Sumitomo Drive Technologies

HF-620 Series

Inverter

Single-phase 200V class 0.2 to 2.2kW
Three-phase 200V class 0.2 to 7.5kW
Three-phase 400V class 0.4 to 7.5kW

User´s Guide

<Note>

- This product should be handled by only those who have been trained for the work.
  Please read this manual carefully before use.
- Deliver this manual to the customer who will actually use the product.
- This manual should be carefully stored.

Sumitomo Heavy Industries, Ltd. User's Guide DM2502E-1

Introduction

Thank you for purchasing HF-620 Inverter.
This is a guide that describes the handling and maintenance of HF-620.
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)
This document is 'Original instructions'.
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-620 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 carefully read the Instruction manual, User's Guide and each optional products instruction manuals.
In addition any personnel handling or performing maintenance of the product must carefully read 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-620 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.

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Chapter 1 Safety Instructions/Risks

1

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

1.1 Warning indications and symbols

1.1.1 Details of warning indications

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

⚠ 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 serious personal injury or death, and may result in major physical loss or damage.

Furthermore, ⚠ "CAUTION" level description may lead to a serious risk depend on the circumstances.
Be sure to follow the instruction because whichever contains important safety description.
There are the text includes notes using a only safety symbol "⚠". These also contains important safety instructions, so be sure to follow the instructions.

1.1.2 Description of symbols

This document contains annotations with graphic symbols. Be sure to pay close attention to the contents and be sure to follow them.

△	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.	
	⚠	The drawing on the left indicates "a non-specific and general danger or caution".
	⚡	The drawing on the left indicates "a possible damage due to electric shock".
⊘	Indicates "what you must not do" to prohibit the described acts in the operation of the product.	
❗	Indicates "what you must do" according to the instructions in the operation of the product.	

1.2 Cautions

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.

Precautions for installation

⚠ WARNING

Fire / Prohibited / DO

● **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, corrosive gases, flammable gases, grinding fluid mist, hydrogen sulfide or salt water.

Fire / Prohibited

● **Risk of injury!**

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

Fall Injury / Prohibited / DO

● **Risk of injury due to the inverter falling!**

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

● **Risk of failure of the inverter !**

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

Precautions for wiring

⚠DANGER

Electric shock Fire
DO

● **Risk of an electric shock and fire!**

- 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 minutes. (Confirm than the charge lamp is OFF and the voltage between terminals [P/+] and [N/-] is DC45V or less.)

Failure
Prohibited

● **Risk of failure of the inverter!**

- Do not pull the wire after wiring.

Electric Shock Injury
DO

● **Risk of an electric shock and injury!**

- Perform the wiring only after installing the inverter.

⚠WARNING

Injury Fire
Prohibited
DO

● **Risk of injury and fire!**

- Do not connect AC power supply to any of the inverter output terminals ([U/T1], [V/T2], and [W/T3]).
- 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

DO

● **Risk of electric shock and injury!**

- Before operating the slide switch 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 minutes. (Confirm that the charge lamp on the inverter is off and the DC voltage between terminals [P/+] and [N/-] is DC45V or less.)
- Prevent the distribution cable from being compressed or getting caught to avoid damage to the cable.

Fire

Prohibited

DO

● **Risk of fire!**

- Do not input a single-phase power supply to the three-phase model.
- Do not connect a resistor directly to any of the DC terminals ([P1/+1], [P/+], [N/-]).
- Do not use the magnetic contactor installed on the primary and secondary sides of the inverter to stop its operation.
- Tighten the screws and bolts with 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

DO

● **Risk of damage to the inverter and burnout of the motor!**

- Do not operate the inverter when an output phase is lost (output phase loss).

Precautions for running and test running

⚠ DANGER

Electric Shock Fire

Prohibited

● **Risk of electric shock and 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/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

● **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

● **Risk of injury and fire!**

- While power is supplied to the inverter, do not touch the terminal of the inverter, even if it has stopped.

