adh	Logical calculation output signal LOG5 selection 2	R/W		
CC-54	14254	37Aeh	Logical calculation output signal LOG5 operator selection	R/W	0 ~ 2	
CC-55	14255	37Afh	Logical calculation output signal LOG6 selection 1	R/W	0 ~ 93	
CC-56	14256	37B0h	Logical calculation output signal LOG6 selection 2	R/W		
CC-57	14257	37B1h	Logical calculation output signal LOG6 operator selection	R/W	0 ~ 2	
CC-58	14258	37B2h	Logical calculation output signal LOG7 selection 1	R/W	0 ~ 93	
CC-59	14259	37B3h	Logical calculation output signal LOG7 selection 2	R/W		
CC-60	14260	37B4h	Logical calculation output signal LOG7 operator selection	R/W	0 ~ 2	
Cd-01	14301	37DDh	[FRQ] terminal output form selection	R/W	0 ~ 1	1
Cd-02	14302	37Deh	[FRQ] terminal standard frequency (for PWM output)	R/W	0 ~ 3600	1Hz
Cd-03	14303	37DFh	[FRQ] terminal output selection	R/W	0 to 65535 (register No. of d, F codes)	1
Cd-04	14304	37E0h	[AMV] terminal output selection	R/W		
Cd-05	14305	37E1h	[AMI] terminal output selection	R/W		
Cd-10	14310	37E6h	Analog monitor adjustment mode selection	R/W	0 ~ 1	
Cd-11	14311	37E7h	[FRQ] output filter time constant	R/W	1 ~ 500	1ms
Cd-12	14312	37E8h	[FRQ] output data type selection	R/W	0 ~ 1	1
Cd-13	14313	37E9h	[FRQ] bias adjustment	R/W	-1000 ~ 1000	0.1%
Cd-14	14314	37Eah	[FRQ] gain adjustment	R/W	-10000 ~ 10000	
Cd-15	14315	37Ebh	[FRQ] output level in the adjustment mode	R/W	-1000 ~ 1000	
Cd-21	14321	37F1h	[AMV] output filter time constant	R/W	1 ~ 500	1ms
Cd-22	14322	37F2h	[AMV] output data type selection	R/W	0 ~ 1	1
Cd-23	14323	37F3h	[AMV] bias adjustment (common to voltage/current)	R/W	-1000 ~ 1000	0.1%
Cd-24	14324	37F4h	[AMV] gain adjustment (common to voltage/current)	R/W	-10000 ~ 10000	
Cd-25	14325	37F5h	[AMV] output level in the adjustment mode	R/W	-1000 ~ 1000	
Cd-31	14331	37FBh	[AMI] output filter time constant	R/W	1 ~ 500	1ms
Cd-32	14332	37FCh	[AMI] output data type selection	R/W	0 ~ 1	1
Cd-33	14333	37FDh	[AMI] bias adjustment (common to voltage/current)	R/W	-1000 ~ 1000	0.1%
Cd-34	14334	37Feh	[AMI] gain adjustment (common to voltage/current)	R/W	-10000 ~ 10000	
Cd-35	14335	37FFh	[AMI] output level in the adjustment mode	R/W	-1000 ~ 1000	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
CE101	14401	3841h	First low current signal output mode selection	R/W	0 ~ 1	1
CE102	14402	3842h	First low current detection level 1	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE103	14403	3843h	First low current detection level 2	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE105	14405	3845h	First overload prewarning signal output mode selection	R/W	0 ~ 1	1
CE106	14406	3846h	First overload prewarning level 1	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE107	14407	3847h	First overload prewarning level 2	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE-10	14410	384Ah	Acceleration reaching frequency 1	R/W	0 ~ 59000	0.01Hz
CE-11	14411	384Bh	Deceleration reaching frequency 1	R/W	0 ~ 59000	0.01Hz
CE-12	14412	384Ch	Acceleration reaching frequency 2	R/W	0 ~ 59000	0.01Hz
CE-13	14413	384Dh	Deceleration reaching frequency 2	R/W	0 ~ 59000	0.01Hz
CE120	14420	3854h	First over torque level (forward powered)	R/W	0 ~ 5000	0.1%
CE121	14421	3855h	First over torque level (reverse regenerative)	R/W	0 ~ 5000	0.1%
CE122	14422	3856h	First over torque level (reverse powered)	R/W	0 ~ 5000	0.1%
CE123	14423	3857h	First over torque level (forward regenerative)	R/W	0 ~ 5000	0.1%
CE-30	14430	385Eh	Electronic thermal warning level (Motor)	R/W	0 ~ 10000	0.01%
CE-31	14431	385Fh	Electronic thermal warning level (Inverter)	R/W	0 ~ 10000	0.01%
CE-33	14433	3861h	Zero-speed detection value level	R/W	0 ~ 10000	0.01Hz
CE-34	14434	3862h	Cooling fin heating prewarning level	R/W	0 ~ 200	1°C
CE-36	14436	3864h	RUN time/power supply ON time level (High)	R/W	0 ~ 100000	1hr
(CE-37)	14437	3865h	RUN time/power supply ON time level (Low)	R/W	0 ~ 100000	1hr
CE-40	14440	3868h	Window comparator [VRF] upper limit level	R/W	0 ~ 100	1%
CE-41	14441	3869h	Window comparator [VRF] lower limit level	R/W	0 ~ 100	1%
CE-42	14442	386Ah	Window comparator [VRF] hysteresis range	R/W	0 ~ 10	1%
CE-43	14443	386Bh	Window comparator [IRF] upper limit level	R/W	0 ~ 100	1%
CE-44	14444	386Ch	Window comparator [IRF] lower limit level	R/W	0 ~ 100	1%
CE-45	14445	386Dh	Window comparator [IRF] hysteresis range	R/W	0 ~ 10	1%
CE-46	14446	386Eh	Window comparator [VF2] upper limit level	R/W	-100 ~ 100	1%
CE-47	14447	386Fh	Window comparator [VF2] lower limit level	R/W	-100 ~ 100	1%
CE-48	14448	3870h	Window comparator [VF2] hysteresis range	R/W	0 ~ 10	1%
CE-50	14450	3872h	[VRF] operation level at disconnection	R/W	0 ~ 100	1%
CE-51	14451	3873h	[VRF] operation level selection at disconnection	R/W	0 ~ 2	1
CE-52	14452	3874h	[IRF] operation level at disconnection	R/W	0 ~ 100	1%
CE-53	14453	3875h	[IRF] operation level selection at disconnection	R/W	0 ~ 2	1
CE-54	14454	3876h	[VF2] operation level at disconnection	R/W	-100 ~ 100	1%
CE-55	14455	3877h	[VF2] operation level selection at disconnection	R/W	0 ~ 2	1
CE201	24401	5F51h	Second low current signal output mode selection	R/W	0 ~ 1	1
CE202	24402	5F52h	Second low current detection level 1	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE203	24403	5F53h	Second low current detection level 2	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE205	24405	5F55h	Second overload prewarning signal output mode selection	R/W	0 ~ 1	1
CE206	24406	5F56h	Second overload prewarning level 1	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE207	24407	5F57h	Second overload prewarning level 2	R/W	(0 to 2.0)×Inverter rated current	0.1A
CE220	24420	5F64h	Second over torque level (forward powered)	R/W	0 ~ 5000	0.1%
CE221	24421	5F65h	Second over torque level (reverse regenerative)	R/W	0 ~ 5000	0.1%
CE222	24422	5F66h	Second over torque level (reverse powered)	R/W	0 ~ 5000	0.1%
CE223	24423	5F67h	Second over torque level (forward regenerative)	R/W	0 ~ 5000	0.1%
CF-01	14501	38A5h	Communication transmission speed selection (baudrate selection)	R/W	3 ~ 10	1
CF-02	14502	38A6h	Communication station number selection	R/W	1 ~ 247	1
CF-03	14503	38A7h	Communication parity selection	R/W	0 ~ 2	1
CF-04	14504	38A8h	Communication stop bit selection	R/W	1 ~ 2	1
CF-05	14505	38A9h	Communication error selection	R/W	0 ~ 4	1
CF-06	14506	38Aah	Communication timeout time	R/W	0 ~ 10000	0.01s
CF-07	14507	38Abh	Communication waiting time	R/W	0 ~ 1000	1ms
CF-08	14508	38Ach	Communication method selection	R/W	1 ~ 3	1
CF-11	14511	38AFh	Resister data A,V⇔% conversion function	R/W	0 ~ 1	1
CF-20	14520	38B8h	EzCOM start INV station number	R/W	1 ~ 8	1
CF-21	14521	38B9h	EzCOM end INV station number	R/W	1 ~ 8	1
CF-22	14522	38Bah	EzCOM start selection	R/W	0 ~ 1	1
CF-23	14523	38BBh	Number of EzCOM data	R/W	1 ~ 5	1
CF-24	14524	38BCh	EzCOM transmission destination station number 1	R/W	1 ~ 247	1

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
CF-25	14525	38BDh	EzCOM transmission destination register 1	R/W	0 ~ 65535	1
CF-26	14526	38Beh	EzCOM transmission source register 1	R/W		
CF-27	14527	38BFh	EzCOM transmission destination station number 2	R/W	1 ~ 247	
CF-28	14528	38C0h	EzCOM transmission destination register 2	R/W	0 ~ 65535	
CF-29	14529	38C1h	EzCOM transmission source register 2	R/W		
CF-30	14530	38C2h	EzCOM transmission destination station number 3	R/W	1 ~ 247	
CF-31	14531	38C3h	EzCOM transmission destination register 3	R/W	0 ~ 65535	
CF-32	14532	38C4h	EzCOM transmission source register 3	R/W		
CF-33	14533	38C5h	EzCOM transmission destination station number 4	R/W	1 ~ 247	
CF-34	14534	38C6h	EzCOM transmission destination register 4	R/W	0 ~ 65535	
CF-35	14535	38C7h	EzCOM transmission source register 4	R/W		
CF-36	14536	38C8h	EzCOM transmission destination station number 5	R/W	1 ~ 247	
CF-37	14537	38C9h	EzCOM transmission destination register 5	R/W	0 ~ 65535	
CF-38	14538	38Cah	EzCOM transmission source register 5	R/W		
CF-50	14550	38D6h	USB station number selection	R/W	1 ~ 247	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
HA-01	15001	3A99h	Auto-tuning selection	R/W	0 ~ 3	1
HA-02	15002	3A9Ah	Operation command for auto-tuning	R/W	0 ~ 1	
HA-03	15003	3A9Bh	Online tuning selection	R/W		
HA110	15010	3AA2h	First stability constant	R/W	0 ~ 1000	1%
HA112	15012	3AA4h	First stability ramp function end ratio	R/W	0 ~ 100	
HA113	15013	3AA5h	First stability ramp function start ratio	R/W		
HA115	15015	3AA7h	First speed response	R/W	0 ~ 1000	
HA120	15020	3AACh	First gain switch selection	R/W	0 ~ 1	1
HA121	15021	3AADh	First gain switch selection	R/W	0 ~ 10000	1ms
HA122	15022	3AAEh	First gain switch intermediate speed 1	R/W	0 ~ 59000	0.01Hz
HA123	15023	3AAFh	First gain switch intermediate speed 2	R/W		
HA124	15024	3AB0h	First gain mapping maximum speed	R/W		
HA125	15025	3AB1h	First gain mapping P gain 1	R/W	0 ~ 10000	0.1%
HA126	15026	3AB2h	First gain mapping I gain 1	R/W		
HA127	15027	3AB3h	First gain mapping P control P gain 1	R/W		
HA128	15028	3AB4h	First gain mapping P gain 2	R/W		
HA129	15029	3AB5h	First gain mapping I gain 2	R/W		
HA-01	15001	3A99h	Auto-tuning selection	R/W	0 ~ 3	1
HA-02	15002	3A9Ah	Operation command for auto-tuning	R/W	0 ~ 1	
HA-03	15003	3A9Bh	Online tuning selection	R/W		
HA110	15010	3AA2h	First stability constant	R/W	0 ~ 1000	1%
HA115	15015	3AA7h	First speed response	R/W		
HA120	15020	3AACh	First gain switch selection	R/W	0 ~ 1	1
HA121	15021	3AADh	First gain switch selection	R/W	0 ~ 10000	1ms
HA122	15022	3AAEh	First gain switch intermediate speed 1	R/W	0 ~ 59000	0.01Hz
HA123	15023	3AAFh	First gain switch intermediate speed 2	R/W		
HA124	15024	3AB0h	First gain mapping maximum speed	R/W		
HA125	15025	3AB1h	First gain mapping P gain 1	R/W	0 ~ 10000	0.1%
HA126	15026	3AB2h	First gain mapping I gain 1	R/W		
HA127	15027	3AB3h	First gain mapping P control P gain 1	R/W		
HA128	15028	3AB4h	First gain mapping P gain 2	R/W		
HA129	15029	3AB5h	First gain mapping I gain 2	R/W		
HA130	15030	3AB6h	First gain mapping P control P gain 2	R/W		
HA131	15031	3AB7h	First gain mapping P gain 3	R/W		
HA132	15032	3AB8h	First gain mapping I gain 3	R/W		
HA133	15033	3AB9h	First gain mapping P gain 4	R/W		
HA134	15034	3ABAh	First gain mapping I gain 4	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
HA210	25010	61B2h	Second stability constant (V/f, A.bst)	R/W	0 ~ 1000	1%
HA212	25012	61B4h	Second stability ramp function end ratio	R/W	0 ~ 100	
HA213	25013	61B5h	Second stability ramp function start ratio	R/W		
HA215	25015	61B7h	Second speed response	R/W	0 ~ 1000	
HA220	25020	61BCh	Second gain switch selection	R/W	0 ~ 1	1
HA221	25021	61BDh	Second gain switch time	R/W	0 ~ 10000	1ms
HA222	25022	61Beh	Second gain switch intermediate speed 1	R/W	0 ~ 59000	0.01Hz
HA223	25023	61BFh	Second gain switch intermediate speed 2	R/W		
HA224	25024	61C0h	Second gain mapping maximum speed	R/W		
HA225	25025	61C1h	Second gain mapping P gain 1	R/W	0 ~ 10000	0.1%
HA226	25026	61C2h	Second gain mapping I gain 1	R/W		
HA227	25027	61C3h	Second gain mapping P control P gain 1	R/W		
HA228	25028	61C4h	Second gain mapping P gain 2	R/W		
HA229	25029	61C5h	Second gain mapping I gain 2	R/W		
HA230	25030	61C6h	Second gain mapping P control P gain 2	R/W		
HA231	25031	61C7h	Second gain mapping P gain 3	R/W		
HA232	25032	61C8h	Second gain mapping I gain 3	R/W		
HA233	25033	61C9h	Second gain mapping P gain 4	R/W		
HA234	25034	61Cah	Second gain mapping I gain 4	R/W		
Hb101	15101	3AFDh	First IM motor setting	R/W	0 ~ 3	1
Hb102	15102	3AFEh	First IM motor capacity selection	R/W	1 ~ 16000	0.01kW
Hb103	15103	3AFFh	Selection of number of first IM motor poles	R/W	0 ~ 23	1
Hb104	15104	3B00h	First IM base frequency	R/W	1000 ~ 59000	0.01Hz
Hb105	15105	3B01h	First IM maximum frequency	R/W		
Hb106	15106	3B02h	First IM motor's rated voltage	R/W	1 ~ 1000	1V
Hb108	15108	3B04h	First IM motor's rated current (High)	R/W	1 ~ 1000000	0.01A
(Hb109)	15109	3B05h	(Low)			
Hb110	15110	3B06h	First IM motor constant R1 (High)	R/W	1 ~ 1000000000	0.000001Ω
(Hb111)	15111	3B07h	(Low)			
Hb112	15112	3B08h	First IM motor constant R2 (High)	R/W		
(Hb113)	15113	3B09h	(Low)			
Hb114	15114	3B0Ah	First IM motor constant L (High)	R/W		0.000001mH
(Hb115)	15115	3B0Bh	(Low)			
Hb116	15116	3B0Ch	First IM motor constant Io (High)	R/W	1 ~ 1000000	0.01A
(Hb117)	15117	3B0Dh	(Low)			
Hb118	15118	3B0Eh	First IM motor constant J (High)	R/W	1 ~ 1000000000	0.00001kg・m^2
(Hb119)	15119	3B0Fh	(Low)			
Hb130	15130	3B1Ah	First minimum frequency (V/f, A.bst, IM-SLV)	R/W	10 ~ 1000	0.01Hz
Hb131	15131	3B1Bh	First reduced voltage start time (V/f)	R/W	0 ~ 2000	1ms
Hb140	15140	3B24h	First manual torque boost operation mode selection	R/W	0 ~ 3	1
Hb141	15141	3B25h	First amount of manual torque boost (V/f)	R/W	0 ~ 200	0.1%
Hb142	15142	3B26h	First manual torque boost break point (V/f)	R/W	0 ~ 500	
Hb145	15145	3B29h	First energy-saving operation selection (V/f)	R/W	0 ~ 1	1
Hb146	15146	3B2Ah	First energy-saving response/accuracy adjustment (V/f)	R/W	0 ~ 100	1%
Hb150	15150	3B2Eh	First free V/f frequency 1	R/W	0 ~59000 (Hb152)	0.01Hz
Hb151	15151	3B2Fh	First free V/f voltage 1	R/W	0 ~ 10000	0.1V
Hb152	15152	3B30h	First free V/f frequency 2	R/W	0 ~ 59000 (Hb150)~(Hb154)	0.01Hz
Hb153	15153	3B31h	First free V/f voltage 2	R/W	0 ~ 10000	0.1V
Hb154	15154	3B32h	First free V/f frequency 3	R/W	0 ~ 59000 (Hb152)~(Hb156)	0.01Hz
Hb155	15155	3B33h	First free V/f voltage 3	R/W	0 ~ 10000	0.1V
Hb156	15156	3B34h	First free V/f frequency 4	R/W	0 ~ 59000 (Hb154)~(Hb158)	0.01Hz
Hb157	15157	3B35h	First free V/f voltage 4	R/W	0 ~ 10000	0.1V

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Hb158	15158	3B36h	First free V/f frequency 5	R/W	0 ~ 59000 (Hb156)~(Hb160)	0.01Hz
Hb159	15159	3B37h	First free V/f voltage 5	R/W	0 ~ 10000	0.1V
Hb160	15160	3B38h	First free V/f frequency 6	R/W	0 ~ 59000 (Hb158)~(Hb162)	0.01Hz
Hb161	15161	3B39h	First free V/f voltage 6	R/W	0 ~ 10000	0.1V
Hb162	15162	3B3Ah	First free V/f frequency 7	R/W	0 ~ 59000 (Hb160)~(Hb104)	0.01Hz
Hb163	15163	3B3Bh	First free V/f voltage 7	R/W	0 ~ 10000	0.1V
Hb170	15170	3B42h	First slip compensation P gain with sensor ∗	R/W	0 ~ 1000	1%
Hb171	15171	3B43h	First slip compensation I gain with sensor ∗	R/W		
Hb180	15180	3B4Ch	First output voltage gain (V/f)	R/W	0 ~ 255	
Hb201	2510	620Dh	Second IM motor setting	R/W	0 ~ 3	1
Hb202	25102	620Eh	Second IM motor capacity selection	R/W	1 ~ 16000	0.01kW
Hb203	25103	620Fh	Selection of number of second IM motor poles	R/W	0 ~ 23	1
Hb204	25104	6210h	Second IM base frequency	R/W	1000 ~ 59000	0.01Hz
Hb205	25105	6211h	Second IM maximum frequency	R/W		
Hb206	25106	6212h	Second IM motor's rated voltage	R/W	1 ~ 1000	1V
Hb208	25108	6214h	Second IM motor's rated current (High)	R/W	1 ~ 1000000	0.01A
(Hb209)	25109	6215h	(Low)			
Hb210	25110	6216h	Second IM motor constant R1 (High)	R/W	1 ~ 1000000000	0.000001Ω
(Hb211)	25111	6217h	(Low)			
Hb212	25112	6218h	Second IM motor constant R2 (High)	R/W		
(Hb213)	25113	6219h	(Low)			
Hb214	25114	621Ah	Second IM motor constant L (High)	R/W		0.000001 mH
(Hb215)	25115	621Bh	(Low)			
Hb216	25116	621Ch	Second IM motor constant Io (High)	R/W	1 ~ 1000000	0.01A
(Hb217)	25117	621Dh	(Low)			
Hb218	25118	621Eh	Second IM motor constant J (High)	R/W	1 ~ 1000000000	0.00001 kg・m^2
(Hb219)	25119	621Fh	(Low)			
Hb230	25130	622Ah	Second minimum frequency (V/f, A.bst, IM-SLV)	R/W	10 ~ 1000	0.01Hz
Hb231	25131	622Bh	Second reduced voltage start time (V/f)	R/W	0 ~ 2000	1ms
Hb240	25140	6234h	Second manual torque boost operation mode selection	R/W	0 ~ 3	1
Hb241	25141	6235h	Second amount of manual torque boost (V/f)	R/W	0 ~ 200	0.1%
Hb242	25142	6236h	Second manual torque boost break point (V/f)	R/W	0 ~ 500	
Hb245	25145	6239h	Second energy-saving operation selection (V/f)	R/W	0 ~ 1	1
Hb246	25146	623Ah	Second energy-saving response/accuracy adjustment (V/f)	R/W	0 ~ 100	1%
Hb250	25150	623Eh	Second free V/f frequency 1	R/W	0 ~ 59000 (Hb252)	0.01Hz
Hb251	25151	623Fh	Second free V/f voltage 1	R/W	0 ~ 10000	0.1V
Hb252	25152	6240h	Second free V/f frequency 2	R/W	0 ~ 59000 (Hb250)~(Hb254)	0.01Hz
Hb253	25153	6241h	Second free V/f voltage 2	R/W	0 ~ 10000	0.1V
Hb254	25154	6242h	Second free V/f frequency 3	R/W	0 ~ 59000(Hb252)~(Hb256)	0.01Hz
Hb255	25155	6243h	Second free V/f voltage 3	R/W	0 ~ 10000	0.1V
Hb256	25156	6244h	Second free V/f frequency 4	R/W	0 ~ 59000 (Hb254)~(Hb258)	0.01Hz
Hb257	25157	6245h	Second free V/f voltage 4	R/W	0 ~ 10000	0.1V
Hb258	25158	6246h	Second free V/f frequency 5	R/W	0 ~ 59000 (Hb256)~(Hb260)	0.01Hz
Hb259	25159	6247h	Second free V/f voltage 5	R/W	0 ~ 10000	0.1V
Hb260	25160	6248h	Second free V/f frequency 6	R/W	0 ~ 59000 (Hb258)~(Hb262)	0.01Hz
Hb261	25161	6249h	Second free V/f voltage 6	R/W	0 ~ 10000	0.1V
Hb262	25162	624Ah	Second free V/f frequency 7	R/W	0 ~ 59000 (Hb260)~(Hb204)	0.01Hz
Hb263	25163	624Bh	Second free V/f voltage 7	R/W	0 ~ 10000	0.1V
Hb270	25170	6252h	Second slip compensation P gain with sensor ∗	R/W	0 ~ 1000	1%
Hb271	25171	6253h	Second slip compensation I gain with sensor ∗	R/W		
Hb280	25180	625Ch	Second output voltage gain (V/f)	R/W	0 ~ 255	

∗ (V/f, A.bst)

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
HC101	15201	3B61h	First automatic torque boost voltage compensation gain	R/W	0 ~ 255	1%
HC102	15202	3B62h	First automatic torque boost slip compensation gain	R/W		
HC110	15210	3B6Ah	First zero-speed range limiter (IM-0Hz-SLV)	R/W	0 ~ 100	
HC111	15211	3B6Bh	First amount of boost at the start (IM-SLV)	R/W	0 ~ 50	
HC112	15212	3B6Ch	First amount of boost at the start (IM-0Hz-SLV)	R/W		
HC113	15213	3B6Dh	First selection of whether a secondary-resistance correction is to be conducted ＊1	R/W	0 ~ 1	1
HC114	15214	3B6Eh	First selection of reversal prevention ＊1	R/W		
HC115	15215	3B6Fh	First selection for the torque transformation	R/W	00～01	
HC120	15220	3B74h	First time constant for torque current command filter ＊2	R/W	0 ~ 100	1ms
HC121	15221	3B75h	First speed feed forward compensation adjustment gain ＊2	R/W	0 ~ 1000	1%
HC137	15237	3B85h	First flux settling level	R/W	0.0 ~ 100.0	0.1%
HC140	15240	3B88h	First forcing leve	R/W	0 ~ 1000	1%
HC141	15241	3B89h	First modulation threshold 1	R/W	0 ~ 133	
HC142	15242	3B8Ah	First modulation threshold 2	R/W		
HC201	25201	6271h	Second automatic torque boost voltage compensation gain	R/W	0 ~ 255	
HC202	25202	6272h	Second automatic torque boost slip compensation gain	R/W		
HC210	25210	627Ah	Second zero-speed range limiter (IM-0Hz-SLV)	R/W	0 ~ 100	
HC211	25211	627Bh	Second amount of boost at the start (IM-SLV)	R/W	0 ~ 50	
HC212	25212	627Ch	Second amount of boost at the start (IM-0Hz-SLV)	R/W		
HC213	25213	627Dh	Second selection of whether a secondary-resistance correction is to be conducted ＊1	R/W	0 ~ 1	1
HC214	25214	627Eh	Second selection of reversal prevention ＊1	R/W		
HC215	25215	3B6Fh	Second selection for the torque transformation	R/W	00～01	
HC220	25220	6284h	Second time constant for torque current command filter ＊2	R/W	0 ~ 100	1ms
HC221	25221	6285h	Second speed feed forward compensation adjustment gain ＊2	R/W	0 ~ 1000	1%
HC237	25237	6295h	Second first flux settling level	R/W	0.0 ~ 100.0	0.1%
HC240	25240	6298h	Second first forcing leve	R/W	0 ~ 1000	1%
HC241	25241	6299h	Second modulation threshold 1	R/W	0 ~ 133	
HC242	25242	629Ah	Second modulation threshold 2	R/W		

＊1 (IM-SLV, IM-0Hz-SLV, IM-CLV)

＊2 (IM-SLV, IM-0Hz-SLV, IM-CLV, SM-CLV)

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Hd102	15302	3BC6h	First SM (PMM) motor capacity selection	R/W	1 ~ 16000	0.01kW
Hd103	15303	3BC7h	First selection of number of SM (PMM) motor poles	R/W	0 ~ 23	1
Hd104	15304	3BC8h	First SM (PMM) base frequency	R/W	1000 ~ 59000	0.01Hz
Hd105	15305	3BC9h	First SM (PMM) maximum frequency	R/W		
Hd106	15306	3BCAh	First SM (PMM) motor's rated voltage	R/W	1 ~ 1000	1V
Hd108	15308	3BCCh	First SM (PMM) motor's rated current (High)	R/W	1 ~ 1000000	0.01A
(Hd109)	15309	3BCDh	(Low)			
Hd110	15310	3BCEh	First SM (PMM) motor's constant R (High)	R/W	1 ~ 1000000000	0.000001Ω
(Hd111)	15311	3BCFh	(Low)			
Hd112	15312	3BD0h	First SM (PMM) motor's constant Ld (High)	R/W		0.000001 mH
(Hd113)	15313	3BD1h	(Low)			
Hd114	15314	3BD2h	First SM (PMM) motor's constant Lq (High)	R/W		
(Hd115)	15315	3BD3h	(Low)			
Hd116	15316	3BD4h	First SM (PMM) motor's constant Ke (High)	R/W	1 ~ 1000000	0.1mVs/rad
(Hd117)	15317	3BD5h	(Low)			
Hd118	15318	3BD6h	First SM (PMM) motor's constant J (High)	R/W	1 ~ 1000000000	0.00001 kg·m^2
(Hd119)	15319	3BD7h	(Low)			

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Hd130	15330	3BE2h	First SM minimum frequency (switch) (SM-SLV, SM-IVMS)	R/W	0 ~ 50	1%
Hd131	15331	3BE3h	First SM no-load current (SM-SLV, SM-IVMS)	R/W	0 ~ 100	
Hd132	15332	3BE4h	First SM start method selection ＊1	R/W	0 ~ 1	1
Hd133	15333	3BE5h	First SM initial position estimation zero-V stand-by times ＊1	R/W	0 ~ 255	
Hd134	15334	3BE6h	First SM initial position estimation detection stand-by times ＊1	R/W		
Hd135	15335	3BE7h	First SM initial position estimation detection times ＊1	R/W		
Hd136	15336	3BE8h	First SM initial position estimation voltage gain ＊1	R/W	0 ~ 200	1%
Hd137	15337	3BE9h	First SM initial position estimation magnetic-pole position offset ＊1	R/W	0 ~ 359	1deg
Hd-41	15341	3BEDh	IVMS carrier frequency ＊2	R/W	5 ~ 160	0.1kHz
Hd-42	15342	3BEEh	Filter gain of IVMS detection current ＊2	R/W	0 ~ 1000	1
Hd-43	15343	3BEFh	Open-phase voltage detection gain selection ＊2	R/W	0 ~ 3	
Hd-44	15344	3BF0h	Selection of open-phase switch threshold correction ＊2	R/W	0 ~ 1	
Hd-45	15345	3BF1h	Speed control P gain ＊2	R/W	0 ~ 1000	
Hd-46	15346	3BF2h	Speed control I gain ＊2	R/W	0 ~ 10000	
Hd-47	15347	3BF3h	Waiting time for open-phase switching ＊2	R/W	0 ~ 1000	
Hd-48	15348	3BF4h	Restriction on the rotation-direction determination ＊2	R/W	0 ~ 1	
Hd-49	15349	3BF5h	Adjustment of the timing for detecting the open-phase voltage ＊2	R/W	0 ~ 1000	
Hd-50	15350	3BF6h	Minimum pulse width adjustment ＊2	R/W		
Hd-51	15351	3BF7h	Current limit of IVMS threshold ＊2	R/W	0 ~ 255	
Hd-52	15352	3BF8h	IVMS threshold gain ＊2	R/W		
Hd-58	15358	3BFEh	IVMS carrier-frequency switching start/finish point ＊2	R/W	0 ~ 50	1%
Hd202	25302	62D6h	Second SM (PMM) motor capacity selection	R/W	1 ~ 16000	0.01kW
Hd203	25303	62D7h	Second selection of number of SM (PMM) motor poles	R/W	0 ~ 23	1
Hd204	25304	62D8h	Second SM (PMM) base frequency	R/W	1000 ~ 59000	0.01Hz
Hd205	25305	62D9h	Second SM (PMM) maximum frequency	R/W		
Hd206	25306	62Dah	Second SM (PMM) motor's rated voltage	R/W	1 ~ 1000	1V
Hd208	25308	62DCh	Second SM (PMM) motor's rated current (High)	R/W	1 ~ 1000000	0.01A
(Hd209)	25309	62DDh	(Low)			
Hd210	25310	62Deh	Second SM (PMM) motor's constant R (High)	R/W	1 ~ 1000000000	0.000001Ω
(Hd211)	25311	62DFh	(Low)			
Hd212	25312	62E0h	Second SM (PMM) motor's constant Ld (High)	R/W		0.000001 mH
(Hd213)	25313	62E1h	(Low)			
Hd214	25314	62E2h	Second SM (PMM) motor's constant Lq (High)	R/W		
(Hd215)	25315	62E3h	(Low)			
Hd216	25316	62E4h	Second SM (PMM) motor's constant Ke (High)	R/W	1 ~ 1000000	0.1mVs/rad
(Hd217)	25317	62E5h	(Low)			
Hd218	25318	62E6h	Second SM (PMM) motor's constant J (High)	R/W	1 ~ 1000000000	0.00001 kg·m^2
(Hd219)	25319	62E7h	(Low)			
Hd230	25330	62F2h	Second SM minimum frequency (switch) (SM-SLV, SM-IVMS)	R/W	0 ~ 50	1%
Hd231	25331	62F3h	Second SM no-load current (SM-SLV, SM-IVMS)	R/W	0 ~ 100	
Hd232	25332	62F4h	Second SM start method selection ＊3	R/W	0 ~ 1	1
Hd233	25333	62F5h	Second SM initial position estimation zero-V stand-by times ＊3	R/W	0 ~ 255	
Hd234	25334	62F6h	Second SM initial position estimation detection stand-by times ＊3	R/W		
Hd235	25335	62F7h	Second SM initial position estimation detection times ＊3	R/W		
Hd236	25336	62F8h	Second SM initial position estimation voltage gain ＊3	R/W	0 ~ 200	1%
Hd237	25337	62F9h	Second SM initial position estimation magnetic-pole position offset ＊3	R/W	0 ~ 359	1deg

＊1 (SM-SLV, SM-IVMS, SM-CL)
＊2 Hd-41 to 58 are reserved parameters.
＊3 (SM-SLV, SM-IVMS, SM-CLV)

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oA-10	16010	3E8Ah	Operation selection when option error occurs (SLOT-1)	R/W	0 ~ 1	1
oA-11	16011	3E8Bh	Communication monitoring timer setting	R/W	0 ~ 10000	0.01s
oA-12	16012	3E8Ch	Operation setting at the time of communication error	R/W	0 ~ 4	1
oA-13	16013	3E8Dh	Selection of operation command behavior at start of option (SLOT-1)	R/W	0 ~ 1	1
oA-20	16020	3E94h	Operation selection when option error occurs (SLOT-2)	R/W	0 ~ 1	1
oA-21	16021	3E95h	Communication monitoring timer setting	R/W	0 ~ 10000	0.01s
oA-22	16022	3E96h	Operation setting at the time of communication error	R/W	0 ~ 4	1
oA-23	16023	3E97h	Selection of operation command behavior at start of option (SLOT-2)	R/W	0 ~ 1	1
oA-30	16030	3E9Eh	Operation selection when option error occurs (SLOT-3)	R/W	0 ~ 1	1
oA-31	16031	3E9Fh	Communication monitoring timer setting	R/W	0 ~ 10000	0.01s
oA-32	16032	3EA0h	Operation setting at the time of communication error	R/W	0 ~ 4	1
oA-33	16033	3EA1h	Selection of operation command behavior at start of option (SLOT-3)	R/W	0 ~ 1	1
ob-01	16101	3EE5h	Encoder constant set-up (option)	R/W	32 ~ 65535	1pls
ob-02	16102	3EE6h	Encoder phase sequence selection (option)	R/W	0 ~ 1	1
ob-03	16103	3EE7h	Motor gear ratio's numerator (option)	R/W	1 ~ 10000	1
ob-04	16104	3EE8h	Motor gear ratio's denominator (option)	R/W	1 ~ 10000	1
ob-10	16110	3EEEh	Pulse train input SA/SB (option) detection target selection	R/W	0 ~ 1	1
ob-11	16111	3EEFh	Pulse train input SA/SB (option) mode selection	R/W	0 ~ 2	1
ob-12	16112	3EF0h	Pulse train frequency scale (option)	R/W	5 ~ 20000	0.01kHz
ob-13	16113	3EF1h	Pulse train frequency filter time constant (option)	R/W	1 ~ 200	0.01s
ob-14	16114	3EF2h	Pulse train frequency bias amount (option)	R/W	-1000 ~ 1000	0.1%
ob-15	16115	3EF3h	Pulse train frequency detection upper limit (option)	R/W	0 ~ 1000	0.1%
ob-16	16116	3EF4h	Pulse train frequency detection lower level (option)	R/W	0 ~ 1000	0.1%
oc-01 to oc-28	16201 to 16228	3F49h to 3F64h	Reserved	R/W	-	-

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oE-01	16401	4011h	[Ai4] terminal input filter time constant	R/W	1 ~ 500	1ms
oE-03	16403	4013h	[Ai4] terminal start amount	R/W	0 ~ 10000	0.01%
oE-04	16404	4014h	[Ai4] terminal end amount	R/W		
oE-05	16405	4015h	[Ai4] terminal start ratio	R/W	0 ~ 1000 (oE-06)	0.1%
oE-06	16406	4016h	[Ai4] terminal end ratio	R/W	(oE-05) 0 ~ 1000	
oE-07	16407	4017h	[Ai4] terminal start selection	R/W	0 ~ 1	1
oE-11	16411	401Bh	[Ai5] terminal input filter time constant	R/W	1 ~ 500	1ms
oE-13	16413	401Dh	[Ai5] terminal start amount	R/W	0 ~ 10000	0.01%
oE-14	16414	401Eh	[Ai5] terminal end amount	R/W		
oE-15	16415	401Fh	[Ai5] terminal start ratio	R/W	0 ~ 1000 (oE-16)	0.1%
oE-16	16416	4020h	[Ai5] terminal end ratio	R/W	(oE-15) 0 ~ 1000	
oE-17	16417	4021h	[Ai5] terminal start selection	R/W	0 ~ 1	1
oE-21	16421	4025h	[Ai6] terminal input filter time constant	R/W	1 ~ 500	1ms
oE-23	16423	4027h	[Ai6] terminal start amount	R/W	-10000 ~ 10000	0.01%
oE-24	16424	4028h	[Ai6] terminal end amount	R/W		
oE-25	16425	4029h	[Ai6] terminal start ratio	R/W	-1000 ~ 1000 (oE-26)	0.1%
oE-26	16426	402Ah	[Ai6] terminal end ratio	R/W	(oE-25) -1000 ~ 1000	
oE-28	16428	402Ch	[Ai4] voltage/current bias adjustment	R/W	-10000 ~ 10000	0.01%
oE-29	16429	402Dh	[Ai4] voltage/current adjustment gain	R/W	0 ~ 20000	
oE-30	16430	402Eh	[Ai5] voltage/current bias adjustment	R/W	-10000 ~ 10000	
oE-31	16431	402Fh	[Ai5] voltage/current adjustment gain	R/W	0 ~ 20000	
oE-32	16432	4030h	[Ai6] voltage bias adjustment	R/W	-10000 ~ 10000	
oE-33	16433	4031h	[Ai6] voltage adjustment gain	R/W	0 ~ 20000	
oE-35	16435	4033h	Window comparator [Ai4] upper limit level	R/W	0 ~ 100	1%
oE-36	16436	4034h	Window comparator [Ai4] lower limit level	R/W		
oE-37	16437	4035h	Window comparator [Ai4] hysteresis range	R/W	0 ~ 10	
oE-38	16438	4036h	Window comparator [Ai5] upper limit level	R/W	0 ~ 100	
oE-39	16439	4037h	Window comparator [Ai5] lower limit level	R/W		
oE-40	16440	4038h	Window comparator [Ai5] hysteresis range	R/W	0 ~ 10	
oE-41	16441	4039h	Window comparator [Ai6] upper limit level	R/W	-100 ~ 100	
oE-42	16442	403Ah	Window comparator [Ai6] lower limit level	R/W		
oE-43	16443	403Bh	Window comparator [Ai6] hysteresis range	R/W	0 ~ 10	
oE-44	16444	403Ch	[AI4] operation level at disconnection	R/W	0 ~ 100	
oE-45	16445	403Dh	[Ai4] operation level selection at disconnection	R/W	0 ~ 2	1
oE-46	16446	403Eh	[Ai5] operation level at disconnection	R/W	0 ~ 100	1%
oE-47	16447	403Fh	[Ai5] operation level selection at disconnection	R/W	0 ~ 2	1
oE-48	16448	4040h	[Ai6] operation level at disconnection	R/W	-100 ~ 100	1%
oE-49	16449	4041h	[Ai6] operation level selection at disconnection	R/W	0 ~ 2	1
oE-50	16450	4042h	[Ao3] terminal output selection	R/W	0 to 65535 (register No.)	
oE-51	16451	4043h	[Ao4] terminal output selection	R/W		
oE-52	16452	4044h	[Ao5] terminal output selection	R/W		
oE-56	16456	4048h	[Ao3] output filter time constant	R/W	1 ~ 500	1ms
oE-57	16457	4049h	[Ao3] terminal sign selection	R/W	0 ~ 1	1
oE-58	16458	404Ah	[Ao3] bias adjustment (voltage/current)	R/W	-1000 ~ 1000	0.1%
oE-59	16459	404Bh	[Ao3] gain adjustment (voltage/current)	R/W	-10000 ~ 10000	
oE-60	16460	404Ch	[Ao3] output level in the adjustment mode	R/W	-1000 ~ 1000	
oE-61	16461	404Dh	[Ao4] output filter time constant	R/W	1 ~ 500	1ms
oE-62	16462	404Eh	[Ao4] output data type selection	R/W	0 ~ 1	1
oE-63	16463	404Fh	[Ao4] bias adjustment (voltage/current)	R/W	-1000 ~ 1000	0.1%
oE-64	16464	4050h	[Ao4] gain adjustment (voltage/current)	R/W	-10000 ~ 10000	
oE-65	16465	4051h	[Ao4] output level in the adjustment mode	R/W	-1000 ~ 1000	
oE-66	16466	4052h	[Ao5] output filter time constant	R/W	1 ~ 500	1ms
oE-67	16467	4053h	[Ao5] output data type selection	R/W	0 ~ 1	1

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oE-68	16468	4054h	[Ao5] bias adjustment (voltage)	R/W	-1000 ~ 1000	0.1%
oE-69	16469	4055h	[Ao5] gain adjustment (voltage)	R/W	-10000 ~ 10000	
oE-70	16470	4056h	[Ao5] output level in the adjustment mode	R/W	-1000 ~ 1000	
oH-01	16701	413Dh	IP address selection (P1-EN)	R/W	0 ~ 1	1
oH-02	16702	413Eh	Transmission speed (port 1) (P1-EN)	R/W	0 ~ 4	
oH-03	16703	413Fh	Transmission speed (port 2) (P1-EN)	R/W		
oH-04	16704	4140h	Ethernet communication timeout (P1-EN)	R/W	1 ~ 65535	1 (×10ms)
oH-05	16705	4141h	Modbus TCP port number (IPv4)	R/W	502,1024 ~ 65535	1
oH-06	16706	4142h	Modbus TCP port number (IPv6)	R/W		
oH-20	16720	4150h	Profibus Node address	R/W	0 ~ 125	
oH-21	16721	4151h	Profibus Clear Mode selection	R/W	0 ~ 1	
oH-22	16722	4152h	Profibus Map selection	R/W	0 ~ 2	
oH-23	16723	4153h	Selection of setting from the Profibus master	R/W	0 ~ 1	
oH-24	16724	4154h	Selection of setpoint telegram/Actual value telegram Gr (P1-PB)	R/W	0 ~ 2	
oH-30	16730	415Ah	IP address selection (P1-PN)	R/W	0 ~ 1	
oH-31	16731	415Bh	Transmission speed (port 1) (P1-PN)	R/W	0 ~ 4	
oH-32	16732	415Ch	Transmission speed (port 2) (P1-PN)	R/W		
oH-33	16733	415Dh	Ethernet communication timeout (P1-PN)	R/W	1 ~ 65535	1 (×10ms)
oH-34	16734	415Eh	Selection of setpoint telegram/Actual value telegram Gr (P1-PN)	R/W	0 ~ 2	1

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oJ-01	16801	41A1h	Gr.A flexible command registration writing register 1	R/W	0 ~ 65535	1
oJ-02	16802	41A2h	Gr.A flexible command registration writing register 2	R/W		
oJ-03	16803	41A3h	Gr.A flexible command registration writing register 3	R/W		
oJ-04	16804	41A4h	Gr.A flexible command registration writing register 4	R/W		
oJ-05	16805	41A5h	Gr.A flexible command registration writing register 5	R/W		
oJ-06	16806	41A6h	Gr.A flexible command registration writing register 6	R/W		
oJ-07	16807	41A7h	Gr.A flexible command registration writing register 7	R/W		
oJ-08	16808	41A8h	Gr.A flexible command registration writing register 8	R/W		
oJ-09	16809	41A9h	Gr.A flexible command registration writing register 9	R/W		
oJ-10	16810	41AAh	Gr.A flexible command registration writing register 10	R/W		
oJ-11	16811	41ABh	Gr.A flexible command registration reading register 1	R/W		
oJ-12	16812	41ACh	Gr.A flexible command registration reading register 2	R/W		
oJ-13	16813	41ADh	Gr.A flexible command registration reading register 3	R/W		
oJ-14	16814	41AEh	Gr.A flexible command registration reading register 4	R/W		
oJ-15	16815	41AFh	Gr.A flexible command registration reading register 5	R/W		
oJ-16	16816	41B0h	Gr.A flexible command registration reading register 6	R/W		
oJ-17	16817	41B1h	Gr.A flexible command registration reading register 7	R/W		
oJ-18	16818	41B2h	Gr.A flexible command registration reading register 8	R/W		
oJ-19	16819	41B3h	Gr.A flexible command registration reading register 9	R/W		
oJ-20	16820	41B4h	Gr.A flexible command registration reading register 10	R/W		
oJ-21	16821	41B5h	Gr.B flexible command registration writing register 1	R/W		
oJ-22	16822	41B6h	Gr.B flexible command registration writing register 2	R/W		
oJ-23	16823	41B7h	Gr.B flexible command registration writing register 3	R/W		
oJ-24	16824	41B8h	Gr.B flexible command registration writing register 4	R/W		
oJ-25	16825	41B9h	Gr.B flexible command registration writing register 5	R/W		
oJ-26	16826	41BAh	Gr.B flexible command registration writing register 6	R/W		
oJ-27	16827	41BBh	Gr.B flexible command registration writing register 7	R/W		
oJ-28	16828	41BCh	Gr.B flexible command registration writing register 8	R/W		
oJ-29	16829	41BDh	Gr.B flexible command registration writing register 9	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oJ-30	16830	41BEh	Gr.B flexible command registration writing register 10	R/W	0 ~ 65535	1
oJ-31	16831	41BFh	Gr.B flexible command registration reading register 1	R/W		
oJ-32	16832	41C0h	Gr.B flexible command registration reading register 2	R/W		
oJ-33	16833	41C1h	Gr.B flexible command registration reading register 3	R/W		
oJ-34	16834	41C2h	Gr.B flexible command registration reading register 4	R/W		
oJ-35	16835	41C3h	Gr.B flexible command registration reading register 5	R/W		
oJ-36	16836	41C4h	Gr.B flexible command registration reading register 6	R/W		
oJ-37	16837	41C5h	Gr.B flexible command registration reading register 7	R/W		
oJ-38	16838	41C6h	Gr.B flexible command registration reading register 8	R/W		
oJ-39	16839	41C7h	Gr.B flexible command registration reading register 9	R/W		
oJ-40	16840	41C8h	Gr.B flexible command registration reading register 10	R/W		
oJ-41	16841	41C9h	Gr.C flexible command registration writing register 1	R/W		
oJ-42	16842	41CAh	Gr.C flexible command registration writing register 2	R/W		
oJ-43	16843	41CBh	Gr.C flexible command registration writing register 3	R/W		
oJ-44	16844	41CCh	Gr.C flexible command registration writing register 4	R/W		
oJ-45	16845	41CDh	Gr.C flexible command registration writing register 5	R/W		
oJ-46	16846	41CEh	Gr.C flexible command registration writing register 6	R/W		
oJ-47	16847	41CFh	Gr.C flexible command registration writing register 7	R/W		
oJ-48	16848	41D0h	Gr.C flexible command registration writing register 8	R/W		
oJ-49	16849	41D1h	Gr.C flexible command registration writing register 9	R/W		
oJ-50	16850	41D2h	Gr.C flexible command registration writing register 10	R/W		
oJ-51	16851	41D3h	Gr.C flexible command registration reading register 1	R/W		
oJ-52	16852	41D4h	Gr.C flexible command registration reading register 2	R/W		
oJ-53	16853	41D5h	Gr.C flexible command registration reading register 3	R/W		
oJ-54	16854	41D6h	Gr.C flexible command registration reading register 4	R/W		
oJ-55	16855	41D7h	Gr.C flexible command registration reading register 5	R/W		
oJ-56	16856	41D8h	Gr.C flexible command registration reading register 6	R/W		
oJ-57	16857	41D9h	Gr.C flexible command registration reading register 7	R/W		
oJ-58	16858	41DAh	Gr.C flexible command registration reading register 8	R/W		
oJ-59	16859	41DBh	Gr.C flexible command registration reading register 9	R/W		
oJ-60	16860	41DCh	Gr.C flexible command registration reading register 10	R/W		
oL-01	16901	4205h	Gr.1 IPv4 IP address (1)	R/W	0 ~ 255	1
oL-02	16902	4206h	Gr.1 IPv4 IP address (2)	R/W		
oL-03	16903	4207h	Gr.1 IPv4 IP address (3)	R/W		
oL-04	16904	4208h	Gr.1 IPv4 IP address (4)	R/W		
oL-05	16905	4209h	Gr.1 IPv4 subnet mask (1)	R/W		
oL-06	16906	420Ah	Gr.1 IPv4 subnet mask (2)	R/W		
oL-07	16907	420Bh	Gr.1 IPv4 subnet mask (3)	R/W		
oL-08	16908	420Ch	Gr.1 IPv4 subnet mask (4)	R/W		
oL-09	16909	420Dh	Gr.1 IPv4 default gateway (1)	R/W		
oL-10	16910	420Eh	Gr.1 IPv4 default gateway (2)	R/W		
oL-11	16911	420Fh	Gr.1 IPv4 default gateway (3)	R/W		
oL-12	16912	4210h	Gr.1 IPv4 default gateway (4)	R/W		
oL-20	16920	4218h	Gr.1 IPv6 IP address (1)	R/W	0 ~ 65535	
oL-21	16921	4219h	Gr.1 IPv6 IP address (2)	R/W		
oL-22	16922	421Ah	Gr.1 IPv6 IP address (3)	R/W		
oL-23	16923	421Bh	Gr.1 IPv6 IP address (4)	R/W		
oL-24	16924	421Ch	Gr.1 IPv6 IP address (5)	R/W		
oL-25	16925	421Dh	Gr.1 IPv6 IP address (6)	R/W		
oL-26	16926	421Eh	Gr.1 IPv6 IP address (7)	R/W		
oL-27	16927	421Fh	Gr.1 IPv6 IP address (8)	R/W		
oL-28	16928	4220h	Gr.1 IPv6 subnet prefix	R/W	0 ~ 127	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
oL-29	16929	4221h	Gr.1 IPv6 default gateway (1)	R/W	0 ~ 65535	1
oL-30	16930	4222h	Gr.1 IPv6 default gateway (2)	R/W		
oL-31	16931	4223h	Gr.1 IPv6 default gateway (3)	R/W		
oL-32	16932	4224h	Gr.1 IPv6 default gateway (4)	R/W		
oL-33	16933	4225h	Gr.1 IPv6 default gateway (5)	R/W		
oL-34	16934	4226h	Gr.1 IPv6 default gateway (6)	R/W		
oL-35	16935	4227h	Gr.1 IPv6 default gateway (7)	R/W		
oL-36	16936	4228h	Gr.1 IPv6 default gateway (8)	R/W		
oL-40	16940	422Ch	Gr.2 IPv4 IP address (1)	R/W	0 ~ 255	
oL-41	16941	422Dh	Gr.2 IPv4 IP address (2)	R/W		
oL-42	16942	422Eh	Gr.2 IPv4 IP address (3)	R/W		
oL-43	16943	422Fh	Gr.2 IPv4 IP address (4)	R/W		
oL-44	16944	4230h	Gr.2 IPv4 subnet mask (1)	R/W		
oL-45	16945	4231h	Gr.2 IPv4 subnet mask (2)	R/W		
oL-46	16946	4232h	Gr.2 IPv4 subnet mask (3)	R/W		
oL-47	16947	4233h	Gr.2 IPv4 subnet mask (4)	R/W		
oL-48	16948	4234h	Gr.2 IPv4 default gateway (1)	R/W		
oL-49	16949	4235h	Gr.2 IPv4 default gateway (2)	R/W		
oL-50	16950	4236h	Gr.2 IPv4 default gateway (3)	R/W		
oL-51	16951	4237h	Gr.2 IPv4 default gateway (4)	R/W		
oL-60	16960	4240h	Gr.2 IPv6 IP address (1)	R/W	0 ~ 65535	
oL-61	16961	4241h	Gr.2 IPv6 IP address (2)	R/W		
oL-62	16962	4242h	Gr.2 IPv6 IP address (3)	R/W		
oL-63	16963	4243h	Gr.2 IPv6 IP address (4)	R/W		
oL-64	16964	4244h	Gr.2 IPv6 IP address (5)	R/W		
oL-65	16965	4245h	Gr.2 IPv6 IP address (6)	R/W		
oL-66	16966	4246h	Gr.2 IPv6 IP address (7)	R/W		
oL-67	16967	4247h	Gr.2 IPv6 IP address (8)	R/W		
oL-68	16968	4248h	Gr.2 IPv6 subnet prefix	R/W	0 ~ 127	
oL-69	16969	4249h	Gr.2 IPv6 default gateway (1)	R/W	0 ~ 65535	
oL-70	16970	424Ah	Gr.2 IPv6 default gateway (2)	R/W		
oL-71	16971	424Bh	Gr.2 IPv6 default gateway (3)	R/W		
oL-72	16972	424Ch	Gr.2 IPv6 default gateway (4)	R/W		
oL-73	16973	424Dh	Gr.2 IPv6 default gateway (5)	R/W		
oL-74	16974	424Eh	Gr.2 IPv6 default gateway (6)	R/W		
oL-75	16975	424Fh	Gr.2 IPv6 default gateway (7)	R/W		
oL-76	16976	4250h	Gr.2 IPv6 default gateway (8)	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
PA-01	17001	4269h	Em-Force mode selection	R/W	0 ~ 1	1
PA-02	17002	426Ah	Em-Force mode frequency setting	R/W	0 ~ 59000	0.01Hz
PA-03	17003	426Bh	Rotation direction command in the Em-Force mode	R/W	0 ~ 1	1
PA-04	17004	426Ch	Commercial power supply bypass function selection	R/W		
PA-05	17005	426Dh	Bypass function delay time	R/W	0 ~ 10000	0.1s
PA-20	17020	427Ch	Simulation mode selection	R/W	0 ~ 1	
PA-21	17021	427Dh	Selection of error code for alarm test	R/W	0 ~ 255	1
PA-22	17022	427Eh	Output current monitor optional output selection	R/W	0 ~ 7	
PA-23	17023	427Fh	Output current monitor optional setting value	R/W	(0 to 3.00) × CTL rated current	0.1A
PA-24	17024	4280h	P-N voltage monitor optional output selection	R/W	0 ~ 7	1
PA-25	17025	4281h	P-N voltage monitor optional setting value	R/W	200Vclass:0 ~ 4500 400Vclass:0 ~ 9000	0.1Vdc
PA-26	17026	4282h	Output voltage monitor optional output selection	R/W	0 ~ 7	1
PA-27	17027	4283h	Output voltage monitor optional setting value	R/W	200Vclass:0 ~ 3000 400Vclass:0 ~ 6000	0.1V
PA-28	17028	4284h	Output torque monitor optional output selection	R/W	0 ~ 7	1
PA-29	17029	4285h	Output torque monitor optional setting value	R/W	-5000 ~ 5000	0.1%
PA-30	17030	4286h	Frequency adjustment optional output selection	R/W	0 ~ 7	1
PA-31	17031	4287h	Frequency matching frequency optional setting value	R/W	0 ~ 59000	0.01Hz