Injury
Damage
Prohibited

● **Risk of injury and damage to 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

● **Risk of injury!**

- If the retry mode has been selected, the inverter will restart automatially 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/RESET key on the keypad can be enabled/disabled using the "STOP-key enable [AA-13]". Prepare an emergency stop switch separately.
- If a RUN 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.
- When an error (alarm) occurs, before moving to the next operation (resetting the alarm status or reapplying the power), make sure that no RUN command has been input. If the inverter has received a RUN command, it restarts automatically.
- When an unexpected event occurs, do not touch the inverter or cable.
- Thoroughly understand and check the functions set in the inverter, and use it only after confirming safety. Be careful that RUN command or resetting operation do not cause an unexpected restart.

Warning

Injury
Damage
DO

● **Risk of injury and damage to 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

● **Risk of burn injury!**

- Do not touch the heat sink, which heats up during the inverter operation.

Injury
DO

● **Risk of injury and damage to machine!**

- Install an external brake system if needed.

Precautions for maintenance/daily inspection

⚠ DANGER

Electric shock
Prohibited
DO

● **Risk of electric shock!**

- Do not perform maintenance, inspection, and the replacement of parts other than designated person.
(Be sure to remove wristwatches and metal accessories, e.g., bracelets, before maintenance and inspection work and to use insulated tools for the work.)
- Before inspecting the inverter, be sure to turn off the power supply and more than 10 minutes. (Confirm that the Charge lamp on the inverter is off and the DC voltage between terminals [P/+] and [N/-] is DC45V or less.)

Precautions for disposal

⚠ DANGER

Injury
Explosion
DO

● **Risk of injury and explosion!**

- For disposal of the inverter, outsource 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.
- A qualified industrial waste disposal contractor includes industrial waste collector or transporter and industrial waste disposal operator.
- Follow the laws and regulations of each country for disposing of the inverter.

Other caution

⚠ DANGER

Electric
Shock
Fire
Injury
Prohibited

● **Risk of electric shock, fire and injury!**

- Never modify the inverter.

⚠ CAUTION

Life cycle
DO

● **Risk of significantly shortening the life cycle of a product!**

- 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.

Note: For risks other than the above, also refer to "Chapter 6 Operation Check/Residual Risk".

1.3 Compliance to european directive (CE)

1.3.1 Caution for EMC (electromagnetic compatibility)

The HF-620 inverter complies with Electromagnetic Compatibility (EMC) Directive (2014/30/EU). 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:
   - Voltage fluctuation must be -15% to +10% or less.
   - Voltage imbalance must be ±3% or less.
   - Frequency variation must be ±4% or less.
   - Total harmonic distortion (THD) of voltage must be ±10% or less.

2. Installation requirements:
   - HF-620 complies with the EMC Directive by installing an EMC filter. Applicable EMC filter depends on the series and capacity of the inverter. Be sure to use an EMC filter compatible with the inverter model by referring "Applicable EMC Filter" on the next page.

3. Wiring requirements:
   - Use a shielded wire (screened cable) with a length of 25m or less for motor wiring.
   - If the length of the motor wire exceeds 25m, use an output AC reactor to reduce the leakage current.
   - The carrier frequency should be 10kHz or lower, which satisfies the EMC requirement.
   - The main circuit wiring must be separated from the control circuit wiring.

4. Environmental requirements (to be met when a filter is used):
   - Ambient temperature: -10 to 50 ˚C (at ND rating), -10 to 40 ˚C (at LD rating)
     (current derating required)
   - Humidity: 20 to 90 %RH (non-condensing)
   - Vibration: 10 to 57Hz: amplitude 0.075mm
     57 to 150Hz: 9.8m/s^2 (1.0G)
   - Install location: altitude 1000m or less (free from corrosive gases and dust)

■Applicable EMC filter

Power Supply	Model	EMC filter	EMC class		Carrier Frequency	Cable Length
			In metal cabinet	Nonmetal cabinet		
Single-phase 200V class	HF620S-A20	FPF-9120-10-SW Note	C1	C2	10kHz	25m (Shielded)
	HF620S-A40					
	HF620S-A75	FPF-9120-14-SW Note				
	HF620S-1A5	FPF-9120-24-SW Note				
	HF620S-2A2					
Three-phase 200V class	HF6202-A20	NF-CEH7	-	C3		
	HF6202-A40					
	HF6202-A75					
	HF6202-1A5	NF-CEH10				
	HF6202-2A2	NF-CEH20				
	HF6202-3A7					
	HF6202-5A5	NF-CEH30				
	HF6202-7A5	NF-CEH40				
Three-phase 400V class	HF6204-A40	FPF-9340-05-SW Note	C1	C2		
	HF6204-A75					
	HF6204-1A5	FPF-9340-10-SW Note				
	HF6204-2A2					
	HF6204-3A7	FPF-9340-14-SW Note				
	HF6204-5A5	FPF-9340-30-SW Note				
	HF6204-7A5					

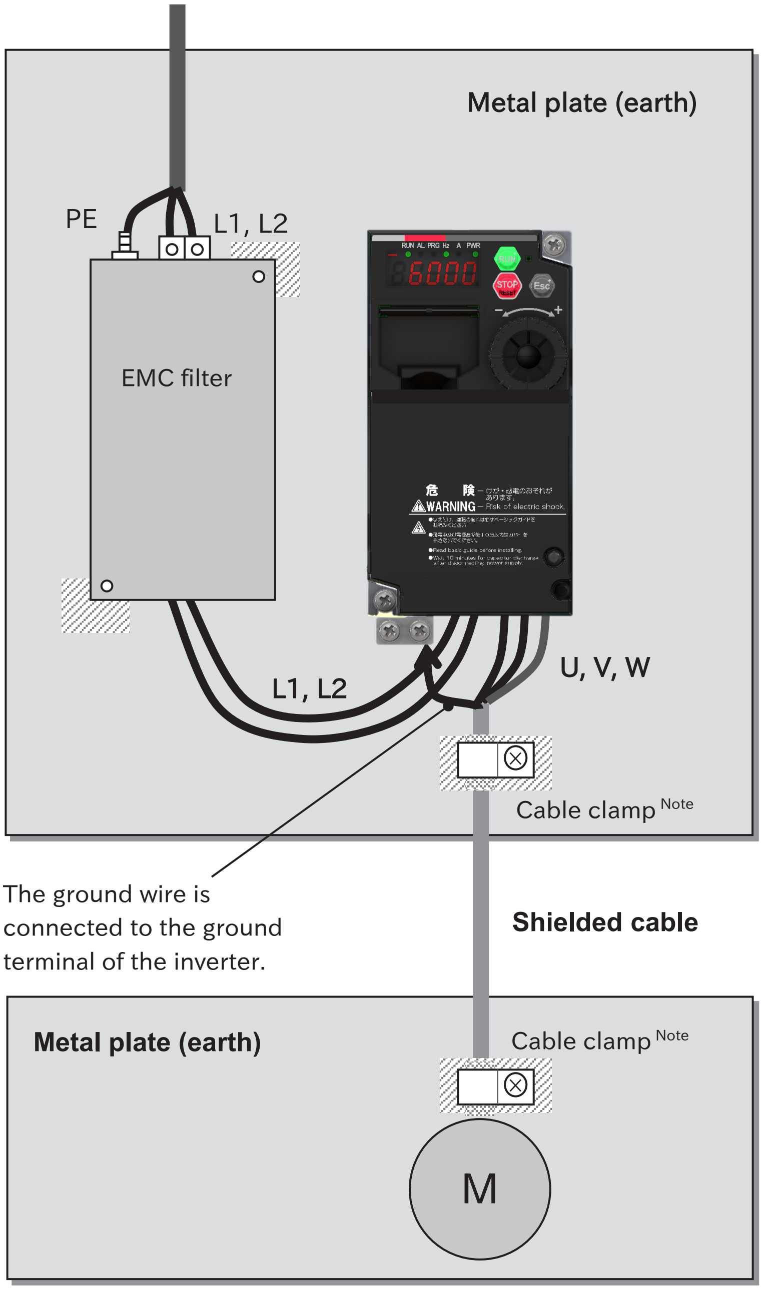
Note: Made by TDK

Cautions for installation and wiring

1. Input AC reactor or other equipment is required if necessary to comply with EMC directive from the harmonic distortion point of view (IEC 61000-3-2: 2018, IEC61000-3-4: 1998).
2. If the motor cable length exceeds 20m, use output AC reactor to avoid unexpected problem due to the leakage current from the motor cable (such as malfunction of the thermal relay, vibration of the motor, etc.).
3. As user you must ensure that the HF (high frequency) impedance between adjustable frequency inverter, filter, and ground is as small as possible.
   Ensure that the connections are metallic and have the largest possible contact areas (zinc-plated mounting plates).
4. Avoid conductor loops that act like antennas, especially loops that encompass large areas.
   Avoid unnecessary conductor loops.
   Avoid parallel arrangement of low-level signal wiring and power-carrying or noise-prone conductors.
5. Use shielded wiring for the motor cable and all analog and digital control lines.
   Allow the effective shield area of these lines to remain as large as possible, i.e. do not strip away the shield (screen) further away from the cable end than absolutely necessary.
   With integrated systems (for example, when the adjustable frequency inverter is communicating with some type of supervisory controller or host computer in the same control cabinet and they are connected at the same ground + PE-potential), connect the shields of the control lines to ground + PE (protective earth) at both ends.
   With distributed systems (for example the communicating supervisory controller or host computer is not in the same control cabinet and there is a distance between the systems), we recommend connecting the shield of the control lines only at the end connecting to the adjustable frequency inverter. If possible, route the other end of the control lines directly to the cable entry section of the supervisory controller or host computer.
   The shield conductor of the motor cables always must be connected to ground + PE at both ends.