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
UA-10	18010	465Ah	Display selection	R/W	0 ~ 4	
UA-12	18012	465Ch	Clearing of integrated input power	R/W	0 ~ 1	
UA-13	18013	465Dh	Integrated input power display gain	R/W	1 ~ 1000	
UA-14	18014	465Eh	Clearing of integrated output power	R/W	0 ~ 1	
UA-15	18015	465Fh	Integrated output power display gain	R/W	1 ~ 1000	
UA-16	18016	4660h	Soft-lock selection	R/W		
UA-17	18017	4661h	Soft-lock target selection	R/W	0 ~ 1	
UA-18	18018	4662h	Data R/W selection	R/W		
UA-19	18019	4663h	Battery level warning selection	R/W	0 ~ 2	
UA-20	18020	4664h	Operation selection at disconnection of operator keypad	R/W	0 ~ 4	
UA-21	18021	4665h	Second setting parameter display selection	R/W		
UA-22	18022	4666h	Option parameter display selection (when full display is selected)	R/W	0 ~ 1	
UA-30	18030	466Eh	User parameter auto setting selection	R/W		
UA-31	18031	466Fh	User parameter 1 selection	R/W		1
UA-32	18032	4670h	User parameter 2 selection	R/W		
UA-33	18033	4671h	User parameter 3 selection	R/W		
UA-34	18034	4672h	User parameter 4 selection	R/W		
UA-35	18035	4673h	User parameter 5 selection	R/W		
UA-36	18036	4674h	User parameter 6 selection	R/W		
UA-37	18037	4675h	User parameter 7 selection	R/W		
UA-38	18038	4676h	User parameter 8 selection	R/W	0 to 65535 (register No.)	
UA-39	18039	4677h	User parameter 9 selection	R/W		
UA-40	18040	4678h	User parameter 10 selection	R/W		
UA-41	18041	4679h	User parameter 11 selection	R/W		
UA-42	18042	467Ah	User parameter 12 selection	R/W		
UA-43	18043	467Bh	User parameter 13 selection	R/W		
UA-44	18044	467Ch	User parameter 14 selection	R/W		
UA-45	18045	467Dh	User parameter 15 selection	R/W		
UA-46	18046	467Eh	User parameter 16 selection	R/W		

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
UA-47	18047	467Fh	User parameter 17 selection	R/W	0 to 65535 (register No.)	1
UA-48	18048	4680h	User parameter 18 selection	R/W		
UA-49	18049	4681h	User parameter 19 selection	R/W		
UA-50	18050	4682h	User parameter 20 selection	R/W		
UA-51	18051	4683h	User parameter 21 selection	R/W		
UA-52	18052	4684h	User parameter 22 selection	R/W		
UA-53	18053	4685h	User parameter 23 selection	R/W		
UA-54	18054	4686h	User parameter 24 selection	R/W		
UA-55	18055	4687h	User parameter 25 selection	R/W		
UA-56	18056	4688h	User parameter 26 selection	R/W		
UA-57	18057	4689h	User parameter 27 selection	R/W		
UA-58	18058	468Ah	User parameter 28 selection	R/W		
UA-59	18059	468Bh	User parameter 29 selection	R/W		
UA-60	18060	468Ch	User parameter 30 selection	R/W		
UA-61	18061	468Dh	User parameter 31 selection	R/W		
UA-62	18062	468Eh	User parameter 32 selection	R/W		
UA-90 to UA-94	-	-	Reserved	R/W	-	-
Ub-01	18101	46B5h	Selection of initialization	R/W	0 ~ 8	1
Ub-02	18102	46B6h	Selection of initial values	R/W	0 ~ 3	
Ub-03	18103	46B7h	Load type selection	R/W	0 ~ 2	
Ub-05	18105	46B9h	Initialization start selection	R/W	0 ~ 1	
UC-01	18201	4719h	Debug mode selection	R/W	0 ~ 3	1
Ud-01	18301	477Dh	Trace function selection	R/W	0 ~ 1	1
Ud-02	18302	477Eh	Trace start	R/W		
Ud-03	18303	477Fh	Selection of the number of trace data	R/W	0 ~ 8	
Ud-04	18304	4780h	Trace signal number selection	R/W		
Ud-10	18310	4786h	Trace data -0 selection	R/W	0 to 65535 (register No. of d, F codes)	
Ud-11	18311	4787h	Trace data -1 selection	R/W		
Ud-12	18312	4788h	Trace data -2 selection	R/W		
Ud-13	18313	4789h	Trace data -3 selection	R/W		
Ud-14	18314	478Ah	Trace data -4 selection	R/W		
Ud-15	18315	478Bh	Trace data -5 selection	R/W		
Ud-16	18316	478Ch	Trace data -6 selection	R/W		
Ud-17	18317	478Dh	Trace data -7 selection	R/W		
Ud-20	18320	4790h	Trace signal -0 I/O selection	R/W	0 ~ 1	
Ud-21	18321	4791h	Trace signal -0 input terminal selection	R/W	0 ~ 110	
Ud-22	18322	4792h	Trace signal -0 output terminal selection	R/W	0 ~ 93	
Ud-23	18323	4793h	Trace signal -1 I/O selection	R/W	0 ~ 1	
Ud-24	18324	4794h	Trace signal -1 input terminal selection	R/W	0 ~ 110	
Ud-25	18325	4795h	Trace signal -1 output terminal selection	R/W	0 ~ 93	
Ud-26	18326	4796h	Trace signal -2 I/O selection	R/W	0 ~ 1	
Ud-27	18327	4797h	Trace signal -2 input terminal selection	R/W	0 ~ 110	
Ud-28	18328	4798h	Trace signal -2 output terminal selection	R/W	0 ~ 93	
Ud-29	18329	4799h	Trace signal -3 I/O selection	R/W	0 ~ 1	
Ud-30	18330	479Ah	Trace signal -3 input terminal selection	R/W	0 ~ 110	

Function Code	Register No.	Register No. (hexadecimal)	Function Name	R/W	Monitor Content and Setting Item	Data Resolution Unit
Ud-31	18331	479Bh	Trace signal -3 output terminal selection	R/W	0 ~ 93	1
Ud-32	18332	479Ch	Trace signal -4 I/O selection	R/W	0 ~ 1	
Ud-33	18333	479Dh	Trace signal -4 input terminal selection	R/W	0 ~ 110	
Ud-34	18334	479Eh	Trace signal -4 output terminal selection	R/W	0 ~ 93	
Ud-35	18335	479Fh	Trace signal -5 I/O selection	R/W	0 ~ 1	
Ud-36	18336	47A0h	Trace signal -5 input terminal selection	R/W	0 ~ 110	
Ud-37	18337	47A1h	Trace signal -5 output terminal selection	R/W	0 ~ 93	
Ud-38	18338	47A2h	Trace signal -6 I/O selection	R/W	0 ~ 1	
Ud-39	18339	47A3h	Trace signal -6 input terminal selection	R/W	0 ~ 110	
Ud-40	18340	47A4h	Trace signal -6 output terminal selection	R/W	0 ~ 93	
Ud-41	18341	47A5h	Trace signal -7 I/O selection	R/W	0 ~ 1	
Ud-42	18342	47A6h	Trace signal -7 input terminal selection	R/W	0 ~ 110	
Ud-43	18343	47A7h	Trace signal -7 output terminal selection	R/W	0 ~ 93	
Ud-50	18350	47AEh	Trace trigger 1 selection	R/W	0 ~ 16	
Ud-51	18351	47AFh	Selection of trigger 1 operation at trace data trigger	R/W	0 ~ 1	
Ud-52	18352	47B0h	Trigger 1 level at trace data trigger	R/W	0 ~ 100	1%
Ud-53	18353	47B1h	Selection of trigger 1 operation at trace signal trigger	R/W	0 ~ 1	1
Ud-54	18354	47B2h	Trace trigger 2 selection	R/W	0 ~ 16	
Ud-55	18355	47B3h	Selection of trigger 2 operation at trace data trigger	R/W	0 ~ 1	
Ud-56	18356	47B4h	Trigger 2 level at trace data trigger	R/W	0 ~ 100	1%
Ud-57	18357	47B5h	Selection of trigger 2 operation at trace signal trigger	R/W	0 ~ 1	1
Ud-58	18358	47B6h	Trigger condition selection	R/W	0 ~ 3	
Ud-59	18359	47B7h	Trigger point setting	R/W	0 ~ 100	1%
Ud-60	18360	47B8h	Sampling time setting	R/W	1 ~ 10	1

15

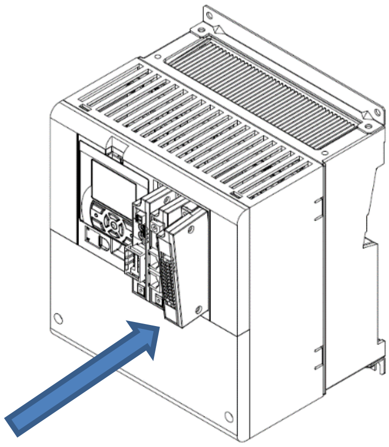
Chapter 15 Optional Cassettes

15.1 What This Chapter Explains

- This chapter describes optional boards that are able to connect to HF-430NEO.
- For details, refer to the instruction manual provided together with respective optional devices.

15.2 Installation of Optional Cassettes

- When inserting an optional cassette, remove the slot cover screws and straightly insert an optional cassette you want to use. Then set the optional cassette to be secured with the removed screws.
- Connection state of optional cassettes can be monitored on the option slot mounted state monitors [dA-81] (SLOT1) to [dA-83] (SLOT3).



Connection Part	Name	Description
SLOT1	Optional cassette slot 1	For connecting various optional cassettes.
SLOT2	Optional cassette slot 2	For connecting various optional cassettes. The encoder feedback option (HF-FB) must be connected to the slot 2.
SLOT3	Optional cassette slot 3	For connecting various optional cassettes.

15.3 Parameters Related to Optional Devices

15.3.1 Common settings of optional cassettes

■Operation selection when option error occurs
(Operation when communication error occurs between HF-430NEO and optional cassette)

- You can set up operations to be executed when a factor for option errors (E060, E069/E070, E079/E080, E089) occurs, per slot ([oA-10]/[oA-20]/[oA-30]).
- For operation errors, refer to the instruction manual provided together with each optional cassette.

- When “continues operating (01)” is selected for “operation setting when option error occurs ([oA-10]/[oA-20]/[oA-30])”, even when an operation stop command is given via an optional cassette, an operation may not be stopped via the optional cassette.
  Make sure to design a system configuration so that an operation can be stopped via option cassettes.
- Option errors except for E060, E069/E070, E079/E080, and E089, as well as errors exclusive to optional cassettes (E090 to E109) are disabled in this inverter.
  (An error occurs and the inverter stops operating.)

■Parameters

Item	Parameter	Data	Description
Operation selection when option error occurs (slot 1)	[oA-10]	00	Stops after an error occurs.
		01	Continues operating.
Operation selection when option error occurs (slot 2)	[oA-20]	00	Stops after an error occurs.
		01	Continues operating.
Operation selection when option error occurs (slot 3)	[oA-30]	00	Stops after an error occurs.
		01	Continues operating.

■Operation setting for communication error
- This function is for optional cassettes P1-PB and P1-PN. The function is disabled when other optional cassettes are used.
- For details, refer to the guides for optional cassettes P1-PB and P1-PN.

■Parameters

Item	Parameter	Data	Description
Communication monitoring timer setting (slot 1)	[oA-11]	0.00~100.00 (s)	Communication error monitoring time
Operation setting for communication error (slot 1)	[oA-12]	00	An error occurs.
		01	An error occurs after a deceleration stop.
		02	Ignore
		03	Free-run stop
		04	Deceleration stop
Communication monitoring timer setting (slot 2)	[oA-21]	0.00~100.00 (s)	Communication error monitoring time
Operation setting for communication error (slot 2)	[oA-22]	00	An error occurs.
		01	An error occurs after a deceleration stop.
		02	Ignore
		03	Free-run stop
		04	Deceleration stop
Communication monitoring timer setting (slot 3)	[oA-31]	0.00~100.00 (s)	Communication error monitoring time
Operation setting for communication error (slot 3)	[oA-32]	00	An error occurs.
		01	An error occurs after a deceleration stop.
		02	Ignore
		03	Free-run stop
		04	Deceleration stop

■Operation command behavior at start of option

- When a communication option is used, if “00” is selected for “operation command behavior at start of option”, an operation command is accepted after connection with the communication option is confirmed.

- If “01” is set for “selection of operation command behavior at start of option”, an operation command is accepted without waiting for confirmation of connection with the communication option.
  When a communication option is used only for monitoring power and an operation command is given using input terminal function or the like, an output operation may start faster by setting “01” for the said selection.

■Parameters

Item	Parameter	Data	Description
Selection of operation command behavior at start of option (slot 1)	[oA-13]	00	Operation command disabled
		01	Operation command enabled
Selection of operation command behavior at start of option (slot 2)	[oA-23]	00	Operation command disabled
		01	Operation command enabled
Selection of operation command behavior at start of option (slot 3)	[oA-33]	00	Operation command disabled
		01	Operation command enabled

15.4 Feedback Option Overview

15.4.1 Options for line driver

- Option HF-FB for line driver is an interface option to inverters which is corresponding to 5V line driver output for incremental type rotary encoder.
- Combining this option with an inverter to detect and feedback rotation speed of the motor with encoder suppresses speed fluctuation and realizes high precision operation.
- In addition, by inputting pulse string position command, you can execute position control, synchronous operation, orientation function, etc. For details, refer to the following sections contained herein and HF-FB user’s guide.

■On settings of encoder
“12.9.17 Use encoder”

■On control mode
“12.9.1 Selection of control mode”

■On settings of pulse train input
“12.4.6 Make pulse train input command."

■On position control
"12.17.7 Conduct pulse train position control"
12.17.8 Stopping at Designated Position
"12.17.9 Control in the origin-based absolute position"

■Related parameters
Refer to the aforementioned sections contained herein and HF-FB user’s guide.

15.5 Communication Option Overview

- When using a communication option, do not change “CF-11 resister data selection” from “00:(A, V).
- Do not change the settings of following parameters:

Parameter
[oC-01]~[oC-28]
[oE-01]~[oE-70]
[oH-20]~[oH-34]
[oJ-01]~[oJ-60]

■Related parameters (common to communication options)

Item	Parameter
Gr.1 IPv4 IP address (1)	[oL-01]
Gr.1 IPv4 IP address (2)	[oL-02]
Gr.1 IPv4 IP address (3)	[oL-03]
Gr.1 IPv4 IP address (4)	[oL-04]
Gr.1 IPv4 subnet mask (1)	[oL-05]
Gr.1 IPv4 subnet mask (2)	[oL-06]
Gr.1 IPv4 subnet mask (3)	[oL-07]
Gr.1 IPv4 subnet mask (4)	[oL-08]
Gr.1 IPv4 default gateway (1)	[oL-09]
Gr.1 IPv4 default gateway (2)	[oL-10]
Gr.1 IPv4 default gateway (3)	[oL-11]
Gr.1 IPv4 default gateway (4)	[oL-12]
Gr.1 IPv6 IP address (1)	[oL-20]
Gr.1 IPv6 IP address (2)	[oL-21]
Gr.1 IPv6 IP address (3)	[oL-22]
Gr.1 IPv6 IP address (4)	[oL-23]
Gr.1 IPv6 IP address (5)	[oL-24]
Gr.1 IPv6 IP address (6)	[oL-25]
Gr.1 IPv6 IP address (7)	[oL-26]
Gr.1 IPv6 IP address (8)	[oL-27]
Gr.1 IPv6 subnet prefix	[oL-28]
Gr.1 IPv6 default gateway (1)	[oL-29]
Gr.1 IPv6 default gateway (2)	[oL-30]
Gr.1 IPv6 default gateway (3)	[oL-31]
Gr.1 IPv6 default gateway (4)	[oL-32]
Gr.1 IPv6 default gateway (5)	[oL-33]
Gr.1 IPv6 default gateway (6)	[oL-34]
Gr.1 IPv6 default gateway (7)	[oL-35]
Gr.1 IPv6 default gateway (8)	[oL-36]

Item	Parameter
Gr.2 IPv4 IP address (1)	[oL-40]
Gr.2 IPv4 IP address (2)	[oL-41]
Gr.2 IPv4 IP address (3)	[oL-42]
Gr.2 IPv4 IP address (4)	[oL-43]
Gr.2 IPv4 subnet mask (1)	[oL-44]
Gr.2 IPv4 subnet mask (2)	[oL-45]
Gr.2 IPv4 subnet mask (3)	[oL-46]
Gr.2 IPv4 subnet mask (4)	[oL-47]
Gr.2 IPv4 default gateway (1)	[oL-48]
Gr.2 IPv4 default gateway (2)	[oL-49]
Gr.2 IPv4 default gateway (3)	[oL-50]
Gr.2 IPv4 default gateway (4)	[oL-51]
Gr.2 IPv6 IP address (1)	[oL-60]
Gr.2 IPv6 IP address (2)	[oL-61]
Gr.2 IPv6 IP address (3)	[oL-62]
Gr.2 IPv6 IP address (4)	[oL-63]
Gr.2 IPv6 IP address (5)	[oL-64]
Gr.2 IPv6 IP address (6)	[oL-65]
Gr.2 IPv6 IP address (7)	[oL-66]
Gr.2 IPv6 IP address (8)	[oL-67]
Gr.2 IPv6 subnet prefix	[oL-68]
Gr.2 IPv6 default gateway (1)	[oL-69]
Gr.2 IPv6 default gateway (2)	[oL-70]
Gr.2 IPv6 default gateway (3)	[oL-71]
Gr.2 IPv6 default gateway (4)	[oL-72]
Gr.2 IPv6 default gateway (5)	[oL-73]
Gr.2 IPv6 default gateway (6)	[oL-74]
Gr.2 IPv6 default gateway (7)	[oL-75]
Gr.2 IPv6 default gateway (8)	[oL-76]

15.5.1 Ethernet (Modbus-TCP) option

- Ethernet communication is performed with Modbus-TCP protocol.
  For details, refer to the guide for optional cassette P1-EN.

■Related parameters (Ethernet options)

Item	Parameter
IP address selection (P1-EN)	[oH-01]
Transmission speed (port 1) (P1-EN)	[oH-02]
Transmission speed (port 2) (P1-EN)	[oH-03]
Ethernet communication timeout (P1-EN)	[oH-04]
Modbus TCP port number (IPv4)	[oH-05]
Modbus TCP port number (IPv6)	[oH-06]

15.6 Terminal Extension Option Overview

15.6.1 Analog extension options

- This is an option for extending analog inputs and outputs (voltage/current) on the control circuit terminal block. For details, refer to the guide for optional cassette P1-AG.

■Related parameters (AG options)

Item	Parameter
[Ai4] terminal input filter time constant	[oE-01]
[Ai4] terminal start amount	[oE-03]
[Ai4] terminal end amount	[oE-04]
[Ai4] terminal start ratio	[oE-05]
[Ai4] terminal end ratio	[oE-06]
[Ai4] terminal start selection	[oE-07]
[Ai5] terminal input filter time constant	[oE-11]
[Ai5] terminal start amount	[oE-13]
[Ai5] terminal end amount	[oE-14]
[Ai5] terminal start ratio	[oE-15]
[Ai5] terminal end ratio	[oE-16]
[Ai5] terminal start selection	[oE-17]
[Ai6] terminal input filter time constant	[oE-21]
[Ai6] terminal start amount	[oE-23]
[Ai6] terminal end amount	[oE-24]
[Ai6] terminal start ratio	[oE-25]
[Ai6] terminal end ratio	[oE-26]
[Ai4] voltage/current bias adjustment	[oE-28]
[Ai4] voltage adjustment gain	[oE-29]
[Ai5] voltage/current bias adjustment	[oE-30]
[Ai5] voltage adjustment gain	[oE-31]
[Ai6] voltage bias adjustment	[oE-32]
[Ai6] voltage adjustment gain	[oE-33]
Window comparator [Ai4] upper limit level	[oE-35]
Window comparator [Ai4] lower limit level	[oE-36]
Window comparator [Ai4] hysteresis range	[oE-37]
Window comparator [Ai5] upper limit level	[oE-38]
Window comparator [Ai5] lower limit level	[oE-39]

Item	Parameter
Window comparator [Ai5] hysteresis range	[oE-40]
Window comparator [Ai6] lower limit level	[oE-41]
Window comparator [Ai6] lower limit level	[oE-42]
Window comparator [Ai6] hysteresis range	[oE-43]
[Ai4] operation level at disconnection	[oE-44]
[Ai4] operation level selection at disconnection	[oE-45]
[Ai5] operation level at disconnection	[oE-46]
[Ai5] operation level selection at disconnection	[oE-47]
[Ai6] operation level at disconnection	[oE-48]
[Ai6] operation level selection at disconnection	[oE-49]
[Ao3] terminal output selection	[oE-50]
[Ao4] terminal output selection	[oE-51]
[Ao5] terminal output selection	[oE-52]
[Ao3] output filter time constant	[oE-56]
[Ao3] output data type selection	[oE-57]
[Ao3] bias adjustment (voltage/current)	[oE-58]
[Ao3] gain adjustment (voltage/current)	[oE-59]
[Ao3] output level in the adjustment mode	[oE-60]
[Ao4] output filter time constant	[oE-61]
[Ao4] output data type selection	[oE-62]
[Ao4] bias adjustment (voltage/current)	[oE-63]
[Ao4] gain adjustment (voltage/current)	[oE-64]
[Ao4] output level in the adjustment mode	[oE-65]
[Ao5] output filter time constant	[oE-66]
[Ao5] output data type selection	[oE-67]
[Ao5] bias adjustment (voltage)	[oE-68]
[Ao5] gain adjustment (voltage)	[oE-69]
[Ao5] output level in the adjustment mode	[oE-70]

■Related monitors

Item	Parameter
Analog I/O selection monitor	[dA-60]
Extended analog input [Ai4] monitor	[dA-64]
Extended analog input [Ai5] monitor	[dA-65]
Extended analog input [Ai6] monitor	[dA-66]

Chapter 16 PC software SAFS001

16

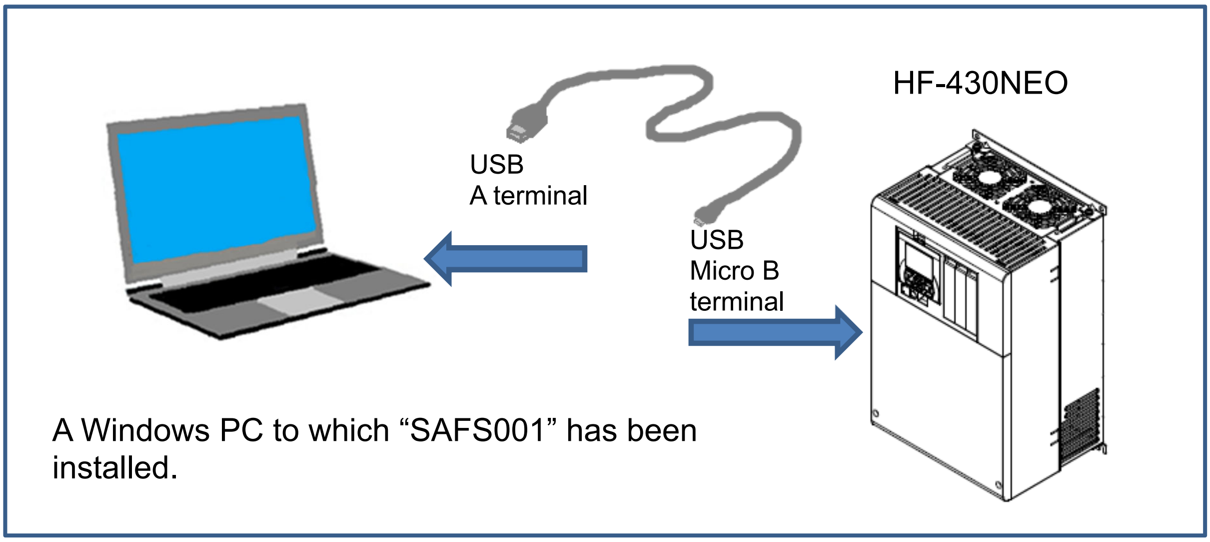
16.1 What This Chapter Explains

This chapter provides the inverter side details related to PC software “SAFS001” (Ver.2 or more).
For more details, see the instruction manuals of “SAFS001”.

16.2 “SAFS001”

16.2.1 Connecting PC and inverter

- Install “SAFS001” to your PC.
- Connect the inverter and the PC using a USB cable.
- With the PC tool “SAFS001”, the following functions are usable: wizard function for supporting an operation setting; function for writing a parameter to and reading out a parameter from a file; function for creating a program and downloading to inverters; function for tracing an error when it occurs; etc.
- For installation procedure, see the instruction manual of “SAFS001”.



16.2.2 What you can do with “SAFS001”

■Parameter setting function
- You can configure various parameter settings such as setting parameters individually and searching parameters changed from the factory setting.
- Parameters can be stored and read as CSV file format.

■Monitor function
- You can set arbitrary parameters and conduct monitoring accordingly.
- Monitor data can be stored and read out in the CSV file format.

■Trace function
- This function enables you to set parameters and triggers in order to show data graphically at occurrence of a trigger.
- Traced data can be stored and read as CSV file format.

16.3Trace Functions

16.3.1 Trace function specification

- The trace function is a function for obtaining and accumulating the inverter monitor data under the set conditions.
- With “SAFS001”, accumulated data (accumulated trace data) can be uploaded, shown graphically, and stored.
- For more details, see the instruction manual of “SAFS001”.

■Specifications

Item	Description
Number of trace data	Monitor data: Max. 8 data Signal: Max. 8 signals (Select from the Input/output terminal function.)
Accumulated trace data size	8kbytes
Sampling time (interval)	Select from 0.2 ms, 0.5 ms, 1 ms, 2 ms, 5 ms, 10 ms, 50 ms,100 ms, 500 ms, and 1000 ms.
Number of sampling points	It varies depending on the number of trace data, the number of signals, and data size of parameters to be traced. Ex. 953 sampling points if “the number of trace data is 4; the number of signals is 1; and the data size of them is respectively 2 bytes”.
Trace starting method	“SAFS001”, parameter setting, input terminal (DTR (data trace starting signal))
Trigger condition	2 conditions (4 conditions in total by the combination of them) Select either Trip or Trace data (monitor data, signal). Trigger level and trigger point can be set.
Others	• Trace function state signals ([WFT] is ON in a trigger stand-by state, and [TRA] is ON during tracing) • To graph or store accumulated trace data, “SAFS002” is required.

16.3.2 Trace function use procedure

■Trace function use procedure

No.	Description	Remarks
1	Enable the trace function. (Set [Ud-01] to 01(Enable).)	See "16.4.3 Trace function related parameters". (These items can also be set with “SAFS001”.)
2	Set the number of data ([Ud-03]) and signals ([Ud-04]) to be traced.	
3	Select parameters to be traced. ([Ud-10]~[Ud-17])	
4	Select whether a signal to be traced is of input terminal function or output terminal function. ([Ud-20] [Ud-23] [Ud-26] [Ud-29] [Ud-32] [Ud-35] [Ud-38] [Ud-41]) Then, select a signal (terminal function) to be traced. (Input: [Ud-21] [Ud-24] [Ud-27] [Ud-30] [Ud-33] [Ud-36] [Ud-39] [Ud-42]) (Output: [Ud-22] [Ud-25] [Ud-28] [Ud-31] [Ud-34] [Ud-37] [Ud-40] [Ud-43])	
5	Select and set trigger conditions. ([Ud-50]~[Ud-59])	
6	Select sampling time (interval). ([Ud-60])	
7	Start tracing. (Set [Ud-02] to 01(Start).) (This item can also be set with the input terminal function DTR or “SAFS001”.)	
8	The inverter enters the trace stop state as tracing is completed. *1) *2) (Wait until the inverter finishes tracing.) When it’s done, [Ud-02] will be changed to 00 (Stop).)	
9	Read out, show graphically, and store the accumulated trace data, using “SAFS001”. *3)	“SAFS001” is required.

*1) Note that the accumulated trace data will be erased if the inverter power supply is shut off.
*2) Do not interrupt tracing while it is being executed because some accumulated trace data may be remained.
*3) During data readout, trace data may be missing. In such a case, carry out readout again.

16.3.3 Trace function related parameters

■Related parameters

Item	Parameter	Data	Description
Trace function selection	[Ud-01]	00	Disable
		01	Enable
Trace start	[Ud-02]	00	Stop tracing.
		01	Start tracing and enters the trigger stand-by state.
Selection of the number of trace data (the number of parameters)	[Ud-03]	0~8	Select the number of data to be traced.
Trace signal selection	[Ud-04]	0~8	Select the number of I/O signals to be traced.
Trace data 0 to 7 selection	[Ud-10]~[Ud-17]	See the trace target data described in the following section.	Select monitor parameters to be traced.
Trace signal 0 to 7 I/O selection	[Ud-20] [Ud-23] [Ud-26] [Ud-29] [Ud-32] [Ud-35] [Ud-38] [Ud-41]	00	Trace the input terminals. When 00 is selected, [Ud-21] [Ud-24] [Ud-27] [Ud-30] [Ud-33] [Ud-36] [Ud-39] [Ud-42] are enabled.
		01	Trace the output terminals. When 01 is selected, [Ud-22] [Ud-25] [Ud-28] [Ud-31] [Ud-34] [Ud-37] [Ud-40] [Ud-43] are enabled.
Trace signal 0 to 7 input terminal selection	[Ud-21] [Ud-24] [Ud-27] [Ud-30] [Ud-33] [Ud-36] [Ud-39] [Ud-42]	See options for [CA-01].	Set input terminal number to be traced.
Trace signal 0 to 7 output terminal selection	[Ud-22] [Ud-25] [Ud-28] [Ud-31] [Ud-34] [Ud-37] [Ud-40] [Ud-43]	See options for [CC-01].	Set output terminal number to be traced.
Selection of trace trigger 1, 2	[Ud-50] [Ud-54]	00	Set trip generation as trigger.
		01~08	Trace data 0 to 7 is trigger.
		09~16	Trace signal 0 to 7 is trigger.
Selection of trigger 1, 2 operation at trace data trigger	[Ud-51] [Ud-55]	00	Record the trace data when the trigger level rises.
		01	Record the trace data when the trigger level falls.
Trigger 1, 2 level at trace data trigger	[Ud-52] [Ud-56]	0~100 (%)	Adjust the trigger level, considering the Max. value of each selected monitor parameter as 100%.
Selection of trigger 1, 2 operation at trace signal trigger	[Ud-53] [Ud-57]	00	Record the trace data when the signal is ON.
		01	Record the trace data when the signal is OFF.
Trigger condition selection	[Ud-58]	00	Record the trace data when trigger 1 is satisfied.
		01	Record the trace data when trigger 2 is satisfied.
		02	Record when either of trigger 1 or 2 is satisfied.
		03	Record when both triggers 1 and 2 are satisfied.
Trigger point setting	[Ud-59]	0~100 (%)	Determine the trigger point for recording trace data.
Sampling time setting	[Ud-60]	01~10	Obtain data at the set intervals. 01 (0.2ms), 02 (0.5ms), 03 (1ms), 04 (2ms), 05 (5ms), 06 (10ms), 07 (50ms), 08 (100ms), 09 (500ms), 10 (1,000ms)
Input terminal function	[CA-01]~[CA-11]	108	DTR: Data trace starting signal
Output terminal function	[CC-01]~[CC-07]	078	WFT: Trace function trigger stand-by signal
	[CC-01]~[CC-07]	079	TRA: Trace function during-tracing signal

■Trace target data

• Set the following monitor parameters to the trace data 0 to 7 selection ([Ud-10] to [Ud-17]).

<table>
<tr><th>Parameter No. and Name</th><th>Data Size (bytes)</th></tr>
<tr><td>dA-01 (Output frequency monitor)</td><td>4</td></tr>
<tr><td>dA-02 (Output current monitor)</td><td>2</td></tr>
<tr><td>dA-04 (Frequency command (after calculation))</td><td rowspan="4">4</td></tr>
<tr><td>dA-08 (Speed detection value monitor)</td></tr>
<tr><td>dA-12 (Output frequency monitor (with sign))</td></tr>
<tr><td>dA-14 (Frequency upper limit monitor)</td></tr>
<tr><td>dA-15 (Torque command monitor (after calculation))</td><td rowspan="2">2</td></tr>
<tr><td>dA-16 (Torque limit monitor)</td></tr>
<tr><td>dA-17 (Output torque monitor)</td><td rowspan="2">4</td></tr>
<tr><td>dA-18 (Output voltage monitor)</td></tr>
<tr><td>dA-30 (Input power monitor)</td><td rowspan="15">2</td></tr>
<tr><td>dA-34 (Output power monitor)</td></tr>
<tr><td>dA-38 (Motor temperature monitor)</td></tr>
<tr><td>dA-40 (DC voltage monitor)</td></tr>
<tr><td>dA-41 (DBTR load factor monitor)</td></tr>
<tr><td>dA-42 (Electronic thermal load factor monitor (MTR))</td></tr>
<tr><td>dA-43 (Electronic thermal load factor monitor (CTL))</td></tr>
<tr><td>dA-61 (Analog input [VRF] monitor)</td></tr>
<tr><td>dA-62 (Analog input [IRF] monitor)</td></tr>
<tr><td>dA-63 (Analog input [VF2] monitor)</td></tr>
<tr><td>dA-64 (Extended analog input [Ai4] monitor)</td></tr>
<tr><td>dA-65 (Extended analog input [Ai5] monitor)</td></tr>
<tr><td>dA-66 (Extended analog input [Ai6] monitor)</td></tr>
<tr><td>dA-70 (Pulse train input monitor (main body))</td></tr>
<tr><td>dA-71 (Pulse train input monitor (option))</td></tr>
<tr><td>db-01～db-23（Reserved）</td><td>-</td></tr>
<tr><td>db-30 (PID1 feedback data 1 monitor)</td><td rowspan="3">4</td></tr>
<tr><td>db-32 (PID1 feedback data 2 monitor)</td></tr>
<tr><td>db-34 (PID1 feedback data 3 monitor)</td></tr>
</table>

<table>
<tr><th>Parameter No. and Name</th><th>Data Size (bytes)</th></tr>
<tr><td>db-36 (PID2 feedback data monitor)</td><td rowspan="5">4</td></tr>
<tr><td>db-38 (PID3 feedback data monitor)</td></tr>
<tr><td>db-40 (PID4 feedback data monitor)</td></tr>
<tr><td>db-42 (PID1 target value monitor (after computing))</td></tr>
<tr><td>db-44 (PID1 feedback data monitor (after computing))</td></tr>
<tr><td>db-50 (PID1 output monitor)</td><td rowspan="11">2</td></tr>
<tr><td>db-51 (PID1 deviation monitor)</td></tr>
<tr><td>db-52 (PID1 deviation 1 monitor)</td></tr>
<tr><td>db-53 (PID1 deviation 2 monitor)</td></tr>
<tr><td>db-54 (PID1 deviation 3 monitor)</td></tr>
<tr><td>db-55 (PID2 output monitor)</td></tr>
<tr><td>db-56 (PID2 deviation monitor)</td></tr>
<tr><td>db-57 (PID3 output monitor)</td></tr>
<tr><td>db-58 (PID3 deviation monitor)</td></tr>
<tr><td>db-59 (PID4 output monitor)</td></tr>
<tr><td>db-60 (PID4 deviation monitor)</td></tr>
<tr><td>db-64 (PID feed forward monitor)</td><td>4</td></tr>
<tr><td>dC-15 (Cooling fin temperature monitor)</td><td>2</td></tr>
<tr><td>FA-01 (Main speed command (monitor + setting))</td><td rowspan="2">4</td></tr>
<tr><td>FA-02 (Auxiliary speed command (monitor + setting))</td></tr>
<tr><td>FA-15 (Torque command monitor (monitor + setting))</td><td rowspan="2">2</td></tr>
<tr><td>FA-16 (Torque bias monitor (monitor + setting))</td></tr>
<tr><td>FA-30 (PID1 target value 1 (monitor + setting))</td><td rowspan="6">4</td></tr>
<tr><td>FA-32 (PID1 target value 2 (monitor + setting))</td></tr>
<tr><td>FA-34 (PID1 target value 3 (monitor + setting))</td></tr>
<tr><td>FA-36 (PID2 target value (monitor + setting))</td></tr>
<tr><td>FA-38 (PID3 target value (monitor + setting))</td></tr>
<tr><td>FA-40 (PID4 target value (monitor + setting))</td></tr>
</table>

■Data tracing time

• Data tracing time varies depending on the sampling time setting [Ud-60], the number of trace data [Ud-03], the number of trace signals [Ud-04], and data size of monitor parameters to be traced.

No. of Trace Data [Ud-03]	Data Tracing Time *1) *2)			
	Sampling time [Ud-60]: 01 (0.2ms) (Min.)		Sampling time [Ud-60]: 10 (1,000ms) (Max.)	
	If all are 4-byte data,	If all are 2-byte data,	If all are 4-byte data,	If all are 2-byte data,
1	344ms (1,724 points)	576ms (2,880 points)	1,724s (1,724 points)	2,880s (2,880 points)
2	190ms (953 points)	344ms (1,724 points)	953s (953 points)	1,724s (1,724 points)
3	131ms (656 points)	245ms (1,228 points)	656s (656 points)	1,228s (1,228 points)
4	100ms (500 points)	190ms (953 points)	500s (500 points)	953s (953 points)
5	80ms (402 points)	155ms (778 points)	402s (402 points)	778s (778 points)
6	67ms (336 points)	131ms (656 points)	336s (336 points)	656s (656 points)
7	57ms (288 points)	113ms (568 points)	288s (288 points)	568s (568 points)
8	50ms (252 points)	100ms (500 points)	252s (252 points)	500s (500 points)

*1) For cases when the number of trace signals other than 0 is selected for [Ud-04].
*2) "Points" in parentheses indicate the number of sampling points.

Chapter 17 Connection with PLC

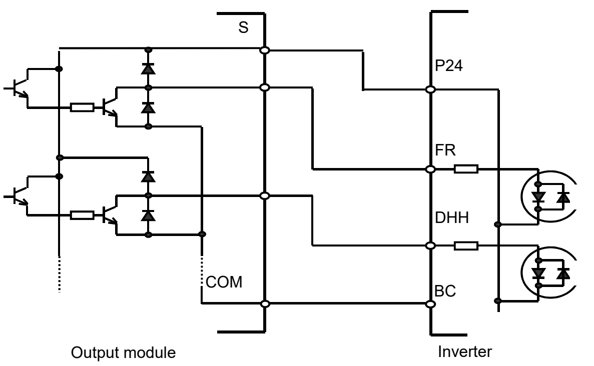
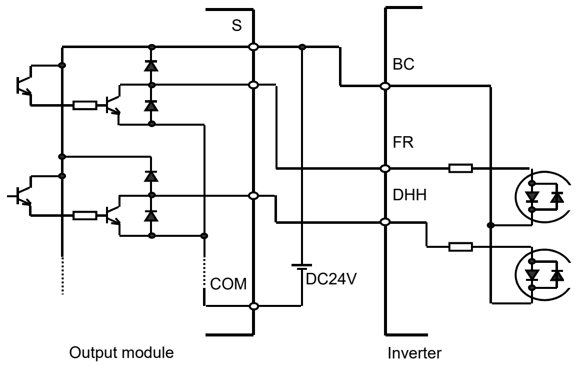
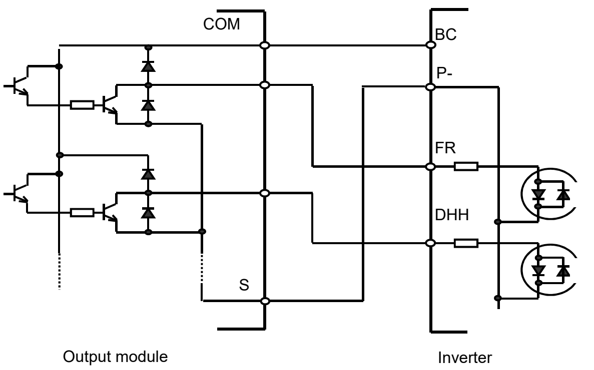
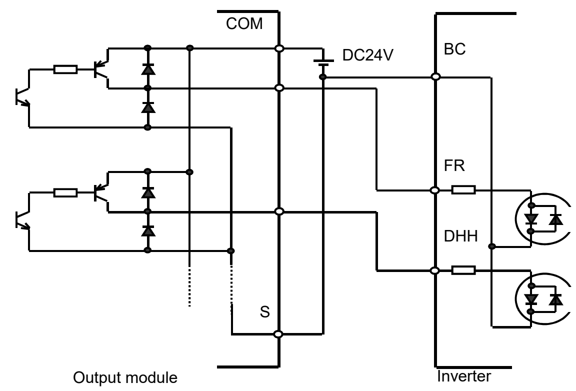
17

17.1 What This Chapter Explains

This chapter describes the method for connecting the inverter with a programmable logic controller (PLC). Perform connection in accordance with the guidance given hereunder. Incorrect wiring may result in unexpected operations and breakage of the inverter and PLC.
Furthermore, make sure to carefully read “Chapter 1 Safety Instructions/Risks” for safety work.

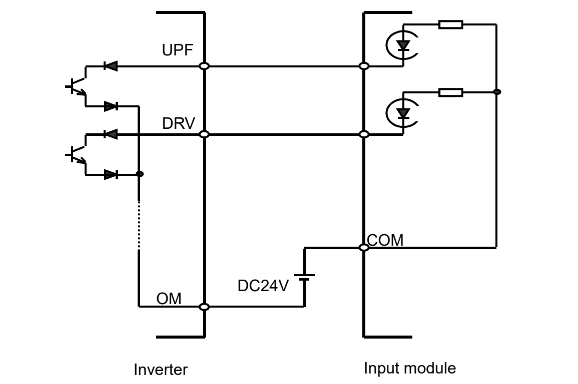
17.2 Connection with PLC

（1）Connecting input terminals to a programmable logic controller

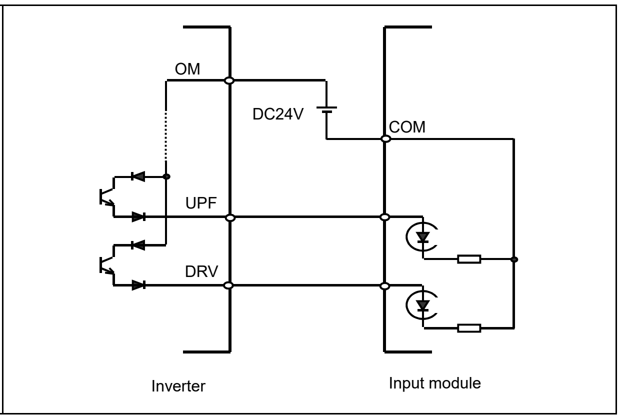
	With the power supply for interface within inverter(Slide SW5 to IN.) EX SW5 IN	With an external power supply (Slide SW5 to EX.) EX SW5 IN
Sink logic (Slide SW6 to SINK.) SRC SW6 SINK		
Source logic (Slide SW6 to SRC.) SRC SW6 SINK		

（2）Connecting output terminals to a programmable logic controller

Sink logic



Source logic



Chapter 18 Troubleshooting

18

18.1 What This Chapter Explains

This chapter provides troubleshooting information for protection-function related errors, warning-function related warnings, and “When something seems wrong”.

18.2 Self Diagnosis of Problems

An error occurred and the inverter tripped.

You are stuck although no error appears.

An error appears.
Chapter 18-5 “18.4 Troubleshooting for Protection-function Related Errors”

A warning is issued.
Chapter 18-28 “18.5 Troubleshooting for Warning -function Related Errors”

The inverter doesn’t work properly.
Chapter 18-37 “When something seems wrong”

The problem cannot be solved.

Contact our sales personnel, or your supplier.

Before making an inquiry, please check the information shown on the right and have them ready.
(1) Inverter model
(2) Manufacturing number (MFG No.)
(3) Date of purchase
(4) Content of the inquiry

18.3 Checking Error Information

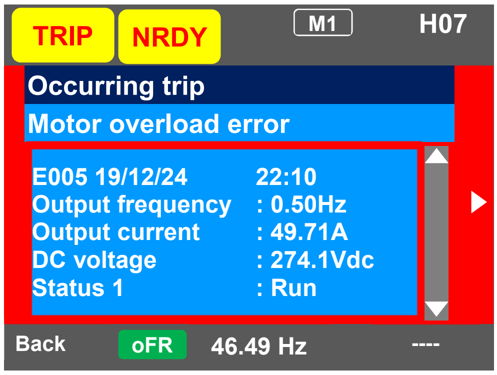
18.3.1 Checking trip information

- Up to 10 trips in the past is displayed as the trip history.
- The latest trip history is displayed on the trip monitor 1.

- The following data items are displayed on the monitor:

1) Error factor for trip
2) Output frequency (Hz) at trip
3) Output current (A) at trip
4) Main circuit DC voltage (V) at trip
5) Operation state at trip
6) Cumulative inverter operating time (h) before trip
7) Cumulative inverter power-on time (h) before trip

■Display of occurring trip



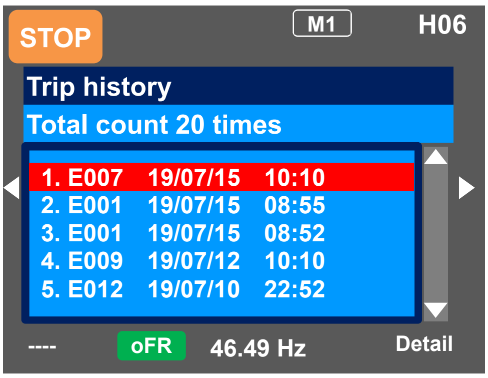
- The information of the moment of error occurrence may not be fetched properly if the inverter is forcibly turned OFF by its hardware.
- Values of respective data items may be reset to 0 when an error occurred and the inverter entered the trip condition.
- For a ground fault or a momentary overcurrent event, the current may be recorded in a value lower than the actual value.
- The trip monitor and the trip count monitor can be cleared by initialization of the trip history.

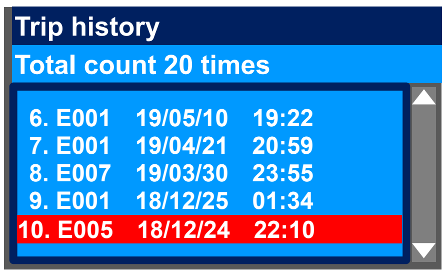
■Parameters

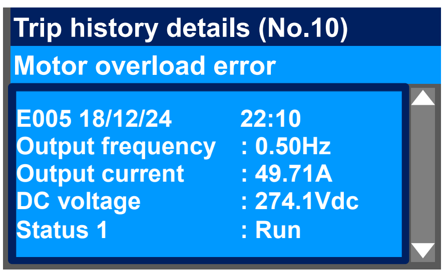
Item	Parameter	Data	Description
Trip monitor 1 to 10	Detailed monitor	See above data items.	On the parameter monitor, you can view data items 1) to 7) in sequence by UP/DOWN keys.
Trip count monitor	Detailed monitor	0 - 65535 (Counts)	Trip count data is stored in the inverter.

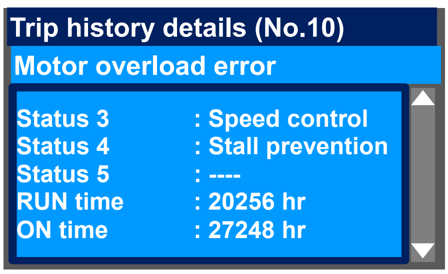
■"Detailed monitor" for checking the history

- You can look through the history with the arrow keys.









18.3.2 Checking retry information

- The last 9 retry histories are displayed.
- The latest retry history is displayed on the retry monitor 1.

- The following data items are displayed on the monitor:

1) Error factor for retry
2) Output frequency (Hz) at retry
3) Output current (A) at retry
4) Main circuit DC voltage (V) at retry
5) Operation state at retry
6) Cumulative inverter operating time (h) before retry
7) Cumulative inverter power-on time (h) before retry

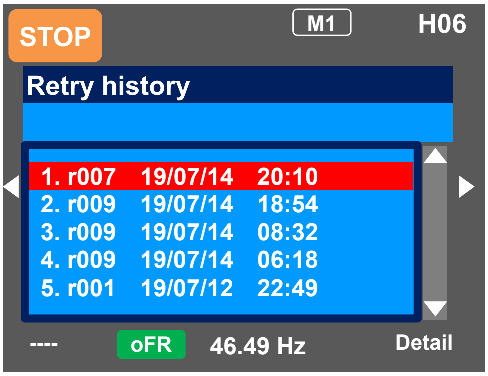
- While a retry is underway, the inverter tries to continue running. For a trip after a retry, the trip information is recorded on the trip history.
- The information of the moment of error occurrence may not be fetched properly if the inverter is forcibly turned OFF by its hardware.
- For a momentary overcurrent event, the current may be recorded in a value lower than the actual value.

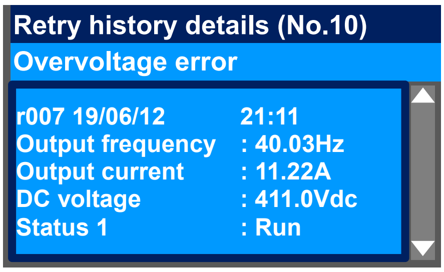
■Parameter

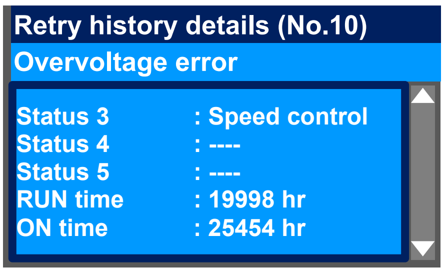
Item	Parameter	Data	Description
Retry monitor 1 to 10	Detailed monitor 2	See above data items.	On the parameter monitor, you can view data items 1) to 7) in sequence by UP/DOWN keys.

■"Detailed monitor 2" for checking the history

- You can look through the history with the arrow keys.







18.4 Troubleshooting for Protection-function Related Errors

- You need to take a measure according to the error number and the type of error.
  Refer to the explanation pages shown in the table below.

Error No.	Error Name	Explanation Page
E001	Overcurrent error	18-6
E005	Motor overload error *2)	18-7
E006	Braking resistor overload error	18-8
E007	Overvoltage error	18-9
E008	Memory error	
E009	Under voltage error	18-10
E010	Current detector error *1)	
E011	CPU error *1)	18-11
E012	External trip error	
E013	USP error	
E014	Ground fault error *1)	18-12
E015	Incoming overvoltage error	
E016	Instantaneous power failure error	
E019	Temperature detector error *1)	18-13
E020	Cooling fan rotation speed reduction temperature error *1)	
E021	Temperature error	
E024	Input open-phase error	18-14
E030	IGBT error	
E034	Output open-phase error	18-15
E035	Thermistor error	
E036	Brake error	
E038	Low-speed range overload error	18-16
E039	Inverter overload error *2)	
E040	Operator keypad disconnection error	18-17
E041	RS485 communication error	
E042	RTC error	

*1) When a serious fault error occurred, it cannot be released by a reset operation.
*2) When a controller overload error occurred, or a motor overload error occurred in the condition that [bC112] had been set to 00, the inverter does not accept a reset input for 10 s. Wait for a while before performing a reset operation.

Error No.	Error Name	Explanation Page
E060	Option 1 error 0	18-17
E061	Option 1 error 1	
E062	Option 1 error 2	
E063	Option 1 error 3	
E064	Option 1 error 4	
E065	Option 1 error 5	
E066	Option 1 error 6	
E067	Option 1 error 7	
E068	Option 1 error 8	
E069	Option 1 error 9	
E070	Option 2 error 0	18-18
E071	Option 2 error 1	
E072	Option 2 error 2	
E073	Option 2 error 3	
E074	Option 2 error 4	
E075	Option 2 error 5	
E076	Option 2 error 6	
E077	Option 2 error 7	
E078	Option 2 error 8	
E079	Option 2 error 9	
E080	Option 3 error 0	
E081	Option 3 error 1	
E082	Option 3 error 2	
E083	Option 3 error 3	
E084	Option 3 error 4	
E085	Option 3 error 5	
E086	Option 3 error 6	
E087	Option 3 error 7	
E088	Option 3 error 8	
E089	Option 3 error 9	
E090	STO shutoff error	
E091	STO internal error	
E092	STO path 1 error	
E093	STO path 2 error	
E094	FS option internal error	
E095	FS option path 1 error	
E096	FS option path 2 error	
E097	FS option connection error	
E100	Encoder disconnection error	
E104	Position control range error	18-19
E105	Speed deviation error	
E106	Position deviation error	18-20
E107	Over-speed error	
E110	Contactor error	
E112	FB option connection error	

E001 Overcurrent error

A large current flowing in the inverter results in a failure. To prevent this, the inverter turns OFF its output. By setting the parameter, you can perform retries for a fixed number of times without generating an error. Overcurrent level can be set in the [bb160].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred abruptly during operation.	• A steep load change occurred.	• [bA120] Overcurrent suppression function and [bA122] Stall prevention function are effective to suppress overcurrent. • When the vector control is used, the situation may be improved by adjusting the response to control in [HA115].
	• Hunting of motor	• The situation may be improved by setting the IM motor capacity in [Hb102], the number of IM poles in [Hb103], or the auto-tuning selection in [HA-01]. • The situation may be improved by adjusting stabilization control gain in [HA110].
Error occurred during acceleration.	• Insufficient acceleration time • Insufficient acceleration torque • Load inertia is large. • Friction torque is large.	• Setting longer acceleration time in [FA-10] can ease the insufficient acceleration torque. • When acceleration torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and making adjustments with control method in [AA121]. • Re-examination of load condition may improve the situation.
Error occurred during deceleration.	• Insufficient deceleration time • Insufficient regenerative torque • Load inertia is large.	• Setting longer deceleration time in [FA-12] can ease the insufficient regenerative torque. • When regenerative torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and making adjustments with control method in [AA121].
Error occurred right after an operation command input.	• A ground fault has occurred. • Output line is short-circuited or in open phase. • Output element failure	• The inverter may be broken if the error persists even when the power of inverter only is turned ON again after the power was turned OFF and the output line to the motor was removed. • If the issue is solved when the output line to the motor is removed, you need to check the wiring and/or motor.
	• Motor is locked. • Load inertia is large.	• Error may occur when the motor rotation is locked. • The situation may be improved by taking a measure for the case "Error occurred during acceleration".
Error occurred right after power was turned ON.	• Output element failure • Current detector failure	• Failure output element or current detector may be the cause. An investigation and repair are required.
Error occurred after long hours of use.	• System environment changes	• The situation may be improved by reducing the motor load, or performing a system maintenance (e.g., cleaning the fan to be driven and removing clogging in the duct).
	• Aging deterioration	• If the issue is not solved by reduction of the load and system maintenance, aging deterioration of a life-limited component may be the cause. A repair is required.