   - To achieve a large area contact between shield and ground + PE-potential, use a PG screw with a metallic shell, or use a metallic mounting clip.
   - Use only cable with braided, tinned copper mesh shield (type "CY") with 85% coverage.
   - The shielding continuity should not be broken at any point in the cable. If the use of reactors, contactors, terminals, or safety switches in the motor output is necessary, the unshielded section should be kept as short as possible.
   - Some motors have a rubber gasket between terminal box and motor housing. Very often, the terminal boxes, and particularly the threads for the metal PG screw connections, are painted. Make sure there is always a good metallic connection between the shielding of the motor cable, the metal PG screw connection, the terminal box, and the motor housing. If necessary, carefully remove paint between conducting surfaces.
6. Take measures to minimize interference that is frequently coupled in through installation cables.
   Separate interfering cables with 0.25m minimum from cables susceptible to interference. A particularly critical point is laying parallel cables over longer distances. If two cables intersect (one crosses over the other), the interference is smallest if they intersect at an angle of 90°.
7. Cables susceptible to interference should therefore only intersect motor cables, intermediate circuit cables, or the wiring of a rheostat at right angles and never be laid parallel to them over longer distances. Minimize the distance between an interference source and an interference sink (interference- threatened device), thereby decreasing the effect of the emitted interference on the interference sink.
   You should use only interference-free devices and maintain a minimum distance of 0.25 m from the adjustable frequency inverter.
8. Follow safety measures in the filter installation.
   If using external EMC filter, ensure that the ground terminal (PE) of the filter is properly connected to the ground terminal of the adjustable frequency inverter. An HF ground connection via metal contact between the housings of the filter and the adjustable frequency inverter, or solely via cable shield, is not permitted as a protective conductor connection. The filter must be solidly and permanently connected with the ground potential so as to preclude the danger of electric shock upon touching the filter if a fault occurs.
   - To achieve a protective ground connection for the filter:
     - Ground the filter with a conductor of at least 10mm^2 cross-sectional area.
     - Connect a second grounding conductor, using a separate grounding terminal parallel to the protective conductor. (The cross section of each single protective conductor terminal must be sized for the required nominal load.)