E005 Motor overload error

The built-in electronic thermal function monitors the output current of the inverter and when a motor overload is detected, the inverter turns OFF its output. The inverter trips according to the setting of the motor electronic thermal function.
When a motor overload error occurred, the inverter does not accept a reset input for 10 seconds.

Occurrence	Estimated cause(s)	Exemplar measures to be taken
Error occurred after a fixed period of operation.	• Operation under heavy load condition has continued.	• Re-examination of operation condition or correction of load condition may improve the situation.
	• Thermal level is set high.	• When the motor thermal level setting in [bC110] is not appropriate, re-examination of the setting may improve the situation.
Error occurred during acceleration.	• Insufficient acceleration torque • Load inertia is large. • Friction torque is large.	• Setting longer acceleration time in [FA-10] can ease the insufficient acceleration torque. • When acceleration torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and making adjustments with control method in [AA121].
	• A function to suppress overcurrent is at work.	• A factor for overcurrent may have been occurred. Re-examination of acceleration time or load condition is required.
Error occurred during deceleration.	• Load inertia is large.	• Setting longer deceleration time in [FA-12] can ease the insufficient regenerative torque. • When regenerative torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and adjusting with control method in [AA121]. • Re-examination of load condition may improve the situation.
	• A function to suppress overvoltage is at work.	• Current may increase as a result of suppressing overvoltage. Re-examination of deceleration time or load condition in [FA-12] is required.
Error occurred after long hours of use.	• System environment changes	• The situation may be improved by reducing the motor load, or performing a system maintenance (e.g., cleaning the fan to be driven and removing clogging in the duct).
	• Aging deterioration	• If the issue is not solved by reduction of the load and system maintenance, aging deterioration of a life-limited component may be the cause. A repair is required.

E006 Braking resistor overload error

When the use rate of inverter's braking resistor operation circuit (BRD) exceeds the use rate set beforehand in [bA-60], the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during deceleration.	• Insufficient deceleration time • Load inertia is large. • Capacity of braking resistor is small.	• Setting longer deceleration time in [FA-12] may improve the situation that the motor is rapidly decelerated. If deceleration time cannot be shortened, choice of resistor must be re-examined.
Error occurred during operation.	• Continuous regenerative operation • Capacity of braking resistor is small.	• The resistor may not be able to fully consume the power because the regenerative power returned from the motor is high. Load condition or choice of resistor must be re-examined.
	• Rotated by external force.	• The resistor may not be able to fully consume the power because the fan is rotated by a strong wind, or because the regenerative power returned from the motor increases when loads are lowered by a crane or the like. Load condition or choice of resistor must be re-examined.
Error occurred during repetitive operations.	• Repetition cycle of operation is high.	• Reduction of repetition cycle of operation may improve the situation. Adjustment of deceleration time in [FA-12] and re-examination of choice of resistor may also improve the situation.

E007 Overvoltage error

Too high P-N voltage results in a failure. To prevent this, the inverter turns OFF its output. When P-N voltage exceeds approx. 410Vdc (200V class) or approx. 820Vdc (400V class), the output is turned OFF. By setting the parameter, you can perform retries for a fixed number of times without generating an error.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during deceleration.	• Insufficient deceleration time • Load inertia is large.	• Setting longer deceleration time in [FA-12] may improve the situation that the motor is rapidly decelerated. If deceleration time cannot be shortened, you need to re-examine load condition, enable overvoltage suppression function in [bA140] and [bA146], or use a braking resistor, braking unit, or regenerative converter.
Error occurred during operation.	• Load inertia is large.	• If load inertia is large, high regenerative power returns from the motor; hence an overvoltage is likely to occur. You need to re-examine load condition, enable overvoltage suppression function in [bA140] and [bA146], or use a braking resistor, braking unit, or regenerative converter.
	• Rotated by external force (fan, crane).	• An overvoltage is likely to occur if motor rotation speed exceeds the output frequency (rotation speed) of inverter. You need to re-examine load condition, enable overvoltage suppression function in [bA140] and [bA146], or use a braking resistor, braking unit, or regenerative converter.
Error occurred during stop.	• Abnormality of PS voltage	• Power supply voltage may be raised or fluctuated. Re-examination of power supply environment or use of an AC reactor may improve the situation.
Error occurred during drooping control	• Mutual interference caused by 2 inverters trying to control motors strictly.	• When 2 motors driving a same shaft are controlled by 2 inverters, both the inverters attempt to generate torques, which may result in control divergence. The situation may be improved by setting one of the inverters to P control. See "12.11.3 Perform Drooping Control".

E008 Memory error

If the built-in memory has problems, the inverter turns OFF its output. CPU error may be issued instead.
The inverter recovers by re-turning ON the power; however, you need to check that there is no problem in parameters. The data which has been backed up on the operator keypad beforehand may be restored.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred some time after the power was turned ON.	• Noise is mixed.	• A physical countermeasure such as placing a shielding plate may be required to avoid external noises.
Power has been unintentionally turned OFF before.	• Power-off during memory access	• You need to restore the data by using the data which has been backed up on the operator keypad beforehand. If the data cannot be restored, initialization is required. See “12.2.2 Initialization of inverter”. If the data cannot be restored by initialization, a repair is required.

E009 Under voltage error

A decrease of the main power supply of inverter results in a circuit breakage.
To prevent this, the inverter turns OFF its output. When P-N voltage falls below approx. 160Vdc (200V class) or approx. 320VDC (400V class), the output is turned OFF. By setting the parameter, you can perform retries for a fixed number of times without generating an error. Furthermore, under voltage error during stop can be disabled by setting.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
There was a power failure.	• PS voltage decreased.	• If the internal power supply hasn't been fully turned OFF, it is possible to re-start the inverter after the power supply is recovered, by setting the retry function while it is still on.
Error occurred with the start of operation.	• PS voltage decreased. • PS capacity is insufficient.	• When power supply voltage decreases or power supply capacity is insufficient, re-examination of power supply environment is required.
The inverter doesn't start.	• PS voltage is insufficient.	• Perform power supplying in accordance with the inverter voltage class.
Error occurred after long hours of use.	• System environment changes • Capacitor deterioration • Circuit failure	• If an under voltage occurs frequently, the inverter may have reached its end of life or be broken down. A repair is required.

E010 Current detector error

If the built-in current detector has problems, the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after power was turned ON.	• Current detector circuit is broken.	• If the error recurs after a reset operation, the current detector circuit may be broken down. A repair is required.
	• A noise source is nearby.	• When there is a noise source nearby, the situation may be improved by taking a noise countermeasure such as keeping the noise source away or placing a shielding plate.
Error occurred after long hours of use.	• Current detector circuit is broken.	• If the error recurs after a reset operation, the current detector circuit may be broken down. A repair is required.

E011 CPU error

When a malfunction or problem occurs in the built-in CPU, the inverter turns OFF its output and then displays the error.
If the inverter doesn't recover by re-turning ON the power, the CPU is likely to be broken.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred abruptly.	• The internal CPU is broken.	• The inverter may recover by a reset operation, re-turning ON the power, or initialization operation. When the inverter recovered, an initialization must be executed. • If the inverter doesn't recover, the CPU may be broken down. A repair is required.
	• A noise source is nearby.	• Where there is a noise source nearby, the situation may be improved by taking a noise countermeasure such as keeping the noise source away or placing a shielding plate.
Error occurred during data writing.	• Data is inconsistent.	• The inverter may recover by a reset operation, re-turning ON the power, or initialization operation. When the inverter recovered, an initialization must be executed. See "12.2.2 Initialization of inverter".

E012 External trip error

When the inverter accepted a signal commanded by an external device or equipment, the inverter turns OFF its output. (When external trip function is selected.)

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred unintentionally.	• Terminal logics are reversed. • Wiring is wrong.	• You need to check the state of operations related to external devices or external equipment, and re-examine the assignment of external trip terminal to the inverter input terminal, the setting of a/b contact, the external trip command via communication, etc. • A/b contact of terminal can be changed by inverter setting.

E013 USP error

This error occurs if an operation command has been input to the inverter when the power supply is turned ON.
Operation command detection is carried out for 1 second after the power supply is turned ON.
(When USP function is selected.)

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred unintentionally.	• Operation command was entered too early.	• Re-examination of the sequence to enter operation command is required. You need to wait for 2 seconds or longer to enter operation command after turning ON the power supply.
	• Operation command isn't released.	• You need to release an operation command when turning ON the power supply.
	• You tried to operate with commands other than terminal commands.	• When USP is enabled, commands of the operator keypad and communication commands are treated as errors. You need to wait for 2 seconds or longer to enter operation command after turning ON the power supply.

E014 Ground fault error

This is a function to protect the inverter by the detection of ground faults between the inverter output and the motor at power-on.
The function doesn't work when there is a voltage induced in the motor due to idling or when the inverter trips.
When the control circuit power (r1, t1, or 24V power supply) has been turned ON prior to the main circuit power R, S, or T, the function is activated at the time the main circuit power is turned ON.

Setting the ground fault detection selection [bb-64] to 00 disables the ground fault function. Setting it to 01 enables the function.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred as the power supply was turned ON.	• Ground faults of wires or the motor • Motor insulation deterioration	• Turn OFF the power, remove the wires connected to the motor, and then check the motor and the wires. A ground fault may have been occurred. • Turning ON the power supply in a ground fault state results in a failure. Do not turn ON the power when you check the motor and motor wires.

E015 Incoming over voltage error

This error occurs if high incoming voltage level is held for 100 seconds continuously while the inverter output is stopped when incoming overvoltage level [bb-61] is set to 01. It occurs when the P-N voltage exceeds the voltage level set in the incoming overvoltage level selection [bb-62] due to incoming voltage.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after power was turned ON.	• Incoming voltage is high.	• Re-examination of the power supply environment is required.
Error occurred after long hours of use.	• Power supply has become unstable.	• The power supply environment may have been changed due to facility replacement or the like. Re-examination of the power supply environment is required.

E016 Instantaneous power failure error

At the time of an instantaneous power failure, the inverter turns OFF its output. If the power failure continues, the event is regarded as a normal power-off.
Decrease in the main power R, S, or T generates this error. Decrease in the voltage of control circuit power supply r1 or t1 doesn't generate the error if the J51 connector has been removed and the r1 and t1 are input via a separate system.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after long hours of use.	• PS voltage decreased.	• If the power is turned OFF due to an external factor such as power failure, the inverter can be restarted by using the retry function when the power is restored.
	• There was a contact fault in circuit breaker.	• Failure of magnetic contactor or earth-leakage breaker may be the cause. Although the inverter may recover, a repair is required.
Error occurred with the start of operation.	• PS voltage decreased.	• If an instantaneous power failure hasn't occurred, insufficient capacity of power supply may be the cause. Re-examination of the power supply environment is required.

E019 Temperature detector error

This error occurs if there is a problem in the temperature detector circuit such as disconnection.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after use.	• The temperature detector circuit is disconnected or broken down.	• The temperature detector circuit is broken down. A repair is required.

E020 Cooling fan rotation speed reduction error

If the temperature of inverter gets high due to deterioration of cooling ability resulted from decrease in fan rotation speed, the inverter turns OFF its output. Refer to E021 also.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Cooling fan stopped.	• A foreign object is stuck.	• If there is a foreign object stuck in the fan, the inverter may recover by removing it.
	• It is the end of cooling fan life.	• The cooling fan needs to be replaced.
The cooling fan is working.	• Cooling fan is approaching the end of its life.	• The cooling ability has been deteriorated. The cooling fan needs to be replaced.

E021 Temperature error

When the temperature of inverter gets high, the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during operation.	• Carrier frequency is high.	• The higher the carrier frequency is, the more the temperature inside the inverter tends to increase. Lower the carrier frequency setting.
	• There is clogging in the fin.	• The cooling ability is deteriorated. Cleaning the fin may improve the situation.
	• Used in high temperature environment. • Cooling of the surroundings is insufficient..	• Enhancing the use environment or cooling environment may improve the situation.
	• The formal installation condition is not satisfied.	• Improper installation of the inverter may results in the inverter failure. Install the inverter properly in accordance with the instruction manual.
Error occurred during stop.	• The temperature detector circuit broke down.	• The temperature detector circuit is broken down if the error is generated consecutively even after a reset. A repair is required.

E024 Input open-phase error

When [bb-65] input phase loss selection is set to 01, when a missing phase is detected in input line, the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after power was turned ON.	• An input line or the motor has a loose connection or is disconnected.	• You need to turn OFF the power supply and check the input lines and the wiring condition of breaker. This error may also occur due to PS voltage defect, contact defect, screw tightening failure, etc.
	• Single-phase input is used.	• For input lines, use three-phase connection.
Error occurred after long hours of use.	• An input line or breaker has a loose connection or is disconnected.	• The situation may be improved by mending loose connections due to loosening of screws or the breaker problems.

E030 IGBT error

At the time of an instantaneous overcurrent or the main element failure, the inverter turns OFF its output to protect the main element.

Overcurrent error may be issued instead.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred right after the operation started.	• A ground fault has occurred. • Output line is short-circuited.	• After the power is turned OFF, you need to check the wires connected to the motor, motor disconnection, and the like. If the error occurs after removal of the motor wires, the inverter is broken down. It needs to be repaired.
	• Motor rotation is locked.	• A large current may flow when the motor rotation is locked during operation. The cause needs to be removed.
	• Output element is broken down.	• If output element is broken down, it needs to be repaired.
Error occurred right after power was turned ON.	• Output element is broken down.	• If output element is broken down, it needs to be repaired.
Error occurred during operation.	• Motor rotation is locked.	• A large current may flow when the motor rotation is locked during operation. The cause needs to be removed.

E034 Output open-phase error

When the output phase loss selection [bb-66] is set to 01, when a loose connection or disconnection of output line, disconnection inside the motor, etc. is detected, the inverter turns OFF its output. Detection of phase loss state is executed in the section between 5Hz to 100Hz.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred right after the operation started.	• An output line or the motor has a loose connection or is disconnected.	• You need to turn OFF the power supply and check the output lines and the wiring condition of motor. This error can also occur due to motor insulation breakdown or screw tightening failure.
	• Single-phase output is used.	• For output lines, use three-phase connection.
Error occurred after long hours of operation.	• An output line or the motor has a loose connection or is disconnected.	• You need to turn OFF the power supply and check the output lines and the wiring condition of motor. If there is a loosened screw, the situation may be improved by re-tightening the screw.

E035 Thermistor error

If an abnormal temperature is observed during detection of resistor level change in an external thermistor, the inverter turns OFF its output. (When thermistor function is enabled.)

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Motor is heated.	• The motor hasn't been cooled sufficiently.	• The cooling environment needs to be improved.
	• Heavy load has been applied for a long time.	• The motor's driving environment needs to be re-examined.
Motor is not heated.	• Inadequate thermistor function setting	• Re-examination of the thermistor function setting may improve the situation.
	• The thermistor is broken down.	• The thermistor needs to be repaired.
	• Malfunction due to noise	• The situation may be improved by taking a noise countermeasure such as wiring separation.

E036 Brake error

This error occurs when the inverter cannot detect whether the brake check signal is ON or OFF during waiting time after the inverter has output a brake releasing signal. (When brake function is enabled.)

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after operation.	• Disconnection of signal line.	• Check the wiring of brake check signal and whether the signal is ON or OFF.
	• Brake function setting	• The situation may be improved by re-examination of brake check waiting time or input terminal logics according to the sequence of the signal.

E038 Low-speed range overload error

This error occurs to protect the main element if the inverter has output at a low frequency of 0.2Hz or below. When such a low frequency is detected by the built-in electronic thermal function, the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during output at low speed.	• The motor load is heavy.	• Load at low-speed range needs to be reduced. If the error occurs frequently, you need to select an inverter with a capacity large enough for the motor.

E039 Inverter overload error

The built-in electronic thermal function monitors the output current of the inverter and when inverter overload is detected, the inverter turns OFF its output.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after a fixed period of operation.	• Operation under heavy load condition has continued.	• Re-examination of operation condition or correction of load condition may improve the situation.
Error occurred during acceleration.	• Insufficient acceleration torque • Load inertia is large. • Friction torque is large.	• Setting longer acceleration time in [FA-10] can ease the insufficient acceleration torque. • When acceleration torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and making adjustments with control method in [AA121].
	• A function to suppress overcurrent is at work.	• A factor for overcurrent may have been occurred. Re-examination of acceleration time or load condition is required.
Error occurred during deceleration.	• Load inertia is large.	• Insufficient rotation regeneration torque can be eased by setting longer deceleration time in [FA-12]. • When regenerative torque is required, the situation may be improved by adjusting the boost function in [Hb141], or by operating the inverter and adjusting with control method in [AA121].
	• A function to suppress overvoltage is at work.	• Current may increase as a result of suppressing overvoltage. Re-examination of deceleration time or load condition is required.
Error occurred after long hours of use.	• System environment changes	• The situation may be improved by reducing the motor load, or performing a system maintenance (e.g., cleaning the fan to be driven and removing clogging in the duct).
	• Aging deterioration	• If the issue is not solved by reduction of the load and system maintenance, aging deterioration of a life-limited component may be the cause. A repair is required.

E040 Operator keypad communication error

The inverter displays this error when timeout occurs because of a malfunction due to noises, loose connection or disconnection of circuit for communication with the operator keypad.
This error function can be enabled and disabled by setting of the operation selection at disconnection of operator keypad [UA-20].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after communication is started.	• Loose connection • Disconnection	• Check the wiring to see whether the connection is properly made.
	• Noise is mixed.	• The situation may be improved by taking a noise countermeasure such as wiring separation.

E041 RS485 communication error

The inverter displays this error only when timeout occurs because of a malfunction due to noises, loose connection or disconnection of circuit for RS485 communication (such as Modbus-RTU).
This error function can be enabled and disabled by setting of the communication error selection [CF-05].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred after communication is started.	• Loose connection • Disconnection	• Check the wiring to see whether or not the connection is properly made.
	• Noise is mixed.	• The situation may be improved by taking a noise countermeasure such as wiring separation.

E042 RTC error

The error is generated if the data of RTC incorporated in the operator keypad is returned to the initial data.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred at power-on.	• A battery in the operator runs out.	• Replacement of the battery and setting of the date solve the issue. The error occurs when the power supply is turned ON with a dead battery.

E060 to E069 Option 1 errors 0 to 9

Errors occurring in an option mounted in the option slot 1 (to the observer's left) are detected.
For details, refer to the instruction manual provided together with the option mounted.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred when an option is mounted.	• The option isn't securely mounted.	• The option may not be securely mounted. Check the mounting state.
	• The option is used in the wrong way.	• The type of error varies depending on options. For details, refer to the instruction manuals provided together with the respective options.

E070 to E079 Option 2 errors 0 to 9

Errors occurring in an option mounted in the option slot 2 (to the observer's center) are detected.
For details, refer to the instruction manual provided together with the option mounted.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred when an option is mounted.	• The option isn't securely mounted.	• The option may not be securely mounted. Check the mounting state.
	• The option is used in the wrong way.	• The type of error varies depending on options. For details, refer to the instruction manuals provided together with the respective options.

E080 to E089 Option 3 errors 0 to 9

Errors occurring in an option mounted in the option slot 3 (to the observer's right) are detected.
For details, refer to the instruction manual provided together with the option mounted.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred when an option is mounted.	• The option isn't securely mounted.	• The option may not be securely mounted. Check the mounting state.
	• The option is used in the wrong way.	• The type of error varies depending on options. For details, refer to the instruction manuals provided together with the respective options.

E090 to E096 STO path error, FS option error

This error is output when there is a problem in functional safety circuit path.
For details of E090 to E093, refer to the separate-volume "Functional Safety Guide". For details of E094 to E096, refer to the instruction manual provided together with the option P1-FS

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
The safety function is used.	• The safety function system has problems.	• Refer to the separate-volume "Functional Safety Guide" and "P1-FS Functional Safety Guide".

E100 Encoder disconnection error

This is an error related to feedback options.
For E100 (encoder disconnection error), see the HF-FB user's guide.

E104 Position control range error

When the current position counter exceeds the position control ranges for normal/reverse rotation in the setting of [AE-52] position range (normal) or [AE-54] position range (reverse), the inverter turns OFF its output and displays the error.

Related pages found herein: 12-17-26

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during operation.	• Recheck the setting of electronic gear.	• Re-examination of operation condition or correction of load condition may improve the situation.
	• A slip occurs due to improper encoder setting.	• Check the encoder mounting state. If any, re-examine factors for slipping.
	• Improper encoder setting	• Check the setting of encoder constant and the like.
	• Improper electronic gear setting	• Recheck the setting of electronic gear.

E105 Speed deviation error

When the deviation between the frequency command and the feedback speed exceeds the [bb-83] speed deviation error detection level setting, the inverter judges it as an error. If “01: Error" is specified for [bb-82] Operation for speed deviation error, the inverter turns ON the output terminal function 041 [DSE] with a speed deviation error, turns OFF the inverter output, and displays this error.

Related pages found herein: 12-16-11

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during operation.	• Recheck the setting of electronic gear.	• Re-examination of operation condition or correction of load condition may improve the situation.
	• A slip occurs due to improper encoder setting.	• Check the encoder mounting state. If any, re-examine factors for slipping.
	• Improper encoder setting	• Check the setting of encoder constant and the like.
	• Improper electronic gear setting	• Recheck the setting of electronic gear.

E106 Position deviation error

Related pages found herein: 12-17-18

When the [bb-87] abnormal position deviation time passes with the deviation of the position feedback against the position command exceeding the [bb-86] abnormal position deviation detection level, it is determined to be abnormal. When the behavior of the abnormal position deviation [bb-85] has been set to 01, the output terminal [PDD] is turned ON, the output is turned OFF, and the error is displayed.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during operation.	• Recheck the setting of electronic gear.	• Re-examination of operation condition or correction of load condition may improve the situation.
	• A slip occurs due to improper encoder setting.	• Check the encoder mounting state. If any, re-examine factors for slipping.
	• Improper encoder setting	• Check the setting of encoder constant and the like.
	• Improper electronic gear setting	• Recheck the setting of electronic gear.

E107 Over-speed error

Related pages found herein: 12-16-12

When the speed has exceeded [bb-80] Over-speed error detection level and [bb-81] Over-speed error detection time has elapsed, the output is turned OFF and the error is displayed.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Error occurred during operation.	• Recheck the setting of electronic gear.	• Re-examination of operation condition or correction of load condition may improve the situation.
	• Improper encoder setting	• Check the setting of encoder constant and the like.
	• Improper electronic gear setting	• Recheck the setting of electronic gear.

E110 Contactor error

Related pages found herein: 12-17-10

When an error occurs in the contactor sequence, the output is turned OFF.

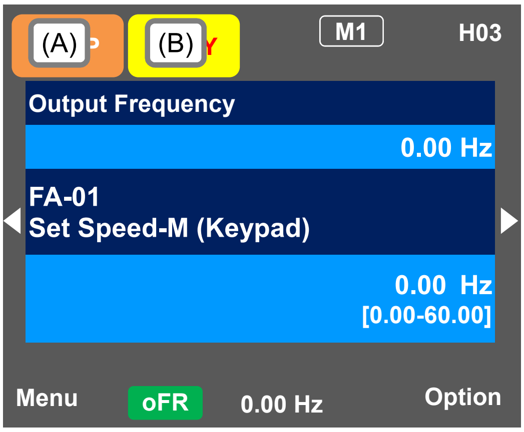
Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
[COK] was not turned ON within the contactor check time at start-up.	• Wiring defect	• Check the setting and wiring of intelligent input.
	• Contactor response defect	• Check the operation of contactor including its response time.
[COK] was not turned OFF within the contactor check time at stop.	• Wiring defect	• Check the setting and wiring of intelligent input.
	• Contactor response defect	• Check the operation of contactor including its response time.

E112 Feedback option connection error

This is an error related to feedback options.
For E112 (FB option connection error), see the HF-FB user's guide.

18.5 Troubleshooting for Warning-function Related Errors

18.5.1 Checking the warning display



Indication (A) Main Operating status display

No.	Indication	Description
A1	RUN FW	Icon shown during normal rotation operation. Some parameters cannot be changed while the inverter is running.
A2	RUN RV	Icon shown during reverse rotation operation. Some parameters cannot be changed while the inverter is running.
A3	RUN 0Hz	Icon shown during outputting under a zero-Hz command. It is also shown while DB, FOC, SON function is working. Some parameters cannot be changed while the inverter is running.
A4	TRIP	Icon shown when an error occurred and the inverter is in trip state. Releasable errors can be released by a reset operation. ⇒ 18.3.1 Checking trip information
A5	WARN	Icon shown when a setting inconsistency exists. Eliminate the inconsistency. ⇒ 18.5.2 Checking setting inconsistencies
A6	STOP	Icon shown while the inverter is forced stop by the following functions although operation command is entered. • An operation command was entered under 0Hz frequency command. • Operation command was entered from a source other than the operation keypad and the operation was stopped with STOP key on the operation keypad. • The inverter stops by instantaneous power failure non-stop function. RUN lamp flashes during this.
A7	STOP	Inverter is stopped because no operation command is given. The inverter cannot be operated if the stop terminal functions such as [RST] and [MBS] or the STO function is ON.

(Notes)
• When A6: STOP (in red) is indicated...

⇒ If the value shown in the indication (F): frequency command is 0.00Hz, the frequency command is 0Hz. Check whether a frequency command is entered or not.

⇒ For example, if the operation was stopped with STOP key while the inverter had been operated with [FR] terminal, turn OFF the [FR] terminal and then ON again to restart the operation.

Indication (B) Warning status display

No.	Indication	Description
B1	LIM	Icon shown while the following functions are working. [dC-37] • Under stall prevention. • Under torque limit. • Under overcurrent suppression. • Under overvoltage suppression. • Under upper/lower limit operation. • Under jump frequency operation. • Under minimum frequency limit.
B2	ALT	Icon shown while the following functions are working. [dC-38] • Overload advance notice • Motor thermal advance notice • Inverter thermal advance notice • Motor overheat advance notice
B3	RETRY	Icon shown during retry standby or restart standby. [dC-39]
B4	NRDY	The inverter cannot be operated even when the operation command is entered. [dC-40] • The main power is under insufficient voltage supply. • The inverter is operating only with 24V power supply. • Under reset operation. • The inverter is OFF as the [REN] terminal function is enabled.
B5	FAN	Icon shown in fan life advance notice state.
B6	C	Icon shown in on-board capacitor life advance notice state.
B7	F/C	Icon shown in fan life advance notice and on-board capacitor life advance notice state.
B8	(None)	A state other than those above.

(Notes)
- B1:LIM and B2:ALT are indicated when the current or internal voltage has increased.
  If an error is generated, re-examination of load or other factors is required.
- The above-mentioned indications are shown when the cooling fan or capacitor on the board is determined to have reached its product life.
- **You can see the detailed warning by pressing UP key on the three-lined monitor screen.**

■(STOP in red) appears.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
RUN key on the keypad was pressed. [FR] terminal was turned ON. Operation command was entered.	If LIM icon is lit, the command is below the minimum frequency and the following reasons are conceivable. • Operation command is entered but not frequency command. • Frequency command destination selection is wrong.	• Check that [FA-01] main speed command is not set to 0.00Hz. • Check whether the command is entered from the command destination indicated on the right of the main speed command [FA-01]. • Check [AA101] main speed command destination.
After STOP key on keypad is pressed, inverter doesn't operate with RUN key.	• STOP key on the operation keypad was pressed when the operation command had been entered from a source other than the operation keypad.	• Cancel the command entered to the operation command destination.
Instantaneous power failure occurred.	• The inverter stopped by the instantaneous power failure non-stop function [bA-30].	• To start operation, turn off the command entered to the operation command destination and turn on again.

■(WARN) appears.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
A setting was configured.	• There is an inconsistency in the parameter setting	• Refer to 18.5.2 "Checking setting inconsistencies".

■Icon 2 LIM monitor

- When LIM is shown, the inverter is in the following condition(s).
- You can see the status of LIM by pressing UP key on the three-lined monitor or on [dC-37].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Output current was high, and [dC-37] LIM was set to 01.	• [bA120] overcurrent suppression function was enabled and the current increased due to the load or other factors.	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel, re-examining the load)
	• The current was increased by the high ratio of motor rotation during DC braking that was caused by the selection of [DB] terminal or [AF101] DC braking.	• Reduce the DC braking force in [AF105] or [AF108]. • For stopping, set longer time for [AF106] DC braking delay time at the time of the stop. • For retry operation at the start, set longer delay time according to the factors. [bb-26] [bb-29] [bb-31]
	• [FA-10] acceleration time is too short.	• Make the acceleration time longer in [FA-10].
Output current was high, and [dC-37] LIM was set to 02.	• [bA122] overload limit function or similar function was enabled and the current increased due to the load or other factors.	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel, re-examining the load)
	• [bA122] overload limit function or similar function was enabled and [FA-10] acceleration time was too short.	• Make the acceleration time longer in [FA-10].
Error occurred during deceleration. [dC-37] LIM was set to 03.	• [bA140] overvoltage suppression function was enabled and P-N voltage increased due to regenerative load or the like.	• Remove the factor for the increased regenerative load. (E.g., by re-examining the state of the motor being rotated by external force, and by re-examining the load)
	• [bA122] overload limit function or similar function was enabled and [FA-12] deceleration time was too short.	• Make the deceleration time longer in [FA-12].
Error occurred during sudden acceleration. [dC-37] LIM was set to 03.	• [bA140] overvoltage suppression function was enabled and P-N voltage increased due to regenerative load or the like.	• Remove the factor for the increased regenerative load. (E.g., by re-examining the state of the motor being rotated by external force, and by re-examining the load)
Output current was high, and [dC-37] LIM was set to 04.	• [bA110] torque limit function or similar function was enabled and the current increased due to the load or other factors.	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel, re-examining the load)
	• [bA110] torque limit function or similar function was enabled and [FA-10] acceleration time was too short.	• Make the acceleration time longer in [FA-10].
Error occurred during operation. [dC-37] LIM was set to 05.	• The normal limiting was performed according to the settings of [bA102] upper limiter, [bA103] lower limiter, and [AG101] and other jump frequencies.	• Re-examine the settings of the upper/lower limiter or jump frequencies if necessary.
Error occurred during operation. [dC-37] LIM was set to 06.	• The frequency command at below the minimum frequency [Hb130] has been input.	• Set the frequency command at the minimum frequency or higher in [FA-01].

■Icon 2 ALT monitor
- When ALT is shown, the inverter is in the following condition(s).
- You can see the status of ALT by pressing UP key on the three-lined monitor or on [dC-38].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Output current was high, and [dC-38] ALT was set to 01.	• The current increased due to load or other factors, exceeding the overload pre warning levels set in [CE106] or the similar parameter.	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel) • Enable [bA122] stall prevention function or similar function.
Output current was high, and [dC-38] ALT was set to 02.	• The electronic thermal function of motor was activated due to increase in current and the load exceeded the electronic thermal warning level (MTR) set in [CE-30].	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel) • Re-examine the electric thermal settings in [bC110] or the similar parameter.
Output current was high, and [dC-38] ALT was set to 03.	• The electronic thermal function of inverter was activated due to increase in current and the load exceeded the electronic thermal warning level (CTL) set in [CE-31].	• Remove the factor for the increased load. (E.g., by cleaning a clogged channel)

■Icon 2 RETRY monitor
- When RETRY is shown, the inverter is in the following condition(s).
- You can see the status of RETRY by pressing UP key on the three-lined monitor or on [dC-39].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Output was turned OFF and [dC-39] RETRY was set to 01.	• The inverter is in the waiting mode after a trip retry operation due to increased current or P-N voltage fluctuation.	• If the wait time become longer, the following delay time become shorter. [bb-26] [bb-29] [bb-31] • If this error is generated consecutively, make the wait time longer. [bb-26] [bb-29] [bb-31]
Output was turned OFF and [dC-39] RETRY was set to 02.	• The inverter is in the waiting mode before restart after power-off by [RST], [MBS], or [CS] terminal.	• If the wait time become longer, the following delay time become shorter. [bb-26]

■Icon 2 NRDY monitor

- When NRDY is shown, the inverter is in the following condition(s).
- You can see the status of NRDY by pressing UP key on the three-lined monitor or on [dC-40].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
TRIP display was shown and [dC-40] NRDY was set to 01.	• There was an error factor, which caused the inverter to trip.	• Remove the error factor. Consult this chapter.
The CTRL icon was shown and [dC-40] NRDY was set to 02.	• The control power supply (r1, t1) has been input, whereas the main circuit power supply R-S-T hasn't been input.	• Check the input of main circuit power supply and examine the breaker, wiring, and so on.
The 24V icon was shown and [dC-40] NRDY was set to 02.	• Only 24V has been input to the backup power supply P+-P-.	• Check the input of main circuit power supply and the control power supply, and examine the breaker, wiring, and so on.
[dC-40] NRDY was set to 03.	• [RST] terminal is ON and the inverter is under reset operation.	• Check the wiring and operation state of [RST] terminal.
[dC-40] NRDY was set to 04.	• The STO circuit is turned OFF or broken.	• Check ST1/ST2 terminals.
[dC-40] NRDY was set to 05.	• The inverter is checking the internal circuit, operator keypad, options, etc.	• If this error is not released, check the operator keypad for contact failure or other problem.
[dC-40] NRDY was set to 06.	• There is an inconsistency in the setting	• Although [AA121] is set to 10 (Vector control with sensor), the option HF-FB is not attached.
		• Refer to 18.5.2 "Checking setting inconsistencies".
[dC-40] NRDY was set to 07.	• There is a sequence operation problem in the brake control.	• Check the setting and signal operation of [AF130] brake control or the similar parameter.
[dC-40] NRDY was set to 08.	• [MBS] terminal or [CS] terminal was turned ON. • [MBS] or [CS] command was entered from the communication.	• Check the signal operation of input terminal for [MBS] or [CS].
[dC-40] NRDY was set to 09.	• Operation command isn't permitted.	• The [REN] terminal has been assigned and is turned OFF.
	• Forced stop is being issued. (Deceleration stop behavior)	• STOP key was pressed when commands had been entered from a source other than the operation keypad.

18.5.2 Checking setting inconsistencies

- You need to take a measure according to the warning number and the type of warning on warning monitor [dE-50].
  Refer to the table below.
- The induction motor (IM) control and synchronous motor (permanent magnetic motor) (SM (PMM)) control can be switched in [AA121].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Warning was generated - 102	(First Max. frequency) < (first upper limiter) IM: [Hb105] < [bA102] SM (PMM): [Hd105] < [bA102]	• Increase the Max. frequency [Hb105]/[Hd105]. • Decrease the upper limiter [bA102].
Warning was generated - 103	(First Max. frequency) < (first lower limiter) IM: [Hb105] < [bA103] SM (PMM): [Hd105] < [bA103]	• Increase the Max. frequency [Hb105]/[Hd105]. • Decrease the lower limiter [bA103].
Warning was generated - 106	(First Max. frequency) < (first main speed command) IM: [Hb105] < [Ab110] SM (PMM): [Hd105] < [Ab110]	• Increase the Max. frequency [Hb105]/[Hd105]. • Decrease the main speed command [Ab110].
Warning was generated - 107	(First Max. frequency) < (first auxiliary speed command) IM: [Hb105] < [AA104] SM (PMM): [Hd105] < [AA104]	• Increase the Max. frequency [Hb105]/[Hd105]. • Decrease the auxiliary speed command [AA104].
Warning was generated - 202	(Second Max. frequency) < (second upper limiter) IM: [Hb205] < [bA202] SM (PMM): [Hd205] < [bA202]	• Increase the Max. frequency [Hb205]/[Hd205]. • Decrease the upper limiter [bA202].
Warning was generated - 203	(Second Max. frequency) < (second lower limiter) IM: [Hb205] < [bA203] SM (PMM): [Hd205] < [bA203]	• Increase the Max. frequency [Hb105]/[Hd105]. • Decrease the lower limiter [bA103].
Warning was generated - 206	(Second Max. frequency) < (second main speed command) IM: [Hb205] < [Ab210] SM (PMM): [Hd205] < [Ab210]	• Increase the Max. frequency [Hb205]/[Hd205]. • Decrease the main speed command [Ab210].
Warning was generated - 207	(Second Max. frequency) < (second auxiliary speed command) IM: [Hb205] < [AA204] SM (PMM): [Hd205] < [AA204]	• Increase the Max. frequency [Hb205]/[Hd205]. • Decrease the auxiliary speed command [AA204].

18.5.3 Checking display messages

- A message appears in an event like communication error, insufficient voltage, or result of auto-tuning.
- Even when there is an error, you can exit the error screen with the XX key; however, you still need to remove the error factor separately.

Message ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Warning xxxxxxxxxxxxxxx Press the XX key.	• Warning of setting inconsistency was generated. There is inconsistency of setting shown in the warning message.	• The warning will be canceled by amending the indicated parameter setting.
Auto-tuning (non-revolving) completed. xxxxxxxxxxxxxxx Press the XX key.	• Non-revolving auto-tuning process is finished.	• See "12.3.3 Auto-tuning of motor".
Auto-tuning (revolving) completed. xxxxxxxxxxxxxxx Press the XX key.	• Revolving auto-tuning process is finished.	• See "12.3.3 Auto-tuning of motor".
Auto-tuning failed. Re-examine the setting and wiring. Press the XX key.	• Revolving auto-tuning process is disturbed and not finished.	• See "12.3.3 Auto-tuning of motor" for troubleshooting.
Initializing... Please wait.	• The inverter is being initialized.	• The initialization completion screen will appear after a while.
Clearing history... Please wait.	• The inverter is being initialized.	• The history clearance completion screen will appear after a while.
Initialization completed !! Target:#:xxxxxxxxxxxx Selection of initial values (Ub-02) xxxxxxxxxxxxx Load type selection Ub-03 xxxxxxxxxxxxx Press the XX key.	• The initialization is completed.	• Press XX key to exit the initialization completion screen.
History clearance completed !! Trip history cleared. Press the XX key.	• The history clearance is completed.	• Press XX key to exit the history clearance completion screen.

Message ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Operation command is limited. Please check operation command.	• Operation command of command direction is limited by the setting of [AA114] operation direction limit. • The rotation direction is reversed from the command direction limited according to the setting of [AA114] operation direction limit because the frequency command is turned negative due to calculation of main speed or auxiliary speed.	• Check the setting of [AA114] operation direction limit. • Check the terminal command FR/RR and the command direction of communication command. • Check whether the calculated frequency command is negative or not.
Resetting. Inverter is being reset. Press the XX key.	• [RST] terminal is ON. • Trip reset was performed. (The screen is transited automatically at trip reset.)	• The inverter is in the condition that [RST] terminal is ON. Re-examine the state of input terminal.
Retrying. Retrying and restarting. Press the XX key.	• The inverter is waiting for restart. (This mode is released after the set wait time has elapsed.) • The inverter may not start if the incoming voltage is low.	• If the wait time for restart is long, the message will continue to be indicated. See "12.14 Changing the Start Mode". • If the incoming voltage is low, check the input voltage.
Main circuit under instantaneous power failure. Power of main circuit is turned OFF. Press the XX key.	• The main circuit power supply (R, S, T) is turned OFF due to lightning strikes, power supply environment, or other factors.	• Check the state of input power supply. • The inverter will recover when the power supply returns.
Main circuit under insufficient voltage. Please check the main circuit power. Press the XX key.	• The control circuit power supply (r1, t1) has been input, whereas the main circuit power supply (R, S, T) has been cut.	• Check the state of input power supply. • The inverter will recover when the power supply of main circuit returns.
POWER OFF POWER OFF Press the XX key.	• The power supply to the inverter is turned OFF.	• Check the state of input power supply. • The inverter will recover when the power supply returns.
Control power under insufficient voltage. Please check the control power supply. Press the XX key.	• The control circuit power supply (r1, t1) is turned OFF.	• Check the state of input power supply. • The inverter will recover when the power supply of control circuit returns.

Message ▶	Estimated cause(s) ▶	Exemplar measures to be taken
Power feeding by external 24Vdc. Only external 24Vdc is feeding power. Press the XX key.	• The inverter is operating only with 24V power supply input to P+ and P- terminals.	• If the input power supply is input, check its state.
Changing load type... Please wait.	• The load type of inverter is being changed.	• The load type change completion screen will appear after a while.
Load type change completion!! Load type selection Ub-03 Rated current value changed. Check current-related parameters. Press the XX key.	• The load type change is completed.	• Press XX key to exit the load type change completion screen.

18.6 When Something Seems Wrong

- Frequently asked questions are listed below.
- Consult this chapter to solve your problem.
- If the problem still persists, please use the contact information shown on the back cover.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S1: Operator keypad doesn't turn ON (the POWER lamp on the operator keypad is not lit.)	• The power supply is not turned ON.	• Check that the power supply which satisfies the specification is turned ON. • When different powers are supplied to the control power supplies r1 and t1, and to P+ and P- terminals, check that r1, t1, or 24V power supply is turned ON.
	• Operator keypad is about to come off.	• The issue will be solved by remounting the operator keypad.
	• The J51 connector is disconnected.	• The J51 connector supplies power to the control power supplies r1 and t1 from the main power supplies R, S, and T. Keep the connector connected if you do not supply power to the control power supply with a different system.
	• The power supply input path is disconnected. • 200V power is supplied to r1 and t1 for 400V class.	• The breaker or wires may be disconnected. You need to re-examine the wiring. • When different power is supplied to the control power supplies r1 and t1, you also need to re-examine r1 and t1.
S2: Operator keypad doesn't turn ON (the POWER lamp on the operator keypad is lit.)	• Operator keypad is in the automatic extinction mode.	• The screen is lit by pressing a key on the operator keypad. • The automatic extinction function can be disabled in the operator keypad system setting.
	• The brightness of operator keypad display is set to low.	• The brightness of the display is adjustable by changing the light control setting in the operator keypad system setting.
	• Operator keypad is about to come off.	• The issue will be solved by remounting the operator keypad. (Check the RJ45 connector.)
	• The liquid crystal has reached the end of its life.	• Replacement of the operator keypad is required.

* Also, see “18.5.1 Checking the warning display”.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S3: The motor doesn’t rotate although an operation command was entered.	• The inverter is tripping.	• When the inverter trips due to an error, you need to remove the error factor and reset the inverter. • See “18.5. Troubleshooting for Protection-function Related Errors” in this chapter.
	• A warning is issued.	• If a warning is issued, you need to eliminate the data inconsistency. • See “18.4. Troubleshooting for Warning-function Related Errors” in this chapter.
	• The operation command isn’t entered.	• The operation command destination may be wrong, or the operation command may not be accepted. ⇒ Proceed to S4.
	• The frequency command destination isn’t entered.	• The frequency command destination may be wrong, or the frequency command may be 0. ⇒ Proceed to S5.
	• A shutoff function is at work.	• The function safety terminal, terminal function [RST], or [MBS] terminal may be enabled, or [ROK] terminal may be disabled. ⇒ Proceed to S6.
	• A limit function is at work.	• The command direction may be limited by the rotation direction limit function. ⇒ Proceed to S7.
	• Motor is locked.	• If the motor shaft is locked by something which hinders the brake or the motor revolution (e.g., clogging), the cause needs to be removed.
	• Wiring or the like is disconnected.	• Check for abnormalities such as disconnection of the output line to the motor or disconnection within the motor.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S4: Operation command destination or operation command is wrong.	• Even though the operation command is entered, the motor does not drive.	• If the LED for RUN on the operator keypad is lit or the operation display appears, the operation command has been entered normally. There is another factor for why the motor is not driven. ⇒ Return to S3.
	• The operation command destination and the operation command input are not the same.	• Check the operation command destination. Check [AA111] and the terminal function. See "12.5 Select a operation command." for details.
	• You want to make operation from the operator keypad but had made the different setting.	• Confirm that "oFR" or "oRR" is shown on the operator keypad. If it is not shown, then confirm that the operation command selection [AA111] is set to 02 RUN key on operator keypad. If it is shown, the terminal function needs to be checked.
	• You want to make operation from the [FR] terminal but had made the different setting.	• Set the operation command selection [AA111] to 00 [FR/RR] terminal. If RUN is not shown when the [FR] terminal is turned ON, other terminal functions need to be checked.
	• There is a cause other than the operation command.	• If the operator keypad doesn't show RUN, a shutoff function or the main power supply may not be turned ON. • There is another factor for why the motor is not driven. ⇒ Return to S3.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S5: Frequency command destination or frequency command is wrong.	• Frequency command is 0. • [dA-04] has been 0.	• The frequency command destination may be wrong, or the setting of the command destination or the input voltage of frequency setter may be 0. Set the value other than 0 for the setting destination.
	• Frequency command destination is wrong.	• Check the frequency command destination. Check [AA101] and the terminal function. See "12.4 Select a frequency command." for details.
	• You want to set the frequency command but [FA-01] has been 0.	• Set the operation command selection [AA101] to 02: Key on operator keypad, and then change the setting of [Ab110].
	• [FA-01] has been 0 even though the frequency setter is operated.	• Connect the main speed selection [AA101] according to the analog input to be used, and operate the frequency setter.
	• [FA-01] is not 0, and there is a cause other than the frequency command.	• If data appears in [FA-01], the frequency command is normal. • There is another factor for why the motor is not driven. ⇒

Occurrence	Estimated cause(s)	Exemplar measures to be taken
S6: A shutoff function is at work.	• The main power supply is not turned ON.	• When the power supply is separated to R, S, T and r1, t1 (J51 connector section), the inverter cannot be operated if the R, S, T, side power is down. The power supply check is required.
	• [RST] terminal is ON.	• If the [RST] terminal is ON, the inverter enters the reset mode and does not accept operation commands. The [RST] terminal needs to be turned OFF.
	• [MBS] terminal is ON.	• If the [MBS] terminal is ON, the inverter enters the free-run stop mode and does not accept operation commands. The [MBS] terminal needs to be turned OFF.
	• [CS] terminal is ON.	• If the [CS] terminal is ON, the inverter enters the mode switched to commercial power supply shutoff and does not accept operation commands. Check the commercial
	• The [ROK] terminal has been assigned and is turned OFF.	• When the [ROK] terminal is used, if the terminal function is OFF, the inverter does not accept operation commands. Check the operation permission signal.
	• STO terminal is not wired or is in OFF state.	• If you do not use the function of STO terminal, you need to attach a short-circuit wire to it.
	• The inverter is tripping.	• When the inverter is tripping, it does not accept operation commands. Identify the factors for trip.
	• Shutoff functions are not on.	• If shutoff functions are not on and the motor is not driven, there is another factor. ⇒ Return to S3.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S7: A limit function is at work.	• The operation permission signal has been assigned to the input terminal function and the signal is turned OFF.	• When the operation permission signal has been assigned, the operation permission signal needs to be turned ON.
	• The command is given to the direction the operation is limited.	• Check the operation command direction limit.
	• Both [FR] terminal and [RR] terminals are turned ON by operation command from input terminal.	• If both [FR] terminal and [RR] terminal are turned ON, input inconsistency is generated and the inverter stops. Use only either one of them to operate the inverter.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S8: Motor speed doesn’t rise.	• The overload limit function is at work.	• The overload limit function suppresses the current by dropping the frequency when the output current exceeds the overload limit level. • Raising the setting level may improve the situation.
	• The frequency command is limited.	• If the upper limiter and the maximum frequency is set to low level, the situation will be improved by setting them to higher level. To limit frequencies, use the upper limiter function instead of the maximum frequency.
	• The frequency command is low.	• The command becomes lower when a more prioritized frequency command such as for jogging or multi-speed command is entered. Re-examination of the terminal function and frequency command destination are required.
	• Acceleration time is long.	• If the acceleration time is set long, acceleration becomes slow. Set the acceleration time short.

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S9: The parameter you are looking for is not shown.	• The display limit has been set.	• Display limit function may be working. Cancel the display limit selection [UA-10].
	• The display is fixed.	• Operation on the operator keypad isn't accepted if the input terminal function 102 [DISP] is ON. Turn OFF the terminal.
S10: Keypad operator cannot be operated.	• The display is fixed.	• Operation on the operator keypad isn't accepted if the input terminal function 102 [DISP] is ON. Turn OFF the terminal.
S11: Setting cannot be made.	• Inverter is running.	• Some parameters cannot be changed while the inverter is running. If that is the case, turn OFF the inverter once.
S12: Motor rotates in a reverse direction.	• The wires connected to the motor are in wrong phase sequence.	• Swapping two phases of wires connected to the motor changes the direction of rotation.
	• When the RUN key on the operator keypad is used, the rotation direction setting is wrong.	• [AA-12] RUN key direction needs to be switched.
	• When the 3-wire function is used, the input of input terminal function F/R is reversed.	• Check the logic of 3-wire normal rotation / reverse rotation terminal (018[F/R]).
S13: Noises of motor and machines are noisy.	• Carrier frequency is set low.	• Raise the carrier frequency setting [bb101]. However, this may increase noise generated in the inverter and leakage currents from the inverter. In addition, derating is required to the output current depending on the models.
	• The revolution frequency of motor and the natural frequency of machines resonate.	• Change the set frequency. If a resonance occurs during acceleration/deceleration, avoid the resonance frequency in settings of the frequency jump functions [AG101] to [AG106].

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S14: Output frequency becomes unstable.	• Inadequate parameters are used.	• Find out the basic parameter settings for motor and set them accordingly.
	• Load fluctuates significantly.	• Re-examination of capacity of both motor and inverter may be required.
	• PS voltage fluctuates.	• Use of the optional reactor AC or DC, or a noise filter on the input side to minimize the power fluctuation may improve the situation.
S15: Torque is not generated.	• V/f control is used.	• Use torque boost, sensor less vector control, or other control instead.
	• The inverter is used for lowering.	• Use a braking resistor or regenerative braking unit if the torque is not sufficient for regenerative operation.
	• The load is too heavy.	• Re-examination of capacity of both motor and inverter may be required.
S16: Operator keypad disconnection error is issued.	• Operation selection at disconnection of operator is inappropriate.	• Set the operation selection at disconnection of operator to 02 (Ignore).

Occurrence ▶	Estimated cause(s) ▶	Exemplar measures to be taken
S17: Operation/setting of Modbus communication cannot be made.	• Changes made to communication parameters haven't been reflected.	• If you changed [CF-01] to [CF-38], turn OFF the control power supply and restart.
	• The operation command selection is not set to RS485.	• Check that operation command selection [AA111] is set to 03 (RS485).
	• The frequency command selection is not set to RS485.	• Check that the main speed command selection [AA111] is set to 03 (RS485).
	• The communication speed setting is wrong.	• Set the correct value in [CF-01], then turn OFF the control power supply and restart.
	• Station numbers are wrongly set or overlapping each other.	• Set the correct value in [CF-02], then turn OFF the control power supply and restart.
	• The communication parity setting is wrong.	• Set the correct value in [CF-03], then turn OFF the control power supply and restart.
	• The communication stop bit setting is wrong.	• Set the correct value in [CF-04], then turn OFF the control power supply and restart.
	• Wiring is wrong.	• Connect wires properly to the SP and SN terminals on the control circuit terminal block.
S18: The earth leakage circuit breaker is activated as the inverter is operated.	• Leakage currents in the inverter are large.	• Lower the carrier frequency [bb101]. • Raise the sensitivity current in the earth leakage circuit breaker, or replace the breaker with the one with higher sensitivity current.
S19: DC braking is disabled.	• The DC braking force is not set.	• Set DC braking force at the time of the stop [AF105] and DC braking force at the start [AF108].
	• The DC braking time is not set.	• Set DC braking time at the time of the stop [AF106] and DC braking time at the start [AF109].
S20: TV and radio have noises near the inverter.	• Radiation noise from the inverter	• Locate the inverter wires as far as possible from a TV and radio. • Install Zero-phase reactor to the main power supply input and output of the inverter.

Chapter 19 Maintenance and Inspection

19

19.1 What This Chapter Explains

- This chapter describes methods of maintenance and inspection.
- **Carefully read "Chapter 1 Safety Instructions" again before performing maintenance and inspection.**

* Components that have finite lives are electrolytic condenser on board, smoothing capacitor, IGBT, diode module, current limiting resistor, relay for driving current limiting resistor or thyristor, cooling fan, and memory element, which are mounted on the board.

Be careful for maintenance and inspection!

DANGER

Electric shock

- **You run the risk of electric shock.**

Do

- Before inspecting the inverter, be sure to turn off the power supply and wait for 10 minutes or more (*1) or 15 minutes or more (*2).
  (Confirm that the charge lamp on the inverter is turned off and the DC voltage between terminals P and N is 45 V or less.)

Prohibited

- Entrust only a designated person for maintenance, inspection, and replacement of parts.
  (Be sure to remove wristwatches and metal accessories, e.g., bracelets, before maintenance and inspection work. Be sure to use insulated tools for the work.)
- Do not perform pressure test.

*1) For models HF4322-5A5 to HF-4322-022 and HF4324-5A5 to HF-4324-022
*2) For models HF4322-030 to HF-4322-055 and HF4324-030 to HF-4324-055

19.2 Notes on Maintenance and Inspection

19.2.1 Daily Inspection

As a basic procedure, check that the following abnormalities are not observed during operation.

No.	Description	Check
1	The motor operates according to the settings	☐
2	There is no abnormality in the environment where the device is installed.	☐
3	There is no abnormality in the cooling system.	☐
4	No abnormal vibration or sound is observed.	☐
5	No abnormal overheat or discoloration is observed.	☐
6	No abnormal smell is observed.	☐

While the inverter is running, check the input voltage of inverter using a tester, etc.

No.	Description	Check
1	There is no frequent occurrence of variation of power supply voltage.	☐
2	Line voltage keeps a good balance.	☐

19.2.2 Cleaning

Make sure to always keep the inverter clean for operation.

No.	Description	Check
1	For cleaning, lightly wipe off dirt with a soft cloth dampened with neutral detergent.	☐
2	Solvents such as acetone, benzene, toluene, and alcohol may cause the inverter surface to dissolve or its coating to peel off, therefore, do not use them.	☐
3	Do not clean the display section including the operator keypad using a detergent or alcohol.	☐

19.2.3 Periodic Inspection

Check sections that cannot be inspected unless operation is stopped and sections requiring periodic inspection.
Please contact us for periodic inspection.

No.	Description	Check
1	There is no abnormality in the cooling system. ・Cleaning of the air filter and other components	☐
2	Checking tightness and re-tightening ・Due to effects of vibration or temperature change, tightened portions of screws or bolts may loosen. Make sure to carefully check and perform the work.	☐
3	No corrosion or damage is observed on the conductors and insulators.	☐
4	Measurement of insulation resistance	☐
5	Checking and replacing the cooling fan, smoothing capacitor, and relay	☐

19.3 Daily Inspection and Periodic Inspection

Target section	Item	Details	Interval: Daily	Interval: Periodic 1 year	Interval: Periodic 2 years	Method	Criteria	Measurement instrument
General	Ambient environment	Check the ambient temperature, humidity, dust, etc.	○			See the installation method.	The ambient temperature and humidity are within the usable range. No freezing, condensation, dust, corrosive gas, explosive gas, flammable gas, mist of grinding fluid, hydrogen sulfide, and salts are permissible.	Thermometer Hydrometer Recorder
General	Entire device	No abnormal vibration or sound is observed.	○			By visual check and hearing	There must be no abnormality.	-
General	Power supply voltage	The main circuit voltage is normal.	○			Measure line voltage between inverter main circuit terminals R, S, and T.	They are within the allowable variation range of AC voltage.	Tester and digital multimeter
Main circuit	General	(1) Megger check (between the main circuit terminals and earth terminals)		○		Remove the input/output wires of main circuit terminal block of the inverter, remove the control terminal block board, then, remove the short bar for switching the functions of filter included in the inverter. Then, using a megger, perform measurement between each portion where R, S, T, U, V, W, P, P1, N, PR, r1, and t1 terminals are shorted and earth terminal.	The measured value shall be 5MΩ or above.	DC 500V-class megger
Main circuit	General	(2) Fastened portions are not loosened.		○		Re-tighten the portion.	There must be no abnormality.	-
Main circuit	General	(3) No residual mark of overheat is observed on each component.		○		By visual check.	There must be no abnormality.	-
Main circuit	Connected conductor and wire	Check for straining in conductors.		○		By visual check.	There must be no abnormality.	-
Main circuit	Connected conductor and wire	Check for cable coating damage.		○		By visual check.	There must be no abnormality.	-
Main circuit	Terminal block	Check for any damage.		○		By visual check.	There must be no abnormality.	-
Main circuit	Inverter Converter (including resistor)	Check resistance between each terminal			○	Remove the wires of the main circuit terminal block of inverter, and perform measurement between terminals R, S, T and terminals P, N, and between terminals U, V, W and terminals P, N at the range of tester ×1Ω.	See 6.5 Checking method of inverter and converter. Appropriate replacement interval of inverter, converter, and thyristor Start/stop: 10^6 cycles *3)	Analog tester
Main circuit	Smoothing capacitor	(1) There is no leakage of fluid.	○			By visual check.	There must be no abnormality. Appropriate service years for replacement: 10 years *1) *3) *4)	-
Main circuit	Smoothing capacitor	(2) The belly (safety valve) shall not stick and there shall be no bump.		○		By visual check.	There must be no abnormality. Appropriate service years for replacement: 10 years *1) *3) *4)	-
Main circuit	Relay	(1) There shall be no beat noise during operation.		○		By hearing.	There must be no abnormality.	-
Main circuit	Relay	(2) There are no worn contacts.		○		By visual check.	There must be no abnormality.	-
Control circuit Protective circuit	Operation check	(1) Through unit operation of inverter, check balance of output voltage between each phase.		○		Measure line voltage between inverter main circuit terminals U, T, and W.	Inter-phase voltage balance 200V class: To be within 4V. 400V class: To be within 8V.	Digital multimeter Flowmeter Voltmeter
Control circuit Protective circuit	Operation check	(2) By conducting the sequence protective operation test, check there is no abnormality in protective operation and display circuit.		○		Simulate short or open condition of the protective circuit output of inverter.	The error is generated on the sequence.	Digital multimeter Flowmeter Voltmeter
Cooling system	Cooling fan	No abnormal vibration or sound is observed.	○			By hearing and visual check. (Warning indication on the operator keypad)	To rotate smoothly. There must be no abnormality. Wind brows in upper section. Appropriate service years for replacement: 10 years *2) *3) *5)	-
Cooling system	Cooling fan	(2) Connections are not loosened.		○		By visual check.	To rotate smoothly. There must be no abnormality. Wind brows in upper section. Appropriate service years for replacement: 10 years *2) *3) *5)	-
Cooling system	Cooling fin	There is no clogging.		○		By visual check.	There is no clogging.	-
Indication	Indication	(1) The LED lamp and screen display are normal.	○			By visual check.	Check the lamp/display lights up.	-
Indication	Indication	(2) Cleaning.		○		Clean with a waste cloth.	-	-
Indication	External meter	The indicated values are normal.	○			Check indicated values of the meters on the boards.	Satisfy the specification values and control values.	Voltmeter, ammeter, etc.
Motor	General	(1) No abnormal vibration or sound is observed.	○			By hearing, sensing, and visual check.	There must be no abnormality.	-
Motor	General	(2) No abnormal smell is observed.	○			Check for abnormal smell due to overheat, damage, etc.	There must be no abnormality.	-
Motor	Insulation resistance	Megger check (between the main circuit terminals and earth terminals)			*6)	Disconnect U, V, and W inverter main circuit terminals, short the motor line (for three phases), and perform measurement between the motor wire and earth terminal using a megger.	The measured value shall be 5MΩ or above.	DC 500V-class megger

*1) The service life of smoothing capacitor is affected by the ambient temperature.
See "5.Smoothing capacitor life curve" to determine replacement period.

*2) The life of cooling fan varies depending on the environment conditions such as ambient temperature and dust. Check operating conditions by daily inspection.

*3) The replacement period (number of years/cycles) and "5. Capacitor life curve" are based on the designed expected life, which is not a guaranteed value.

*4) When you replace with a capacitor that has passed storage period more than three years, perform aging in the following conditions before using it.

- Initially apply 80% of rated voltage of capacitor for one hour in normal temperature
- Then, increase the voltage to 90% and apply for one hour
- Lastly, apply rated voltage for five hours in normal temperature

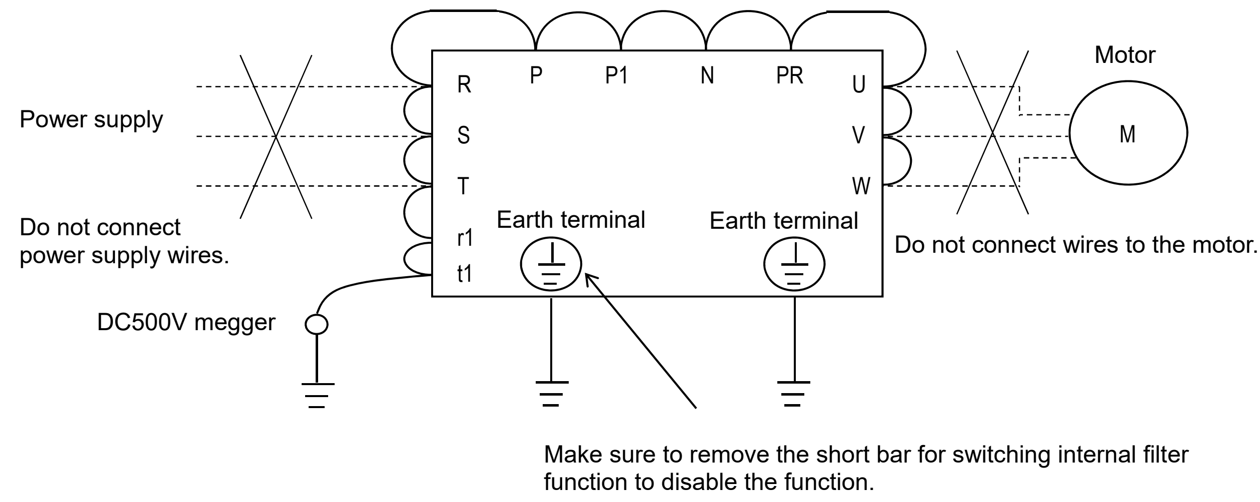
*5) If the cooling fan is locked due to dust, etc., it takes about 5 to 10 seconds until re-rotation is enabled even if dust is removed.

*6) Perform inspection in accordance with the instruction manual of motor.

19.4 Megger Test

- When conducting megger test on the external circuit, remove all terminals of the inverter to avoid applying the test voltage is not applied to the inverter.
- For energization test on the control circuit, use a tester (high-resistance range), and do not use a megger or buzzer.
- Conduct megger test for the inverter itself only on the main circuit, and do not perform megger test on the control circuit.
- For megger test, use a DC500V megger.

- Before conducting a megger test on the inverter main circuit, make sure to remove the short bar for switching the filtering function included in the inverter, and short terminals R, S, T, U, V, W, P, P1, N, PR, r1, and t1 as shown in the figure below.
- After megger test, remove the wires on which R, S, T, U, V, W, P, P1, N, PR, r1, and t1 terminals that are shorted, and connect the short bar for switching the filter function included in the inverter to the original position.



19.5 Pressure Test

- Do not perform pressure test.
  If pressure test is conducted, it is dangerous because the components inside the inverter may be damaged or deteriorated.

19.6 Checking Method of Inverter and Converter

・Using a tester, you can check the condition of inverter and converter if it is good or bad.

(Preparation)

(i) Remove the power lines connected from an external source (R, S, T), wires connecting to the motor (U, V, W), and regenerative braking resistor (P, PR).

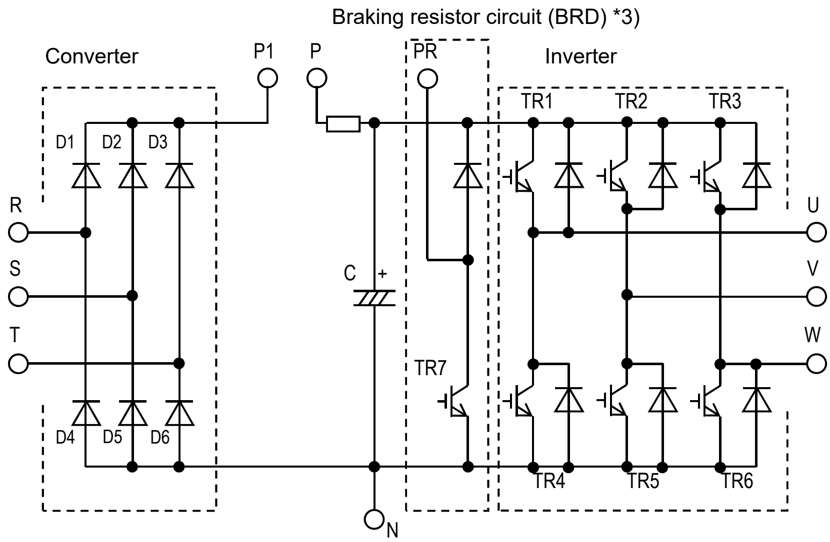
(ii) Prepare a tester. (The range used is 1Ω resistance measurement range.)

(Checking method) *1)

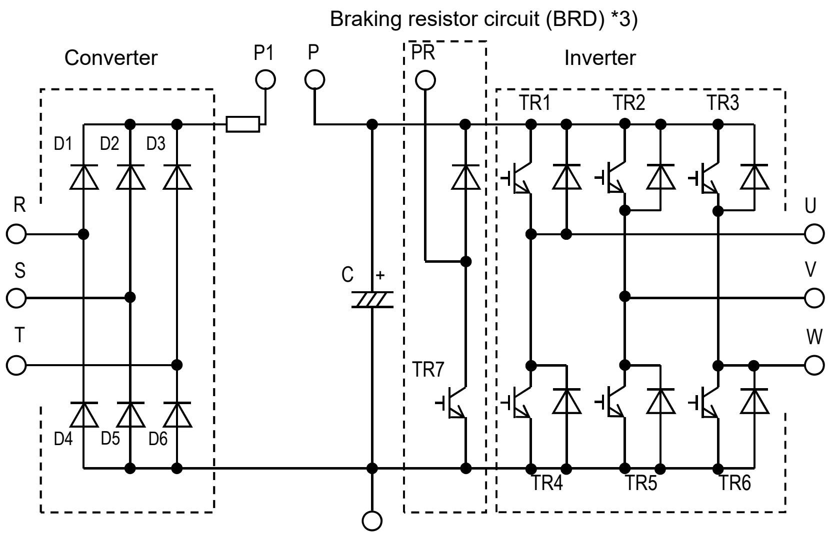
・You can determine the good-or-bad condition of conduction status of terminals on the inverter main circuit terminal block R, S, T, U, V, W, PR, P, and N by alternately changing the polarity of tester for measurement.

		Tester polarity ⊕ (Red)	Tester polarity ⊖ (Black)	Measured value *2)
Converter	D1	R	P1	Non-conductive
		P1	R	Conductive
	D2	S	P1	Non-conductive
		P1	S	Conductive
	D3	T	P1	Non-conductive
		P1	T	Conductive
	D4	R	N	Conductive
		N	R	Non-conductive
	D5	S	N	Conductive
		N	S	Non-conductive
	D6	T	N	Conductive
		N	T	Non-conductive
Inverter	TR1	U	P	Non-conductive
		P	U	Conductive
	TR2	V	P	Non-conductive
		P	V	Conductive
	TR3	W	P	Non-conductive
		P	W	Conductive
	TR4	U	N	Conductive
		N	U	Non-conductive
	TR5	V	N	Conductive
		N	V	Non-conductive
	TR6	W	N	Conductive
		N	W	Non-conductive
BRD	TR7	PR	P	Non-conductive
		P	PR	Conductive
		PR	N	Non-conductive
		N	PR	Non-conductive

Model
200V class: HF4322-5A5 to 011 400V class: HF4324-5A5 to 011



Model
200V class: HF4322-015 to 055 400V class: HF4324-015 to 055



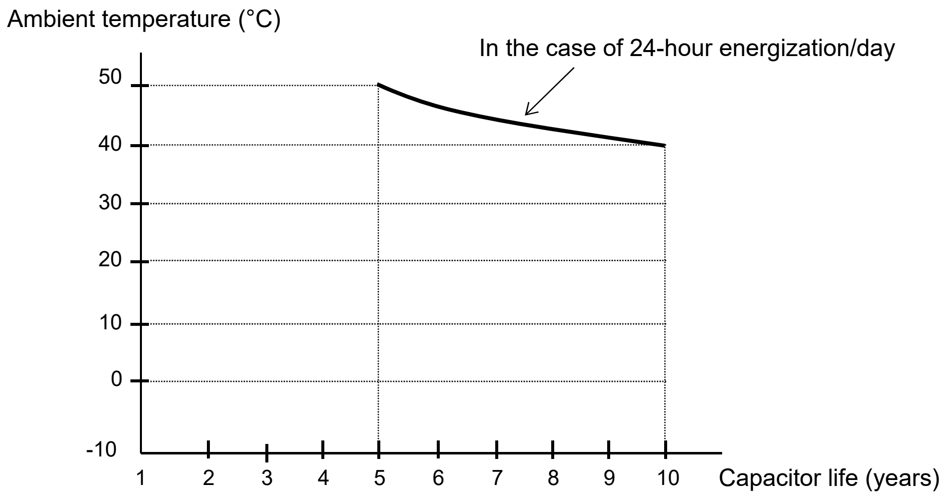
*1) By measuring the voltage between P and N in the DC voltage range, check that electricity is fully discharged from the smoothing capacitor before performing check.

*2) When electricity is not conducted, a nearly infinite value is demonstrated. Due to effects of the smoothing capacitor, electricity may be conducted instantly, not showing an infinite value. When electricity is conducted, a numeric value range will be indicated from some to dozens in a unit of Ω. The values vary depending on the element type, tester, type, etc. However, it is acceptable if numeric values obtained for each item are nearly the same. The measured value may be varied some degree in Ω by the reason of the preventing inrush current of current limiting resistor.

*3) The braking circuit (BRD) section is equipped as standard on the following models: HF4322-5A5 to HF4322-022 and HF4324-5A5 to HF4324-037.

19.7 Capacitor Life Curve

* When the inverter is continuously driven at 80% of ND rated current.



Note 1) The ambient temperature is a temperature measured at a position about 5cm from the bottom center of the inverter. (Atmospheric temperature)
If the inverter is stored inside the panel, it is in-panel temperature.

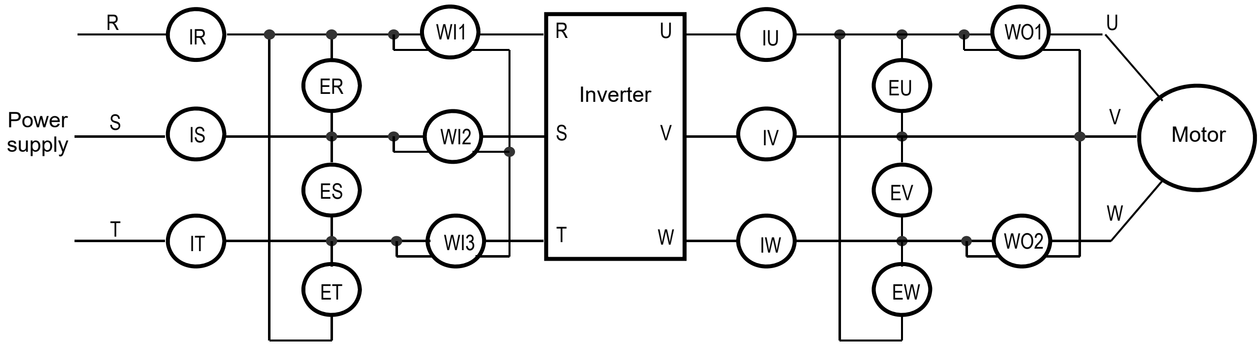
Note 2) The capacitor is a finite life component which occurs chemical reaction inside, replacement is required after 10 years of use (It is a designed expected life, not a guaranteed value).
However, if the inverter is used in an environment at high temperature or in a heavy-load environment where the rated current is exceeded, the life is significantly shortened.

19.8 Life Alarming Output

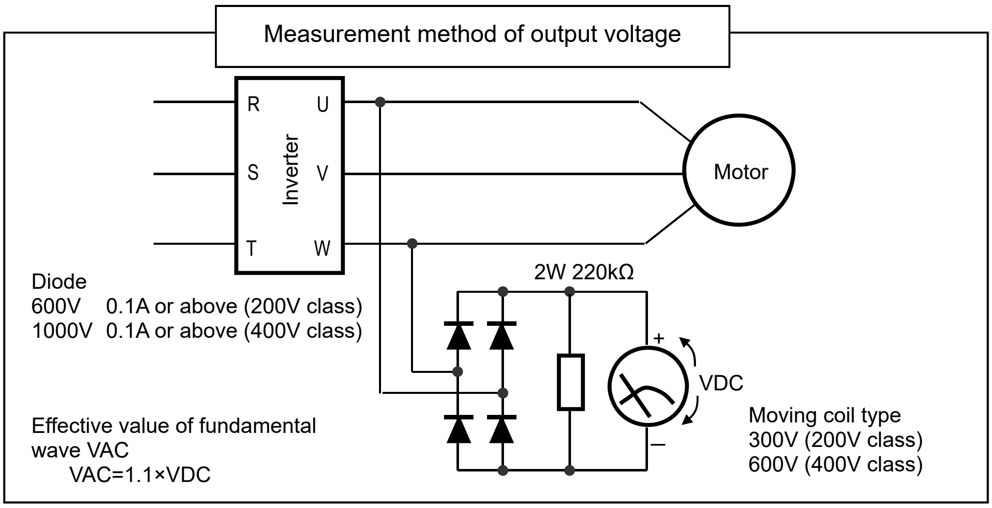
・When the life of component (capacitor or cooling fan) is near its end, an alarm can be generated based on self-diagnosis.
Use this alarm as a sign of part replacement period. For details, see the life diagnosis monitor [dC-16] and output terminal function selection [CC-01] to [CC-07].
Note that alarms are generated based on diagnosis of designed expected life (not a guaranteed value).
There will be differences due to use environments, operating conditions, etc. Please conduct maintenance in advance.

19.9 Measurement Method of I/O Voltage, Current, and Power

The following shows general measurement instruments used for measurement of input/output voltage, current, and power.



Measurement item	Target section	Measurement instrument	Remarks	Criteria
Power supply voltage E_{IN}	Between R-S, S-T, and T-R (E_R), (E_S), (E_T)	Moving iron voltmeter or Rectifier type voltmeter	All effective values	200V class: 200-240V 50/60Hz 400V class: 380-500V 50/60Hz
Power supply current I_{IN}	Current of R, S, and T (I_R), (I_S), (I_T)	Moving iron ammeter		If input current is imbalanced $I_{IN}=(I_R+I_S+I_T)/3$
Power from power supply W_{IN}	Between R-S, S-T, and T-R (W_{I1})+(W_{I2})+(W_{I3})	Electrodynamometer type wattmeter		Three wattmeter method
Power rate of power supply P_{fIN}	This value is calculated using measurement values of power supply voltage E_{IN}, power supply current I_{IN}, and power supply power W_{IN}. $P_{fIN}=\frac{W_{IN}}{\sqrt{3}\cdot E_{IN}\cdot I_{IN}}\times 100$			-
Output voltage E_{OUT}	Between U-V, V-W, and W-U (E_U), (E_V), (E_W)	See the figure below or Rectifier type voltmeter	Effective value of fundamental wave	
Output current I_{OUT}	Current of U, V, and W (I_U), (I_V), (I_W)	Moving iron ammeter	All effective values	
Output power W_{OUT}	Between U-V and V-W (W_{O1})+(W_{O2})	Electrodynamometer type wattmeter		Two wattmeter method (or three wattmeter method)
Output power factor P_{fOUT}	This value is calculated using measurement values of output voltage E_{OUT}, output current I_{OUT}, and output power W_{OUT}. $P_{fOUT}=\frac{W_{OUT}}{\sqrt{3}\cdot E_{OUT}\cdot I_{OUT}}\times 100$			-



Note)
1. Use an instrument that indicates effective values of fundamental wave for output voltage, and use instruments that indicate all effective values for current and power.
2. The output waveform of inverter generates errors especially at low frequency because it is a waveform control by PWM. Take care because a tester (general-purpose product) may not be adapted due to noise.

Chapter 20 Specifications

20

20.1 What This Chapter Explains

This chapter describes product specifications.
The abbreviations used in the product specifications show the following meanings.

Rated duty:

・ND (normal duty rating)

・LD (low duty rating)

・VLD (very low duty rating)

Motor types:

・IM (induction motor)

・SM/PMM: (synchronous motor/permanent magnet motor)

In the following specifications, information after input power may be omitted. In this case, the specifications described are not related to the omitted part. For product models, see “Chapter 4.3.1 Product Models".

20.2 Inverter Specifications

20.2.1 200V Class Specifications

Model name				HF4322- 5A5	7A5	011	015	022	030	037	045	055
Applicable motor (4 poles) (kW)			VLD / LD	7.5	11	15	18.5	30	37	45	55	75
			ND	**5.5**	**7.5**	**11**	**15**	**22**	**30**	**37**	**45**	**55**
Output	Rated output current(A)		VLD	33.0	46.0	60.0	80.0	124	153	185	229	295
			LD	30.0	40.0	56.0	73.0	113	140	169	210	270
			ND	**24.0**	**32.0**	**46.0**	**64.0**	**95.0**	**121**	**145**	**182**	**220**
	Overload current rating		VLD	110% 60sec / 120% 3sec								
			LD	120% 60sec / 150% 3sec								
			ND	**150% 60sec / 200% 3sec**								
	Rated output voltage			Three-phase(3 wire)200 to 240V (Corresponding to the incoming voltage)								
	Rated capacity (kVA)	200V	VLD	11.4	15.9	20.8	27.7	43.0	53.0	64.1	79.3	102.2
			LD	10.4	13.9	19.4	25.3	39.1	48.5	58.5	72.7	93.5
			ND	**8.3**	**11.1**	**15.9**	**22.2**	**32.9**	**41.9**	**50.2**	**63.0**	**76.2**
		240V	VLD	13.7	19.1	24.9	33.3	51.5	63.6	76.9	95.2	122.6
			LD	12.5	16.6	23.3	30.3	47.0	58.2	70.3	87.3	112.2
			ND	**9.9**	**13.3**	**19.1**	**26.6**	**39.4**	**50.2**	**60.2**	**75.6**	**91.4**
Input	Rated input current(A) ***1)**		VLD	39.3	54.8	71.4	95.2	147.6	182.1	220.2	272.6	351.2
			LD	35.7	47.6	66.7	86.9	134.5	166.7	201.2	250.0	321.4
			ND	**29.8**	**38.1**	**54.8**	**76.2**	**113.1**	**145.2**	**173.8**	**216.7**	**261.9**
	Rated input AC voltage ***2)**			Control power: Single-phase supply 200 to 240V , Permissible AC voltage 170 to 264 , 50Hz/60Hz(±5%)								
				Main circuit power supply: Three-phase(3 wire) 200 to 240V , Permissible AC voltage 170 to 264 , 50Hz/60Hz(±5%)								
	Power supply capacity (kVA) ***3)**		VLD	15.0	20.9	27.2	36.3	56.3	69.4	83.9	103.9	133.8
			LD	13.6	18.1	25.4	33.1	51.3	63.5	76.7	95.3	122.5
			ND	**11.3**	**14.5**	**20.9**	**29.0**	**43.1**	**55.3**	**66.2**	**82.6**	**99.8**
Carrier frequency variation ***4)**			VLD	0.5 to 10.0kHz								
			LD	0.5 to 12.0kHz								
			ND	**0.5 to 16.0kHz**								
Starting torque ***5)**				150% or more								
Braking	Regenerative			Internal BRD circuit (external discharge resistor value)					External regenerative braking unit			
	Minimum resistance value(Ω)			16	10		7.5	5	2			
Dimensions ***6)**	H(height)(mm)			260			390		540	550		700
	W(width)(mm)			210			245		300	390		480
	D(Depth)(mm)			170			190		195	250		250
Protective structure				IP20 – UL Open Type								
Aprox. weight (kg)				6			10		22	33		47

*1) The rated input current is the value when the drive is operated in the rated output current. The value of the impedance at the supply side changes due to the wiring, breaker, input reactor, etc.
*2) Following are for Low Voltage Directive (LVD) compliant.
- Pollution degree 2
- Overvoltage category 3

*3) The power supply capacity is the value of the rated output current at 220V. The value of the impedance at the supply side changes due to the wiring, breaker, input reactor, etc.
*4) It is necessary to set the carrier frequency settings [bb101]/ [bb201] equal or greater than the (maximum output frequency x 10) Hz. For induction motor IM, set the carrier frequency to 2 kHz or more except V/f control. For synchronous motor (SM), permanent magnet motor (PMM) set the carrier frequency to 8 kHz or more.
*5) The value is specified for the standard motor controlled by the sensor less vector control when ND rating. Torque characteristics may vary by the control system and the use of the motor.
*6) The key height of keypad are exclued from dimensions. When an option is connected, the depth is increased. Refer to the each optional instruction.

20.2.2 400V Class Specifications

Model name				HF4324-								
				5A5	**7A5**	**011**	**015**	**022**	**030**	**037**	**045**	**055**
Applicable motor (4 poles) (kW)			VLD / LD	7.5	11	15	18.5	30	37	45	55	75
			ND	**5.5**	**7.5**	**11**	**15**	**22**	**30**	**37**	**45**	**55**
Output	Rated output current(A)		VLD	17.5	25.0	31.0	40.0	62.0	77.0	93.0	116	147
			LD	16.0	22.0	29.0	37.0	57.0	70.0	85.0	105	135
			ND	**12.0**	**16.0**	**23.0**	**32.0**	**48.0**	**58.0**	**75.0**	**90.0**	**110**
	Overload current rating		VLD	110% 60sec / 120% 3sec								
			LD	120% 60sec / 150% 3sec								
			ND	**150% 60sec / 200% 3sec**								
	Rated output voltage			Three-phase(3 wire)380～500V (Corresponding to the incoming voltage)								
	Rated capacity (kVA)	400V	VLD	12.1	17.3	21.5	27.7	43.0	53.3	64.4	80.4	101.8
			LD	11.1	15.2	20.1	25.6	39.5	48.5	58.9	72.7	93.5
			ND	**9.7**	**13.1**	**15.9**	**22.2**	**33.3**	**40.2**	**52.0**	**62.1**	**76.2**
		500V	VLD	15.2	21.7	26.8	34.6	53.7	66.7	80.5	100.5	127.3
			LD	13.9	19.1	25.1	32.0	49.4	60.6	73.6	90.9	116.9
			ND	**10.4**	**13.9**	**19.9**	**27.7**	**41.6**	**50.2**	**65.0**	**77.9**	**95.3**
Input	Rated input current(A) ***1)**		VLD	20.8	29.8	36.9	47.6	73.8	91.7	110.7	138.1	175.0
			LD	19.0	26.2	34.5	44.0	67.9	83.3	101.2	125.0	160.7
			ND	**17.6**	**22.6**	**29.8**	**38.1**	**57.1**	**72.6**	**89.3**	**108.3**	**133.3**
	Rated input AC voltage ***2)**			Control power: Single-phase supply 380 to 500V , Permissible AC voltage 323 to 550V , 50Hz/60Hz(±5%)								
				Main circuit power supply: Three-phase(3 wire) 380 to 500V , Permissible AC voltage 323 to 550 , 50Hz/60Hz(±5%)								
	Power supply capacity (kVA) ***3)**		VLD	15.9	22.7	28.1	36.3	56.3	69.9	84.4	105.2	133.4
			LD	14.5	20.0	26.3	33.6	51.7	63.5	77.1	95.3	122.5
			ND	**13.4**	**17.2**	**22.7**	**29.0**	**43.5**	**55.3**	**68.0**	**82.6**	**101.6**
Carrier frequency variation ***4)**			VLD	0.5～10.0kHz								
			LD	0.5～12.0kHz								
			ND	**0.5～16.0kHz**								
Starting torque *5)				150% or more								
Braking	Regenerative			Internal BRD circuit (external discharge resistor value)							Ext. regenerative braking unit	
	Minimum resistance value(Ω)			70	35		24	20	15		10	
Dimensions *6)	H(height)(mm)			260			390		540	550		
	W(width)(mm)			210			245		300	390		
	D(Depth)(mm)			170			190		195	250		
Protective structure				IP20 – UL Open Type								
Aprox. weight (kg)				6			8.5		22	31		

*1) The rated input current is the value when the drive is operated in the rated output current. The value of the impedance at the supply side changes due to the wiring, breaker, input reactor, etc.

*2) Make sure the following for Low Voltage Directive (LVD) compliant.
- Pollution degree 2
- Overvoltage category 3 (for 380～460Vac Input supply)
- Overvoltage category 2 (for over 460Vac Input supply)

*3) The power supply capacity is the value of the rated output current at 440V. The value of the impedance at the supply side changes due to the wiring, breaker, input reactor, etc.

*4) It is necessary to set the carrier frequency settings [bb101]/[bb201] equal or greater than the (maximum output frequency x 10)Hz. For induction motor IM, set the carrier frequency to 2 kHz or more except V/f control. For synchronous motor (SM), permanent magnet motor (PMM) set the carrier frequency to 8 kHz or more.

*5) The value is specified for the standard motor controlled by the sensor less vector control when ND rating. Torque characteristics may vary by the control system and the use of the motor.

*6) The key height of keypad are excluded from dimensions. When an option is connected, the depth is increased. Refer to the each optional instruction.

20.2.3 Common Specifications

PWM system			Sine-wave PWM system	
Output frequency range ***1)**			0.00～590.00Hz	
Frequency accuracy			For the highest frequency, digital±0.01%, analog±0.2% (25±10℃)	
Frequency resolution			Digital: 0.01Hz Analog: Max. frequency/4000 (VRF terminal/IRF terminal:12bit/0～+10V or 0～+20mA, VF2 terminal 12bit/-10～+10V)	
Control system ***2)**			IM	V/f control (constant torque/reduced torque/ free / automatic boost control) V/f with encoder(constant torque/reduced torque/ free / automatic boost control) Cascade type sensorless vector control, 0Hz sensorless vector control, Vector control with encoder
			SM/PMM	synchronous startup for smart sensorless vector control , IVMS start type sensor less vector control
Speed fluctuation ***3)**			±0.5%(sensorless vector control)	
Acceleration/deceleration time			0.00～3600.00s (Linear, S-curve, U-curve, Inverted-U-curve, EL-S-curve)	
Display			Output frequency, Output current, Output torque, trip history, input/output terminal status, input/output terminal function input/output power, PN voltage, etc, the rest is described in the chapter 4.	
Start functions			DC braking after the start, matching frequency after the start, active frequency matching start, Low-voltage start, retry restart	
Stop functions			After free run stop, deceleration stop, DC braking or external DC braking operation (Braking force, time, adjustment of operation speed)	
Stall prevention function			Overload limit function, overcurrent supression, overvoltage suppresion function	
Protection functions ***4)**			Overcurrent error, overload error, brake resistor overload, overvoltage error, memory error, undervoltage error, current detector error, CPU error, external trip error, USP error, ground error, supply overvoltage error, power loss error, temperature detector error, Cooling-fan rotation speed decrease, temperature error, phase input error, IGBT error, phase output error, thermistor error brake error, low-speed range overload error, inverter overload, RS485communication error, RTC error, the rest is described in the chapter 5.	
Other functions			V/f free setting (7 points), upper and lower speed limit, speed jump, curve acceleration and deceleration, manual torque boost energy-saven operation, analog output adjustment, minimun speed, carrier frequency adjustment, motor electronic thermal function(free is possible), inverter thermal function, external start-end(speed and rate), frequency input selection, trip retry, restart stop, various signal output, inilization setting, PID control, auto-decel at shut-off, brake control function, commercial switching function, auto-tuning (on/offline), etc. the rest is described in the chapter 4.	
Input	Frequency reference	Panel	UP, DOWN keys according to the set parameter.	
Input	Frequency reference	External signal ***5)**	VRF/IRF terminal (for voltage input)	0～10Vdc set by the voltage input (Input impedance:10kΩ)
Input	Frequency reference	External signal ***5)**	VRF/IRF terminal (for current input)	0～20mA set by the current input (Input impedance:100Ω)
Input	Frequency reference	External signal ***5)**	VF2 terminal	-10～+10Vdc set by the voltage input (Input impedance:10kΩ)
Input	Frequency reference	External signal ***5)**	Multi-speed terminal	16multi-speed(With the use of the intelligent input terminal)
Input	Frequency reference	External signal ***5)**	Pulse train-input	Maximum 32kHz×2
Input	Frequency reference	Communication port	RS485 serial communication (Protocol: Modbus-RTU)	
Input	RUN/Stop Forward/Reverse	Keypad	By RUN/Stop key (With the set parameter, forward/reverse can be switched)	
Input	RUN/Stop Forward/Reverse	External signal	Forward (FR)/Reverse(RR)(When input terminal functions are allocated) 3-wire input allowed(When input terminal functions are allocated)	
Input	RUN/Stop Forward/Reverse	Communication Port	Set by RS485 communication (Maximum: 115.2kbps)	
Input	Input terminals		11 terminals (A or B terminal accept a pulse train)	
Input	Input terminals		FR(Forward rotation)/RR(Reverse rotation), DFL/DFM/DFH/DHH(Multi-speed 1～4), SF1～7(Multi-speed bit 1～7), ADD(Trigger for frequency addition), AUT(Command change), STA(3-wire start)/STP(3-wire stop)/ F/R(Forward/reverse by 3-wire), AHD(Analog command holding, UP(Remote control up)/DWN(Remote control down), UDC(Remote data clearance), F-OP(Forcible operation), SET(2nd-motor), RST(Reset), JOG(Jogging), DB(External DC braking), AD2(2-stage accel/decel), MBS(Free-run stop), ES(External trip) USP(Unattended start protection), CS(Commercial power supply switching), SFT(Software lock), BOK(Braking confirmation) OLR(Overload restriction selection), KHC(Accumulated input power clear), OKHC(Accumulated input), PID(PID1 disable), PIDC(PID1 integration reset), PID2(PID2 disable), PIDC2(PID2 integration reset), PID3(PID3 disable), PIDC3(PID3 integration reset), PID4(PID4 disable), PIDC4(PID4 integration reset), SVC1～4(PID1 multistage target value 1～4), PRO(PID gain change), PIO1(PID output change 1), PIO2(PID output change 2), SLEP(SLEEP trigger)/WAKE(WAKE trigger), TL(Enable torque limit), TRQ1/2(Torque limit 1/2), PPI(P/PI switching), CAS(Control gain switching), SON(Servo-ON), FOC(Forcing), ATR(Enable torque command input), TBS(Enable torque bias), ORT(Home search function), LAC(LAD cancellation), PCLR(Position deviation clearance), STAT(Enable 90°-shift phase) PUP(Position bias addition), PDN(Position bias subtraction), CP1～4(Multistage position 1～4), ORL(Zero-return limit function) ORG(Zero-return trigger function), FOT(Forward drive stop), ROT(Reverse drive stop), SPD(Speed/position change), PSET(Position data pre-set), PCC(Pulse counter clearance), HLD(accel/decel stop), REN(Motion enable signal), DISP(Display lock), PLA(Pulse train input A), PLB(Pulse train input B), EMF(Emergency-force drive activation), COK(Contactor check signal), DTR(Data trace start signal) PLZ(Pulse train input Z), TCH(Teach-in signal)	
Input	Backup supply terminal		P+/P-: DC24V input(Input allowable voltage: 24V±10%)	
Input	Functional safety STO input terminal		2 terminals (Simultaneous input)	
Input	Thermistor input terminal		1 terminal (PTC/NTC resistor allowed)	

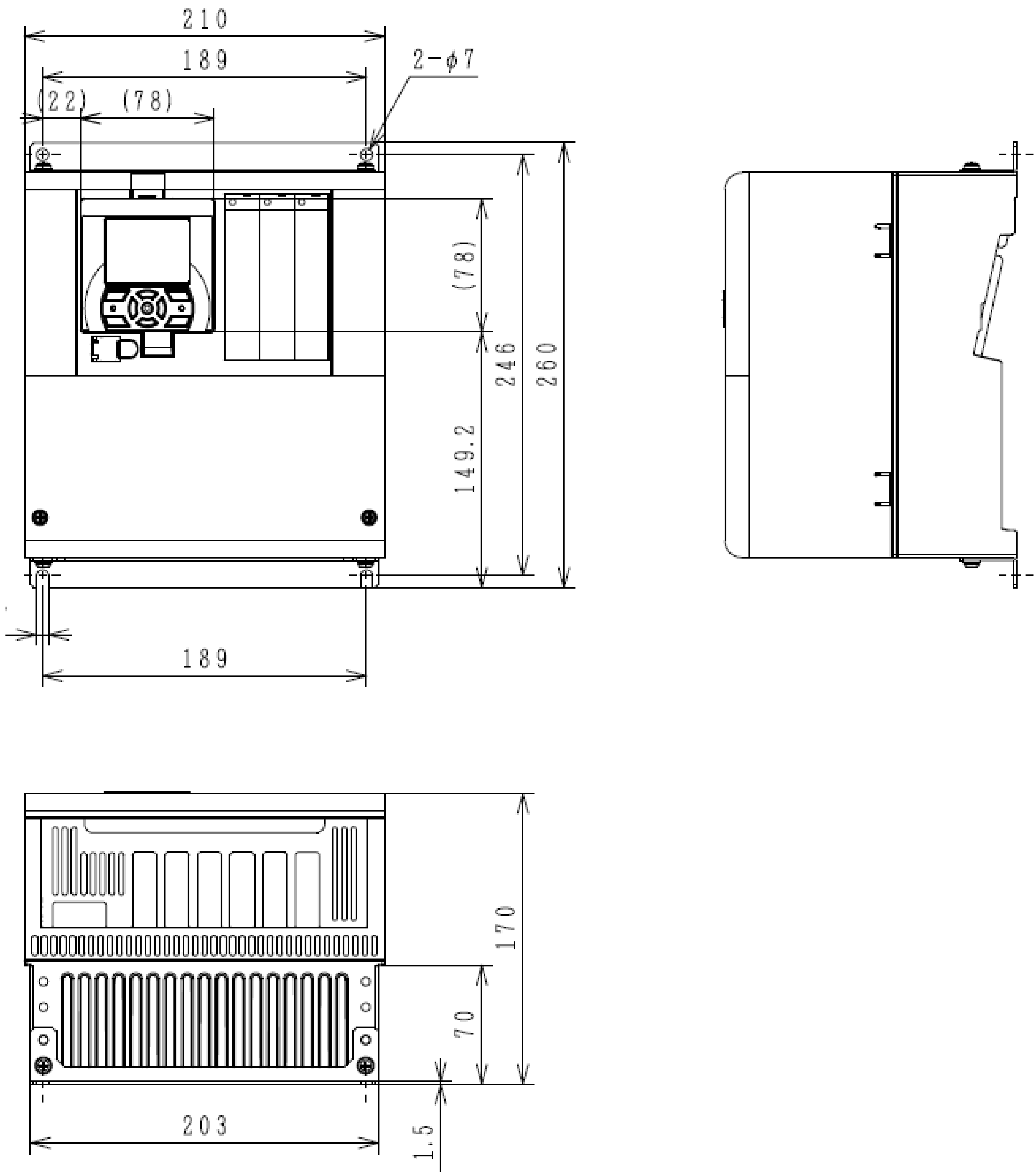
Common specifications (continued)

Output	Output terminals	Transistor output terminal 5, 1a contact relay 1 point, 1c contact relay 1 point	
Output	Output terminals / Relay/Alarm relay (1a, 1c) function	DRV(While in run), UPF1～5(Reached frequency signal), IRDY(Inverter ready), FRR(Forward rotation), RRR(Reverse rotation), FREF(panel frequency reference), REF(panel motion operation), SETM(2nd-motor selected), OPO(Option-Output), AL(Alarm signal), MJA(Major failure signal), OTQ(Over-torque), IP(Power loss), UV(Undervoltage), TRQ(Torque limited), IPS(Decel. Power loss), RNT(RUN time exceeded), ONT(ON time exceeded), THM(Motor electronic thermal warning), THC(Electronic thermal warning), WAC(Capacitor life warning), WAF(Cooling-fan life warning), FS(Operation signal), OHF(heat sink overheat warning), LOC/LOC2(Low-current indication signal), OL/OL2(Overload warning signal 1/2), BRK(Brake release)/BER(Brake error) CON(Contactor control), ZS(0Hz detection signal) DSE(Maximum speed deviation), PDD(Maximum position deviation), POK(Positioning completed), PCMP(Pulse counter compare output) OD/OD2/OD3/OD4(Output deviation for PID control), FBV/FBV2/FBV3/FBV4(PID feedback comparison), NDc(Communication disconnection), VRFDc/IRFDc/VF2Dc(Analog VRF/IRF/VF2 disconnection), Ai4Dc/Ai5Dc/Ai6Dc(Option analog Ai4/Ai5/Ai6 disconnection) WCVRF/WCIRF/WCVF2(Window comparator VRF/IRF/VF2), WCAi4/WCAi5/WCAi6(Window comparator Ai4/Ai5/Ai6),LOG1～7(logical operation result 1～7),EMFC(Emergency force drive indicator), EMBP(Bypass mode indicator), WFT(Trace waiting signal), TRA(Trace running signal), LBK(Low battery of panel), OVS(Overvoltage power Supply), AC0-3(Alarm code bit-0 to 4), SSE(PID soft start error)	
Output	EDM output terminal	Functional safety diagnostic output	
Output	Output terminal monitor *6)	The data of the monitor can be selected by the parameter of the output.	
EMC filter *7)		EMC filter can be enable (The filter exchange method can alter depending on the model)	
PC external access		USB Micro-B	
Operating environment	Ambient temperature	ND	-10～50°C
Operating environment	Ambient temperature	LD	-10～45°C
Operating environment	Ambient temperature	VLD	-10～40°C
Operating environment	Storage temperature *8)	-20～65°	
Operating environment	Level of humidity	20～90%RH(No condensation allowed)	
Operating environment	Vibration tolerance *9)	Model: up to HF4322-022 and up to HF4324-022	5.9m/s² (0.6G), 10～55Hz
Operating environment	Vibration tolerance *9)	Model: more than HF4322-030 and more than HF4324-030	2.94m/s² (0.3G), 10～55Hz
Operating environment	Installation place *10)	A maximum altitude of 1000m, without gases or dust.	
Components life span		The life span of the main circuit smoothing capacitors is 10 years.	
Components life span		The life span of the cooling-fan is 10 years.	
Conformity standards *11)		UL, cUL, CE marking, RCM Functional safety (STO function/ IEC61800-5-2,IEC62061,IEC61508: SIL3/ EN ISO13849-1: Cat.4 PLe)	
Coating color		Black	
Optional slots		3 ports	
Optional	Input/ouput option	Analog input/output option(available soon)	
Optional	Communication option *12)	CC-Link, PROFIBUS, PROFINET, Modbus-TCP	
Optional	Feedback option	Line driver input (RS422)	
Optional	Functional safety option	Functional safety option(STO/SS1/SBC/SLS/SDI/SSM function / IEC61800-5-2,IEC62061, IEC61508: SIL3/ EN ISO13849-1: Cat.4 PLe)	
Other optional components		Braking resistor, AC reactor, DC reactor, Noise filter,Radio noise filter, Zero phase reactor,operator cable, regenerative braking unit, PC software	

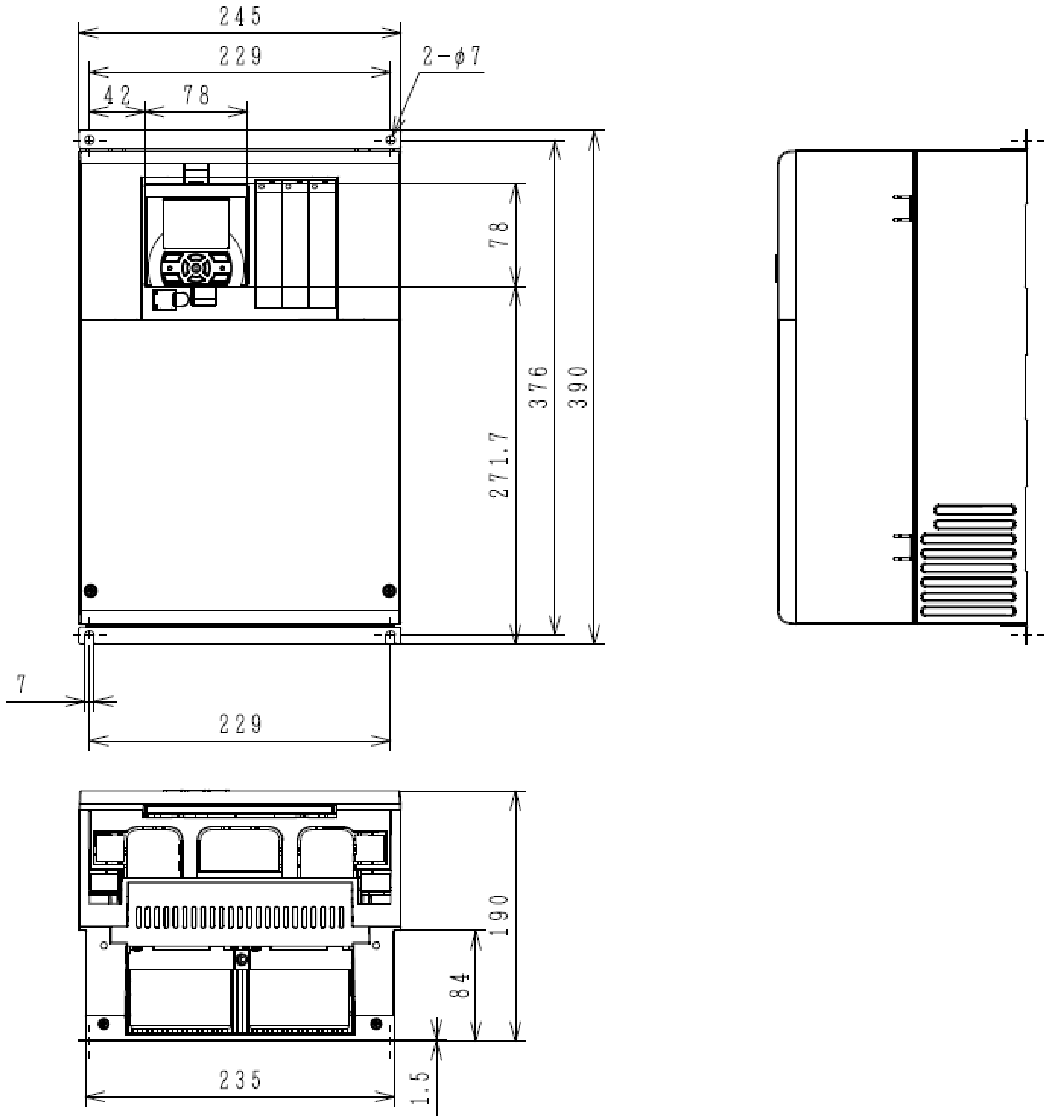
*1) Output frequency range will depend on the motor control method and the motor used. Consult the motor manufacturer for the maximum allowable frequency of the motor when operating beyond 60Hz.
*2) In case of the control mode is changed and the motor constant is not set appropriately, the desired starting torque cannot be obtained and also exists the possibility of tripping.
*3) Regarding the speed range regulation of motor, the variable range depends on the client system and the environment in which the motor is used.
*4) If the IGBT error [E030] occurs by the protective function, it may have happened by the short-circuit protection, but also can occur if the IGBT is damaged. Depending on the operation status of the inverter, instead of the IGBT error, the overcurrent error [E001] may also occur.
*5) At factory setting, the maximum output frequency for analogue input signal VRF/IRF is adjusted to 9.8V for voltage input and 19.6mA for current input. In order to adjust the specification use analogue start/end function.
*6) The analogue voltage and analogue current monitor are estimated outputs of the analogue meter connection. Maximum output value might deviate slightly from 10V or 20mA by variation of the analogue output circuit. If you want to change the characteristics, adjust the Ao1 and Ao2 adjustment functions.
There are some monitor data that cannot be output.
*7) In order to enable the EMC filter, connect to the neutral grounding supply. Otherwise, the leakage current may increase.
*8) Storage temperature is the temperature during transport.
*9) In accordance with the test methods of JIS C 60068-2-6:2010(IEC 60068-2-6:2007).
*10) In case of utilization at an altitude of 1000m or more, take into account that the atmospheric pressure is reduced by 1% for every 100m up. Apply 1% derating from the rated current by increasing every 100m, and conduct an evaluation test.
When using above 2500m ambient, please contact Hitachi Inverter distributer.
*11) Insulation distance is in accordance with the UL and CE standards.
*12) Modbus is a registered trademark of Schneider Automation Inc.
PROFIBUS® and PROFINET® is registered trademark of PROFIBUS Nutzerorganisation e.V. (PNO).

20.3 External dimensions

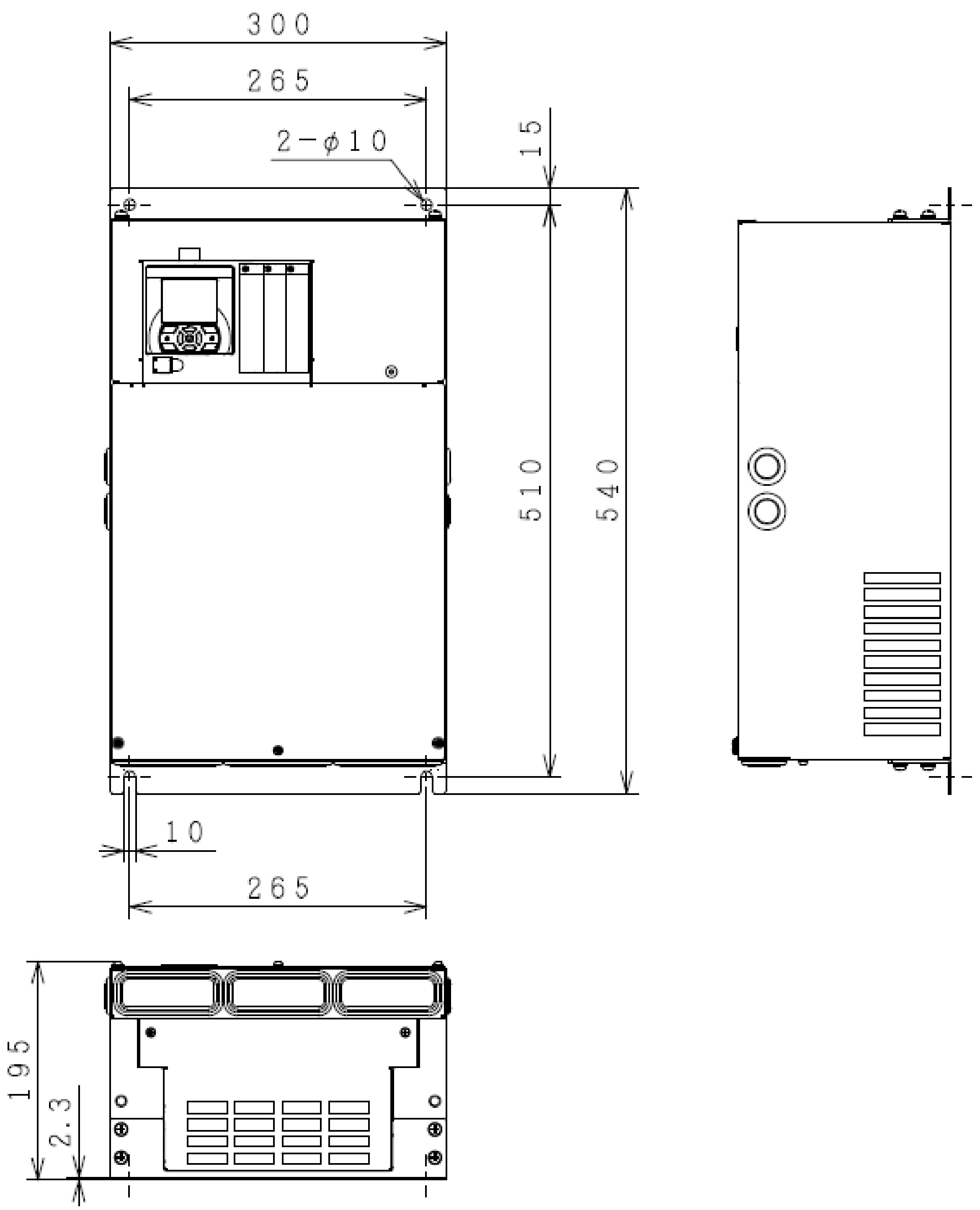
Model			
200V class: HF4322-5A5 to HF4322-011（5.5～11kW） 400V class: HF4324-5A5 to HF4324-011（5.5～11kW）			
Dimension	W (mm)	H (mm)	D (mm)
	210	260	170



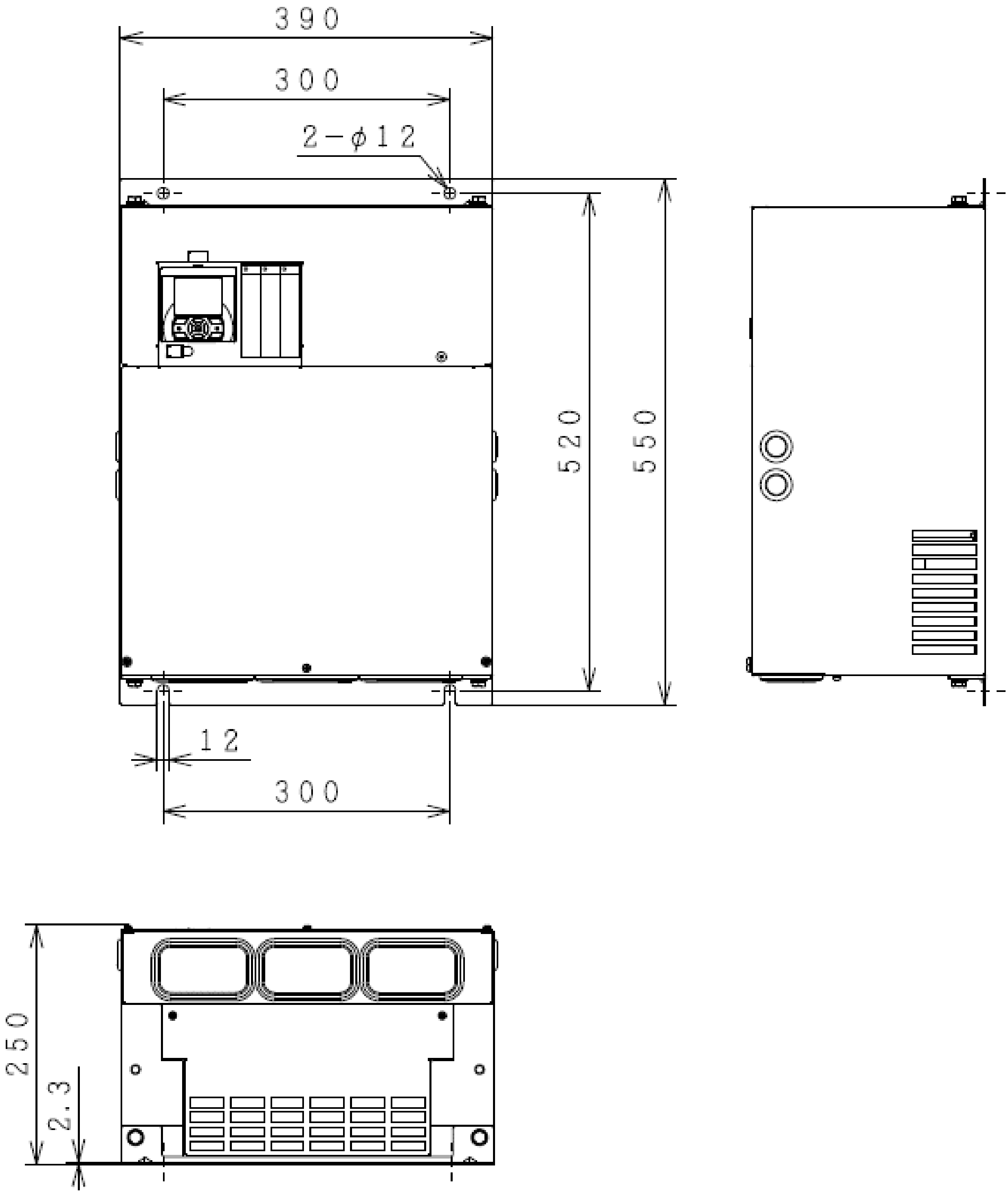
Model			
200V class: HF4322-015（15kW）HF4322-022（22kW） 400V class: HF4324-015（15kW）HF4324-022（22kW）			
Dimension	W (mm)	H (mm)	D (mm)
	245	390	190



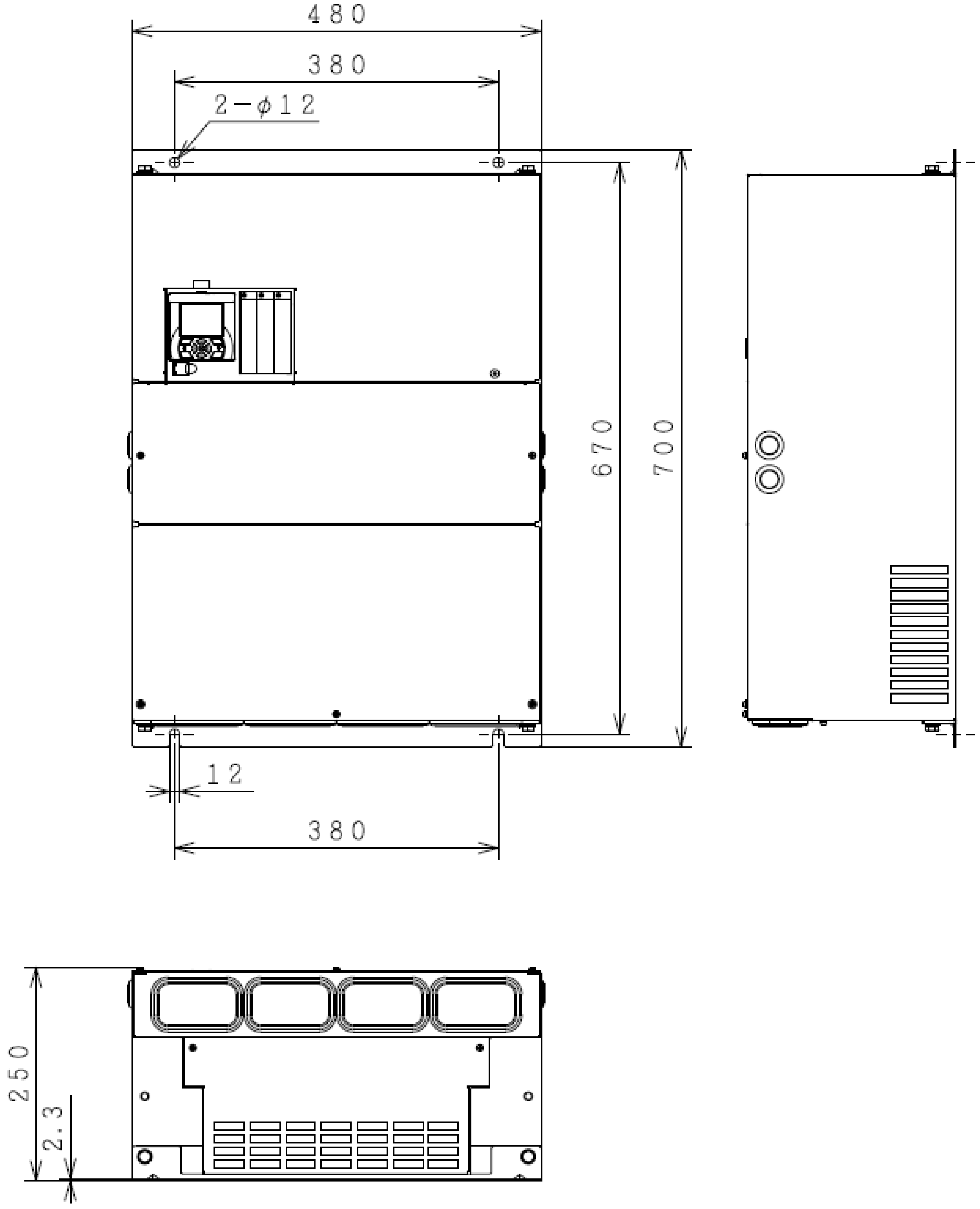
Model			
200V class: HF4322-030（30kW） 400V class: HF4324-030（30kW）			
Dimension	W (mm)	H (mm)	D (mm)
	300	540	195



Model		
200V class: HF4322-037 (37kW), HF4322-045 (45kW) 400V class: HF4324-037 to HF4324-055 (37,45,55kW)			
Dimension	W (mm)	H (mm)	D (mm)
	390	550	250



Model			
200V class: HF4322-055 (55kW)			
Dimension	W (mm)	H (mm)	D (mm)
	480	700	250



20.4 Current Derating Table

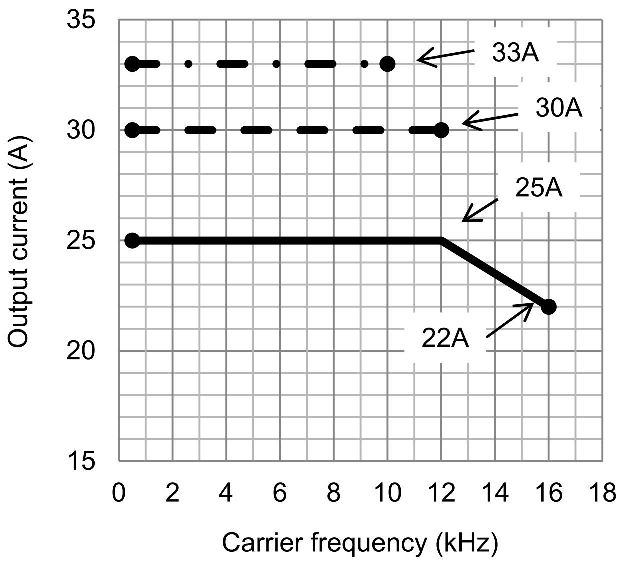
Caution

Please use the inverter within the current range in accordance with the derating tables of respective models. If you use the inverter exceeding the derating range, note that the inverter may be damaged or its life may be shortened.

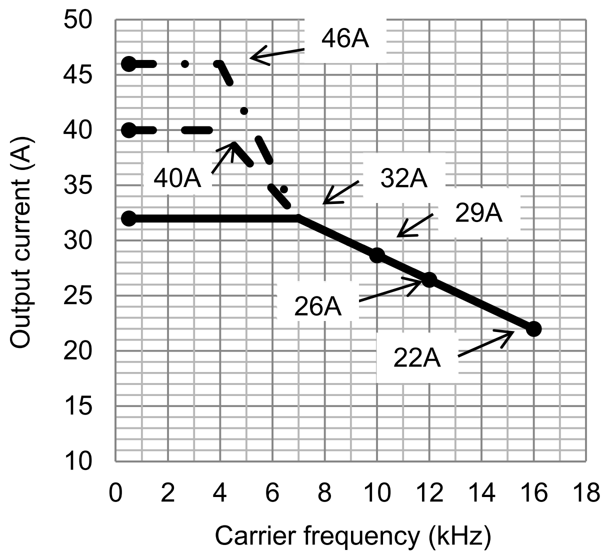
20.4.1 200V class

50°C: ND rating (normal duty rating)
45°C: LD rating (low duty rating)
40°C: VLD rating (very low duty

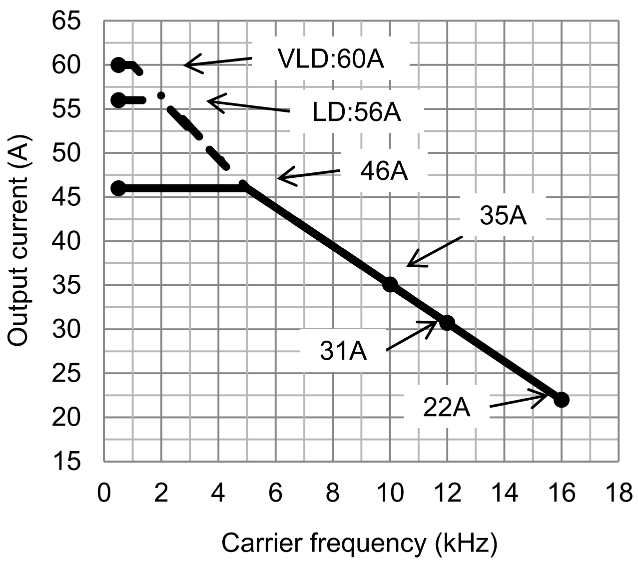
■HF4322-5A5（5.5kW）



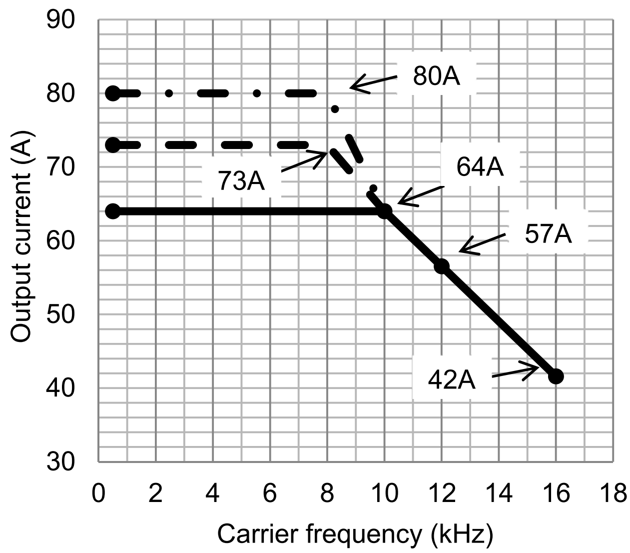
■HF4322-7A5（7.5kW）



■HF4322-011（11kW）



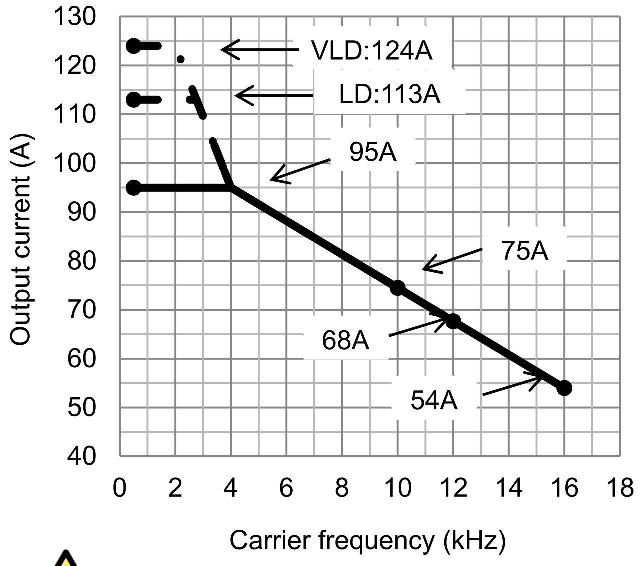
■HF4322-015（15kW）



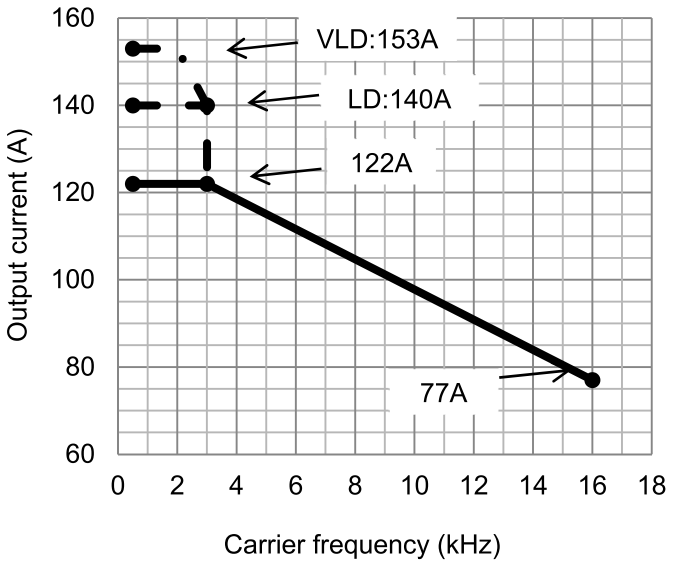
Caution

When using HF4322-011 at LD (low duty rating) / VLD (very low duty rating), care must be taken for installation. See notes described in “6.3 External Dimensions".

■HF4322-022（22kW）

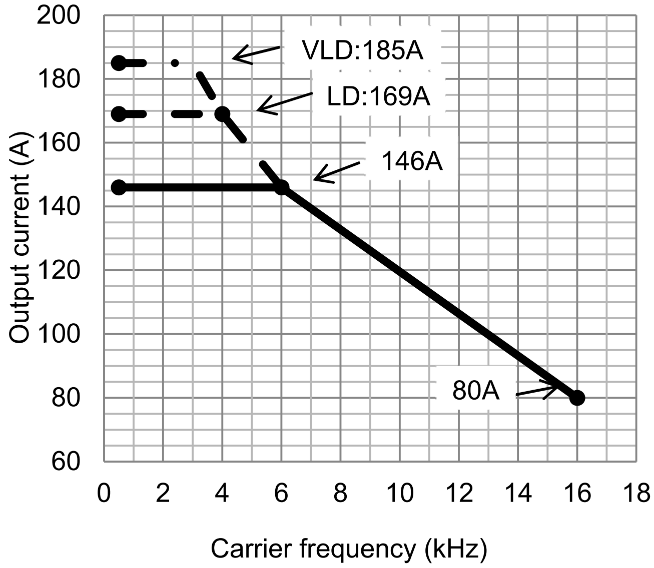


■HF4322-030（30kW）

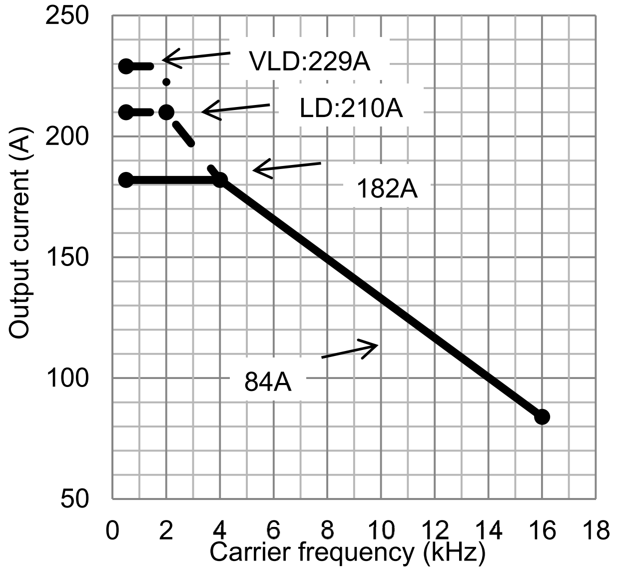


Caution When using HF4322-022 at VLD (very low duty rating), care must be taken for installation. See notes described in “6.3 External Dimensions".

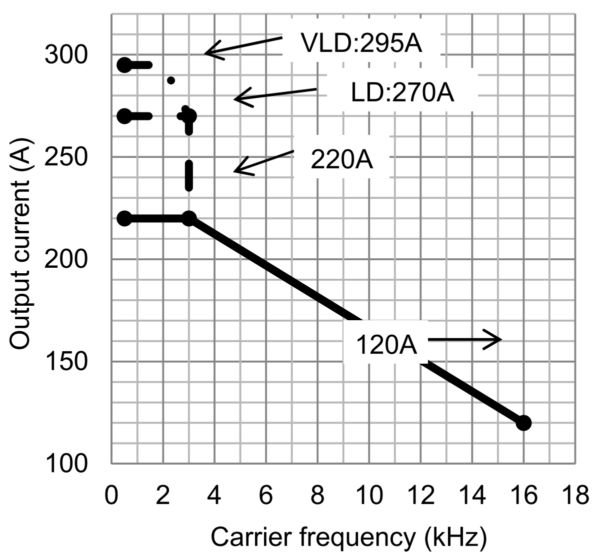
■HF4322-037（37kW）



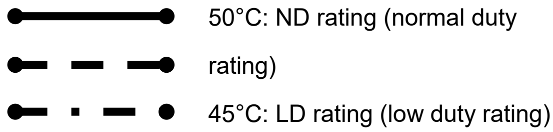
■HF4322-045（45kW）



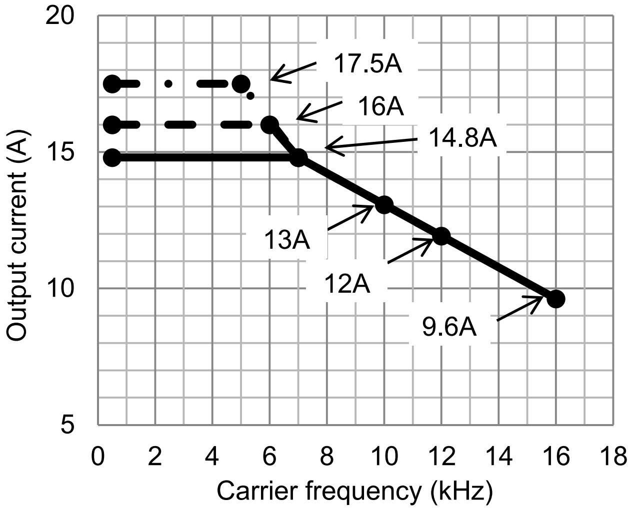
■HF4322-055（55kW）



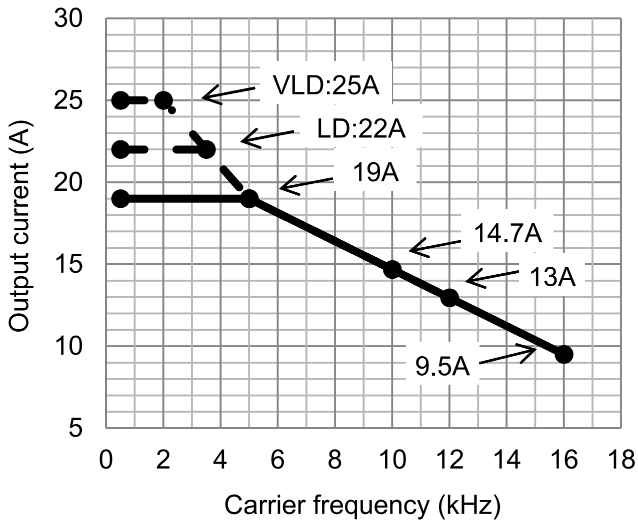
20.4.2 400V class



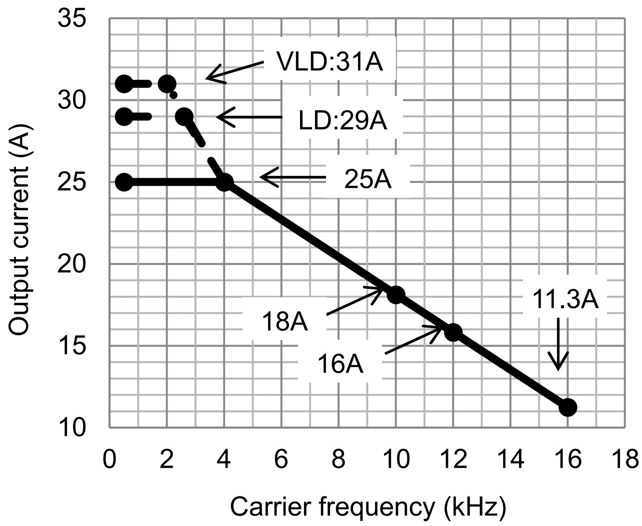
■HF4324-5A5（5.5kW）



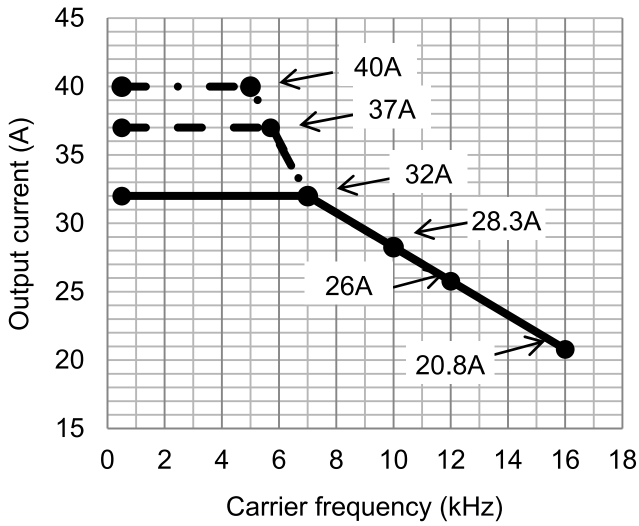
■HF4324-7A5（7.5kW）



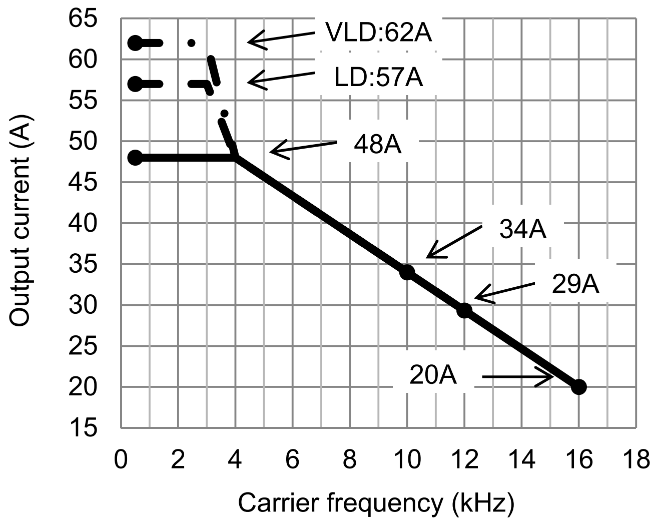
■HF4324-011（11kW）



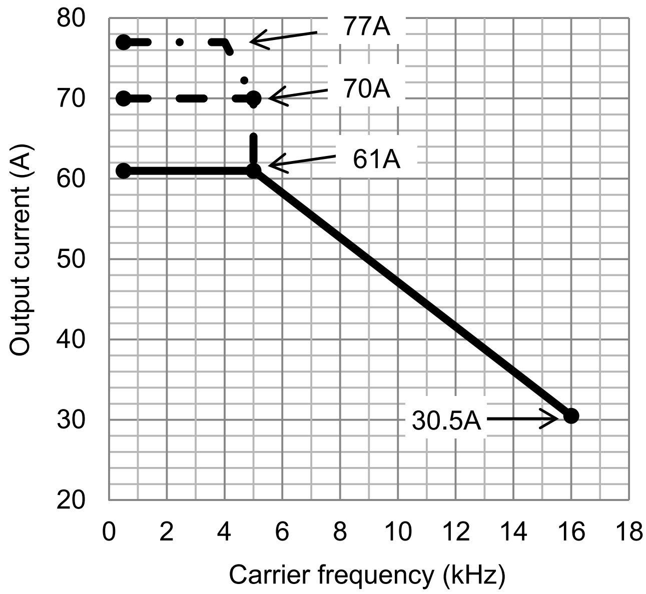
■HF4324-015（15kW）



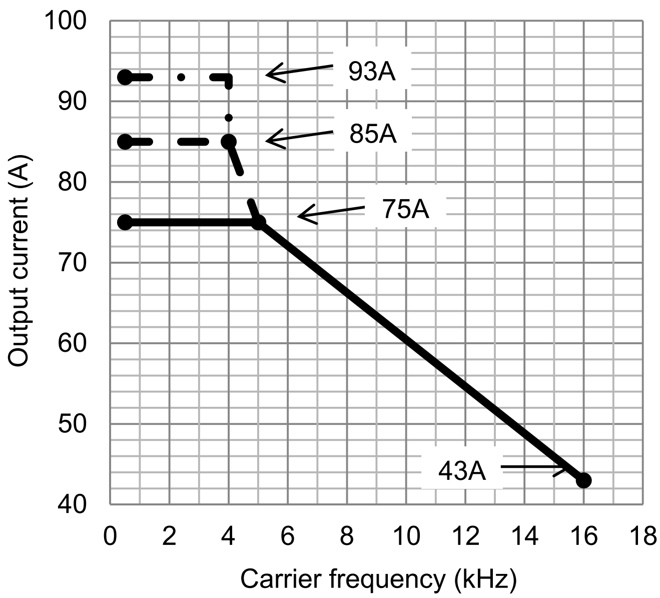
■HF4324-022（22kW）



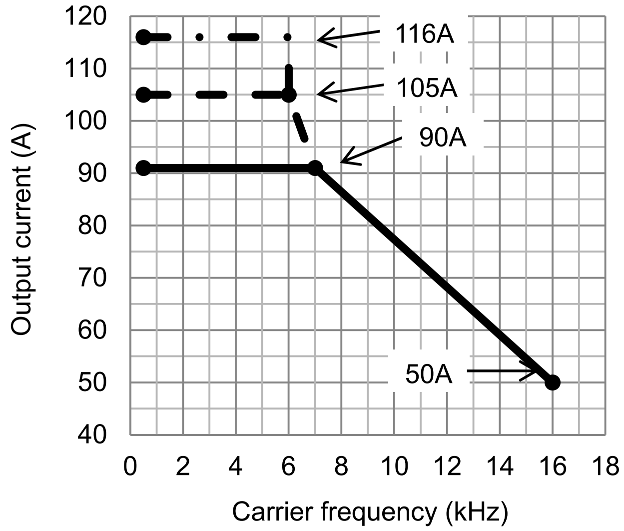
■HF4324-030（30kW）



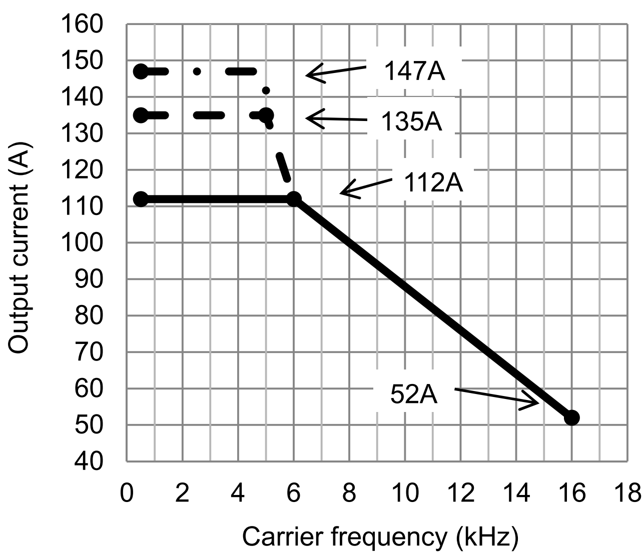
■HF4324-037（37kW）



■HF4324-045（45kW）



■HF4324-055（55kW）



Chapter 21 Technical Notes

21

21.1 What This Chapter Explains

This chapter describes technical notes on the inverter.
It also provides points to be noted on the replacement method from HF-430α. (In preparation)
For detailed replacement procedure of each model, check the inverter replacement procedure.
Please access our web site or contact our sales agency.
For conversion of setting parameter, you can use PC software SAFS001. (In preparation)

21.2 Replacement from HF-430α

21.2.1 Comparison of External Dimensions

・Since HF-430α and HF-430NEO have the same installation pitch, installation is available without any change when replacing.
・When installing HF-430NEO, see "Chapter 6 Installation".

21.2.2 Parameters

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
d001	Output frequency monitor	dA-01	-
d002	Output current monitor	dA-02	
d003	Operation direction monitor	dA-03	
d004	PID feedback monitor	db-30	
d005	Intelligent input monitor	dA-51	
d006	Intelligent output monitor	dA-54	
d007	Frequency conversion monitor	dA-06	
d008	Real frequency monitor	dA-08	
d009	Torque command monitor	FA-15	
d010	Torque bias monitor	FA-16	
d012	Output torque monitor	dA-17	AA-121and AA-221＝07～12：Available
d013	Output voltage monitor	dA-18	
d014	Input power monitor	dA-30	
d015	Integrated power monitor	dA-32	
d016	Cumulative operating hours monitor during RUN	dC-22	
d017	Power ON time monitor	dC-24	
d018	Cooling fin temperature monitor	dC-15	
d019	Motor temperature monitor	dA-38	
d022	Life diagnostic monitor	dC-16	
d023	Program counter	db-03	
d024	Program number monitor	db-02	
d025	User monitor 0	db-08	
d026	User monitor 1	db-10	
d027	User monitor 2	db-12	
d028	Pulse counter monitor	dA-28	
d029	Position command monitor	FA-20	
d030	Current position monitor	dA-20	
d060	Inverter mode monitor	dC-01 dC-45	The monitor can be checked with dC-01: duty type and dC-45: IM/SM.
d080	Trip frequency monitor	-	Display function is equipped on the operator keypad.
d081	Trip history monitor 1		
d082	Trip history monitor 2		
d083	Trip history monitor 3		
d084	Trip history monitor 4		
d085	Trip history monitor 5		
d086	Trip history monitor 6		
d090	Warning monitor		
d102	DC voltage monitor	dA-40	-
d103	BRD load factor monitor	dA-41	
d104	BRD thermal load factor monitor	dA-42	
F001	Output frequency setting	FA-01	-
F002	First acceleration time setting	AC120	
F202	Second acceleration time setting	AC220	
F302	Third acceleration time setting	-	Abolition of third control
F003	First deceleration time setting	AC122	-
F203	Second deceleration time setting	AC222	
F303	Third deceleration time setting	-	Abolition of third control
F004	Operation direction selection	AA-12	-

＊The content of parameters may be different depending on HF-430α and HF-430NEO.
Set parameters after fully checking description of the functions.

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
A001	Frequency command selection	AA101	Addition of individual settings for second control
A002	Operation command selection	AA111	-
A003	First base frequency	Hb104/Hd104	Hb104：IM, Hd104：SM(PMM)
A203	Second base frequency	Hb204/Hd204	Hb204：IM, Hd204：SM(PMM)
A303	Third base frequency	-	Abolition of third control
A004	First maximum frequency	Hb105/Hd105	Hb105：IM, Hd105：SM(PMM)
A204	Second maximum frequency	Hb205/Hd205	Hb205：IM, Hd205：SM(PMM)
A304	Third maximum frequency	-	Abolition of third control
A005	AUT terminal selection	-	This function is substituted by the setting of AA101/AA102 and AUT (input terminal 015)
A006	VRF2 selection	-	This function is substituted by the setting of Cb-22
A011	VRF start	Cb-03	For VRF
A012	VRF end	Cb-04	
A013	VRF start ratio	Cb-05	
A014	VRF end ratio	Cb-06	
A015	VRF start selection	Cb-07	
A016	Analog input filter	Cb-01	For VRF (IRF: Cb-11, VF2: Cb-21)
A017	Simplified sequence function selection	UE-02	-
A019	Multistep speed selection	Ab-03	
A020	0th speed of the 1st multi-step speed	Ab110	
A220	0th speed of the 2nd multi-step speed	Ab210	
A320	0th speed of the 3rd multi-step speed	-	Abolition of third control
A021	1st speed of the multi-step speed	Ab-11	-
A022	2nd speed of the multi-step speed	Ab-12	
A023	3rd speed of the multi-step speed	Ab-13	
A024	4th speed of the multi-step speed	Ab-14	
A025	5th speed of the multi-step speed	Ab-15	
A026	6th speed of the multi-step speed	Ab-16	
A027	7th speed of the multi-step speed	Ab-17	
A028	8th speed of the multi-step speed	Ab-18	
A029	9th speed of the multi-step speed	Ab-19	
A030	10th speed of the multi-step speed	Ab-20	
A031	11th speed of the multi-step speed	Ab-21	
A032	12th speed of the multi-step speed	Ab-22	
A033	13th speed of the multi-step speed	Ab-23	
A034	14th speed of the multi-step speed	Ab-24	
A035	15th speed of the multi-step speed	Ab-25	
A038	Jogging frequency	AG-20	
A039	Jogging selection	AG-21	
A041	First torque boost selection	AA121	When A041 is set to 01, select 03: automatic boost for AA121.
A241	Second torque boost selection	AA221	When A241 is set to 01, select 03: automatic boost for AA221.
A042	First manual torque boost volume	Hb141	* Re-confirmation is required for setting.
A242	Second manual torque boost volume	Hb241	
A342	Third manual torque boost volume	-	Abolition of third control
A043	First manual torque boost break point	Hb142	* Re-confirmation is required for setting.
A243	Second manual torque boost break point	Hb242	
A343	Third manual torque boost break point	-	Abolition of third control
A044	First control mode	AA121	* Re-confirmation is required for setting.
A244	Second control mode	AA221	
A344	Third control mode	-	Abolition of third control
A045	Output voltage gain	Hb180	Addition of individual settings for second control
A046	First voltage compensation gain for automatic torque boost	HC101	-

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
A246	Second voltage compensation gain for automatic torque boost	HC201	-
A047	First slip compensation gain for automatic torque boost	HC102	
A247	Second slip compensation gain for automatic torque boost	HC202	
A051	DC braking selection	AF101	Addition of individual settings for second control
A052	DC braking frequency	AF103	
A053	DC braking delay time	AF104	
A054	DC braking force	AF105	
A055	DC braking time	AF106	
A056	DC braking edge/level selection	AF107	
A057	DC braking force at the start	AF108	
A058	DC braking time at the start	AF109	
A059	DC braking carrier frequency	-	Integrated into bb101
A061	First frequency upper limiter	bA102	-
A261	Second frequency upper limiter	bA202	
A062	First frequency lower limiter	bA103	
A262	Second frequency lower limiter	bA203	
A063	Jump frequency 1	AG101	Addition of individual settings for second control
A064	Jump frequency width 1	AG102	
A065	Jump frequency 2	AG103	
A066	Jump frequency width 2	AG104	
A067	Jump frequency 3	AG105	
A068	Jump frequency width 3	AG106	
A069	Acceleration stop frequency	AG110	
A070	Acceleration stop time	AG111	
A071	PID selection	AH-01	
A072	PID P gain	AH-61	
A073	PID I gain	AH-62	
A074	PID D gain	AH-63	
A075	PID scale	-	Configured with AH-04 - AH-06
A076	PID feedback selection	AH-51	-
A077	PID deviation reverse output	AH-02	
A078	PID changeable range	AH-71	
A079	PID feed forward selection	AH-70	
A081	AVR selection	bA146	Second control extension 00→00, 01→01, 02→02 The same values are used for equivalent operations.
A082	Motor incoming voltage selection	Hb106/Hd106	Configured with Hb106 (IM)/Hd106 (SM/PMM).
A085	Operation mode selection	Hb145	Addition of individual settings for second control
A086	Energy-saving response/accuracy adjustment	Hb146	
A092	First acceleration time 2	AC124	-
A292	Second acceleration time 2	AC224	
A392	Second acceleration time 3	-	Abolition of third control
A093	First deceleration time 2	AC126	-
A293	Second deceleration time 2	AC226	
A393	Second deceleration time 3	-	Abolition of third control
A094	First 2-step acceleration/deceleration selection	AC115	-
A294	Second 2-step acceleration/deceleration selection	AC215	
A095	First 2-stage acceleration frequency	AC116	
A295	Second 2-stage acceleration frequency	AC216	
A096	First 2-stage deceleration frequency	AC117	
A296	Second 2-stage deceleration frequency	AC217	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
A097	Acceleration pattern selection	AC-03	-
A098	Deceleration pattern selection	AC-04	
A101	IRF start	Cb-13	For IRF
A102	IRF end	Cb-14	
A103	IRF start ratio	Cb-15	
A104	IRF end ratio	Cb-16	
A105	IRF start selection	Cb-17	
A111	VRF2 start	Cb-23	For VF2
A112	VRF2 end	Cb-24	
A113	VRF2 start ratio	Cb-25	
A114	VRF2 end ratio	Cb-26	
A131	Acceleration curve constant	AC-05	-
A132	Deceleration curve constant	AC-06	
A141	Operation frequency selection 1	AA101	Integrated into main speed/auxiliary speed command. Addition of individual settings for second control
A142	Arithmetic operation frequency selection 2	AA102	
A143	Arithmetic operation operator selection	AA105	Addition of individual settings for second control
A145	Additional frequency setting	AA106	
A146	Additional frequency sign selection	-	You can change the sign by setting AA106 with ±.
A150	Curvature 1 for EL-S-shaped acceleration	AC-08	-
A151	Curvature 2 for EL-S-shaped acceleration	AC-09	
A152	Curvature 1 for EL-S-shaped deceleration	AC-10	
A153	Curvature 2 for EL-S-shaped deceleration	AC-11	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
b001	Selection of instantaneous power failure/ under voltage restart	bb-24	Specify b001=00 (trip) with retry count (instantaneous power failure [bb-20]/under voltage [bb-21]) with zero.
b002	Allowable instantaneous power failure time	bb-25	-
b003	Retry stand-by time for instantaneous power failure and insufficient voltage	bb-26	
b004	Instantaneous power failure/under voltage tripping selection during stop	bb-27	
b005	Selection of instantaneous power failure retry count	bb-20	0: trip, 255: infinite
b006	Input phase loss selection	bb-65	-
b007	f matching lower limit frequency setting	bb-42	
b008	Trip retry selection	bb-28	Specify b008=00 (trip) with retry count (overvoltage [bb-22]/undercurrent [bb-23]) with zero.
b009	Selection of under voltage retry count	bb-21	0: trip, 255: infinite
b010	Selection of overvoltage/overcurrent retry count	bb-22 bb-23	Specify overvoltage [bb-22] and overcurrent [bb-23] individually.
b011	Trip retry standby time	bb-29	-
b012	First electronic thermal level	bC110	
b212	Second electronic thermal level	bC210	
b312	Third electronic thermal level	-	Abolition of third control
b013	Selection of first electronic thermal characteristics	bC111	-
b213	Selection of second electronic thermal characteristics	bC211	
b313	Selection of third electronic thermal characteristics	-	Abolition of third control
b015	Free electronic thermal frequency 1	bC120	Addition of individual settings for second control
b016	Free electronic thermal current 1	bC121	
b017	Free electronic thermal frequency 2	bC122	
b018	Free electronic thermal current 2	bC123	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
b019	Free electronic thermal frequency 3	bC124	Addition of individual settings for second control
b020	Free electronic thermal current 3	bC125	
b021	Overload limit selection	bA122	
b022	Overload limit level	bA123	
b023	Overload limit constant	bA124	
b024	Overload limit selection 2	bA126	
b025	Overload limit level 2	bA127	
b026	Overload limit constant 2	bA128	
b027	Overcurrent suppression selection	bA120	
b028	Frequency pull-in restart level	bb-43	-
b029	Frequency pull-in restart constant	bb-44	
b030	Start frequency selection for frequency pull-in restart	bb-47	
b031	Soft-lock selection	UA-16	
b034	RUN time/power supply ON time level	CE-36	
b035	Operation direction limit selection	AA114	Addition of individual settings for second control
b036	Reduced voltage start selection	Hb131	
b037	Display selection	UA-10	-
b038	Initial screen selection	UA-91	For the operator keypad, you can select an initial screen in System settings of keypad.
b039	User parameter automatic setting function	UA-30	-
b040	Torque limit selection	bA110	Addition of individual settings for second control
b041	Torque limit 1 (Four-quadrant mode normal powered)	bA112	
b042	Torque limit 2 (Four-quadrant mode reverse regenerative)	bA113	
b043	Torque limit 3 (Four-quadrant mode reverse powered)	bA114	
b044	Torque limit 4 (Four-quadrant mode normal regenerative)	bA115	
b045	Torque LADSTOP selection	bA116	
b046	Selection of reversal prevention	HC114	
b050	Instantaneous power failure non-stop selection	bA-30	-
b051	Instantaneous power failure non-stop starting voltage	bA-31	
b052	Instantaneous power failure non-stop OV-LADSTOP level (target voltage level)	bA-32	
b053	Instantaneous power failure non-stop deceleration time	bA-34	
b054	Instantaneous power failure non-stop deceleration start range	bA-36	
b055	Instantaneous power failure non-stop proportional gain setting	bA-37	
b056	Instantaneous power failure non-stop integrated time setting	bA-38	
b060	Window comparator VRF upper limit	CE-40	
b061	Window comparator VRF lower limit	CE-41	
b062	Window comparator VRF hysteresis width	CE-42	
b063	Window comparator IRF upper limit level	CE-43	
b064	Window comparator IRF lower limit level	CE-44	
b065	Window comparator IRF hysteresis width	CE-45	
b066	Window comparator VRF2 upper limit level	CE-46	
b067	Window comparator VRF2 lower limit level	CE-47	
b068	Window comparator VRF2 hysteresis width	CE-48	
b070	VRF operation level at disconnection	CE-50	
b071	IRF operation level at disconnection	CE-52	
b072	VRF2 operation level at disconnection	CE-54	
b078	Deletion of integrated power	UA-12	
b079	Integrated power display gain	UA-13	
b082	Starting frequency	Hb130	Addition of individual settings for second control
b083	Carrier frequency	bb101	
b084	Selection of initialization	Ub-01	-
b085	Initialization data selection	Ub-02	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
b086	Frequency conversion coefficient	Ab-01	-
b087	Stop key selection	AA-13	
b088	Free-run stop selection	bb-40	
b089	Automatic carrier reduction	bb103	Addition of individual settings for second control
b090	BRD use rate	bA-60	-
b091	Stop mode selection	AA115	Addition of individual settings for second control
b092	Cooling fan operation selection	bA-70	-
b095	DBTR selection	bA-61	
b096	DBTR on level	bA-62	
b098	Thermistor selection	Cb-40	
b099	Thermistor error level	bb-70	
b100	Free V/f frequency 1	Hb150	Addition of individual settings for second control
b101	Free V/f voltage 1	Hb151	
b102	Free V/f frequency 2	Hb152	
b103	Free V/f voltage 2	Hb153	
b104	Free V/f frequency 3	Hb154	
b105	Free V/f voltage 3	Hb155	
b106	Free V/f frequency 4	Hb156	
b107	Free V/f voltage 4	Hb157	
b108	Free V/f frequency 5	Hb158	
b109	Free V/f voltage 5	Hb159	
b110	Free V/f frequency 6	Hb160	
b111	Free V/f voltage 6	Hb161	
b112	Free V/f frequency 7	Hb162	
b113	Free V/f voltage 7	Hb163	
b120	Brake control selection	AF130	
b121	Establishment waiting time	AF131	
b122	Acceleration waiting time	AF132	
b123	Stop waiting time	AF133	
b124	Brake check waiting time	AF134	
b125	Brake release frequency	AF135	
b126	Brake release current	AF136	
b127	Brake apply frequency	AF137	
b130	Overvoltage suppression function selection	bA140	
b131	Overvoltage suppression level	bA141	
b132	Overvoltage suppression constant	bA142	
b133	Overvoltage suppression proportional gain setting	bA144	
b134	Overvoltage suppression integrated time setting	bA145	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
C001	Selection of intelligent input terminal RST	CA-09	-
C002	Selection of intelligent input terminal ES	CA-08	
C003	Selection of intelligent input terminal JOG	CA-07	
C004	Selection of intelligent input terminal MBS	CA-06	
C005	Selection of intelligent input terminal AUT	CA-05	
C006	Selection of intelligent input terminal DFM	CA-04	
C007	Selection of intelligent input terminal DFL	CA-03	
C008	Selection of intelligent input terminal RR	CA-02	
C011	Selection of intelligent input terminal RST a/b (NO/NC)	CA-29	
C012	Selection of intelligent input terminal ES a/b (NO/NC)	CA-28	
C013	Selection of intelligent input terminal JOG a/b (NO/NC)	CA-27	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
C014	Selection of intelligent input terminal MBS a/b (NO/NC)	CA-26	-
C015	Selection of intelligent input terminal AUT a/b (NO/NC)	CA-25	
C016	Selection of intelligent input terminal DFM a/b (NO/NC)	CA-24	
C017	Selection of intelligent input terminal DFL a/b (NO/NC)	CA-23	
C018	Selection of intelligent input terminal RR a/b (NO/NC)	CA-22	
C019	Selection of FR terminal a/b (NO/NC)	CA-01	For CA-01 = FR (input terminal 001)
C021	Selection of intelligent output terminal UPF	CC-01	-
C022	Selection of intelligent output terminal DRV	CC-02	
C023	Selection of intelligent output terminal X1	CC-03	
C024	Selection of intelligent output terminal X2	CC-04	
C025	Selection of intelligent output terminal X3	CC-05	
C026	Selection of intelligent relay terminal	CC-07	
C027	FRQ selection	Cd-03	
C028	AMV selection	Cd-04	
C029	AMI selection	Cd-05	
C030	Reference value of digital current monitor	-	Configured with Cd-02 (settings need to be checked)
C031	Selection of intelligent output terminal UPF a/b (NO/NC)	CC-11	-
C032	Selection of intelligent output terminal DRV a/b (NO/NC)	CC-12	
C033	Selection of intelligent output terminal X1 a/b (NO/NC)	CC-13	
C034	Selection of intelligent output terminal X2 a/b (NO/NC)	CC-14	
C035	Selection of intelligent output terminal X3 a/b (NO/NC)	CC-15	
C036	Selection of intelligent relay a/b (NO/NC)	CC-17	
C038	Low current signal output mode selection	CE101	Addition of individual settings for second control
C039	Low current detection level	CE102	
C040	Overload advance notice signal output mode selection	CE105	
C041	Overload advance notice level	CE106	
C042	Acceleration reaching frequency	CE-10	-
C043	Deceleration reaching frequency	CE-11	
C044	PID excessive deviation level	AH-72	
C045	Acceleration reaching frequency 2	CE-12	
C046	Deceleration reaching frequency 2	CE-13	
C052	Feedback comparison signal OFF level	AH-73	
C053	Feedback comparison signal ON level	AH-74	
C055	Over torque level (normal rotation powered)	CE120	Addition of individual settings for second control
C056	Over torque level (reverse rotation regenerative)	CE121	
C057	Over torque level (reverse rotation powered)	CE122	
C058	Over torque level (normal rotation regenerative)	CE123	
C061	Thermal warning level	CE-30	-
C062	Alarm code selection	-	This function is enabled when an alarm code (084-087) is set to an input terminal.
C063	0Hz detection level	CE-33	-
C064	Cooling fin overheat advance notice level	CE-34	
C071	Communication transmission speed selection	CF-01	
C072	Communication station number selection	CF-02	
C073	Communication bit length selection	-	Abolished due to Modbus communication
C074	Communication parity selection	CF-03	-
C075	Communication stop bit selection	CF-04	
C076	Communication error selection	CF-05	
C077	Communication trip time	CF-06	
C078	Stop waiting time	CF-07	
C079	Communication method selection	-	Abolished due to Modbus communication
C081	VRF adjustment	-	Adjusted with Cb-30 or Cb-31
C082	IRF adjustment	-	Adjusted with Cb-32 or Cb-33
C083	VF2 adjustment	-	Adjusted with Cb-34 or Cb-35

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
C085	Thermistor adjustment	Cb-41	-
C091	Debug mode selection	UC-01	
C101	UP/DWN memory selection	CA-61	
C102	Reset selection	CA-72	
C103	Reset f matching selection	bb-41	
C105	FRQ gain setting	Cd-14	
C106	AMV gain setting	Cd-24	
C107	AMI gain setting	Cd-34	
C109	AMV bias setting	Cd-23	
C110	AMI bias setting	Cd-33	
C111	Overload advance notice level 2	CE107	
C121	VRF zero adjustment	Cb-30/Cb-31	Adjusted with Cb-30 or Cb-31
C122	IRF zero adjustment	Cb-32/Cb-33	Adjusted with Cb-32 or Cb-33
C123	VRF2 zero adjustment	Cb-34/Cb-35	Adjusted with Cb-34 or Cb-35
C130	Output UPF on-delay time	CC-20	-
C131	Output UPF off-delay time	CC-21	
C132	Output DRV on-delay time	CC-22	
C133	Output DRV off-delay time	CC-23	
C134	Output X1 on-delay time	CC-24	
C135	Output X1 off-delay time	CC-25	
C136	Output X2 on-delay time	CC-26	
C137	Output X2 off-delay time	CC-27	
C138	Output X3 on-delay time	CC-28	
C139	Output X3 off-delay time	CC-29	
C140	Output relay on-delay time	CC-32	
C141	Output relay off-delay time	CC-33	
C142	Logical output signal 1 selection 1	CC-40	
C143	Logical output signal 1 selection 2	CC-41	
C144	Logical output signal 1 operator selection	CC-42	
C145	Logical output signal 2 selection 1	CC-43	
C146	Logical output signal 2 selection 2	CC-44	
C147	Logical output signal 2 operator selection	CC-45	
C148	Logical output signal 3 selection 1	CC-46	
C149	Logical output signal 3 selection 2	CC-47	
C150	Logical output signal 3 operator selection	CC-48	
C151	Logical output signal 4 selection 1	CC-49	
C152	Logical output signal 4 selection 2	CC-50	
C153	Logical output signal 4 operator selection	CC-51	
C154	Logical output signal 5 selection 1	CC-52	
C155	Logical output signal 5 selection 2	CC-53	
C156	Logical output signal 5 operator selection	CC-54	
C157	Logical output signal 6 selection 1	CC-55	
C158	Logical output signal 6 selection 2	CC-56	
C159	Logical output signal 6 operator selection	CC-57	
C160	Input terminal response time RST	CA-49	
C161	Input terminal response time ES	CA-48	
C162	Input terminal response time JOG	CA-47	
C163	Input terminal response time MBS	CA-46	
C164	Input terminal response time AUT	CA-45	
C165	Input terminal response time DFM	CA-44	
C166	Input terminal response time DFL	CA-43	
C167	Input terminal response time RR	CA-42	
C168	Input terminal response time FR	CA-41	
C169	Multistage speed/position determination time	CA-55	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
H001	Auto-tuning selection	HA-01	-
H002	First motor constant selection	-	Abolition of selection (setting of IE3 motor)
H202	Second motor constant selection	-	
H003	First motor capacity selection	Hb102	-
H203	Second motor capacity selection	Hb202	
H004	First selection of the number of motor poles	Hb103	
H204	Second selection of the number of motor poles	Hb203	
H005	First speed response	HA115	* Adjustment may be required.
H205	Second speed response	HA215	
H006	First stability constant	HA110	
H206	Second stability constant	HA210	
H306	Third stability constant	-	Abolition of third control
H020	First motor R1	Hb110	* Adjustment may be required.
H220	Second motor R1	Hb210	
H021	First motor R2	Hb112	
H221	Second motor R2	Hb212	
H022	First motor L	Hb114	
H222	Second motor L	Hb214	
H023	First motor I0	Hb116	
H223	Second motor I0	Hb216	
H024	First motor J	Hb118	
H224	Second motor J	Hb218	
H030	First motor R1 (auto-tuning data)	-	Hb110: Integration of setting location
H230	Second motor R1 (auto-tuning data)	-	Hb210: Integration of setting location
H031	First motor R2 (auto-tuning data)	-	Hb112: Integration of setting location
H231	Second motor R2 (auto-tuning data)	-	Hb212: Integration of setting location
H032	First motor L (auto-tuning data)	-	Hb114: Integration of setting location
H232	Second motor L (auto-tuning data)	-	Hb214: Integration of setting location
H033	First motor I0 (auto-tuning data)	-	Hb116: Integration of setting location
H233	Second motor I0 (auto-tuning data)	-	Hb216: Integration of setting location
H034	First motor J (auto-tuning data)	-	Hb118: Integration of setting location
H234	Second motor J (auto-tuning data)	-	Hb218: Integration of setting location
H050	First PI proportional gain	HA125	* Adjustment may be required.
H250	Second PI proportional gain	HA225	
H051	First PI proportional gain	HA126	
H251	Second PI integrated gain	HA226	
H060	First 0Hz range limiter	HC110	-
H260	Second 0Hz range limiter	HC210	
H061	First 0Hz range SLV start boost volume	HC112	
H261	Second 0Hz range SLV start boost volume	HC212	
H070	For switching PI proportional gain	HA128	* Adjustment may be required.
H071	For switching PI integrated gain	HA129	
H072	For switching P proportional gain	HA130	
H073	Gain switch time	HA121	-

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
P001	Selection of operation at option 1 error	oA-12	-
P002	Selection of operation at option 2 error	oA-22	
P011	Number of pulses of encoder	ob-01	
P012	Control mode selection	AA123	
P013	Pulse string mode selection	ob-11	
P014	Orientation stop position	AE-11	
P015	Orientation speed setting	AE-12	
P016	Orientation direction setting	AE-13	
P017	Positioning completion range setting	AE-04	
P018	Positioning completion delay time setting	AE-05	
P019	Electronic gear installation position selection	AE-01	
P020	Numerator of electronic gear ratio	AE-02	
P021	Denominator of electronic gear ratio	AE-03	
P022	Positioning control feed forward gain	AE-06	
P023	Position loop gain	AE-07	
P024	Position bias volume	AE-08	
P025	Selection of whether a secondary-resistance correction is to be conducted.	HC113	Addition of individual settings for second control
P026	Over speed error detection level	bb-80	-
P027	Over speed deviation error detection level	bb-81	
P028	Numerator of motor gear ratio	ob-03	
P029	Denominator of motor gear ratio	ob-04	
P031	Acceleration or deceleration time input type	AC-01	
P032	Orientation stop position input type	AE-10	
P033	Torque command input selection	Ad-01	
P034	Torque command setting	Ad-02	
P035	Selection of pole at torque command by VRF2	Ad-03	Not limited to VF2.
P036	Torque bias mode	Ad-11	-
P037	Torque bias value	Ad-12	
P038	Torque bias polarity selection	Ad-13	
P039	Torque control speed limit value (for normal rotation)	Ad-41	
P040	Torque control speed limit value (for reverse rotation)	Ad-42	
P044	Timer setting for monitoring of DeviceNet operation command	oA-11	
P045	Operation setting at the time of communication error	oA-12	
P046	OUTPUT assembly instance No. setting	(reserved)	
P047	INPUT assembly instance No. setting		
P048	Operation setting at the time of detection of idle mode		
P049	Setting of the number of poles for rotation speed	-	Integrated to Hb103 (IM) Hd103 (SM/PMM)
P055	Pulse string frequency scale	ob-12	-
P056	Pulse string frequency time constant	ob-13	
P057	Position string bias volume	ob-14	
P058	Pulse string limit	ob-15	
P060	Position command 0	AE-20	
P061	Position command 1	AE-22	
P062	Position command 2	AE-24	
P063	Position command 3	AE-26	
P064	Position command 4	AE-28	
P065	Position command 5	AE-30	
P066	Position command 6	AE-32	
P067	Position command 7	AE-34	
P068	Zero return mode	AE-70	
P069	Zero return direction selection	AE-71	

HF-430α		HF-430NEO	Remarks
Display code	Function name	New code	
P070	Low speed zero return frequency	AE-72	-
P071	High speed zero return frequency	AE-73	
P072	Position range designation (forward rotation side)	AE-52	
P073	Position range designation (reverse rotation side)	AE-54	
P074	Teaching selection	AE-60	
U001	User 1 selection	UA-31	-
U002	User 2 selection	UA-32	
U003	User 3 selection	UA-33	
U004	User 4 selection	UA-34	
U005	User 5 selection	UA-35	
U006	User 6 selection	UA-36	
U007	User 7 selection	UA-37	
U008	User 8 selection	UA-38	
U009	User 9 selection	UA-39	
U010	User 10 selection	UA-40	
U011	User 11 selection	UA-41	
U012	User 12 selection	UA-42	

21.3 STO Terminal Functions

21.3.1 Safety Function – STO (Safe Torque Off)

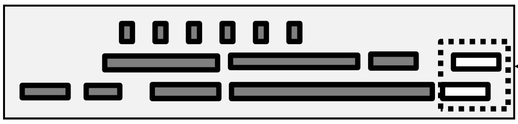
・HF-430NEO is equipped with the STO (Safe torque off) function defined in IEC61800-5-2.
This function is equivalent to stop category 0 defined in EN/IEC60204-1.

21.3.2 Operation Procedure of Safety Function

■STO input terminal

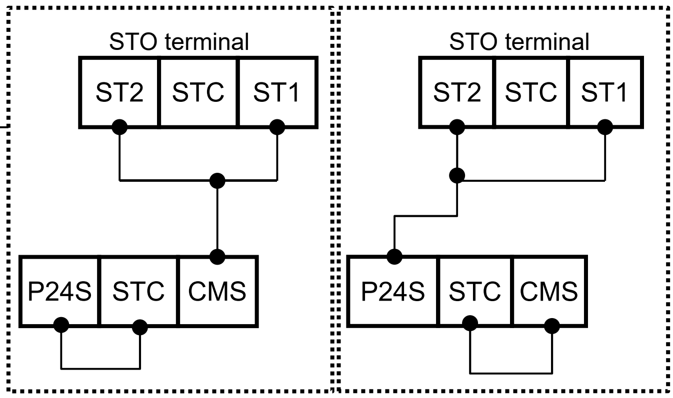
・Input of STO signal is performed by redundant input of STO terminals ST1 and ST2.
・When voltage is applied to each input terminal and current flows, operation of safety path is enabled.
(When shipped from the factory, operation is always enabled. See the figure below.)
・If voltage is not applied to at least one of the input terminals, the corresponding blocking path shuts off output of the inverter.

Control circuit terminal area



Connection of STO input terminal
When shipped from the factory, wiring is performed so that STO terminal is disabled.

Always drive the STO function using both STO inputs.



Sink logic

Source logic

■Terminal specifications

Terminal symbol	Terminal name	Description	Electrical characteristics
P24S	24V output terminal (for STO input only)	A DC24V power supply for contact signals dedicated for ST1/ST2 terminals. The common terminal is CMS.	Maximum output current: 100mA
CMS	24V output terminal common (for STO input only)	A common terminal for DC24V power supply for contact signals dedicated for ST1/ST2 terminals.	
STC	Input logic switching terminal	A logic switching terminal for STO input. You can change the input logic changing the connecting point of short-circuit line. When an external power supply is used, remove the short-circuit line and use this terminal as the input common for ST1/ST2	<for sink logic> Short-circuit line: Connect between P24S and STC <For source logic> Short-circuit line: Connect between CMS and STC
ST1/ST2	STO input terminal	An input terminal of STO.	Voltage between ST1 and STC/ST1 and STC ・ON voltage: Min.DC15V ・OFF voltage Max. DC5V ・Maximum allowable voltage DC27V ・Load current 5.8mA (at DC27V) Internal resistance: 4.7kΩ
ED+	EDM signal output terminal (+)	A plus terminal of EDM signal (STO status monitoring).	Open collector output ・Between ED+ and ED- ・Voltage drop at ON: 4V or less ・Maximum allowable voltage: 27V ・Maximum allowable current: 50mA
ED-	EDM signal output terminal (-)	A minus terminal of EDM signal (STO status monitoring).	

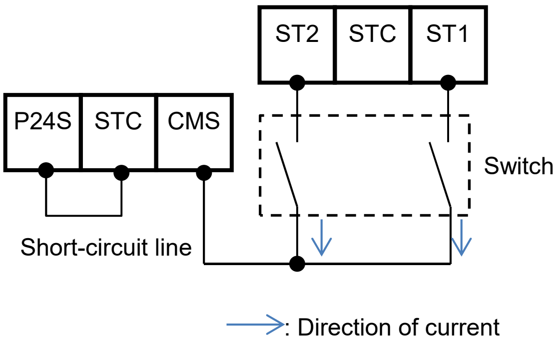
21.3.3 Input Method of STO Signal

- Input voltage for the STO signal can be chosen from the internal power supply of inverter (P24S terminal) or an external DC24V power supply.

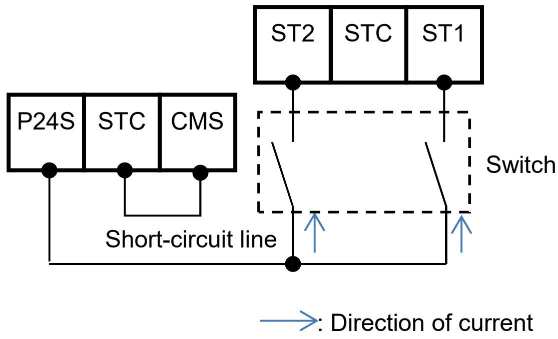
- Also, by changing the connecting point of short-circuit line, you can choose input logic from sink and source.
- By turning off the external switch (contact point) for STO input shown in the wiring example below, STO function is enabled, and output to the motor is shuts off.

■Wiring example

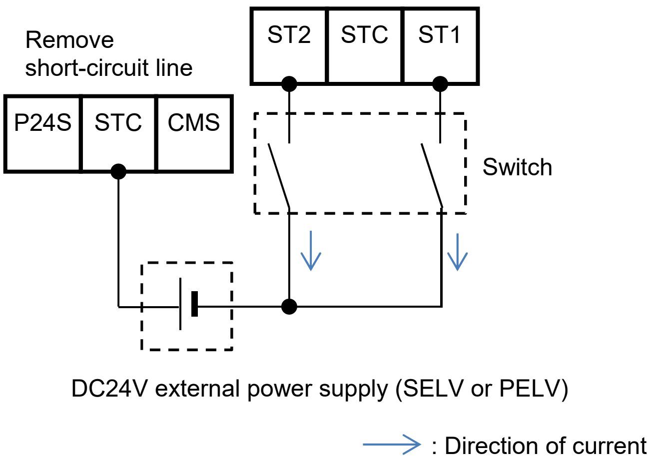
■Internal power supply+Sink logic



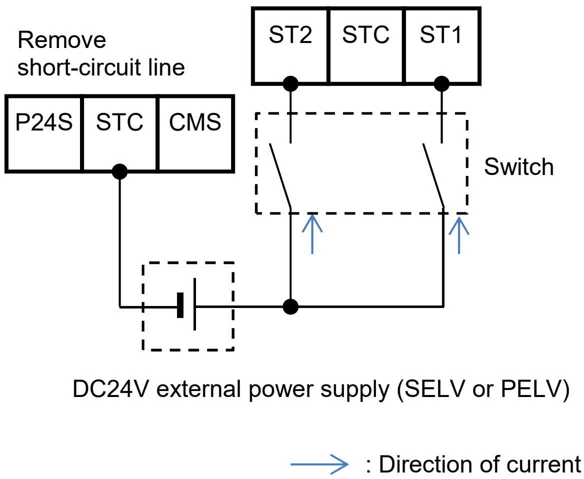
■Internal power supply+Source logic



■External power supply+Sink logic



■External power supply+Source logic



21.3.4 STO Status Retention Function

The retention function that retains the blocked status of internal safety path even if STO input is canceled is not implemented as a safety circuit.
Therefore, if an operation command is input after cancellation of STO input or STO input is canceled while it is input, the inverter starts output to the motor.
Hence, to satisfy the requirement about cancellation of emergency stop specified in EN/IEC60204-1, you need to take either of the following measures.

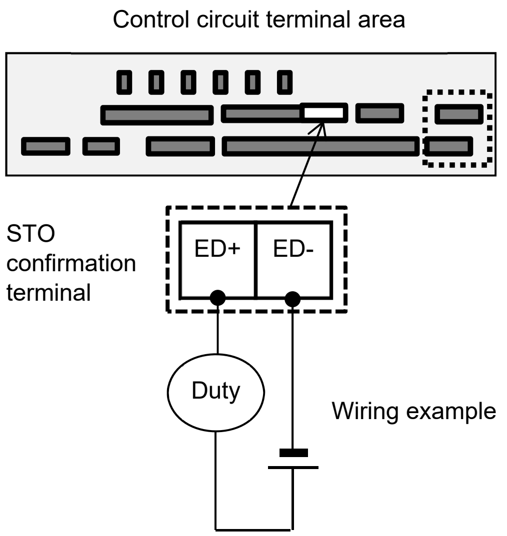
(1) At the same time as STO input, set the operation command to the inverter to stopped status
(2) Configure the system so that STO input to HF-430NEO is canceled when system reboot is required by the user.

By setting parameters of the main unit, you can select the following operations. (see 4.7)
(1) Trip the inverter by STO input. In this case, the inverter is tripped and output is stopped until power is shut off or the error reset signal for the inverter is input.
(2) If two STO input systems to the inverter are not input at the same time, the inverter is shut off and enters standby mode until STO input for the two systems is input.

21.3.5 STO Confirmation Signal Output (EDM Signal)

The STO confirmation signal output (EDM output) is the output signal for monitoring the input status of STO signal and failure detection status on the internal safety path.

■EDM terminal (ED+ / ED-) and wiring example



For operation of ST1/St2 and output of STO confirmation signal against failure detection status, see the matrix below. EDM turns ON only when both STO inputs are correctly input and internal failure is not detected.

■Signal matrix

Signal	Status 1	Status 2	Status 3	Status 4	Status 5
ST1 ＊	STO	Operation permitted	STO	Operation permitted	*
ST2 ＊	STO	STO	Operation permitted	Operation permitted	*
Failure detection	None	None	None	None	Detected
EDM	ON	OFF	OFF	OFF	OFF
Output to the motor	Off	Off	Off	Output permitted	Off

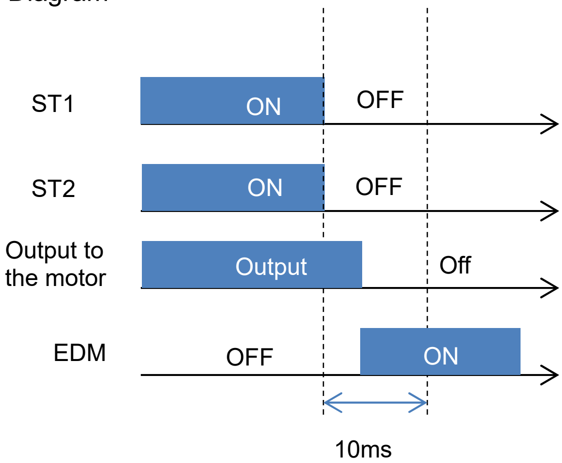
＊The following table shows the correspondence between the input status of ST1/ST2 described in the table above and status of contact points.

Input status	Contact point
STO	OFF
Operation permitted	ON

21.3.6 Timing Diagram

The following shows the timing diagram of output to the motor and output of EDM signals for STO inputs ST1/ST2.

■Timing Diagram



21.3.7 Status Indication Function

By setting parameters described in the table below, you can STO input status on the control panel screen. You can also check the status by checking the monitor parameter [dA-45].

■Parameters related to STO function indication

Item	Parameter	Data	Description
STO input indication selection	[bd-01]	00	If input of both ST1 and ST2 is STO (input contact point is OFF),"STO" is shown on the control panel screen.
		01	Also if input of both ST1 and ST2 is STO (input contact point is OFF),"STO" is not shown on the control panel.
		02	If input of both ST1 and ST2 is STO (input contact point is OFF), [E090] error occurs. * Even if either ST1 or ST2 is set to STO, [E090] error does not occur.
STO allowable input switch time	[bd-02]	0.00~ 60.00 (s)	Set the allowable time during which input status of ST1 and ST2 is different (e.g., input contact point: ST1=ON, ST2=OFF). If there is a difference between the switching time of ST1 and that of ST2, set the maximum allowable time the difference can be generated. If it is set to 0.00, the determination of allowable time becomes invalid.
STO indication selection within allowable input time	[bd-03]	00	Displays a warning at the time difference of status occurs between ST1 and ST2 until the STO allowable input switch time configured in [bd-02] has elapsed.
		01	Does not display a warning at the time difference of status occurs between ST1 and ST2 until the STO allowable input switch time configured in [bd-02] has elapsed.
STO operation selection after allowable input time	[bd-04]	00	Displays a warning after the STO allowable input switch time configured in [bd-02] has elapsed.
		01	Does not display a warning after the STO allowable input switch time configured in [bd-02] has elapsed.
		02	After the STO allowable input switch time configured in [bd-02] has elapsed, [E092] or [E093] error occurs.

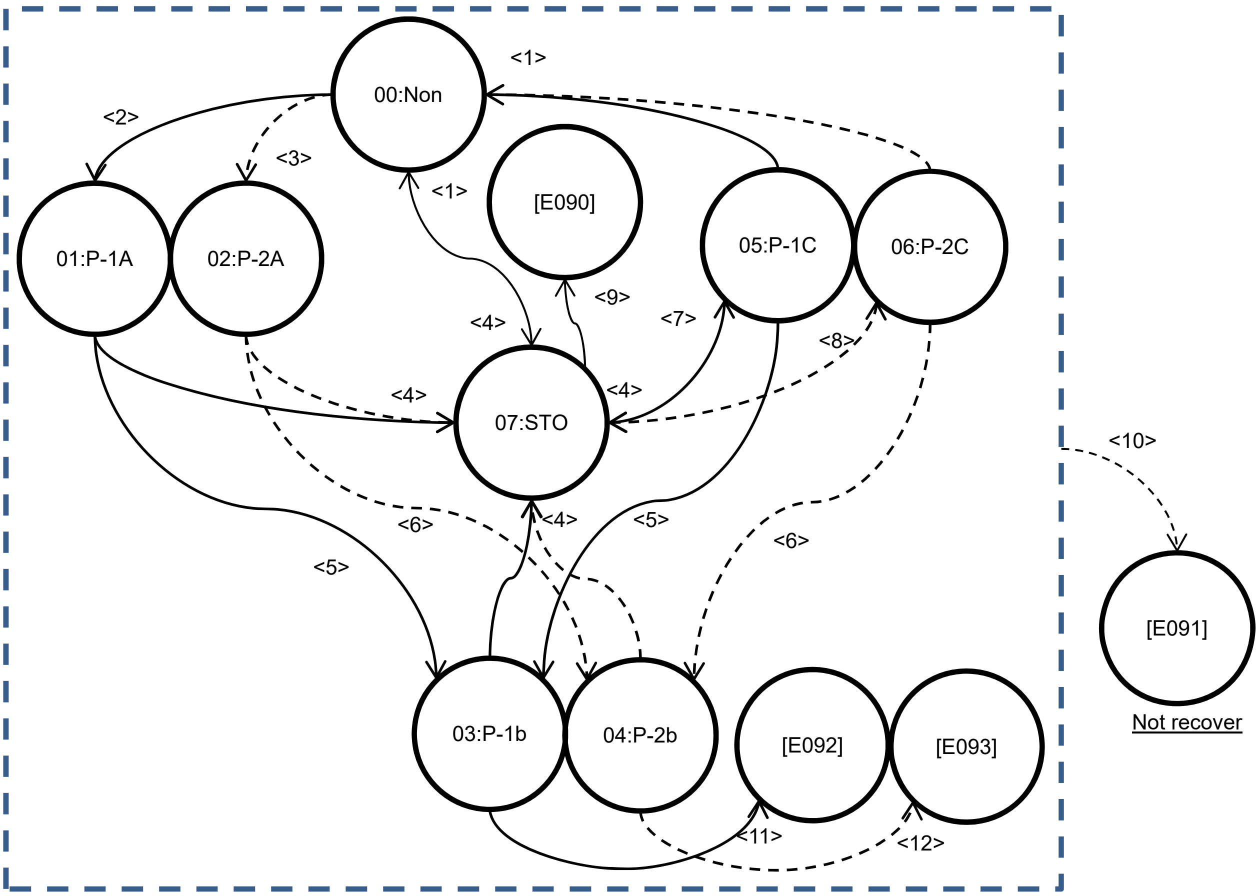
■STO monitor [dA-45] and status indication on the upper right of the operator keypad

STO monitor [dA-45] data display contents	(Status indication on the upper right of the operator keypad)	Condition	Description
00:Non	(No indication)	<1>	Operation is permitted on both ST1 and ST2 (contact point is ON) and inverter output is available.
01:P-1A	P-1A	<2>	When operation is permitted on both ST1 and ST2 (contact point is ON), only ST2 changes to STO (contact point is OFF). Then, operation is permitted (contact point is ON) on ST1 again for the entire STO switch allowable time [bd-02].
02:P-2A	P-2A	<3>	When operation is permitted on both ST1 and ST2 (contact point is ON), only ST1 changes to STO (contact point is OFF). Then, operation is permitted (contact point is ON) on ST1 again for the entire STO switch allowable time [bd-02].
03:P-1b	P-1b	<5>	(1) The P-1A or P-1b status is kept until the STO switch allowable time [bd-02] has elapsed. (2) When operation is permitted on both ST1 and ST2 (contact point is ON), only ST2 changes to STO (contact point is OFF), and then the operation is permitted (contact point is ON) again.
04:P-2b	P-2b	<6>	(1) The P-12 or P-2b status is kept until the STO switch allowable time [bd-02] has elapsed. (2) When operation is permitted on both ST1 and ST2 (contact point is ON), only ST1 changes to STO (contact point is OFF), and then the operation is permitted (contact point is ON) again.
05:P-1C	P-1C	<7>	From the status that both ST1 and ST2 is STO (contact point is ON), operation is permitted (contact point is ON) only on ST2. Then, ST1 is at STO (contact point is OFF) again for the entire STO switch allowable time [bd-02].
06:P-2C	P-2C	<8>	From the status that both ST1 and ST2 is STO (contact point is ON), operation is permitted (contact point is ON) only on ST2. Then, ST1 is at STO (contact point is OFF) again for the entire STO switch allowable time [bd-02].
07:STO	STO	<4>	Both ST1 and ST2 are at STO (contact point is OFF).

■Error indication

Item	Error	Condition	Description
STO shut-off error	[E090]	<9>	If [bd-01] is set to 02, the error occurs when both ST1 and ST2 are input.
STO internal error	[E091]	<10>	The error occurs when internal failure is found. It cannot be canceled by reset operation.
STP path 1 error	[E092]	<11>	If [bd-04] is set to 02, the error occurs at [P-1b].
STP path 2 error	[E093]	<12>	If [bd-04] is set to 02, the error occurs at [P-2b].

■Status transition



List of Parameters

■Monitors related to output（D code：Monitor）

Code	Name	Data range	Page
dA-01	Output frequency monitor	0.00~590.00 (Hz)	13-1
dA-02	Output current monitor	0.0~655.35 (A)	13-5
dA-03	Operation direction monitor	F (Normal rotation in process)/r (Reverse rotation in process) d (0Hz output)/ o (Stopped)	13-3
dA-04	Frequency command	-590.00~590.00 (Hz)	13-1
dA-06	Output frequency conversion monitor	0.00~59000.00 (Hz)	13-2
dA-08	Speed detection value monitor	-590.00~590.00 (Hz)	13-8
dA-12	Output frequency monitor (with sign)		13-1
dA-14	Frequency upper limit monitor	0.00~590.00 (Hz)	12-6-1
dA-15	Torque command monitor (after calculation)	-1000.0~1000.0 (%)	12-11-12
dA-16	Torque limit monitor	0.0~500.0 (%)	12-11-7
dA-17	Output torque monitor	-1000.0~1000.0 (%)	12-11-12
dA-18	Output voltage monitor	0.0~800.0 (V)	13-5
dA-20	Current position monitor	When [AA121]≠10 or [AA123]≠03 -268435455~+268435455(pls) When [AA121]=10 and [AA123]=03 -1073741823~+1073741823	12-17-29
dA-26	Pulse string position deviation monitor	-2147483647~+2147483647 (pls)	12-17-17
dA-28	Pulse counter monitor	0~2147483647 (pls)	12-24-13
dA-30	Input power monitor	0.00~75.00 (kW)	13-7
dA-32	Integrated input power monitor	0.0~1000000.0 (kW)	
dA-34	Output power monitor	0.00~75.00 (kW)	
dA-36	Integrated output power monitor	0.0~1000000.0 (kW)	
dA-38	Motor temperature monitor	-20.0~200.0 (°C)	12-7-6
dA-40	DC voltage monitor	0.0~1000.0 (V)	13-5
dA-41	Braking resistor circuit (DBTR) duty ratio monitor	0.00~100.00 (%)	13-9
dA-42	Electronic thermal duty ratio monitor (motor)		
dA-43	Electronic thermal duty ratio monitor (inverter)		

■Monitors related to control circuit

Code	Name	Data range	Page
dA-45	STO monitor	00 (no input)/ 01 (P-1A)/ 02 (P-2A)/ 03 (P-1b) 04 (P-2b)/05 (P-1C)/06 (P-2C)/ 07 (STO)	21-16
dA-46,47	Reserved	-	-
dA-50	Terminal block option mounted	00 (P1-TM: standard terminal block) 02 (P1-TM2: terminal block with round screws)/15 (not connected)	13-13
dA-51	Input terminal monitor	LLLLLLLLLLL~HHHHHHHHHHH [L:OFF/H:ON] [Left side] (terminal DHH) (terminal DFH) (terminal RST) - (terminal FR) [Right side]	13-4
dA-54	Output terminal monitor	LLLLLLL-HHHHHHH [L:OFF/H:ON] [Left side] (terminal FL) (terminal RL) (terminal X3) - (terminal UPF) [Right side]	
dA-60	Analog I/O selection monitor	AAAAAAAA- VVVVVVVV [A: current/V: voltage] [Left side] (terminal Ao4 (Io4/Vo4)) (terminal Ao3 (Io3/Vo3)) (terminal Ai4 (Ii4/Vi4)) (terminal VF2 (Ii3/Vi3)) (terminal AMI) (terminal AMV) (terminal IRF) (terminal VRF) [Right side]	13-10
dA-61	Analog input [VRF] monitor	0.00~100.00 (%)	13-13
dA-62	Analog input [IRF] monitor		
dA-63	Analog input [VF2] monitor	-100.00~100.00 (%)	
dA-64	Extended analog input [Ai4] monitor	0.00~100.00 (%)	
dA-65	Extended analog input [Ai5] monitor		
dA-66	Extended analog input [Ai6] monitor	-100.00~100.00 (%)	
dA-70	Pulse string input monitor		12-4-5
dA-71	Pulse string input monitor (HF-FB)		12-4-7

■Option slot monitor

Code	Name	Data range	Page
dA-81	Option slot 1 mounted	00: (none) /01: (P1-EN) /03: (P1-PN) / 06: (P1-PB) 07: (P1-CCL) /18: (P1-AG) <hereafter only da-82 is indicated>33: (HF-FB)	13-10
dA-82	Option slot 2 mounted		
dA-83	Option slot 3 mounted		

■ Monitors related to PID function

Code	Name	Data range	Page
db-01 to 23	Reserved	-	-
db-30	PID1 feedback data 1 monitor	0.00~100.00 (%) (adjustable in [AH-04][AH-05][AH-06])	12-10-7
db-32	PID1 feedback data 2 monitor		
db-34	PID1 feedback data 3 monitor		
db-36	PID2 feedback data monitor	0.00~100.00 (%) (adjustable in [AJ-04][AJ-05][AJ-06])	12-10-22
db-38	PID3 feedback data monitor	0.00~100.00 (%) (adjustable in [AJ-24][AJ-25][AJ-26])	
db-40	PID4 feedback data monitor	0.00~100.00 (%) (adjustable in [AJ-44][AJ-45][AJ-46])	
db-42	PID1 target value monitor	0.00~100.00 (%) (adjustable in [AH-04][AH-05][AH-06])	12-10-7
db-44	PID1 feedback data monitor		
db-50	PID1 output monitor	-100.00~100.00 (%)	
db-51	PID1 deviation monitor		
db-52	PID1 deviation 1 monitor		
db-53	PID1 deviation 2 monitor		
db-54	PID1 deviation 3 monitor		
db-55	PID2 output monitor		12-10-25
db-56	PID2 deviation monitor		
db-57	PID3 output monitor		
db-58	PID3 deviation monitor		
db-59	PID4 output monitor		
db-60	PID4 deviation monitor		
db-61	PID current P gain monitor	0~100.00 (%)	12-10-7
db-62	PID current I gain monitor	0.0~3600.0 (s)	
db-63	PID current D gain monitor	0.00~100.00 (s)	
db-64	PID feed-forward monitor		

■Monitors for checking internal condition

Code	Name	Data range	Page
dC-01	Monitor for checking selection of inverter duty spec	00 (very low duty) 01 (low duty/02 (normal duty)	13-11
dC-02	Rated current monitor	0.0~6553.5 (A)	
dC-07	Main speed command destination monitor	00 (disabled)/01 (VRF)/02 (IRF)/03 (VF2)/04 (Ai4)/05 (Ai5)/06 (Ai6) 07 (Multistage speed 0)/08 (auxiliary speed)/09 (Multistage speed 1) 10 (Multistage speed 2)/11 (Multistage speed 3)/12 (Multistage speed 4) 13 (Multistage speed 5)/14 (Multistage speed 6)/15 (Multistage speed 7) 16 (Multistage speed 8)/17 (Multistage speed 9)/18 (Multistage speed 10) 19 (Multistage speed 11)/20 (Multistage speed 12)/21 (Multistage speed 13) 22 (Multistage speed 14)/23 (Multistage speed 15)/24 (JOG)/25 (RS485) 26 (Option 1)/27 (Option 2)/28 (Option 3)/29 (Pulse array (main unit)) 30 (Pulse array (HF-FB))/31 (Reserved)/32 (PID)/33 (Reserved) 34 (AHD retention speed)	
dC-08	Auxiliary speed command destination monitor		
dC-10	Operation command destination monitor	00 ([FR]/[RR] terminal)/01 (3 wire)/02 (RUN key on operator keypad) 03 (RS485 setting)/04 (Option 1)/05 (Option 2)/06 (Option 3)	
dC-15	Cooling fin temperature monitor	-20.0~200.0 (°C)	13-6
dC-16	Life diagnostic monitor	LL - HH [L: normal/H: reduction of life] [Left side] (FAN life) (lives of the capacitors on the circuit board) [Right side]	13-8
dC-20	Total start-up count	1 - 65535 (Counts)	13-6
dC-21	Power-on count		
dC-22	Cumulative operating hours monitor during RUN	1~1000000 (hr)	13-5
dC-24	Cumulative power-on time		
dC-26	Cumulative operating time of cooling fan		13-8
dC-37	Detailed monitor for icon 2LIM	00 (Condition other than below)/01 (Overcurrent suppression in process) 02 (Overload being limited)/03 (Overvoltage suppression in process) 04 (Torque being limited) 05 (Upper/lower limit and jump frequency setting being limited) 06 (Setting of minimum frequency being limited)	13-12
dC-38	Detailed monitor for icon 2ALT	00 (Condition other than below)/01 (Overload advance notice) 02 (Motor thermal advance notice)/03 (Controller thermal advance notice) 04 (Motor overheat advance notice)	
dC-39	Detailed monitor for icon 2RETRY	00 (Condition other than below)/01 (Retry standby)/02 (Restart standby	
dC-40	Detailed monitor for icon 2NRDY	00 (Preparation completed condition other than below IRDY=OFF) 01 (Trip occurred)/02 (Power supply abnormality)/03 (Resetting)/04 (STO) 05 (Standby)/06 (Data inconsistency Others (including no FB, consistency of settings of A and B phases, etc.)) 07 (Sequence abnormality)/08 (Free run)/09 (Forced stop)	
dC-45	IM/SM (PMM) monitor	00 (Induction motor IM being selected) 01 (Synchronous motor SM (permanent magnet motor PMM) being selected)	12-9-1
dC-50	Firmware version monitor	0.000~99.255	-
dC-53	Firmware grade monitor	00 (Standard)	
dE-50	Warning monitor	See the right section	18-26

■Monitors（F code：Reference Monitor / setting）

Code	Name	Data range	Note	Page
FA-01	Main speed command monitor	0.00~590.00 (Hz)		13-2
FA-02	Auxiliary speed command monitor	-590.00 - 590.00 (Hz) (for monitoring)/0.00 - 590.00 (Hz) (for setting)		
FA-10	Acceleration time monitor	0.00~3600.00 (s)		13-3
FA-12	Deceleration time monitor			
FA-15	Torque command monitor	-500.0~500.0 (%)		12-11-12
FA-16	Torque bias command monitor			12-11-10
FA-20	Position command monitor	When [AA121]≠10 or [AA123]≠03 -268435455~+268435455 (pls) When [AA121]=10 and [AA123]=03 -1073741823~+1073741823 (pls)		12-17-29
FA-30	PID1 target value 1	0.00~100.00 (%) (adjustable in [AH-04][AH-05][AH-06])		12-10-7
FA-32	PID1 target value 2			
FA-34	PID1 target value 3			
FA-36	PID2 target value	0.00~100.00 (%) (adjustable in [AJ-04][AJ-05][AJ-06])		12-10-29
FA-38	PID3 target value	0.00~100.00 (%) (adjustable in [AJ-24][AJ-25][AJ-26])		
FA-40	PID4 target value	0.00~100.00 (%) (adjustable in [AJ-44][AJ-45][AJ-46])		

＊FA parameter indicates the current command value, and automatically displays data of the command destination that is being adopted.

Example 1：If the command destination is the operator keypad, it can be changed using the arrow keys.

Example 2：If the command destination is the analog input VRF, it can be changed by changing input to the terminal [VRF].

■Parameter mode (A code：Standard Function)

Code	Name	Data range	Initial value	Note	Page
AA101	First main speed command selection	01 (VRF terminal input)/02 (IRF terminal input) 03 (VF2 terminal input)/04 (Ai4 terminal input) 05 (Ai5 terminal input)/06 (Ai6 terminal input) 07 (Parameter setting)/08 (RS 485)/09 (Option 1) 10 (Option 2)/11 (Option 3)/12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)/14 (Reserved) 15 (PID calculation)/16 (Reserved)	07		12-4-1
AA102	First auxiliary speed command selection	00 (Disabled)/01 (VRF terminal input)/02 (IRF terminal input) 03 (VF2 terminal input)/04 (Ai4 terminal input) 05 (Ai5 terminal input)/06 (Ai6 terminal input) 07 (Parameter setting)/08 (RS 485)/09 (Option 1) 10 (Option 2)/11 (Option 3)/12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)/14 (Reserved) 15 (PID calculation)/16 (Reserved)	00		
AA104	First auxiliary speed setting	0.00~590.00 (Hz)	0.00		
AA105	First operator selection	00 (Disabled)/01 (Addition)/02 (Subtraction) 03(Multiplication)	00		12-4-9
AA106	First additional frequency setting	-590.00~590.00 (Hz)	0.00		12-4-14
AA111	First operation command selection	00 ([FR]/[RR] terminal)/01 (3 wire) 02 (RUN key on operator keypad)/03 (RS485)/04 (Option 1) 05 (Option 2)/06 (Option 3)	02		12-5-1
AA-12	RUN key operation direction selection	00 (Normal rotation)/01 (Reverse rotation)	00		
AA-13	STOP key selection	00 (Disabled)/01 (Enabled)/02 (Only reset is enabled)	01		12-5-4
AA114	First operation direction limit selection	00 (No limitation)/01 (Only normal rotation) 02 (Only reverse rotation)	00		12-6-2
AA115	First stop mode selection	00 (Deceleration stop)/01 (Free run stop)	00		12-15-1
AA121	First control mode	00 ([V/f] Fixed torque characteristics (IM)) 01 ([V/f] Reducing torque characteristics (IM)) 02 ([V/f] Free V/f (IM))/03 ([V/f] Auto torque boost (IM)) 04 ([V/f with sensor] Fixed torque characteristics (IM) 05 ([V/f with sensor] Reduced torque characteristics (IM) 06 ([V/f with sensor] Free V/f (IM) 07 ([V/f with sensor] Auto torque boost (IM) 08 (Sensorless vector control (IM)) 09 (Zero-Hz range sensorless vector control (IM)) *1) 10 (Vector control with sensor (IM)) *1) 11 (Synchronous start type sensorless vector control (SM/PMM)) 12 (IVMS start type sensorless vector control (SM/PMM)) *2)	00		12-9-1
AA123	First vector control mode selection	00 (Speed/torque control mode) 01 (Pulse string position control mode) 02 (Absolute position control mode) 03 (High-resolution absolute position control mode)	00		12-9-15

*1) Cannot be selected if [Ub-03] duty spec selection is 01 (LD) or 02 (VLD).
*2) Cannot be selected if [Ub-03] duty spec selection is 02 (VLD) or 02 (VLD).

Code	Name	Data range	Initial value	Note	Page
AA201	Second main speed command selection	Same as AA101	07		12-17-1
AA202	Second auxiliary speed command selection	Same as AA102	00		12-17-1
AA204	Second auxiliary speed setting	Same as AA104	0.00		12-17-1
AA205	Second operator selection	Same as AA105	00		12-17-1
AA206	Second additional frequency setting	Same as AA106	0.00		12-17-1
AA211	Second operation command selection	Same as AA111	02		12-17-1
AA214	Second operation direction limit selection	Same as AA114	00		12-17-1
AA215	Second stop mode selection	Same as AA115	00		12-17-1
AA221	Second control mode	Same as AA121	00		12-17-1
AA223	Second vector control mode selection	Same as AA123	00		12-17-1

*1) Cannot be selected if [Ub-03] duty spec selection is 01 (LD) or 02 (VLD).
*2) Cannot be selected if [Ub-03] duty spec selection is 02 (VLD) or 02 (VLD).

Code	Name	Data range	Initial value	Note	Page
Ab-01	Frequency conversion coefficient	0.01~100.00	1.00		13-3
Ab-03	Multistep speed selection	00 (16th speed: binary (DFL~DHH)) 01 (8th speed: bit (SF1-SF7))	00		12-4-11
Ab110	0th speed of the 1st multi-step speed	0.00~590.00 (Hz)	10.00		12-4-2
Ab-11	1st speed of the multi-step speed	0.00~590.00 (Hz)	20.00		12-4-11
Ab-12	2nd speed of the multi-step speed	0.00~590.00 (Hz)	30.00		12-4-11
Ab-13	3rd speed of the multi-step speed	0.00~590.00 (Hz)	40.00		12-4-11
Ab-14	4th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-15	5th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-16	6th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-17	7th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-18	8th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-19	9th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-20	10th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-21	11th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-22	12th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-23	13th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-24	14th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab-25	15th speed of the multi-step speed	0.00~590.00 (Hz)	0.00		12-4-11
Ab210	0th speed of the 2nd multi-step speed	0.00~590.00 (Hz)	10.00		12-17-1

Code	Name	Data range	Initial value	Note	Page
AC-01	Acceleration or deceleration time input type selection	00 (Parameter setting)/01 (Option 1) 02 (Option 2)/03 (Option 3)/04 (Reserved)	00		12-8-1
AC-02	Multi-stage acceleration or deceleration selection	00 (Common) 01 (Multi-stage acceleration/deceleration)	00		12-8-5
AC-03	Acceleration pattern selection	00 (Linear)/01 (S-shaped)/02 (U-shaped) 03 (Reverse U-shaped)/04 (Elevator S-shaped)	00		12-8-10
AC-04	Deceleration pattern selection	00 (Linear)/01 (S-shaped)/02 (U-shaped) 03 (Reverse U-shaped)/04 (Elevator S-shaped)	00		12-8-10
AC-05	Acceleration curve constant (S-shaped, U-shaped, reverse U-shaped)	1~10	2		12-8-10
AC-06	Deceleration curve constant (S-shaped, U-shaped, reverse U-shaped)	1~10	2		12-8-10
AC-08	Curvature 1 for EL-S-shaped acceleration	0~100	25		12-8-10
AC-09	Curvature 2 for EL-S-shaped acceleration	0~100	25		12-8-10
AC-10	Curvature 1 for EL-S-shaped deceleration	0~100	25		12-8-10
AC-11	Curvature 2 for EL-S-shaped deceleration	0~100	25		12-8-10
AC115	First 2-stage acceleration or deceleration selection	00 ([AD2] terminal)/01 (Parameter setting) 02 (Switching normal/reverse rotation)	00		12-8-3
AC116	First 2-stage acceleration frequency	0.00~590.00 (Hz)	0.00		12-8-3
AC117	First 2-stage deceleration frequency	0.00~590.00 (Hz)	0.00		12-8-3
AC120	First acceleration time 1	0.00~3600.00 (s)	30.00		12-8-3
AC122	First deceleration time 1	0.00~3600.00 (s)	30.00		12-8-3
AC124	First acceleration time 2	0.00~3600.00 (s)	30.00		12-8-3
AC126	First deceleration time 2	0.00~3600.00 (s)	30.00		12-8-3

Code	Name	Data range	Initial value	Note	Page
AC-30	Acceleration time for multi-speed 1st speed	0.00~3600.00 (s)	0.00		12-8-5
AC-32	Deceleration time for multi-speed 1st speed				
AC-34	Acceleration time for multi-speed 2nd speed				
AC-36	Deceleration time for multi-speed 2nd speed				
AC-38	Acceleration time for multi-speed 3rd speed				
AC-40	Deceleration time for multi-speed 3rd speed				
AC-42	Acceleration time for multi-speed 4th speed				
AC-44	Deceleration time for multi-speed 4th speed				
AC-46	Acceleration time for multi-speed 5th speed				
AC-48	Deceleration time for multi-speed 5th speed				
AC-50	Acceleration time for multi-speed 6th speed				
AC-52	Deceleration time for multi-speed 6th speed				
AC-54	Acceleration time for multi-speed 7th speed				
AC-56	Deceleration time for multi-speed 7th speed				
AC-58	Acceleration time for multi-speed 8th speed				
AC-60	Deceleration time for multi-speed 8th speed				
AC-62	Acceleration time for multi-speed 9th speed				
AC-64	Deceleration time for multi-speed 9th speed				
AC-66	Acceleration time for multi-speed 10th speed				
AC-68	Deceleration time for multi-speed 10th speed				
AC-70	Acceleration time for multi-speed 11th speed				
AC-72	Deceleration time for multi-speed 11th speed				
AC-74	Acceleration time for multi-speed 12th speed				
AC-76	Deceleration time for multi-speed 12th speed				
AC-78	Acceleration time for multi-speed 13th speed				
AC-80	Deceleration time for multi-speed 13th speed				
AC-82	Acceleration time for multi-speed 14th speed				
AC-84	Deceleration time for multi-speed 14th speed				
AC-86	Acceleration time for multi-speed 15th speed				
AC-88	Deceleration time for multi-speed 15th speed				
AC215	Second 2-stage acceleration or deceleration selection	00 ([AD2] terminal)/01 (Parameter setting) 02 (Switching normal/reverse rotation)	00		12-17-1
AC216	Second 2-stage acceleration frequency	0.00~590.00 (Hz)	0.00		
AC217	Second 2-stage deceleration frequency				
AC220	Second acceleration time 1	0.00~3600.00 (s)	30.00		
AC222	Second deceleration time 1				
AC224	Second acceleration time 2				
AC226	Second deceleration time 2				

Code	Name	Data range	Initial value	Note	Page
Ad-01	Torque command input selection	00 (Disabled)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS 485)/09 (Option 1)/10 (Option 2)/11 (Option 3) 12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)/15 (PID calculation)	01		12-11-12
Ad-02	Torque command setting	-500.0~500.0 (%) (Limited at a torque equivalent to 200% of inverter ND rating)	0.0		
Ad-03	Torque command polarity selection	00 (As per the sign)/01 (Follow the revolution direction)	00		
Ad-04	Speed/torque control switch time	0~1000 (ms)	100		12-11-10
Ad-11	Torque bias input selection	Same as Ad-01	00		
Ad-12	Torque bias setting	-500.0~500.0 (%) (Limited at a torque equivalent to 200% of inverter ND rating)	0.0		
Ad-13	Torque bias polarity selection	00 (As per the sign)/01 (Follow the revolution direction)	00		
Ad-14	Torque bias enable terminal [TBS] selection	00 (Disabled) 01 (Enabled)	00		
Ad-40	Torque control speed limit value input selection	01 (VRF terminal input)/02 (IRF terminal input) 03 (VF2 terminal input)/04 (Ai4 terminal input) 05 (Ai5 terminal input)/06 (Ai6 terminal input) 07 (Parameter setting)/08 (RS 485)/09 (Option 1) 10 (Option 2)/11 (Option 3) 12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)	07		12-11-11
Ad-41	Torque control frequency limit value (for forward rotation)	0.00~590.00 (Hz)	0.00		
Ad-42	Torque control frequency limit value (for reverse rotation)				

Code	Name	Data range	Initial value	Note	Page
AE-01	Electronic gear installation position selection	00 (Feedback side) 01 (Command side)	00		12-17-16
AE-02	Electronic gear ratio numerator	1~10000	1		
AE-03	Electronic gear ratio denominator				
AE-04	Positioning completion range setting	0~1000 (ms)	5		
AE-05	Positioning completion delay time setting	0.00~10.00 (s)	0.00		
AE-06	Position control feed forward	0.00~655.35	0.00		
AE-07	Position loop gain	0.00~100.00	0.50		
AE-08	Position bias amount	-2048~2048	0		
AE-10	Orientation stop position input destination selection	00 (Parameter setting) 01 (Option 1) 02 (Option 2)/03 (Option 3)	00		12-17-22
AE-11	Orientation stop position	0~4095	0		
AE-12	Orientation speed setting	0.00~120.00	5.00		
AE-13	Orientation direction setting	00 (Forward rotation) 01 (Reverse rotation)	00		
AE-20	Position command 0	When [AA121]≠10 or [AA123]≠03 -268435455~+268435455 (pls) When [AA121]=10 and [AA123]=03 -1073741823~+1073741823 (pls)	0		12-17-29
AE-22	Position command 1				
AE-24	Position command 2				
AE-26	Position command 3				
AE-28	Position command 4				
AE-30	Position command 5				
AE-32	Position command 6				
AE-34	Position command 7				
AE-36	Position command 8				
AE-38	Position command 9				
AE-40	Position command 10				
AE-42	Position command 11				
AE-44	Position command 12				
AE-46	Position command 13				
AE-48	Position command 14				
AE-50	Position command 15				
AE-52	Position range designation (forward rotation side)	When [AA121]≠10 or [AA123]≠03 0~+268435455 (pls) When [AA121]=10 and [AA123]=03 0~+1073741823 (pls)	268435455		
AE-54	Position range designation (reverse rotation side)	When [AA121]≠10 or [AA123]≠03 –268435455~0 (pls) When [AA121]=10 and [AA123]=03 -1073741823~0 (pls)	-268435455		
AE-56	Positioning mode selection	00 (With limit)/01 (Without limit)	00		12-17-30
AE-60	Teaching selection	00 (X00)~15 (X15)	X00		
AE-61	Memorization of current position at power-off	00 (Disabled)/01 (Enabled)	00		
AE-62	Preset position data	When [AA121]≠10 or [AA123]≠03 0~+268435455 When [AA121]=10 and [AA123]=03 0~+1073741823	0		
AE-64	Gain for calculating the deceleration stop distance	50.00~200.00	100.00		12-17-23
AE-65	Bias for calculating the deceleration stop distance	0.00~655.35	0.00		
AE-66	APR control speed limit	0.00~100.00	1.00		
AE-67	APR start speed		0.20		
AE-70	Zero return mode selection	00 (Low speed zero return) 01 (High speed zero return) 02 (High speed zero return 2)	00		12-17-30
AE-71	Zero return direction selection	00 (Forward rotation) 01 (Reverse rotation)	00		
AE-72	Low speed zero return speed	0.00~10.00 (Hz)	0.00		
AE-73	High speed zero return speed	0.00~590.00 (Hz)	0.00		
AF101	First DC braking selection	00 (Disabled)/01 (Enabled) 02 (Frequency command)	00		12-14-2 12-15-2
AF102	First braking mode selection	00 (DC braking) 01 (Speed servo lock) 02 (Position servo lock)	00		
AF103	First DC braking frequency setting	0.00~590.00 (Hz)	0.50		12-15-2
AF104	First DC braking delay time	0.00~5.00 (s)	0.00		
AF105	First DC braking force at the time of the stop	0-100 (%) (with internal limitation)	0		
AF106	First DC braking time at the time of the stop	0.00~60.00 (s)	0.00		
AF107	First DC braking trigger selection	00 (Edge mode)/01 (Level mode)	01		12-17-8
AF108	First DC braking force at the start	0-100 (%) (with internal limitation)	0		12-14-2
AF109	First DC braking time at the start	0.00~60.00 (s)	0.00		

Code	Name	Data range	Initial value	Note	Page
AF120	First contactor control selection	00 (Disabled) 01 (Enabled: primary side) 02 (Enabled: secondary side)	00		12-17-8
AF121	First start waiting time	0.00~2.00 (s)	0.20		
AF122	First contactor release delay time		0.10		
AF123	First contactor check time	0.00~5.00 (s)	0.10		
AF130	First brake control selection	00 (Disabled) 01 (Brake control 1 common forward/reverse rotation) 02 (Brake control 1 forward/reverse set individually) 03 (Brake control 2)	00		12-17-6
AF131	First brake release establishment waiting time (forward)	0.00~5.00 (s)	0.00		
AF132	First acceleration waiting time (forward)				
AF133	First stop waiting time (forward)				
AF134	First brake confirmation waiting time (forward)				
AF135	First brake release frequency (forward)	0.00~590.00 (Hz)	0.00		
AF136	First brake release current (forward)	(0.00 to 2.00) × Inverter rated current (A)	*		
AF137	First brake apply frequency (forward)	0.00~590.00 (Hz)	0.00		
AF138	First brake release establishment waiting time (reverse)	0.00~5.00 (s)	0.00		
AF139	First acceleration waiting time (reverse)				
AF140	First stop waiting time (reverse)				
AF141	First brake confirmation waiting time (reverse)				
AF142	First brake release frequency (reverse)	0.00~590.00 (Hz)	0.00		
AF143	First brake release current (reverse)	(0.00 to 2.00) × Inverter rated current (A)	*		
AF144	First brake apply frequency (reverse)	0.00~590.00 (Hz)	0.00		
AF150	First brake release delay time	0.00~2.00 (s)	0.20		12-17-8
AF151	First brake apply delay time				
AF152	First brake check time	0.00~5.00 (s)	0.10		
AF153	First servo lock time at start	0.00~10.00 (s)	0.60		
AF154	First servo lock time at stop				
AF201	Second DC braking selection	Same as AF101	00		12-17-1
AF202	Second braking mode selection	Same as AF102			
AF203	Second DC braking frequency setting	Same as AF103	0.50		
AF204	Second DC braking delay time	Same as AF104	0.00		
AF205	Second DC braking force at the time of the stop	Same as AF105	0		
AF206	Second DC braking time at the time of the stop	Same as AF106	0.00		
AF207	Second DC braking trigger selection	Same as AF104	01		
AF208	Second DC braking force at the start	Same as AF108	0		
AF209	Second DC braking time at the start	Same as AF109	0.00		
AF220	Second contactor control selection	Same as AF120	00		
AF221	Second start waiting time	Same as AF121	0.20		
AF222	Second contactor release delay time	Same as AF122	0.10		
AF223	Second contactor check time	Same as AF123			
AF230	Second brake control selection	Same as AF130	00		
AF231	Second brake release establishment waiting time (normal rotation)	Same as AF131	0.00		
AF232	Second acceleration waiting time (normal rotation)	Same as AF132			
AF233	Second stop waiting time (normal rotation)	Same as AF133			
AF234	Second brake confirmation waiting time (normal rotation)	Same as AF134			
AF235	Second brake release frequency (normal rotation)	Same as AF135	0.00		
AF236	Second brake release current (normal rotation)	Same as AF136	*		
AF237	Second brake apply frequency (normal rotation)	Same as AF137	0.00		

*1.00 × Inverter rated current

Code	Name	Data range	Initial value	Note	Page
AF238	Second brake release establishment waiting time (forward)	Same as AF138	0.00		12-17-1
AF239	Second acceleration waiting time (forward)	Same as AF139			
AF240	Second stop waiting time (forward)	Same as AF140			
AF241	Second brake confirmation waiting time (reverse)	Same as AF141			
AF242	Second brake release frequency (reverse)	Same as AF142			
AF243	Second brake release current (reverse)	Same as AF143	1.00 × Inverter rated current		
AF244	Second brake apply frequency (reverse)	Same as AF144	0.00		
AF250	Second brake release delay time	Same as AF150	0.20		
AF251	Second brake apply delay time	Same as AF151			
AF252	Second brake check time	Same as AF152	0.10		
AF253	Second servo lock time at start	Same as AF153	0.60		
AF254	Second servo lock time at stop	Same as AF154			
AG101	First jump frequency 1	0.00~590.00 (Hz)	0.00		12-16-7
AG102	First jump frequency width 1	0.00~10.00 (Hz)	0.50		
AG103	First jump frequency 2	0.00~590.00 (Hz)	0.00		
AG104	First jump frequency width 2	0.00~10.00 (Hz)	0.50		
AG105	First jump frequency 3	0.00~590.00 (Hz)	0.00		
AG106	First jump frequency width 3	0.00~10.00 (Hz)	0.50		
AG110	First acceleration-stop frequency	0.00~590.00 (Hz)	0.00		12-8-8
AG111	First acceleration-stop time	0.0~60.0 (s)	0.0		
AG112	First deceleration-stop frequency	0.00~590.00 (Hz)	0.00		
AG113	First deceleration-stop time	0.0~60.0 (s)	0.0		
AG-20	Jogging frequency	0.00~10.00 (Hz)	5.00		12-17-3
AG-21	Selecting the jogging stop	00 (Disabled during MBS operation at stop) 01 (Disabled during deceleration stop operation) 02 (Disabled during DB operation at stop) 03 (Enabled during MBS operation at stop) 04 (Enabled during deceleration stop operation) 05 (Enabled during DB operation at stop)	01		
AG201	Second jump frequency 1	Same as AF101	0.00		12-17-1
AG202	Second jump frequency width 1	Same as AF102			
AG203	Second jump frequency 2	Same as AF103			
AG204	Second jump frequency width 2	Same as AF104			
AG205	Second jump frequency 3	Same as AF105			
AG206	Second jump frequency width 3	Same as AF106			
AG210	Second acceleration-stop frequency	Same as AF110			
AG211	Second acceleration-stop time	Same as AF111	0.0		
AG212	Second deceleration-stop frequency	Same as AF112	0.00		
AG213	Second deceleration-stop time	Same as AF113	0.0		
AH-01	PID1 selection	00 (Disabled) 01 (Enabled without reverse output) 02 (Enabled with reverse output)	00		12-10-5
AH-02	PID1 deviation negative	00 (Disabled)/01 (Enabled)	00		
AH-03	PID1 unit selection	See <Unit options> at the end of Appendix-1	01		12-10-30
AH-04	PID1 scale adjustment (0%)	-10000~10000	0		
AH-05	PID1 scale adjustment (100%)		10000		
AH-06	PID1 scale adjustment (decimal point)	0~4	2		
AH-07	PID1 target value 1 input destination selection	00 (None)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS 485)/09 (Option 1)/10 (Option 2) 11 (Option 3)/12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)	07		12-10-10
AH-10	PID1 target value 1 set value	-100.00~100.00 ∗	0.00		
AH-12	PID1 multistage target value 1				
AH-14	PID1 multistage target value 2				
AH-16	PID1 multistage target value 3				
AH-18	PID1 multistage target value 4				
AH-20	PID1 multistage target value 5				
AH-22	PID1 multistage target value 6				
AH-24	PID1 multistage target value 7				
AH-26	PID1 multistage target value 8				
AH-28	PID1 multistage target value 9				
AH-30	PID1 multistage target value 10				

∗Data range differs depending on [AH-04] - [AH-06].

Code	Name	Data range	Initial value	Note	Page
AH-32	PID1 multistage target value 11	-100.00~100.00 ∗	0.00		12-10-10
AH-34	PID1 multistage target value 12				
AH-36	PID1 multistage target value 13				
AH-38	PID1 multistage target value 14				
AH-40	PID1 multistage target value 15				
AH-42	PID1 target value 2 input destination selection	Same as AH-07	00		
AH-44	PID1 target value 2 set value	-100.00~100.00 (%) ∗	0.00		
AH-46	PID1 target value 3 input destination selection	Same as AH-07	00		
AH-48	PID1 target value 3 set value	-100.00~100.00 (%) ∗	0.00		
AH-50	PID1 target value 1 operator selection	01 (Addition)/02 (Subtraction) 03(Multiplication)/04 (Division)	01		
AH-51	PID1 feedback Data 1 Input destination selection	Same as AH-07	01		12-10-6
AH-52	PID1 feedback Data 2 Input destination selection		00		
AH-53	PID1 feedback Data 3 Input destination selection		00		
AH-54	PID1 feedback Data operator selection	01 (Addition)/02 (Subtraction) 03 (Multiplication)/04 (Division)	01		
AH-60	PID1 gain switch method selection	00 (Only gain 1) 01 ([PRO] terminal switch)	00		
AH-61	PID1 proportional gain 1	0.0~100.0	1.0		
AH-62	PID1 integral gain 1	0.0~3600.0 (s)	1.0		
AH-63	PID1 differential gain 1	0.00~100.00 (s)	0.00		
AH-64	PID1 proportional gain 2	0.0~100.0	0.0		
AH-65	PID1 integral gain 2	0.00~3600.0 (s)	0.0		
AH-66	PID1 differential gain 2	0.00~100.00 (s)	0.00		
AH-67	PID1 gain switch time	0~10000 (ms)	100		
AH-70	PID feed-forward selection	00 (Disabled) 01 (VRF terminal input) 02 (IRF terminal input) 03 (VF2 terminal input) 04 (Ai4 terminal input) 05 (Ai5 terminal input) 06 (Ai6 terminal input)	00		
AH-71	PID1 changeable range	0.00~100.00 (%)	0.00		12-10-13
AH-72	PID1 deviation excessive level		3.00		12-10-27
AH-73	PID1 feedback comparison signal OFF level		100.00		12-10-15
AH-74	PID1 feedback comparison signal ON level		0.00		
AH-75	PID soft-start function selection	00 (Disabled)/01 (Enabled)	00		
AH-76	PID soft-start target level	0.00~100.00 (%)	100.00		
AH-78	Acceleration time for PID soft-start	0.00~3600.00 (s)	30.00		
AH-80	PID soft-start time	0.00~100.00 (s)	0.00		
AH-81	PID start abnormal judgment implement selection	00 (Disabled) 01 (Enabled: error output) 02 (Enabled: warning)	00		12-10-16
AH-82	PID start abnormality judgment level	0.00~100.00 (%)	0.00		
AH-85	PID sleep condition selection	00 (Disabled) 01 (Low output) 02 ([SLEP] terminal)	00		12-10-17
AH-86	PID sleep start level	0.00~590.00 (Hz)	0.00		
AH-87	PID sleep operation time	0.00~100.00 (s)	0.00		
AH-88	Boost selection prior to PID sleep	00 (Disabled)/01 (Enabled)	00		
AH-89	Boost time prior to PID sleep	0.00~100.00 (s)	0.00		
AH-90	Boost amount prior to PID sleep	0.00~100.00 (%)	0.00		
AH-91	Minimum operation time prior to PID sleep	0.00~100.00 (s)	0.00		
AH-92	PID sleep status minimum retaining time				
AH-93	PID wake condition selection	01 (Deviation amount) 02 (Low feedback) 03 ([WAKE] terminal)	01		
AH-94	PID wake start level	0.00~100.00 (%)	0.00		
AH-95	PID wake operation time				
AH-96	PID wake start deviation amount				

∗Data range differs depending on [AH-04] - [AH-06].

Code	Name	Data range	Initial value	Note	Page
AJ-01	PID2 selection	00 (Disabled) 01 (Enabled without reverse output) 02 (Enabled with reverse output)	00		12-10-23
AJ-02	PID2 deviation negative	00 (Disabled)/01 (Enabled)	00		
AJ-03	PID2 unit selection	See <Unit options> at the end of Appendix-1	01		12-10-30
AJ-04	PID2 scale adjustment (0%)	-10000~10000	0		
AJ-05	PID2 scale adjustment (100%)		10000		
AJ-06	PID2 scale adjustment (decimal point)	0~4	2		
AJ-07	PID2 target value input destination selection	00 (None)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS 485)/09 (Option 1)/10 (Option 2) 11 (Option 3)/12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)/15 (PID1 output)	07		12-10-23
AJ-10	PID2 target value set value	-100.00~100.00 (%) *1)	0.00		
AJ-12	PID2 feedback data input destination selection	00 (None)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS 485)/09 (Option 1)/10 (Option 2) 11 (Option 3)/12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB)	02		
AJ-13	PID2 proportional gain	0.0~100.0	1.0		
AJ-14	PID2 integral gain	0.0~3600.0 (s)	1.0		
AJ-15	PID2 differential gain	0.00~100.00 (s)	0.00		
AJ-16	PID2 changeable range	0.00~100.00 (%)	0.00		12-10-26
AJ-17	PID2 deviation excessive level		3.00		12-10-27
AJ-18	PID2 feedback comparison signal OFF level		100.00		12-10-28
AJ-19	PID2 feedback comparison signal ON level		0.00		
AJ-21	PID3 selection	Same as AJ-01	00		12-10-23
AJ-22	PID3 deviation negative	00 (Disabled)/01 (Enabled)	00		
AJ-23	PID3 unit selection	See <Unit options> at the end of Appendix-1	01		12-10-30
AJ-24	PID3 scale adjustment (0%)	-10000~10000	0		
AJ-25	PID3 scale adjustment (100%)		10000		
AJ-26	PID3 scale adjustment (decimal point)	0~4	2		
AJ-27	PID3 target value input destination selection	Same as AJ-12	07		12-10-23
AJ-30	PID3 target value set value	-100.00~100.00 (%) *2)	0.00		
AJ-32	PID3 feedback data input destination selection	Same as AJ-12	02		
AJ-33	PID3 proportional gain	0.0~100.0	1.0		
AJ-34	PID3 integral gain	0.00~3600.0 (s)			
AJ-35	PID3 differential gain	0.0~100.00 (s)	0.00		
AJ-36	PID3 changeable range	0.00~100.00 (%)	0.00		12-10-26
AJ-37	PID3 deviation excessive level		3.00		12-10-27
AJ-38	PID3 feedback comparison signal OFF level		100.00		12-10-28
AJ-39	PID3 feedback comparison signal ON level		0.00		
AJ-41	PID4 selection	Same as AJ-01	00		12-10-23
AJ-42	PID4 deviation negative	00 (Disabled)/01 (Enabled)	00		
AJ-43	PID4 unit selection	See <Unit options> at the end of Appendix-1	01		12-10-24
AJ-44	PID4 scale adjustment (0%)	-10000~10000	0		
AJ-45	PID4 scale adjustment (100%)		10000		
AJ-46	PID4 scale adjustment (decimal point)	0~4	2		12-10-26
AJ-47	PID4 target value input destination 1 selection	Same as AJ-12	07		12-10-24
AJ-50	PID4 target value set value 2	-100.00~100.00 (%) *3)	0.00		
AJ-52	PID4 feedback data input destination selection	Same as AJ-12	02		
AJ-53	PID4 proportional gain	0.0~100.0	1.0		
AJ-54	PID4 integral gain	0.00~3600.0 (s)	1.0		
AJ-55	PID4 differential gain	0.0~100.00 (s)	0.00		
AJ-56	PID4 changeable range	0.00~100.00 (%)	0.00		12-10-26
AJ-57	PID4 deviation excessive level		3.00		12-10-27
AJ-58	PID4 feedback comparison signal OFF level		100.00		12-10-28
AJ-59	PID4 feedback comparison signal ON level		0.00		

*1) Data range differs depending on [AJ-04] - [AJ-06].
*2) Data range differs depending on [AJ-24] - [AJ-26].
*3) Data range differs depending on [AJ-44] - [AJ-46].

■Parameter mode (B code：Fine Tuning Function)

Code	Name	Data range	Initial value	Note	Page
bA101	First frequency upper limit selection	00 (Disable)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS485)/09 (Option 1)/10 (Option 2) 11 (Option 3)/12 (Pulse string input (main body)) 13 (Pulse string input HF-FB)	00		12-6-1
bA102	First frequency upper limiter	0.00~590.00 (Hz)	0.00		
bA103	First frequency lower limiter				
bA110	First torque limit selection	00 (Disable)/01 (VRF terminal input) 02 (IRF terminal input)/03 (VF2 terminal input) 04 (Ai4 terminal input)/05 (Ai5 terminal input) 06 (Ai6 terminal input)/07 (Parameter setting) 08 (RS 485)/09 (Option 1)/10 (Option 2) 11 (Option 3)	07		12-11-6
bA111	First torque limit parameter mode selection	00 (Four quadrant specific) 01 ([TRQ] terminal switch)	00		
bA112	First torque limit 1 (Four quadrant normal powered)	0.0~500.0 (%) (Limited at a torque equivalent to 200% of inverter ND rating)	200.0		
bA113	First torque limit 2 (Four quadrant reverse rotation regeneration)				
bA114	First torque limit 3 (Four quadrant reverse powered)				
bA115	First torque limit 4 (Four quadrant normal rotation regeneration)				
bA116	First torque LAD stop selection	00 (Disabled)/01 (Enabled)	00		
bA120	First overcurrent suppression selection		00		12-13-3
bA121	First overcurrent suppression level	(0.00 to 2.50) × Inverter rated current (A)	*1)		
bA122	First stall prevention 1 selection	00 (Disabled)/01 (Accelerate at constant speed) 02 (Only constant speed) 03 (Accelerate at constant speed/Increase speed at regeneration)	01		12-13-2
bA123	First stall prevention level 1	(0.20 to 2.50) × Inverter rated current (A)	*2)		
bA124	First stall prevention 1 operation time	0.10~3600.00 (s)	1.00		
bA126	First stall prevention 2 selection	Same as bA122	01		
bA127	First stall prevention level 2	Same as bA123	*2)		
bA128	First stall prevention 2 operation time	Same as bA124	1.00		
bA-30	Instantaneous power failure non-stop selection	00 (Disabled)/01 (Enabled: deceleration stop) 02 (Enabled: no recovery) 03 (Enabled: with recovery)	00		12-13-15
bA-31	Instantaneous power failure non-stop function starting voltage	(200V class) 0.0 - 410.0 (V) (400V class) 0.0 - 820.0 (V)	220.0 440.0		
bA-32	Instantaneous power failure non-stop target level		360.0 720.0		
bA-34	Instantaneous power failure non-stop deceleration time	0.01~3600.00 (s)	1.00		
bA-36	Instantaneous power failure non-stop deceleration starting range	0.00~10.00 (Hz)	0.00		
bA-37	Instantaneous power failure non-stop constant DC voltage control P gain	0.00~5.00	0.20		
bA-38	Instantaneous power failure non-stop constant DC voltage control I gain	0.00~150.00 (s)	1.00		12-13-3
bA140	First overvoltage suppression function	00 (Disabled) 01 (DC voltage constant deceleration) 02 (Acceleration only at deceleration) 03 (Acceleration at constant speed/deceleration)	00		
bA141	First overvoltage suppression level setting	(200V class) 330.0 - 400.0 (V) (400V class) 660.0 - 800.0 (V)	380.0 760.0		
bA142	First overvoltage suppression operating time	0.00~3600.00 (s)	1.00		
bA144	First DC voltage control P gain	0.00~5.00	0.20		
bA145	First DC voltage control I gain	0.00~150.00 (s)	1.00		
bA146	First over-excitation function selection	00 (Disabled)/01 (Regular operation) 02 (Operation only at deceleration) 03 (Level mode) 04 (Level mode only at deceleration)	00		12-13-5
bA147	First over-excitation filter time constant	0.00~1.00(s)	0.30		
bA148	First over-excitation voltage gain	50~400 (%)	100		
bA149	First over-excitation suppression level setting	(200V class) 330.0 - 400.0 (V) (400V class) 660.0 - 800.0 (V)	360.0 720.0		

*1) 2.00 × Inverter rated current (A)
*2) 1.70 × Inverter rated current (A)

Code	Name	Data range	Initial value	Note	Page
bA-60	Braking resistor operation circuit (DBTR) use rate	0.0 - 10.0×([bA-63]/minimum resistance)^2 (%) *3)	10.0		12-13-6
bA-61	Braking resistor circuit (DBTR) selection	00 (Disabled)/01 (Enabled: disabled at stop) 02 (Enabled: enabled at stop)	00		
bA-62	Braking resistor circuit (DBTR) ON level	(200V class) 330.0 - 400.0 (V) (400V class) 660.0 - 800.0 (V)	360.0 720.0		
bA-63	Braking resistor circuit (DBTR) resistance	Minimum resistance（R） - 600 (Ω)	Min.R *3)		
bA-70	Selection of the cooling fan operation	00 (Always ON)/01 (ON during operation) 02 (Temperature dependent)	00		12-18-1
bA-71	Clear cumulative operating time of cooling fan	00 (Disabled)/01 (Clear)	00		13-8
bA201	Second frequency upper limit selection	Same as bA101	00		12-17-1
bA202	Second frequency upper limiter	Same as bA102	0.00		
bA203	Second frequency lower limiter	Same as bA103			
bA210	Second torque limit selection	Same as bA110	07		
bA211	Second torque limit parameter mode selection	Same as bA111	00		
bA212	Second torque limit 1 (Four quadrant normal powering)	Same as bA112	200.0		
bA213	Second torque limit 2 (Four quadrant reverse rotation regeneration)	Same as bA113			
bA214	Second torque limit 3 (Four quadrant reverse powering)	Same as bA114			
bA215	Second torque limit 4 (Four quadrant normal rotation regeneration)	Same as bA115			
bA216	Second torque LAD stop selection	Same as bA116	00		
bA220	Second overcurrent suppression selection	Same as bA120			
bA221	Second overcurrent suppression level	Same as bA121	*1)		
bA222	Second stall prevention 1 selection	Same as bA122	01		
bA223	Second stall prevention level 1	Same as bA123	*2)		
bA224	Second stall prevention 1 operation time	Same as bA124	1.00		
bA226	Second stall prevention 2 selection	Same as bA126	00		
bA227	Second stall prevention level 2	Same as bA127	*2)		
bA228	Second stall prevention 2 operation time	Same as bA128	1.00		
bA240	Second overvoltage suppression function	Same as bA140	00		
bA241	Second overvoltage suppression level setting	(200V class) 330.0 - 400.0 (V) (400V class) 660.0 - 800.0 (V)	380.0 760.0		
bA242	Second overvoltage suppression operating time	Same as bA142	1.00		
bA244	Second DC voltage control P gain	Same as bA144	0.20		
bA245	Second DC voltage control I gain	Same as bA145	1.00		
bA246	Second over-excitation function selection	Same as bA146	02		
bA247	Second over-excitation filter time constant	Same as bA147	0.30		
bA248	Second over-excitation voltage gain	Same as bA148	100		
bA249	Second over-excitation control level setting	(200V class) 330.0 - 400.0 (V) (400V class) 660.0 - 800.0 (V)	360.0 720.0		
bb101	Carrier frequency	[Ub-03]=02: Normal duty：0.5~16.0 (kHz) [Ub-03]=01: Low duty：0.5~12.0 (kHz) [Ub-03]=00: Very low duty：0.5~10.0 (kHz)	2.0		12-12-1
bb102	Sprinkle carrier pattern selection	00 (Disabled)/01 (Pattern 1 enabled) 02 (Pattern 2 enabled)/03 (Pattern 3 enabled)	00		12-12-3
bb103	Automatic carrier frequency reduction selection	00 (Disabled)/01 (Enabled: current) 02 (Enabled: temperature)			12-12-2
bb-10	Auto-reset selection	00 (Disabled) 01 (Enabled with operation command OFF) 02 (Enable after the setting time)			12-24-16
bb-11	Auto-reset alarm selection	00 (Output)/01 (Not output)			
bb-12	Auto-reset waiting time	0~600 (s)	2		
bb-13	Auto-reset count	0~10	3		
bb-20	Instantaneous power failure retry count	0~16/255	0		12-16-4
bb-21	Undervoltage retry count				
bb-22	Overcurrent retry count	0~5			12-13-11
bb-23	Overvoltage retry count				12-13-13
bb-24	Selection of instantaneous power failure/undervoltage retry	00 (0Hz)/01 (Frequency matching) 02 (Frequency entrainment) 03 (Detection speed) 04 (Trip after frequency matching deceleration stop)	01		12-6-4
bb-25	Allowable instantaneous power failure time	0.3~25.0 (s)	1.0		

*1) 2.00 × Inverter rated current (A)
*2) 1.70 × Inverter rated current (A)
*3) The minimum resistance varies depending on inverter models.

Code	Name	Data range	Initial value	Note	Page
bb-26	Retry wait time after instantaneous power failure/undervoltage	0.3~100.0 (s)	0.3		12-16-4
bb-27	Instantaneous power failure undervoltage tripping selection during stop	00 (Disabled)/01 (Enabled at stop) 02 (Disabled at stop and deceleration stop)	00		
bb-28	Overcurrent trip/retry selection	00 (0Hz)/01 (Frequency matching) 02 (Frequency entrainment)/03 (Detection speed) 04 (Trip after frequency matching deceleration stop)	01		12-13-11
bb-29	Retry wait time after overcurrent	0.3~100.0 (s)	0.3		
bb-30	Overvotage tripping retry selection	00 (0Hz)/01 (Frequency matching) 02 (Frequency entrainment)/03 (Detection speed) 04 (Trip after frequency matching deceleration stop)	01		12-13-13
bb-31	Overvoltage retry standby time	0.3~100.0 (s)	0.3		
bb-40	Restart mode after MBS release	00 (0Hz)/01 (Frequency matching) 02 (Frequency entrainment)/03 (Detection speed)	00		12-14-12
bb-41	Restart mode after RST release	00 (0Hz)/01 (Frequency matching) 02 (Frequency entrainment)/03 (Detection speed)			12-24-6
bb-42	Frequency matching lower limit setting	0.00~590.00 (Hz)	0.00		12-14-6
bb-43	Level of frequency pull-in restart	(0.20 to 2.50) × Inverter rated current (A)	1.00× Inverter rated current		
bb-44	Constant (frequency) of frequency pull-in restart	0.10~30.00 (s)	0.50		
bb-45	Constant (voltage) of frequency pull-in restart				
bb-46	Overcurrent suppression level of frequency pull-in restart	(0.00 to 2.50) × Inverter rated current (A)	1.00× Inverter rated current		
bb-47	Start frequency selection of frequency pull-in restart	00 (Cutoff frequency)/01 (Maximum frequency) 02 (Setting frequency)	00		
bb-50	Frequency matching filter gain	0~1000(%)	50		12-14-3
bb160	First overcurrent detection level	Depend on the inverter model			12-16-3
bb-61	Excessive voltage of accepted power	00 (Warning)/01 (Error)	00		12-19-12
bb-62	Incoming overvoltage level selection	(200V class) 300.0 - 410.0 (V) (400V class) 600.0 - 820.0 (V)	390.0 780.0		
bb-64	Ground fault detection selection	00 (Disabled)/01 (Enabled)	01		18-5
bb-65	Input phase loss selection		00		12-16-1
bb-66	Output phase loss selection				
bb-67	Output phase loss detection sensitivity	1~100 (%)	10		
bb-70	Thermistor error level	0~10000 (Ω)	3000		12-7-6
bb-80	Over-speed error detection level setting	0.0~150.0 (%)	135.0		12-16-9
bb-81	Over-speed error detection time	0.0~5.0 (s)	0.5		
bb-82	Operation for speed deviation error	00 (Warning)/01 (Error)	00		12-16-8
bb-83	Speed deviation error detection level setting	0.0~100.0 (%)	15.0		
bb-84	Speed deviation error detection time	0.0~5.0 (s)	0.5		
bb-85	Behavior when the position deviation is abnormal	00 (Warning)/01 (Error)	00		12-17-17
bb-86	Abnormal position deviation detection level	0.0~65535 (×100pls)	4096		
bb-87	Abnormal position deviation time	0.0~5.0 (s)	0.5		
bb201	Second carrier frequency	Same as bb101	2.0		12-17-1
bb202	Second sprinkle carrier pattern selection	Same as bb102	00		
bb203	Second automatic carrier frequency reduction selection	Same as bb103			
bb260	Second overcurrent detection level	Same as bb160			

Code	Name	Data range	Initial value	Note	Page
bC110	First electronic thermal level	(0.00 - 3.00)× Inverter rated current	∗		12-7-1
bC111	First electronic thermal characteristics selection	00 (Reduction characteristics) 01 (Constant torque characteristics) 02 (Arbitrary setting)	00		
bC112	First electronic thermal subtraction function selection	00 (Disabled)/01 (Enabled)	01		
bC113	First electronic thermal subtraction time	1~1000 (s)	600		12-7-5
bC-14	Electronic thermal counter memory at power-off	00 (Disabled)/01 (Enabled)	01		
bC120	First free electronic thermal frequency 1	0.00~[bC122] (Hz)	0.00		
bC121	First free electronic thermal current 1	(0.00~3.00)× Inverter rated current	0.00		
bC122	First free electronic thermal frequency 2	[bC120]~[bC124] (Hz)	0.00		12-7-3
bC123	First free electronic thermal current 2	(0.00~3.00)× Inverter rated current	0.00		
bC124	First free electronic thermal frequency 3	[bC122]~590.00 (Hz)	0.00		
bC125	First free electronic thermal current 3	(0.00~3.00)× Inverter rated current	0.00		
bC210	Second electronic thermal level	Same as bC110	∗		
bC211	Second electronic thermal characteristics selection	Same as bC111	00		
bC212	Second electronic thermal subtraction function selection	Same as bC112	01		
bC213	Second electronic thermal subtraction time	Same as bC113	600		
bC220	Second free electronic thermal frequency 1	Same as bC120			12-17-1
bC221	Second free electronic thermal current 1	Same as bC121			
bC222	Second free electronic thermal frequency 2	Same as bC122	0.00		
bC223	Second free electronic thermal current 2	Same as bC123			
bC224	Second free electronic thermal frequency 3	Same as bC124			
bC225	Second free electronic thermal current 3	Same as bC125			
bd-01	STO input indication selection	00 (With indication) 01 (Without indication)/02 (Trip)	00		
bd-02	STO allowable input switch time	0.00~60.00 (s)	1.00		
bd-03	STO indication selection within allowable input time	00 (With indication) 01 (Without indication)	00		21-13
bd-04	STOoperation selection after allowable input time	00 (Retain only the condition) 01 (Disabled)/02 (Trip)			

∗1.00× Inverter rated current

■Parameter mode (C code：I/O terminals, RS485)

Code	Name	Data range	Initial value	Note	Page
CA-01	Input terminal function [FR] selection		001		
CA-02	Input terminal function [RR] selection		002		
CA-03	Input terminal function [DFL] selection		003		
CA-04	Input terminal function [DFM] selection		004		
CA-05	Input terminal function [AUT] selection		015		
CA-06	Input terminal function [MBS] selection	See <List of input terminal functions>	032		12-24-1
CA-07	Input terminal function [JOG] selection		029		
CA-08	Input terminal function [ES] selection		033		
CA-09	Input terminal function [RST] selection		028		
CA-10	Input terminal function [DFH] selection		005		
CA-11	Input terminal function [DHH] selection		006		
CA-21	Selection of Input terminal [FR] a/b (NO/NC)				
CA-22	Selection of Input terminal [RR] a/b (NO/NC)				
CA-23	Selection of Input terminal [DFL] a/b (NO/NC)				
CA-24	Selection of Input terminal [DFH] a/b (NO/NC)				
CA-25	Selection of Input terminal [AUT] a/b (NO/NC)				
CA-26	Selection of Input terminal [MBS] a/b (NO/NC)	00 (Normally open) 01 (Normally closed)	00		12-24-3
CA-27	Selection of Input terminal [JOG] a/b (NO/NC)				
CA-28	Selection of Input terminal [ES] a/b (NO/NC)				
CA-29	Selection of Input terminal [RST] a/b (NO/NC)				
CA-30	Selection of Input terminal [DFH] a/b (NO/NC)				
CA-31	Selection of Input terminal [DHH] a/b (NO/NC)				
CA-41	Input terminal [FR] response time				
CA-42	Input terminal [RR] response time				
CA-43	Input terminal [DFL] response time				
CA-44	Input terminal [DFM] response time				
CA-45	Input terminal [AUT] response time				
CA-46	Input terminal [MBS] response time	0~400 (ms)	2		12-24-4
CA-47	Input terminal [JOG] response time				
CA-48	Input terminal [ES] response time				
CA-49	Input terminal [RST] response time				
CA-50	Input terminal [DFH] response time				
CA-51	Input terminal [DHH] response time				

Code	Name	Data range	Initial value	Note	Page
CA-55	Multi-step input determination time	0~2000 (ms)	0		12-4-11
CA-60	UP/DWN target selection	00 (Frequency command)/01 (PID1)	00		12-4-13
CA-61	UP/DWN memory selection	00 (Not save)/01 (Save)			
CA-62	UP/DWN UDC mode selection	00 (0Hz)/01 (saved data)			
CA-64	Acceleration time for UP/DWN functions	0.00~3600.00 (s)	30.00		
CA-66	Deceleration time for UP/DWN functions				
CA-70	[F-OP] frequency command	01 (VRF terminal input)/02 (IRF terminal input) 03 (VF2 terminal input)/04 (Ai4 terminal input) 05 (Ai5 terminal input)/06 (Ai6 terminal input) 07 (Parameter setting)/08 (RS 485) 09 (Option 1)/10 (Option 2)/11 (Option 3) 12 (Pulse string input: main unit) 13 (Pulse string input: HF-FB) 14 (Program function)/15 (PID calculation) 16 (Reserved)	01		12-5-5
CA-71	[F-OP] Operation command	00 ([FR]/[RR] terminal)/01 (3 wire) 02 (RUN key on operator keypad)/03 (RS485) 04 (Option 1)/05 (Option 2)/06 (Option 3)	00		
CA-72	Reset selection	00 (On to Release Trip)/01 (Off to Release Trip) 02 (On to Release at Trip) 03 (Of to Release at Trip)	00		12-24-6
CA-81	Encoder constant set-up	32~65535 (pls)	1024		12-9-34
CA-82	Encoder phase sequence selection	00 (Phase-A is leading)/01 (Phase-B is leading)	00		
CA-83	Motor gear ratio's numerator	1~10000	1		
CA-84	Motor gear ratio's denominator				
CA-90	Pulse string input (main body) detection target selection	00 (Pulse count)/01 (Frequency command) 02 (Speed feedback)/03 (Pulse count)	00		12-4-6
CA-91	Pulse string input (main body) mode selection	00 (90° phase difference) 01 (forward/reverse rotation command and rotation direction) 02 (forward/reverse rotation pulse string)	00		
CA-92	Pulse string frequency (main body) scale	0.05~32.00 (kHz)	25.00		
CA-93	Pulse string frequency (main body) filter time constant	0.01~2.00 (s)	0.10		
CA-94	Pulse string frequency (main body) bias size	-100.0~100.0 (%)	0.0		
CA-95	Pulse string frequency (main body) upper detection limit	0.0~100.0 (%)	100.0		
CA-96	Pulse string frequency (main body) lower detection limit		0.0		
CA-97	Pulse count compare-match output ON level	0~65535	0		12-24-13
CA-98	Pulse count compare-match output OFF level		0		
CA-99	Maximum value for pulse count compare-match output		65535		

Code	Name	Data range	Initial value	Note	Page
Cb-01	[VRF] terminal input filter time constant	1~500 (ms)	500		12-24-9
Cb-03	[VRF] terminal start amount	0.00~100.00 (%)	0.00		
Cb-04	[VRF] terminal end amount		100.00		
Cb-05	[VRF] terminal start ratio	0.0~ [Cb-06] (%)	0.0		
Cb-06	[VRF] terminal end ratio	[Cb-05]~100.0 (%)	100.0		
Cb-07	[VRF] terminal start selection	00 (Start amount)/01 (0%)	01		
Cb-11	[IRF] terminal input filter time constant	1~500 (ms)	500		12-24-10
Cb-13	[IRF] terminal start amount	0.00~100.00 (%)	0.00		
Cb-14	[IRF] terminal end amount		100.00		
Cb-15	[IRF] terminal start ratio	0.0~ [Cb-16] (%)	20.0		
Cb-16	[IRF] terminal end ratio	[Cb-15]~100.0 (%)	100.0		
Cb-17	[IRF] terminal start selection	00 (Start amount)/01 (0%)	01		
Cb-21	[VF2] terminal input filter time constant	1~500 (ms)	500		12-24-11
Cb-22	[VF2] terminal selection	00 (Single)/01 (Added to VRF/IRF: with reversibility) 02 (Added to VRF/IRF: without reversibility)	00		
Cb-23	[VF2] terminal start amount	-100.00~100.00 (%)	-100.00		
Cb-24	[VF2] terminal end amount		100.00		
Cb-25	[VF2] terminal start ratio	-100.0~[Cb-26]	-100.0		
Cb-26	[VF2] terminal end ratio	[Cb-25]~100.0	100.0		
Cb-30	[VRF] voltage/current bias adjustment	-100.00~100.00	0.00		11-4
Cb-31	[VRF] voltage/current adjustment gain	0~200.00	100.00		
Cb-32	[IRF] voltage/current bias adjustment	-100.00~100.00	0.00		
Cb-33	[IRF] voltage/current adjustment gain	0~200.00	100.00		
Cb-34	[VF2] voltage bias adjustment	-100.00~100.00	0.00		11-5
Cb-35	[VF2] voltage adjustment gain	0~200.00	100.00		

Code	Name	Data range	Initial value	Note	Page
Cb-40	Thermistor selection	00 (Disabled) 01 (PTC resistance value enabled) 02 (NTC resistance value enabled)	00		12-7-6
Cb-41	Thermistor [TH+/TH-] adjustment	0.0~1000.0	100.0		
Cb-51 to Cb-57	Reserved	-	-		-
CC-01	Selection of output terminal function [UPF]	See <List of output terminal functions>	002		12-25-1
CC-02	Selection of output terminal function [DRV]		001		
CC-03	Selection of output terminal function [X1]		003		
CC-04	Selection of output terminal function [X2]		007		
CC-05	Selection of output terminal function [X3]		035		
CC-06	Selection of output terminal function [RL]		000		
CC-07	Selection of output terminal function [FL]		017		
CC-11	Selection of output terminal [UPF] a/b (NO/NC)	00 (Normally open) 01 (Normally closed)	00		12-25-3
CC-12	Selection of output terminal [DRV] a/b (NO/NC)				
CC-13	Selection of output terminal [X1] a/b (NO/NC)				
CC-14	Selection of output terminal [X2] a/b (NO/NC)				
CC-15	Selection of output terminal [X3] a/b (NO/NC)				
CC-16	Selection of output terminal [RL] a/b (NO/NC)				
CC-17	Selection of output terminal [FL] a/b (NO/NC)		01		
CC-20	Output terminal [UPF] on-delay time	0.00~100.00 (s)	0.00		12-25-5
CC-21	Output terminal [UPF off-delay time				
CC-22	Output terminal [DRV] on-delay time				
CC-23	Output terminal [DRV] off-delay time				
CC-24	Output terminal [X1] on-delay time				
CC-25	Output terminal [X1] off-delay time				
CC-26	Output terminal [X2] on-delay time				
CC-27	Output terminal [X2] off-delay time				
CC-28	Output terminal [X3] on-delay time				
CC-29	Output terminal [X3] off-delay time				
CC-30	Output terminal [RL] on-delay time				
CC-31	Output terminal [RL] off-delay time				
CC-32	Output terminal [FL] on-delay time				
CC-33	Output terminal [FL] off-delay time				
CC-40	Logical calculation output signal LOG1 selection 1	See <List of output terminal functions>	000		12-23-1
CC-41	Logical calculation output signal LOG1 selection 2				
CC-42	Logical calculation output signal LOG1 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-43	Logical calculation output signal LOG2 selection 1	See <List of output terminal functions>	000		
CC-44	Logical calculation output signal LOG2 selection 2				
CC-45	Logical calculation output signal LOG2 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-46	Logical calculation output signal LOG3 selection 1	See <List of output terminal functions>	000		
CC-47	Logical calculation output signal LOG3 selection 2				
CC-48	Logical calculation output signal LOG3 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-49	Logical calculation output signal LOG4 selection 1	See <List of output terminal functions>	000		
CC-50	Logical calculation output signal LOG4 selection 2				
CC-51	Logical calculation output signal LOG4 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-52	Logical calculation output signal LOG5 selection 1	See <List of output terminal functions>	000		
CC-53	Logical calculation output signal LOG5 selection 2				
CC-54	Logical calculation output signal LOG5 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-55	Logical calculation output signal LOG6 selection 1	See <List of output terminal functions>	000		
CC-56	Logical calculation output signal LOG6 selection 2				
CC-57	Logical calculation output signal LOG6 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		
CC-58	Logical calculation output signal LOG7 selection 1	See <List of output terminal functions>	000		
CC-59	Logical calculation output signal LOG7 selection 2				
CC-60	Logical calculation output signal LOG7 operator selection	00 (AND)/01 (OR)/02 (XOR)	00		

Code	Name	Data range	Initial value	Note	Page
Cd-01	[FRQ] terminal output form selection	00 (PWM)/01 (frequency)	00		12-25-7
Cd-02	[FRQ] terminal standard frequency (for PWM output)	0~3600 (kHz)	2880		
Cd-03	[FRQ] terminal output selection	See the List of output monitor functions	[dA-01]		
Cd-04	[AMV] terminal output selection				12-25-12
Cd-05	[AMI] terminal output selection				
Cd-10	Analog monitor adjustment mode selection	00 (Disabled)/01 (Enabled)	00		12-25-7
Cd-11	[FRQ] output filter time constant	1~500 (ms)	100		
Cd-12	[FRQ] output data type selection	00 (absolute value)/01 (with sign)	00		
Cd-13	[FRQ] bias adjustment	-100.0~100.0 (%)	0.0		
Cd-14	[FRQ] gain adjustment	-1000.0~1000.0 (%)	100.0		
Cd-15	[FRQ] output level in the adjustment mode	-100.0~100.0 (%)			
Cd-21	[AMV] output filter time constant	1~500 (ms)	100		12-25-12
Cd-22	[AMV] output data type selection	00 (absolute value)/01 (with sign)	00		
Cd-23	[AMV] bias adjustment	-100.0~100.0 (%)	0.0		
Cd-24	[AMV] gain adjustment	-1000.0~1000.0 (%)	100.0		
Cd-25	[AMV] output level in the adjustment mode	-100.0~100.0 (%)			
Cd-31	[AMI] output filter time constant	1~500 (ms)	100		
Cd-32	[AMI] output data type selection	00 (absolute value)/01 (with sign)	00		
Cd-33	[AMI] bias adjustment	-100.0~100.0 (%)	20.0		
Cd-34	[AMI] gain adjustment	-1000.0~1000.0 (%)	80.0		
Cd-35	[AMI] output level in the adjustment mode	-100.0~100.0 (%)	100.0		

Code	Name	Data range	Initial value	Note	Page
CE101	First low current signal output mode selection	00 (During acceleration/deceleration, at constant speed) 01 (Only at constant speed)	01		12-19-5
CE102	First low current detection level 1	(0.00 to 2.00) × Inverter rated current	1.00 × Inverter rated current		
CE103	First low current detection level 2				
CE105	First overload prewarning signal output mode selection	00 (During acceleration/deceleration, at constant speed) 01 (Only at constant speed)	01		12-19-4
CE106	First overload prewarning level 1	(0.00 to 2.00) × Inverter rated current	1.00 × Inverter rated current		
CE107	First overload prewarning level 2				
CE-10	Acceleration reaching frequency 1	0.00~590.00 (Hz)	0.00		12-21-2
CE-11	Deceleration reaching frequency 1				
CE-12	Acceleration reaching frequency 2				
CE-13	Deceleration reaching frequency 2				
CE120	First over torque level (normal powered)	0.0~500.0 (%)	100.0		12-11-7
CE121	First over torque level (reverse regenerative)				
CE122	First over torque level (reverse powered)				
CE123	First over torque level (normal regenerative)				
CE-30	Electronic thermal warning level (Motor)	0.00~100.00 (%)	85.00		12-19-8
CE-31	Electronic thermal warning level (Inverter)				12-19-9
CE-33	0-Hz detection value level		0.50		12-21-4
CE-34	Cooling fin heating prewarning level	0~200 (°C)	120		12-19-10
CE-36	RUN time/power-on time level	0~100000 (hr)	0		12-19-11
CE-40	Window comparator [VRF] upper limit level	0~100 (%)	100		12-22-1
CE-41	Window comparator [VRF] lower limit level		0		
CE-42	Window comparator [VRF] hysteresis range	0~10 (%)	0		
CE-43	Window comparator [IRF] upper limit level	0~100 (%)	100		
CE-44	Window comparator [IRF] lower limit level		0		
CE-45	Window comparator [IRF] hysteresis range	0~10 (%)	0		
CE-46	Window comparator [VF2] lower limit level	-100~100 (%)	100		
CE-47	Window comparator [VF2] lower limit level		-100		
CE-48	Window comparator [VF2] hysteresis range	0~10 (%)	0		
CE-50	[VRF] operation level at disconnection	0~100 (%)	0		
CE-51	[VRF] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range) 02 (Enabled: within the range)	00		
CE-52	[IRF] operation level at disconnection	0~100(%)	0		
CE-53	[IRF] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range) 02 (Enabled: within the range)	00		
CE-54	[VF2] operation level at disconnection	-100~100(%)	0		
CE-55	[VF2] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range) 02 (Enabled: within the range)	00		

Code	Name	Data range	Initial value	Note	Page
CE201	Second low current signal output mode selection	00 (During acceleration/deceleration, at constant speed) 01 (Only at constant speed)	01		12-17-1
CE202	Second low current detection level 1	(0.00 to 2.00) × Inverter rated current	1.00 × Inverter rated current		
CE203	Second low current detection level 2				
CE205	Second overload prewarning signal output mode selection	00 (During acceleration/deceleration, at constant speed) 01 (Only at constant speed)	01		
CE206	Second overload prewarning level 1	(0.00 to 2.00) × Inverter rated current	1.00 × Inverter rated current		
CE207	Second overload prewarning level 2				
CE220	Second over torque level (normal powered)	0.0~500.0 (%)	100.0		
CE221	Second over torque level (reverse regenerative)				
CE222	Second over torque level (reverse powered)				
CE223	Second over torque level (normal regenerative)				

Code	Name	Data range	Initial value	Note	Page
CF-01	Communication transmission speed selection (baudrate selection)	03 (2400bps)/04 (4800bps)/05 (9600bps) 06 (19.2kbps)/07 (38.4kbps)/08 (57.6kbps) 09 (76.8kbps)/10 (115.2kbps)	04		14-3
CF-02	Communication station number selection	1~247	1		
CF-03	Communication parity selection	00 (Without parity)/01 (Even number parity) 02 (Odd number parity)	00		
CF-04	Communication stop bit selection	01 (1bit)/02 (2bit)	01		
CF-05	Communication error selection	00 (Error)/01 (Trip after deceleration stop) 02 (Ignore)/03 (Free run)/04 (Deceleration stop)	02		
CF-06	Communication timeout time	0.00~100.00 (s)	0.00		
CF-07	Communication waiting time	0~1000 (ms)	2		
CF-08	Communication method selection	01 (Modbus-RTU)/02 (EzCOM) 03 (EzCOM management)	01		
CF-11	Resister dataA,V⇔% conversion function	00 (A, V)/01 (%)	00		14-51
CF-20	EzCOM start INV station number	01~08	01		14-17
CF-21	EzCOM stop INV station number				
CF-22	EzCOM start selection	00 (ECOM) terminal)/01 (Modbus spec)	00		
CF-23	Numer of EzCOM data sets	01~05	05		14-18
CF-24	EzCOM transmission destination station number 1	1~247	1		
CF-25	EzCOM transmission destination register 1	0000~FFFF	0000		
CF-26	EzCOM transmission source register 1				
CF-27	EzCOM transmission destination station number 2	1~247	2		
CF-28	EzCOM transmission destination register 2	0000~FFFF	0000		
CF-29	EzCOM transmission source register 2				
CF-30	EzCOM transmission destination station number 3	1~247	3		
CF-31	EzCOM transmission destination register 3	0000~FFFF	0000		
CF-32	EzCOM transmission source register 3				
CF-33	EzCOM transmission destination station number 4	1~247	4		
CF-34	EzCOM transmission destination register 4	0000~FFFF	0000		
CF-35	EzCOM transmission source register 4				
CF-36	EzCOM transmission destination station number 5	1~247	5		
CF-37	EzCOM transmission destination register 5	0000~FFFF	0000		
CF-38	EzCOM transmission source register 5				
CF-50	USB station number selection	1~247	1		16-2

■Parameter mode (H code：Motor Control)

Code	Name	Data range	Initial value	Note	Page
HA-01	Auto-tuning selection	00 (Disabled)/01 (Non-rotation)/02 (Rotation) 03 (IVMS)	00		12-3-4
HA-02	Operation command for auto-tuning	00 (RUN key on the operator keypad) 01 ([AA111]/[AA211])	00		12-3-4
HA-03	Online tuning selection	00 (Disabled)/01 (Enabled)	00		12-3-4
HA110	First stability constant	0~1000 (%)	100		12-9-9
HA112	First stabilization ramp function end ratio	0~100 (%)	30		12-9-9
HA113	First stabilization ramp function start ratio	0~100 (%)	10		12-9-9
HA115	First speed response	0~1000 (%)	32		12-9-11
HA120	First gain switch selection	00 ([CAS] terminal)/01 (setting switch)	00		12-11-4
HA121	First gain switch time	0~10000 (ms)	100		12-11-4
HA122	First gain switch intermediate frequency 1	0.00~590.00 (Hz)	0.00		12-11-4
HA123	First gain switch intermediate frequency 2	0.00~590.00 (Hz)	0.00		12-11-4
HA124	First gain mapping maximum frequency	0.00~590.00 (Hz)	0.00		12-11-4
HA125	First gain mapping P gain 1	0.0~1000.0 (%)	100.0		12-11-4
HA126	First gain mapping I gain 1	0.0~1000.0 (%)	100.0		12-11-4
HA127	First gain mapping P control P gain 1	0.0~1000.0 (%)	100.0		12-11-4
HA128	First gain mapping P gain 2	0.0~1000.0 (%)	100.0		12-11-4
HA129	First gain mapping I gain 2	0.0~1000.0 (%)	100.0		12-11-4
HA130	First gain mapping P control P gain 2	0.0~1000.0 (%)	100.0		12-11-4
HA131	First gain mapping P gain 3	0.0~1000.0 (%)	100.0		12-11-4
HA132	First gain mapping I gain 3	0.0~1000.0 (%)	100.0		12-11-4
HA133	First gain mapping P gain 4	0.0~1000.0 (%)	100.0		12-11-4
HA134	First gain mapping I gain 4	0.0~1000.0 (%)	100.0		12-11-4
HA210	Second stability constant	0~1000 (%)	100		12-17-1
HA212	Second stabilization ramp function end ratio	0~100 (%)	30		12-17-1
HA213	Second stabilization ramp function start ratio	0~100 (%)	10		12-17-1
HA215	Second speed response	0~1000 (%)	32		12-17-1
HA220	Second gain switch selection	00 ([CAS] terminal)/01 (setting switch)	00		12-17-1
HA221	Second gain switch time	0~10000 (ms)	100		12-17-1
HA222	Second gain switch intermediate frequency 1	0.00~590.00 (Hz)	00		12-17-1
HA223	Second gain switch intermediate frequency 2	0.00~590.00 (Hz)	100		12-17-1
HA224	Second gain mapping maximum frequency	0.00~590.00 (Hz)	0.00		12-17-1
HA225	Second gain mapping P gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA226	Second gain mapping I gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA227	Second gain mapping P control P gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA228	Second gain mapping P gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA229	Second gain mapping I gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA230	Second gain mapping P control P gain 2	0.0~1000.0 (%)	100.0		12-17-1
HA231	Second gain mapping P gain 3	0.0~1000.0 (%)	100.0		12-17-1
HA232	Second gain mapping I gain 3	0.0~1000.0 (%)	100.0		12-17-1
HA233	Second gain mapping P gain 4	0.0~1000.0 (%)	100.0		12-17-1
HA234	Second gain mapping I gain 4	0.0~1000.0 (%)	100.0		12-17-1

Code	Name	Data range	Initial value	Note	Page
Hb101	Motor setting, 1st-motor	00：IE1 motor/01：AF motor 02：d2G4 motor/03：IE3 motor	03		12-3-1
Hb102	First IM motor capacity selection	0.01~75.00 (kW)	＊		12-3-1
Hb103	Selection of number of first IM motor poles	2 to 48 (poles)	4		12-3-1
Hb104	First IM base frequency	10.00~590.00 (Hz)	60.00		12-3-1
Hb105	First IM maximum frequency	10.00~590.00 (Hz)	60.00		12-3-1
Hb106	First IM motor's rated voltage	1~1000 (V)	200 V class : 200 400 V class : 400		12-3-1
Hb108	First IM motor's rated current	0.01~10000.00 (A)	＊		12-3-1
Hb110	First IM motor constant R1	0.000001~1000.000000 (Ω)	＊		12-3-3
Hb112	First IM motor constant R2	0.000001~1000.000000 (Ω)	＊		12-3-3
Hb114	First motor constant L	0.000001~1000.000000 (mH)	＊		12-3-3
Hb116	First IM motor constant Io	0.01~10000.00 (A)	＊		12-3-3
Hb118	First IM motor constant J	0.00001~10000.00000 (kgm^2)	＊		12-3-3
Hb130	First minimum frequency	0.10~10.00 (Hz)	0.50		12-4-1
Hb131	First reduced voltage start time	0~2000 (ms)	36		12-4-1

＊Varies depending on inverter models and settings of duty rating.

Code	Name	Data range	Initial value	Note	Page
Hb140	First manual torque boost operation mode selection	00 (Disabled)/01 (Always enabled) 02 (Enabled only for forward revolution) 03 (Enabled only for reverse revolution)	01		12-9-7
Hb141	First amount of manual torque boost	0.0~20.0 (%)	1.0		
Hb142	First manual torque boost break point	0.0~50.0 (%)	0.8		
Hb145	First energy-saving operation selection	00 (Disabled)/01 (Enabled)	00		12-9-6
Hb146	First energy-saving response/accuracy adjustment	0.0~100.0(%)	50.0		
Hb150	First free V/f frequency 1	0.00~[Hb152] (Hz)	0.00		
Hb151	First free V/f voltage 1	0.0~1000.0 (V)	0.0		
Hb152	First free V/f frequency 2	[Hb150]~[Hb154] (Hz)	0.00		
Hb153	First free V/f voltage 2	0.0~1000.0 (V)	0.0		
Hb154	First free V/f frequency 3	[Hb152]~[Hb156] (Hz)	0.00		
Hb155	First free V/f voltage 3	0.0~1000.0 (V)	0.0		
Hb156	First free V/f frequency 4	[Hb154]~[Hb158] (Hz)	0.00		
Hb157	First free V/f voltage 4	0.0~1000.0 (V)	0.0		
Hb158	First free V/f frequency 5	[Hb156]~[Hb160] (Hz)	0.00		
Hb159	First free V/f voltage 5	0.0~1000.0 (V)	0.0		
Hb160	First free V/f frequency 6	[Hb158]~[Hb162] (Hz)	0.00		
Hb161	First free V/f voltage 6	0.0~1000.0 (V)	0.0		
Hb162	First free V/f frequency 7	[Hb160]~[Hb104] (Hz)	0.00		
Hb163	First free V/f voltage 7	0.0~1000.0 (V)	0.0		
Hb170	First slip compensation P gain with sensor (V/f with sensor)	0~1000 (%)	100		12-9-26
Hb171	First slip compensation I gain with sensor (V/f with sensor)				
Hb180	First output voltage gain	0~255 (%)			12-9-9
Hb201	Second motor setting	00：IE1 motor/01：AF motor 02：d2G4 motor/03：IE3 motor	03		12-17-1
Hb202	Second IM motor capacity selection	0.01~75.00 (kW)	∗		
Hb203	Selection of number of second IM motor poles	2 to 48 (poles)	4		
Hb204	Second IM base frequency	10.00~590.00 (Hz)	60.00		
Hb205	Second IM maximum frequency				
Hb206	Second IM motor's rated voltage	1~1000 (V)	200 V class : 200 400 V class : 400		
Hb208	Second IM motor's rated current	0.01~10000.00 (A)	∗		
Hb210	Second IM motor constant R1	0.000001~1000.000000 (Ω)			
Hb212	Second IM motor constant R2				
Hb214	Second IM motor constant L	0.000001~1000.000000 (mH)			
Hb216	Second IM motor constant Io	0.01~10000.00 (A)			
Hb218	Second IM motor constant J	0.00001~10000.00000 (kgm^2)			
Hb230	Second minimum frequency	0.10~10.00 (Hz)	0.50		
Hb231	Second reduced voltage start time	0~2000 (ms)	36		
Hb240	Second manual torque boost operation mode selection	00 (Disabled)/01 (Always enabled) 02 (Enabled only for forward revolution) 03 (Enabled only for reverse revolution)	01		
Hb241	Second amount of manual torque boost	0.0~20.0 (%)	0.0		
Hb242	Second manual torque boost break point	0.0~50.0 (%)			
Hb245	Second energy-saving operation selection	00 (Disabled)/01 (Enabled)	00		
Hb246	Second energy-saving response/accuracy adjustment	0.0~100.0 (%)	50.0		
Hb250	Second free V/f frequency 1	0.00~[Hb252] (Hz)	0		
Hb251	Second free V/f voltage 1	0.0~1000.0 (V)	0.0		
Hb252	Second free V/f frequency 2	[Hb250]~[Hb254] (Hz)	0.00		
Hb253	Second free V/f voltage 2	0.0~1000.0 (V)	0.0		
Hb254	Second free V/f frequency 3	[Hb252]~[Hb256] (Hz)	0.00		
Hb255	Second free V/f voltage 3	0.0~1000.0 (V)	0.0		
Hb256	Second free V/f frequency 4	[Hb254]~[Hb258] (Hz)	0.00		
Hb257	Second free V/f voltage 4	0.0~1000.0 (V)	0.0		
Hb258	Second free V/f frequency 5	[Hb256]~[Hb260] (Hz)	0.00		
Hb259	Second free V/f voltage 5	0.0~1000.0 (V)	0.0		
Hb260	Second free V/f frequency 6	[Hb258]~[Hb262] (Hz)	0.00		
Hb261	Second free V/f voltage 6	0.0~1000.0 (V)	0.0		
Hb262	Second free V/f frequency 7	[Hb260]~[Hb204] (Hz)	0.00		
Hb263	Second free V/f voltage 7	0.0~1000.0 (V)	0.0		
Hb270	Second slip compensation I gain with sensor (V/f with sensor)	0~1000 (%)	100		
Hb271	Second slip compensation I gain with sensor (V/f with sensor)				
Hb280	Second output voltage gain	0~255 (%)			

∗Varies depending on inverter models and settings of duty rating.

Code	Name	Data range	Initial value	Note	Page
HC101	First automatic torque boost voltage compensation gain	0~255 (%)	100		12-9-8
HC102	First automatic torque boost slip compensation gain				
HC110	First zero-speed range limiter (IM-0Hz)	0~100 (%)			12-9-13
HC111	First amount of boost at the start (IM-SLV)	0~50 (%)	0		12-9-11
HC112	First amount of boost at the start (IM-oHz)		10		12-9-13
HC113	First selection of secondary-resistance correction that is conducted or not.	00 (Disabled)/01 (Enabled)	00		12-9-11
HC114	First selection of reversal prevention				
HC115	First selection for the torque transformation	00 (Torque)/01 (Current)	01		
HC120	First time constant for torque current command filter	0~100 (ms)	2		
HC121	First speed feed forward gain	0~1000	0		
HC137	First flux setting level	0.0~100.0 (%)	80.0		12-9-9
HC140	First forcing level	0~1000 (%)	100		
HC141	First modulation threshold 1	0~133 (%)	115		
HC142	First modulation threshold 2				
HC201	Second automatic torque boost voltage compensation gain	0~255 (%)	100		12-17-1
HC202	Second automatic torque boost slip compensation gain				
HC210	Second zero-speed range limiter (IM-0Hz)	0~100 (%)	80		
HC211	Second amount of boost at the start (IM-SLV)	0~50 (%)	0		
HC212	Second amount of boost at the start (IM-oHz)		10		
HC213	Second selection of whether a secondary-resistance correction is to be conducted.	00 (Disabled)/01 (Enabled)	00		
HC214	Second selection of reversal prevention				
HC215	Second selection for the torque transformation	Same as HC115	01		
HC220	Second time constant for torque current command filter	0~100 (ms)	2		
HC221	Second speed feed forward gain	0~1000	0		
HC237	Second flux setting level	Same as HC137	80.0		
HC240	Second forcing level	Same as HC140	100		
HC241	Second modulation threshold 1	Same as HC141	115		
HC242	Second modulation threshold 2	Same as HC142			
Hd102	First SM (PMM) motor capacity selection	0.01~75.00 (kW)	*1)		12-3-1
Hd103	First selection of number of SM (PMM) motor poles	2 to 48 (poles)			
Hd104	First SM (PMM) base frequency	10.00~590.00 (Hz)			
Hd105	First SM (PMM) maximum frequency				
Hd106	First SM (PMM) motor's rated voltage	1~1000 (V)			
Hd108	First SM (PMM) motor's rated current	0.01~10000.00 (A)			
Hd110	First SM (PMM) motor's constant R	0.000001~1000.000000 (Ω)			12-3-3
Hd112	First SM (PMM) motor's constant Ld	0.000001~1000.000000 (mH)			
Hd114	First SM (PMM) motor's constant Lq				
Hd116	First SM (PMM) motor's constant Ke	0.1~100000.0 (mVs/rad)			
Hd118	First SM (PMM) motor's constant J	0.00001~10000.00000 (kgm^2)			
Hd130	First SM (PMM) minimum frequency	0~50 (%)	8		12-9-22
Hd131	First SM (PMM) no-load current	0~100 (%)	10		
Hd132	First SM (PMM) start method selection	00 (Position estimation disabled) 01 (Position estimation enabled)	00		
Hd133	First SM (PMM) initial position estimation zero-V stand-by times	0~255	10		
Hd134	First SM (PMM) initial position estimation detection stand-by times				
Hd135	First SM (PMM) initial position estimation detection times		30		
Hd136	First SM (PMM) initial position estimation voltage gain	0~200 (%)	100		
Hd137	First initial position estimation magnetic-pole position offset	0~359 (deg)	0		
Hd-41	IVMS carrier frequency *2)	0.5~16.0 (kHz)	2.0		12-9-21
Hd-42	Filter gain of IVMS detection current *2)	0~1000	100		
Hd-43	Open-phase voltage detection gain selection. *2)	00 (Gain 0)/01 (Gain 1) 02 (Gain 2)/03 (Gain 3)	00		
Hd-44	Selection of open-phase switch threshold correction. *2)	00 (Disabled)/01 (Enabled)	01		
Hd-45	Speed control P gain *2)	0~1000	100		
Hd-46	Speed control I gain *2)	0~10000			
Hd-47	Waiting time for open-phase switching *2)	0~1000	15		
Hd-48	Restriction on the rotation-direction determination *2)	00 (Disabled)/01 (Enabled)	01		
Hd-49	Adjustment of the timing for detecting the open-phase voltage *2)	0~1000	10		
Hd-50	Minimum pulse-width adjustment *2)		100		
Hd-51	Current limit of IVMS threshold *2)	0~255	100		
Hd-52	IVMS threshold gain *2)				
Hd-58	IVMS carrier-frequency switching start/finish point *2)	0~50 (%)	5		

*1) Varies depending on inverter models and settings of duty rating.
*2) Hd-41 to 58 are reserved parameters.

Code	Name	Data range	Initial value	Note	Page
Hd202	Second SM (PMM) motor capacity selection	Same as Hd-102	*1)		12-7-1
Hd203	Second selection of number of SM (PMM) motor poles	Same as Hd-103			
Hd204	Second SM (PMM) base frequency	Same as Hd-104			
Hd205	Second SM (PMM) maximum frequency	Same as Hd-105			
Hd206	Second SM (PMM) motor's rated voltage	Same as Hd-106			
Hd208	Second SM (PMM) motor's rated current	Same as Hd-108			
Hd210	Second SM (PMM) motor's constant R	Same as Hd-110			
Hd212	Second SM (PMM) motor's constant Ld	Same as Hd-112			
Hd214	Second SM (PMM) motor's constant Lq	Same as Hd-114			
Hd216	Second SM (PMM) motor's constant Ke	Same as Hd-116			
Hd218	Second SM (PMM) motor's constant J	Same as Hd-118			
Hd230	Second SM (PMM) minimum frequency	Same as Hd-130	8		
Hd231	Second SM (PMM) no-load current	Same as Hd-131	10		
Hd232	Second SM (PMM) start method selection	Same as Hd-132	00		
Hd233	Second SM (PMM) initial position estimation zero-V stand-by times	Same as Hd-133	10		
Hd234	Second SM (PMM) initial position estimation detection stand-by times	Same as Hd-134			
Hd235	Second SM (PMM) initial position estimation detection times	Same as Hd-135	30		
Hd236	Second SM (PMM) initial position estimation voltage gain	Same as Hd-136	100		
Hd237	Second initial position estimation magnetic-pole position offset	Same as Hd-137	0		

*1) Varies depending on inverter models and settings of duty rating.

■Parameter mode (O code：Option Card)

Code	Name	Data range	Initial value	Note	Page
oA-10	Operation selection when option error occurs (slot 1)	00 (Error)/01 (Continue operation)	00		＊
oA-11	Communication monitoring timer setting (slot1)	0.00~100.00 (s)	1.00		
oA-12	Operation setting at the time of communication error (slot1)	00 (Error)/01 (Trip after deceleration stop) 02 (Ignore)/03 (Free run) 04 (Deceleration stop)	01		
oA-13	Selection of operation command behavior at start (slot 1)	00 (Operation command disabled) 01 (Operation command enabled)			
oA-20	Operation selection when option error occurs (slot 2)	00 (Error)/01 (Continue operation)	00		
oA-21	Communication monitoring timer setting (slot 2)	0.00~100.00 (s)	1.00		
oA-22	Operation setting at the time of communication error (slot 2)	00 (Error)/01 (Trip after deceleration stop) 02 (Ignore)/03 (Free run) 04 (Deceleration stop)	01		
oA-23	Selection of operation command behavior at start (slot 2)	00 (Operation command disabled) 01 (Operation command enabled)	00		
oA-30	Operation selection when option error occurs (slot 3)	00 (Error)/01 (Continue operation)			
oA-31	Communication monitoring timer setting (slot 3)	0.00~100.00 (s)	1.00		
oA-32	Operation setting at the time of communication error (slot 3)	00 (Error)/01 (Trip after deceleration stop) 02 (Ignore)/03 (Free run) 04 (Deceleration stop)	01		
oA-33	Selection of operation command behavior at start (slot 3)	00 (Operation command disabled) 01 (Operation command enabled)	00		
ob-01	Encoder constant set-up (option)	32~65535 (pls)	1024		
ob-02	Encoder phase sequence selection (option)	00 (Phase-A is leading) 01 (Phase-B is leading)	00		
ob-03	Motor gear ratio's numerator (option)	1~10000	1		
ob-04	Motor gear ratio's denominator (option)				
ob-10	Pulse train input SA/SB (option) detection target selection	00 (Command) 01 (Pulse string position command)	00		
ob-11	Pulse train input (option) mode selection	00 (90° phase difference) 01 (forward/reverse rotation command and rotation direction) 02 (forward/reverse rotation pulse string)	01		
ob-12	Pulse train input (option) scale	0.05~200.0 (kHz)	25.00		
ob-13	Pulse train input (option) filter time constant	0.01~2.00 (s)	0.10		
ob-14	Pulse train input (option) bias size	-100.0~100.0 (%)	0.0		
ob-15	Pulse train input (option) upper detection limit	0.0~100.0 (%)	100.0		
ob-16	Pulse train input (option) lower detection limit		0.0		
oC-01 to oC-28	Reserved	-	-	-	-

＊For details, refer to the instruction manual provided together with the each optional cassette.

Code	Name	Data range	Initial value	Note	Page
oE-01	[Ai4] terminal input filter time constant	1~500 (ms)	16		*
oE-03	[Ai4] terminal start amount	0.00~100.00 (%)	0.00		
oE-04	[Ai4] terminal end amount		100.00		
oE-05	[Ai4] terminal start ratio	0.0~ [oE-06] (%)	0.0		
oE-06	[Ai4] terminal end ratio	[oE-05]~100.0 (%)	100.0		
oE-07	[Ai4] terminal start selection	00 (Start amount [oE-03])/01 (0%)	01		
oE-11	[Ai5] terminal input filter time constant	1~500 (ms)	16		
oE-13	[Ai5] terminal start amount	0.00~100.00 (%)	0.00		
oE-14	[Ai5] terminal end amount		100.00		
oE-15	[Ai5] terminal start ratio	0.0~ [oE-16] (%)	0.0		
oE-16	[Ai5] terminal end ratio	[oE-15]~100.0 (%)	100.0		
oE-17	[Ai5] terminal start selection	00 (Start amount [oE-13])/01 (0%)	01		
oE-21	[Ai6] terminal input filter time constant	1~500 (ms)	16		
oE-23	[Ai6] terminal start amount	-100.00~100.00 (%)	-100.00		
oE-24	[Ai6] terminal end amount		100.00		
oE-25	[Ai6] terminal start ratio	-100.0~ [oE-26] (%)	-100.0		
oE-26	[Ai6] terminal end ratio	[oE-25]~100.0 (%)	100.0		
oE-28	[Ai4] voltage/current bias adjustment	-100.00~100.00 (%)	0.00		
oE-29	[Ai4] voltage adjustment gain	0.00~200.00 (%)	100.00		
oE-30	[Ai5] voltage/current bias adjustment	-100.00~100.00 (%)	0.00		
oE-31	[Ai5] voltage adjustment gain	0.00~200.00 (%)	100.00		
oE-32	[Ai6] voltage bias adjustment	-100.00~100.00 (%)	0.00		
oE-33	[Ai6] voltage adjustment gain	0.00~200.00 (%)	100.00		
oE-35	Window comparator [Ai4] upper limit level	0~100 (%)	100		
oE-36	Window comparator [Ai4] lower limit level		0		
oE-37	Window comparator [Ai4] hysteresis range	0~10 (%)	0		
oE-38	Window comparator [Ai5] upper limit level	0~100 (%)	100		
oE-39	Window comparator [Ai5] lower limit level		0		
oE-40	Window comparator [Ai5] hysteresis range	0~10 (%)	0		
oE-41	Window comparator [Ai6] upper limit level	-100~100 (%)	100		
oE-42	Window comparator [Ai6] lower limit level		-100		
oE-43	Window comparator [Ai6] hysteresis range	0~10 (%)	0		
oE-44	[Ai4] operation level at disconnection	-100~100 (%)	0		
oE-45	[Ai4] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range)	00		
oE-46	[Ai5] operation level at disconnection	0~100 (%)	0		
oE-47	[Ai5] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range)	00		
oE-48	[Ai6] operation level at disconnection	0~100 (%)	0		
oE-49	[Ai6] operation level selection at disconnection	00 (Disabled)/01 (Enabled: out of range)	00		
oE-50	[Ao3] terminal output selection	See the List of output monitor functions	dA-01		
oE-51	[Ao4] terminal output selection				
oE-52	[Ao5] terminal output selection				
oE-56	[Ao3] output filter time constant	1~500 (ms)	100		
oE-57	[Ao3] output data type selection	00 (absolute value)/01 (with sign)	00		
oE-58	[Ao3] bias adjustment (voltage/current)	-100.0~100.0 (%)	0.0		
oE-59	[Ao3] gain adjustment (voltage/current)	-1000.0~1000.0 (%)	100.0		
oE-60	[Ao3] output level in the adjustment mode	-100.0~100.0 (%)			
oE-61	[Ao4] output filter time constant	1~500 (ms)	100		
oE-62	[Ao4] output data type selection	00 (absolute value)/01 (with sign)	00		
oE-63	[Ao4] bias adjustment (voltage/current)	-100.0~100.0 (%)	0.0		
oE-64	[Ao4] gain adjustment (voltage/current)	-1000.0~1000.0 (%)	100.0		
oE-65	[Ao4] output level in the adjustment mode	-100.0~100.0 (%)			
oE-66	[Ao5] output filter time constant	1~500(ms)	100		
oE-67	[Ao5] output data type selection	00 (absolute value)/01 (with sign)	00		
oE-68	[Ao5] bias adjustment (voltage)	-100.0~100.0 (%)	0.0		
oE-69	[Ao5] gain adjustment (voltage)	-1000.0~1000.0 (%)	100.0		
oE-70	[Ao5] output level in the adjustment mode	-100.0~100.0 (%)			

∗For details, refer to the instruction manual provided together with the each optional cassette.

Code	Name	Data range	Initial value	Note	Page
oH-01	IP address selection (P1-EN)	00 (Gr.1)/01 (Gr.2)	00		*
oH-02	Transmission speed (port 1) (P1-EN)	00 (Auto negotiation)/01 (100M: full duplex) 02 (100M: half duplex)/03 (10M: full duplex) 04 (10M: half duplex)			
oH-03	Transmission speed (port 2) (P1-EN)				
oH-04	Ethernet communication timeout (P1-EN)	1~65535 (×10ms)	3000		
oH-05	Modbus TCP port number (IPv4)	502, 1024~65535	502		
oH-06	Modbus TCP port number (IPv6)				
oH-20	Profibus Nobe address	0~125	0		
oH-21	Profibus Clear Mode selection	00 (Clear)/01 (Value retained the last time)	00		
oH-22	Profibus Map selection	00 (PPO)/01 (Comvertional)/02 (FlexibleMode)			
oH-23	Selection of setting from the Profibus master	00 (Allowed)/01 (Not allowed)			
oH-24	Selection of setpoint telegram/Actual value telegram Gr	00 (Gr.A)/01 (Gr.B)/02 (Gr.C)			
oH-30	IP address selection (P1-PN)	00 (Gr.1)/01 (Gr.2)			
oH-31	Transmission speed (port 1) (P1-PN)	00 (Auto negotiation)/01 (100M: full duplex) 02 (100M: half duplex)/03 (10M: full duplex) 04 (10M: half duplex)			
oH-32	Transmission speed (port 2) (P1-PN)				
oH-33	Ethernet communication timeout (P1-PN)	1~65535 (×10ms)	3000		
oH-34	Selection of setpoint telegram/Actual value telegram Gr	00 (Gr.A)/01 (Gr.B)/02 (Gr.C)	502		

Code	Name	Data range	Initial value	Note	Page
oJ-01	Gr.A flexible command registration writing register 1	0000~FFFF	0000		*
oJ-02	Gr.A flexible command registration writing register 2				
oJ-03	Gr.A flexible command registration writing register 3				
oJ-04	Gr.A flexible command registration writing register 4				
oJ-05	Gr.A flexible command registration writing register 5				
oJ-06	Gr.A flexible command registration writing register 6				
oJ-07	Gr.A flexible command registration writing register 7				
oJ-08	Gr.A flexible command registration writing register 8				
oJ-09	Gr.A flexible command registration writing register 9				
oJ-10	Gr.A flexible command registration writing register 10				
oJ-11	Gr.A flexible command registration reading register 1				
oJ-12	Gr.A flexible command registration reading register 2				
oJ-13	Gr.A flexible command registration reading register 3				
oJ-14	Gr.A flexible command registration reading register 4				
oJ-15	Gr.A flexible command registration reading register 5				
oJ-16	Gr.A flexible command registration reading register 6				
oJ-17	Gr.A flexible command registration reading register 7				
oJ-18	Gr.A flexible command registration reading register 8				
oJ-19	Gr.A flexible command registration reading register 9				
oJ-20	Gr.A flexible command registration reading register 10				
oJ-21	Gr.B flexible command registration writing register 1				
oJ-22	Gr.B flexible command registration writing register 2				
oJ-23	Gr.B flexible command registration writing register 3				
oJ-24	Gr.B flexible command registration writing register 4				
oJ-25	Gr.B flexible command registration writing register 5				
oJ-26	Gr.B flexible command registration writing register 6				
oJ-27	Gr.B flexible command registration writing register 7				
oJ-28	Gr.B flexible command registration writing register 8				
oJ-29	Gr.B flexible command registration writing register 9				
oJ-30	Gr.B flexible command registration writing register 10				
oJ-31	Gr.B flexible command registration reading register 1				
oJ-32	Gr.B flexible command registration reading register 2				
oJ-33	Gr.B flexible command registration reading register 3				
oJ-34	Gr.B flexible command registration reading register 4				
oJ-35	Gr.B flexible command registration reading register 5				
oJ-36	Gr.B flexible command registration reading register 6				
oJ-37	Gr.B flexible command registration reading register 7				
oJ-38	Gr.B flexible command registration reading register 8				
oJ-39	Gr.B flexible command registration reading register 9				
oJ-40	Gr.B flexible command registration reading register 10				
oJ-41	Gr.C flexible command registration writing register 1				
oJ-42	Gr.C flexible command registration writing register 2				
oJ-43	Gr.C flexible command registration writing register 3				
oJ-44	Gr.C flexible command registration writing register 4				
oJ-45	Gr.C flexible command registration writing register 5				
oJ-46	Gr.C flexible command registration writing register 6				
oJ-47	Gr.C flexible command registration writing register 7				
oJ-48	Gr.C flexible command registration writing register 8				
oJ-49	Gr.C flexible command registration writing register 9				

<table>
<tr><th>Code</th><th>Name</th><th>Data range</th><th>Initial value</th><th>Note</th><th>Page</th></tr>
<tr><td>oJ-50</td><td>Gr.C flexible command registration writing register 10</td><td rowspan="11">0000~FFFF</td><td rowspan="11">0000</td><td></td><td rowspan="69">∗</td></tr>
<tr><td>oJ-51</td><td>Gr.C flexible command registration reading register 1</td><td></td></tr>
<tr><td>oJ-52</td><td>Gr.C flexible command registration reading register 2</td><td></td></tr>
<tr><td>oJ-53</td><td>Gr.C flexible command registration reading register 3</td><td></td></tr>
<tr><td>oJ-54</td><td>Gr.C flexible command registration reading register 4</td><td></td></tr>
<tr><td>oJ-55</td><td>Gr.C flexible command registration reading register 5</td><td></td></tr>
<tr><td>oJ-56</td><td>Gr.C flexible command registration reading register 6</td><td></td></tr>
<tr><td>oJ-57</td><td>Gr.C flexible command registration reading register 7</td><td></td></tr>
<tr><td>oJ-58</td><td>Gr.C flexible command registration reading register 8</td><td></td></tr>
<tr><td>oJ-59</td><td>Gr.C flexible command registration reading register 9</td><td></td></tr>
<tr><td>oJ-60</td><td>Gr.C flexible command registration reading register 10</td><td></td></tr>
<tr><td>oL-01</td><td>Gr.1 IPv4 IP address (1)</td><td rowspan="12">0~255</td><td>192</td><td></td></tr>
<tr><td>oL-02</td><td>Gr.1 IPv4 IP address (2)</td><td>168</td><td></td></tr>
<tr><td>oL-03</td><td>Gr.1 IPv4 IP address (3)</td><td>0</td><td></td></tr>
<tr><td>oL-04</td><td>Gr.1 IPv4 IP address (4)</td><td>2</td><td></td></tr>
<tr><td>oL-05</td><td>Gr.1 IPv4 subnet mask (1)</td><td>255</td><td></td></tr>
<tr><td>oL-06</td><td>Gr.1 IPv4 subnet mask (2)</td><td>255</td><td></td></tr>
<tr><td>oL-07</td><td>Gr.1 IPv4 subnet mask (3)</td><td>255</td><td></td></tr>
<tr><td>oL-08</td><td>Gr.1 IPv4 subnet mask (4)</td><td>0</td><td></td></tr>
<tr><td>oL-09</td><td>Gr.1 IPv4 default gateway (1)</td><td>192</td><td></td></tr>
<tr><td>oL-10</td><td>Gr.1 IPv4 default gateway (2)</td><td>168</td><td></td></tr>
<tr><td>oL-11</td><td>Gr.1 IPv4 default gateway (3)</td><td>0</td><td></td></tr>
<tr><td>oL-12</td><td>Gr.1 IPv4 default gateway (4)</td><td>1</td><td></td></tr>
<tr><td>oL-20</td><td>Gr.1 IPv6 IP address (1)</td><td rowspan="8">0000~FFFF</td><td rowspan="8">0000</td><td></td></tr>
<tr><td>oL-21</td><td>Gr.1 IPv6 IP address (2)</td><td></td></tr>
<tr><td>oL-22</td><td>Gr.1 IPv6 IP address (3)</td><td></td></tr>
<tr><td>oL-23</td><td>Gr.1 IPv6 IP address (4)</td><td></td></tr>
<tr><td>oL-24</td><td>Gr.1 IPv6 IP address (5)</td><td></td></tr>
<tr><td>oL-25</td><td>Gr.1 IPv6 IP address (6)</td><td></td></tr>
<tr><td>oL-26</td><td>Gr.1 IPv6 IP address (7)</td><td></td></tr>
<tr><td>oL-27</td><td>Gr.1 IPv6 IP address (8)</td><td></td></tr>
<tr><td>oL-28</td><td>Gr.1 IPv6 subnet prefix</td><td>0~127</td><td>64</td><td></td></tr>
<tr><td>oL-29</td><td>Gr.1 IPv6 default gateway (1)</td><td rowspan="8">0000~FFFF</td><td rowspan="8">0000</td><td></td></tr>
<tr><td>oL-30</td><td>Gr.1 IPv6 default gateway (2)</td><td></td></tr>
<tr><td>oL-31</td><td>Gr.1 IPv6 default gateway (3)</td><td></td></tr>
<tr><td>oL-32</td><td>Gr.1 IPv6 default gateway (4)</td><td></td></tr>
<tr><td>oL-33</td><td>Gr.1 IPv6 default gateway (5)</td><td></td></tr>
<tr><td>oL-34</td><td>Gr.1 IPv6 default gateway (6)</td><td></td></tr>
<tr><td>oL-35</td><td>Gr.1 IPv6 default gateway (7)</td><td></td></tr>
<tr><td>oL-36</td><td>Gr.1 IPv6 default gateway (8)</td><td></td></tr>
<tr><td>oL-40</td><td>Gr.2 IPv4 IP address (1)</td><td rowspan="12">0~255</td><td>192</td><td></td></tr>
<tr><td>oL-41</td><td>Gr.2 IPv4 IP address (2)</td><td>168</td><td></td></tr>
<tr><td>oL-42</td><td>Gr.2 IPv4 IP address (3)</td><td>0</td><td></td></tr>
<tr><td>oL-43</td><td>Gr.2 IPv4 IP address (4)</td><td>2</td><td></td></tr>
<tr><td>oL-44</td><td>Gr.2 IPv4 subnet mask (1)</td><td>255</td><td></td></tr>
<tr><td>oL-45</td><td>Gr.2 IPv4 subnet mask (2)</td><td>255</td><td></td></tr>
<tr><td>oL-46</td><td>Gr.2 IPv4 subnet mask (3)</td><td>255</td><td></td></tr>
<tr><td>oL-47</td><td>Gr.2 IPv4 subnet mask (4)</td><td>0</td><td></td></tr>
<tr><td>oL-48</td><td>Gr.2 IPv4 default gateway (1)</td><td>192</td><td></td></tr>
<tr><td>oL-49</td><td>Gr.2 IPv4 default gateway (2)</td><td>168</td><td></td></tr>
<tr><td>oL-50</td><td>Gr.2 IPv4 default gateway (3)</td><td>0</td><td></td></tr>
<tr><td>oL-51</td><td>Gr.2 IPv4 default gateway (4)</td><td>1</td><td></td></tr>
<tr><td>oL-60</td><td>Gr.2 IPv6 IP address (1)</td><td rowspan="8">0000~FFFF</td><td rowspan="8">0000</td><td></td></tr>
<tr><td>oL-61</td><td>Gr.2 IPv6 IP address (2)</td><td></td></tr>
<tr><td>oL-62</td><td>Gr.2 IPv6 IP address (3)</td><td></td></tr>
<tr><td>oL-63</td><td>Gr.2 IPv6 IP address (4)</td><td></td></tr>
<tr><td>oL-64</td><td>Gr.2 IPv6 IP address (5)</td><td></td></tr>
<tr><td>oL-65</td><td>Gr.2 IPv6 IP address (6)</td><td></td></tr>
<tr><td>oL-66</td><td>Gr.2 IPv6 IP address (7)</td><td></td></tr>
<tr><td>oL-67</td><td>Gr.2 IPv6 IP address (8)</td><td></td></tr>
<tr><td>oL-68</td><td>Gr.2 IPv6 subnet prefix</td><td>0~127</td><td>64</td><td></td></tr>
<tr><td>oL-69</td><td>Gr.2 IPv6 default gateway (1)</td><td rowspan="8">0000~FFFF</td><td rowspan="8">0000</td><td></td></tr>
<tr><td>oL-70</td><td>Gr.2 IPv6 default gateway (2)</td><td></td></tr>
<tr><td>oL-71</td><td>Gr.2 IPv6 default gateway (3)</td><td></td></tr>
<tr><td>oL-72</td><td>Gr.2 IPv6 default gateway (4)</td><td></td></tr>
<tr><td>oL-73</td><td>Gr.2 IPv6 default gateway (5)</td><td></td></tr>
<tr><td>oL-74</td><td>Gr.2 IPv6 default gateway (6)</td><td></td></tr>
<tr><td>oL-75</td><td>Gr.2 IPv6 default gateway (7)</td><td></td></tr>
<tr><td>oL-76</td><td>Gr.2 IPv6 default gateway (8)</td><td></td></tr>
</table>

∗For details, refer to the instruction manual provided together with the each optional cassette.

■Parameter mode (P code：Special Function)

Code	Name	Data range	Initial value	Note	Page
PA-01	Forced operation mode selection	00 (Disabled)/01 (Enabled)	00		10-7
PA-02	Forced operation frequency setting	0.00~590.00 (Hz)	0.00		
PA-03	Forced operation rotation direction command	00 (Normal rotation)/01 (Reverse rotation)	00		
PA-04	Commercial power supply bypass function selection	00 (Disabled)/01 (Enabled)	00		
PA-05	Bypass function delay time	0.0~1000.0 (s)	5.0		
PA-20	Simulation mode selection	00 (Disabled)/01 (Enabled)	00		
PA-21	Selection of error code for alarm test	000~255	000		
PA-22	Output current monitor optional output selection	00 (Disabled) 01 (Enabled: parameter setting [PA-23]) 02 (Enabled: set from [VRF]) 03 (Enabled: set from [IRF]) 04 (Enabled: set from [VF2]) 05 (Enabled: set from [Ai4]) 06 (Enabled: set from [Ai5]) 07 (Enabled: set from [Ai6])	01		
PA-23	Output current monitor optional setting value	0.0 to 3.0 × Inverter rated current (A)	0.0		
PA-24	P-N voltage monitor optional output selection	00 (Disabled) 01 (Enabled: parameter setting [PA-25]) 02 (Enabled: set from [VRF]) 03 (Enabled: set from [IRF]) 04 (Enabled: set from [VF2]) 05 (Enabled: set from [Ai4]) 06 (Enabled: set from [Ai5]) 07 (Enabled: set from [Ai6])	01		
PA-25	P-N voltage monitor optional setting value	200V class: 0.0 to 450.0 (Vdc) 400V class: 0.0 to 900.0 (Vdc)	270.0 540.0		
PA-26	Output voltage monitor optional output selection	00 (Disabled) 01 (Enabled: parameter setting [PA-27]) 02 (Enabled: set from [VRF]) 03 (Enabled: set from [IRF]) 04 (Enabled: set from [VF2]) 05 (Enabled: set from [Ai4]) 06 (Enabled: set from [Ai5]) 07 (Enabled: set from [Ai6])	01		
PA-27	Output voltage monitor optional setting value	200V class: 0.0-300.0 (V) 400V class: 0.0-600.0 (V)	0.0		
PA-28	Output torque monitor optional output selection	00 (Disabled) 01 (Enabled: parameter setting [PA-29]) 02 (Enabled: set from [VRF]) 03 (Enabled: set from [IRF]) 04 (Enabled: set from [VF2]) 05 (Enabled: set from [Ai4]) 06 (Enabled: set from [Ai5]) 07 (Enabled: set from [Ai6])	01		
PA-29	Output torque monitor optional setting value	-500.0~+500.0 (%)	0.0		
PA-30	Frequency adjustment optional output selection	00 (Disabled) 01 (Enabled: parameter setting [PA-31]) 02 (Enabled: set from [VRF]) 03 (Enabled: set from [IRF]) 04 (Enabled: set from [VF2]) 05 (Enabled: set from [Ai4]) 06 (Enabled: set from [Ai5]) 07 (Enabled: set from [Ai6])	01		
PA-31	Frequency matching optional setting value	0.0~590.00 (Hz)	0.00		

■Parameter mode (U code：Set-up, PDN)

Code	Name	Data range	Initial value	Note	Page
UA-01	Password input for display selection	0000~FFFF	0000		9-34
UA-02	Soft-lock password input				
UA-10	Display selection	00 (Full display)/01 (By function)/02 (User setting) 03 (Conveyor display)/04 (Only monitor display)	00		9-26
UA-12	Clearing of integrated input power	00 (Disabled)/01 (Clear)	00		13-7
UA-13	Integrated input power display gain	1~1000	1		
UA-14	Clearing of integrated output power	00 (Disabled)/01 (Clear)	00		
UA-15	Integrated output power display gain	1~1000	1		
UA-16	Soft-lock selection	00 ([SFT] terminal)/01 (Always enabled)	00		9-26
UA-17	Soft-lock target selection	00 (All data cannot be changed) 01 (Data other than set frequency cannot be changed)	00		
UA-18	Data R/W selection	00 (R/W enabled)/01 (R/W disabled)	00		9-37
UA-19	Battery level warning selection	00 (Disabled)/01 (Warning)/02 (Error)	00		
UA-20	Operation at disconnection of operator keypad	00 (Error)/01 (Error after deceleration stop) 02 (Ignore)/03 (Free run)/04 (Deceleration stop)	02		9-36
UA-21	Selection of second setting parameter display	00 (Not display)/01 (Display)	00		9-26
UA-22	Selection of option parameter display				
UA-30	Selection of user parameter automatic setting	00 (Disabled)/01 (Enabled)			9-33
UA-31	User parameter 1 selection	no/***** (select a parameter)	no		
UA-32	User parameter 2 selection				
UA-33	User parameter 3 selection				
UA-34	User parameter 4 selection				
UA-35	User parameter 5 selection				
UA-36	User parameter 6 selection				
UA-37	User parameter 7 selection				
UA-38	User parameter 8 selection				
UA-39	User parameter 9 selection				
UA-40	User parameter 10 selection				
UA-41	User parameter 11 selection				
UA-42	User parameter 12 selection				
UA-43	User parameter 13 selection				
UA-44	User parameter 14 selection				
UA-45	User parameter 15 selection				
UA-46	User parameter 16 selection				
UA-47	User parameter 17 selection				
UA-48	User parameter 18 selection				
UA-49	User parameter 19 selection				
UA-50	User parameter 20 selection				
UA-51	User parameter 21 selection				
UA-52	User parameter 22 selection				
UA-53	User parameter 23 selection				
UA-54	User parameter 24 selection				
UA-55	User parameter 25 selection				
UA-56	User parameter 26 selection				
UA-57	User parameter 27 selection				
UA-58	User parameter 28 selection				
UA-59	User parameter 29 selection				
UA-60	User parameter 30 selection				
UA-61	User parameter 31 selection				
UA-62	User parameter 32 selection				
UA-90 to UA-94	Reserved	-	-		-
Ub-01	Selection of factory default initialization	00 (Disabled)/01 (Trip history) 02 (Parameter initialization) 03 (Trip history + parameters)/04 (Reserved) 05 (Other than terminal function) 06 (Other than communication function) 07 (Other than terminal&communication functions) 08 (Reserved)	00		12-2-4
Ub-02	Selection of initial values	00 (Mode 0)/01 (Mode 1)/02 (Mode 2)/03 (Mode 3)	00		
Ub-03	Duty type selection	00 (VLD)/01 (LD)/02 (ND)	02		12-2-1
Ub-05	Initialization start selection	00 (Disabled)/01 (Start initialization)	00		12-2-4
UC-01	Debug mode selection	(do not change)	00		-

Code	Name	Data range	Initial value	Note	Page
Ud-01	Trace function selection	00 (Disabled)/01 (Enabled)	00		16-3
Ud-02	Trace start	00 (Stop)/01 (Start)			
Ud-03	Selection of the number of trace data sets	0~8	1		
Ud-04	Selection of the number of trace signals				
Ud-10	Selection of trace data 0	See Appendix 1-29 <List of output monitor functions>.	dA-01		
Ud-11	Selection of trace data 1				
Ud-12	Selection of trace data 2				
Ud-13	Selection of trace data 3				
Ud-14	Selection of trace data 4				
Ud-15	Selection of trace data 5				
Ud-16	Selection of trace data 6				
Ud-17	Selection of trace data 7				
Ud-20	Trace signal 0 I/O selection	00 (Input: [Ud-21])/01 (Output: [Ud-22])	00		
Ud-21	Trace signal 0 input terminal selection	*1)	001		
Ud-22	Trace signal 0 output terminal selection	*2)			
Ud-23	Trace signal 1 I/O selection	00 (Input: [Ud-24])/01 (Output: [Ud-25])	00		
Ud-24	Trace signal 1 input terminal selection	*1)	001		
Ud-25	Trace signal 1 output terminal selection	*2)			
Ud-26	Trace signal 2 I/O selection	00 (Input: [Ud-27]/01 (Output: [Ud-28])	00		
Ud-27	Trace signal 2 input terminal selection	*1)	001		
Ud-28	Trace signal 2 output terminal selection	*2)			
Ud-29	Trace signal 3 I/O selection	00 (Input: [Ud-30])/01 (Output: [Ud-31])	00		
Ud-30	Trace signal 3 input terminal selection	*1)	001		
Ud-31	Trace signal 3 output terminal selection	*2)			
Ud-32	Trace signal 4 I/O selection	00 (Input: [Ud-33])/01 (Output: [Ud-34])	00		
Ud-33	Trace signal 4 input terminal selection	*1)	001		
Ud-34	Trace signal 4 output terminal selection	*2)			
Ud-35	Trace signal 5 I/O selection	00 (Input: [Ud-36])/01 (Output: [Ud-37])	00		
Ud-36	Trace signal 5 input terminal selection	*1)	001		
Ud-37	Trace signal 5 output terminal selection	*2)			
Ud-38	Trace signal 6 I/O selection	00 (Input: [Ud-39])/01 (Output: [Ud-40])	00		
Ud-39	Trace signal 6 input terminal selection	*1)	001		
Ud-40	Trace signal 6 output terminal selection	*2)			
Ud-41	Trace signal 7 I/O selection	00 (Input: [Ud-42])/01 (Output: [Ud-43])	00		
Ud-42	Trace signal 7 input terminal selection	*1)	001		
Ud-43	Trace signal 7 output terminal selection	*2)			
Ud-50	Selection of trace trigger 1	00 (Trip)/01 (Trace data 0)/02 (Trace data 1) 03 (Trace data 2)/04 (Trace data 3)/05 (Trade data 4) 06 (Trace data 5)/07 (Trace data 6)/08 (Trace data 7) 09 (Trace signal 0)/10 (Trace signal 1) 11 (Trace signal 2)/12 (Trace signal 3) 13 (Trace signal 4)/14 (Trace signal 5) 15 (Trace signal 6)/16 (Trace signal 7)	00		
Ud-51	Selection of trigger 1 operation at trace data trigger	00 (Operate when it is above the trigger level) 01 (Operate when it is below the trigger level)	00		
Ud-52	Trigger 1 level at trace data trigger	0~100 (%)	0		
Ud-53	Selection of trigger 1 operation at trace signal trigger	00 (Operate when the signal is ON) 01 (Operate when the signal is OFF)	00		
Ud-54	Selection of trace trigger 2	Same as Ud-50	00		
Ud-55	Selection of trigger 2 operation at trace data trigger	00 (Rising edge) 01 (Falling edge)	00		
Ud-56	Trigger 2 level at trace data trigger	0~100 (%)	0		
Ud-57	Selection of trigger 2 operation at trace signal trigger	00 (Operate when the signal is ON) 01 (Operate when the signal is OFF)	00		
Ud-58	Trigger condition selection	00 (When trigger 1 is satisfied) 01 (When trigger 2 is satisfied) 02 (When trigger 1 or 2 is satisfied) 03 (When trigger 1 and 2 are satisfied)	00		
Ud-59	Trigger point setting	0~100 (%)	0		
Ud-60	Sampling time setting	01 (0.2ms)/02 (0.5ms)/03 (1ms)/04 (2ms)/05 (5ms) 06 (10ms)/07 (50ms)/08 (100ms)/09 (500ms) 10 (1000ms)	03		

*1) See Appendix 1-30 <List of input terminal functions>.
*2) See Appendix 1-31 <List of output terminal functions>.

<List of output monitor functions>

Monitor No.	Function
dA-01	Output frequency monitor
dA-02	Output current monitor
dA-04	Frequency command after calculation
dA-08	Speed detection value monitor
dA-12	Output frequency monitor (with sign)
dA-14	Frequency upper limit monitor
dA-15	Torque command monitor after calculation
dA-16	Torque limit monitor
dA-17	Output torque monitor
dA-18	Output voltage monitor
dA-30	Input power monitor
dA-34	Output power monitor
dA-38	Motor temperature monitor
dA-40	DC voltage monitor
dA-41	DBTR load factor monitor
dA-42	Electronic thermal duty ratio monitor motor
dA-43	Electronic thermal duty ratio monitor inverter
dA-61	Analog input [VRF] monitor
dA-62	Analog input [IRF] monitor
dA-63	Analog input [VF2] monitor
dA-64	Analog input [Ai4] monitor
dA-65	Analog input [Ai5] monitor
dA-66	Analog input [Ai6] monitor
dA-70	Pulse string input monitor main body
dA-71	Pulse string input monitor option
db-01 to db-23	Reserved
db-30	PID1 feedback data 1 monitor
db-32	PID1 feedback data 2 monitor
db-34	PID1 feedback data 3 monitor

Monitor No.	Function
db-36	PID2 feedback data monitor
db-38	PID3 feedback data monitor
db-40	PID4 feedback data monitor
db-42	PID1 target value monitor after calculation
db-44	PID1 feedback data
db-50	PID1 output monitor
db-51	PID1 deviation monitor
db-52	PID1 deviation 1 monitor
db-53	PID1 deviation 2 monitor
db-54	PID1 deviation 3 monitor
db-55	PID2 output monitor
db-56	PID2 deviation monitor
db-57	PID3 output monitor
db-58	PID3 deviation monitor
db-59	PID4 output monitor
db-60	PID4 deviation monitor
db-64	PID feed-forward monitor
dC-15	Cooling fin temperature monitor
FA-01	Main speed command
FA-02	Auxiliary speed command
FA-15	Torque command monitor
FA-16	Torque bias monitor
FA-30	PID1 target value 1
FA-32	PID1 target value 2
FA-34	PID1 target value 3
FA-36	PID2 target value
FA-38	PID3 target value
FA-40	PID4 target value

<Unit options>

No.	Unit
00	non
01	%
02	A
03	Hz
04	V
05	kW
06	W
07	hr
08	s
09	kHz
10	ohm
11	mA
12	ms
13	P
14	kgm^2
15	pls
16	mH
17	Vdc
18	°C
19	kWh
20	mF
21	mVs/rad
22	Nm
23	min^{-1}
24	m/s
25	m/min
26	m/h
27	ft/s
28	ft/min
29	ft/h

No.	Unit
30	m
31	cm
32	°F
33	l/s
34	l/min
35	l/h
36	m^3/s
37	m^3/min
38	m^3/h
39	kg/s
40	kg/min
41	kg/h
42	t/min
43	t/h
44	gal/s
45	gal/min
46	gal/h
47	ft^3/s
48	ft^3/min
49	ft^3/h
50	lb/s
51	lb/min
52	lb/h
53	mbar
54	bar
55	Pa
56	kPa
57	PSI
58	mm

<List of input terminal functions>

Function No.	Abbreviation	Function name	Page
000	no	Without allocation	-
001	FR	Normal rotation	12-5-2
002	RR	Reverse rotation	
003	DFL	Multistage speed 1	12-4-12
004	DFM	Multistage speed 2	
005	DFH	Multistage speed 3	
006	DHH	Multistage speed 4	
007	SF1	Multistage speed bit 1	12-4-13
008	SF2	Multistage speed bit 2	
009	SF3	Multistage speed bit 3	
010	SF4	Multistage speed bit 4	
011	SF5	Multistage speed bit 5	
012	SF6	Multistage speed bit 6	
013	SF7	Multistage speed bit 7	
014	ADD	Addition of frequency	12-4-14
015	AUT	Switching of command	12-4-10
016	STA	3-wire starting up	12-5-3
017	STP	3-wire stopping	
018	F/R	3-wire normal and reverse	
019	AHD	Retention of analog command	12-4-15
020	UP	Acceleration through remote operation	12-4-14
021	DWN	Deceleration through remote operation	
022	UDC	Clearing of remote operation data	
023	F-OP	Forced switching of command	12-5-5
024	SET	Second control	12-17-1
028	RST	Reset	12-24-6
029	JOG	Jogging	12-17-3
030	DB	Braking with external direct current	12-15-2
031	AD2	2-step acceleration/deceleration	12-8-4
032	MBS	Free-run stop	12-15-1
033	ES	External abnormality	12-16-2
034	USP	Prevention of power restoration restarting	
035	CS	Commercial switch	12-17-2
036	SFT	Soft-lock	9-26
037	BOK	Brake check	12-17-4
038	OLR	Switching of stall prevention	12-13-2
039	KHC	Clearing of integrated input power	13-7
040	OKHC	Clearing of integrated output power	
041	PID	PID1 disabled	12-10-13
042	PIDC	Resetting of PID1 integration	
043	PID2	PID2 disabled	12-10-26
044	PIDC2	Resetting of PID2 integration	
045	PID3	PID3 disabled	
046	PIDC3	Resetting of PID3 integration	
047	PID4	PID4 disabled	
048	PIDC4	Resetting of PID4 integration	
051	SVC1	PID1 multistage target value 1	12-10-9
052	SVC2	PID1 multistage target value 2	
053	SVC3	PID1 multistage target value 3	
054	SVC4	PID1 multistage target value 4	
055	PRO	Switching of PID gain	12-10-14
056	PIO	Switching of PID output	12-10-22
058	SLEP	Satisfaction of SLEEP condition	12-10-17
059	WAKE	Satisfaction of WAKE condition	
060	TL	Validation of torque limit	12-11-5
061	TRQ1	Torque limit switchover 1	12-11-6
062	TRQ2	Torque limit switchover 2	
063	PPI	PPI control switch	12-11-1
064	CAS	Control gain switch	

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<tr><td>067</td><td>ATR</td><td colspan="2">Validation of torque control</td><td>12-11-12</td></tr>
<tr><td>068</td><td>TBS</td><td colspan="2">Validation of torque bias</td><td>12-11-9</td></tr>
<tr><td>069</td><td>ORT</td><td colspan="2">Orientation</td><td>12-17-21</td></tr>
<tr><td>071</td><td>LAC</td><td colspan="2">Cancellation of LAD</td><td>12-18-</td></tr>
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<tr><td>075</td><td>PDN</td><td colspan="2">Subtraction of positional bias</td><td>12-17-20</td></tr>
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<tr><td>080</td><td>ORL</td><td colspan="2">Origin input signal</td><td rowspan="2">12-17-28</td></tr>
<tr><td>081</td><td>ORG</td><td colspan="2">Return-to-origin start up signal</td></tr>
<tr><td>082</td><td>FOT</td><td colspan="2">Stopping of forward rotation driving</td><td rowspan="2">12-17-29</td></tr>
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<tr><td>103</td><td>PLA</td><td colspan="2">Pulse string input A</td><td rowspan="2">12-24-13</td></tr>
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<tr><td>105</td><td>EMF</td><td colspan="2">Emergency forced operation</td><td>12-17-12</td></tr>
<tr><td>107</td><td>COK</td><td colspan="2">Contactor check signal</td><td>12-17-9</td></tr>
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<List of output terminal functions>

Function No.	Abbreviation	Function name	Page
000	no	Without allocation	-
001	DRV	During operation	12-20-1
002	UPF1	When the constant speed is attained	12-21-1
003	UPF2	Equal to or above the set frequency	12-21-2
004	UPF3	Set frequency only	12-21-3
005	UPF4	Equal to or above the set frequency 2	12-21-2
006	UPF5	Set frequency only 2	12-21-3
007	IRDY	Operation ready completion	12-20-4
008	FRR	During normal rotation operation	12-20-2
009	RRR	During reverse rotation operation	
010	FREF	Frequency command panel	12-4-2
011	REF	Operation command panel	12-5-1
012	SETM	Second control under selection	12-17-1
016	OPO	Optional output	14-30
017	AL	Alarm signal	12-19-1
018	MJA	Severe failure signal	12-19-2
019	OTQ	Excessive torque	12-11-7
020	IP	During instantaneous power failure	12-19-6
021	UV	Under insufficient voltage	12-19-7
022	TRQ	During torque limitation	12-11-6
023	IPS	During power failure deceleration	12-13-6
024	RNT	RUN time elapsed	12-19-11
025	ONT	Power ON time elapsed	12-19-12
026	THM	Electronic thermal warning	12-19-10
027	THC	Electronic thermal warning	12-19-9
029	WAC	Capacitor life advance notice	12-19-10
030	WAF	Fan life advance notice	12-19-11
031	FS	Operation command signal	12-20-3
032	OHF	Cooling fin heating advance notice	12-19-10
033	LOC	Low current signal	12-19-5
034	LOC2	Low current signal 2	
035	OL	Overload advance notice	12-19-4
036	OL2	Overload advance notice 2	
037	BRK	Brake release	12-17-4
038	BER	Brake abnormality	
039	CON	Contactor control	12-17-9
040	ZS	0 Hz detection signal	12-21-4
041	DSE	Excessive speed deviation	12-16-8
042	PDD	Excessive positional deviation	12-17-20
043	POK	Positioning completed	12-17-21
044	PCMP	Pulse count compare-match output	12-24-13
045	OD	PID excessive deviation	12-10-27
046	FBV	PID feedback comparison	12-10-28
047	OD2	PID2 excessive deviation	12-10-27
048	FBV2	PID2 feedback comparison	12-10-28
049	NDc	Communication disconnection	14-3
050	VRFDc	Analog disconnection VRF	12-22-1
051	IRFDc	Analog disconnection IRF	
052	VF2Dc	Analog disconnection VF2	
053	Ai4Dc	Analog disconnection Ai4	12-22-4
054	Ai5Dc	Analog disconnection Ai5	
055	Ai6Dc	Analog disconnection Ai6	
056	WCVRF	Window comparator VRF	12-22-1
057	WCIRF	Window comparator IRF	
058	WCVF2	Window comparator VF2	
059	WCAi4	Window comparator Ai4	12-22-4
060	WCAi5	Window comparator Ai5	
061	WCAi6	Window comparator Ai6	
062	LOG1	Result of logical operation 1	12-23-1
063	LOG2	Result of logical operation 2	
064	LOG3	Result of logical operation 3	
065	LOG4	Result of logical operation 4	
066	LOG5	Result of logical operation 5	
067	LOG6	Result of logical operation 6	

Function No.	Abbreviation	Function name	Page
068	LOG7	Result of logical operation 7	12-23-1
069 to 075	-	Reserved	-
076	EMFC	Forced operation in process signal	12-17-12
077	EMBP	During-bypass-mode signal	12-17-14
078	WFT	Trace trigger stand-by signal	16-2
079	TRA	During-tracing signal	
080	LBK	Operation panel battery insufficient	9-37
081	OVS	Excessive voltage of accepted power	12-19-12
084	AC0	Alarm code bit 0	12-19-3
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086	AC2	Alarm code bit 2	
087	AC3	Alarm code bit 3	
089	OD3	PID3 excessive deviation	12-10-27
090	FBV3	PID3 feedback comparison	12-10-28
091	OD4	PID4 excessive deviation	12-10-27
092	FBV4	PID4 feedback comparison	12-10-28
093	SSE	PID soft start abnormality	12-10-16

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Warranty

Warranty period	The warranty shall be 18 months from date of shipment or 12 months after initial operation, whichever is shorter.
Warranty condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agreed upon in writing between the Seller and Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product without charge at a designated facility, except as stipulated in the "Warranty Exclusions" as described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of: removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.
Warranty exclusion	Not withstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by: 1.Installation, connection, combination or integration of the Product in or to the other equipment or machine that rendered by any person or entity other than the Seller. 2.Insufficient maintenance or improper operation by the Buyer or its customers such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller; 3.Improper use or operation of the Product by the Buyer or its customers that is not informed to the Seller, including, without limitation, the Buyer's or its customers' operation of the Product not in conformity with the specifications; 4.Any problem or damage on any equipment or machine to which the Product is installed, connected or combined or any specifications particular to the buyer or its customers; 5.Any changes, modifications, improvements or alterations to the Product or those functions that are rendered on the Product by any person or entity other than the Seller; 6.Any parts in the Product that are supplied or designated by the Buyer or its customers; 7.Earthquake, fire, flood, salt air, gas, lightning, acts of God or any other reasons beyond the control of the Seller; 8.Normal wear and tear, or deterioration of the Product's parts, such as the cooling fan bearings; 9.Any other troubles, problems or damage to the Product that are not attributable to the Seller.
Others	The Seller will not be responsibility for the installation and removal of the inverter. Any inverter transportation cost shall be born by both Seller and Buyer.

To inverter users:

The inverter described in this operation manual is used for variable-speed operation of 3-phase induction motors for general industry use.

⚠ CAUTION

▼ The inverter described in this manual is not designed and manufactured for use in equipment or a system used under the following conditions that will directly lead to death or injury: atomic energy control, aerospace equipment, traffic equipment, medical instrument and all kinds of safety devices. When our products are applied to the above equipment or system, be sure to consult us.

▼ Our products are manufactured under stringent quality control. However, install a safety device on the equipment side in order to prevent serious accidents or loss when our products are applied to equipment that may cause serious accidents or loss due to failure or malfunction.

▼ Do not use the inverter for any load other than 3-phase induction motors.
When an explosion-proof motor is selected, pay attention to the installation environment, because the inverter is not of an explosion-proof type.

▼ Carefully read the “Operation Manual” before use for correct operation.
Read the manual carefully also for long-term storage.

▼ Electrical work is necessary for installation of the inverter. Leave the electric work to specialists.

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