Installation method (Example of single-phase 200V class model)

The mounting method is the same for the three-phase 200 V class model and the three-phase 400V class model.



The filter is integrated and mounted between the inverter and the metal plate.
Remove paint from the ground terminal, ensure sufficient contact area, and ground.
(part in the figure left)

Note: The ground at both ends of the shielded cable must be connected to ground with a cable clamp. From the viewpoint of harmonic current, the CE-mark (IEC 61000-3-2: 2018, IEC61000-3-4: 1998) requires an input AC reactor or facility to suppress harmonic current. The conducted noise and radiated noise pass even if the input-side AC reactor is removed.

1.3.2 Caution for Machinery directive (functional safety)

⚠ CAUTION

● **When using STO (Safe Torque Off) function, please be sure to read the "Safety function Guide" of separate !**

・HF-620 conforms to STO (Safe Torque Off) defined in Functional Safety IEC 61800-5-2. When using the STO function, refer to "Safety Function Guide (No. DM2504E)". Please contact your supplier to download the guide.

1.3.3 Note of European directive (CE)

・This product complies with the requirements of IEC 60364-4-41:2005/AMD1: 2017: Clause 411 “Protective measure: automatic disconnection of supply”, since it complies with the requirements of IEC61800-5-1:2007+AMD1:2016:Clause 4.3.9.

・In order to comply with above mentioned requirements, installation must be in line with the conditions in “1.3 Compliance to European Directive (CE)” and “1.4 UL Compliance to UL standards”.

・Regarding IEC61800-5-1:Clause 5.2.3.6.3.3 “Short-circuit between phase terminals of power output and protective earth”, circuitry in compliance test is as described as “Figure 13 Example of short-circuit test between CDM/BDM d.c. link power output and protective earth” and “Class J 30A Non time delay fuse” is used as “OCPD” in “Fault loop”.

1.4 Compliance to UL standards

1.4.1 UL cautions

This section summarizes the items required for UL standard compliant inverter installation.
(The English text is the original and the Japanese text is for reference purposes.)

GENERAL:

・HF 620 series inverter is open type AC Inverter with three/single 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 multi-rated device, and the ratings are selectable according to load types by operator with keypad operation.

Markings:
Maximum Surrounding Temperature:
・ND (Normal Duty): 50deg C
・LD (Low Duty)   : 40deg C
Storage Environment rating:
・-20 to 65deg C (for transportation)
Instruction for installation:
・Pollution degree 2 environment and Overvoltage category 3
Electrical Connections:
・See section [5.2 Main circuit terminal]
Interconnection and wiring diagrams:
・See section [5.4 Control circuit terminal]

Short circuit rating and overcurrent protection device rating:

・Single-phase 200V series model,
HF620S-A20 to 2A2
- [Non-semiconductor Fuses]
Suitable for use on a circuit capable of delivering not more than 5,000rms symmetrical amperes, 240V maximum.
- [Semiconductor Fuses]
Suitable for use on a circuit capable of delivering not more than 100,000rms symmetrical amperes, 240V maximum.

・Three-phase 200V series model,
HF6202-A20 to 3A7
- [Non-semiconductor Fuses]
Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 240 V maximum.

・Three-phase 200V series model,
HF6202-5A5 to 7A5
- [Non-semiconductor Fuses]
Suitable for use on a circuit capable of delivering not more than 5,000rms symmetrical amperes, 240V maximum.

・Three-phase 200V series model,
HF6202-A20 to 7A5
- [Semiconductor Fuses]
Suitable for use on a circuit capable of delivering not more than 100,000rms symmetrical amperes, 240V maximum.

- Three-phase 400V series model,
  HF6204-A40 to 7A5
  - [Non-semiconductor Fuses]
    Suitable for use on a circuit capable of delivering not more than 5,000rms symmetrical amperes, 480V maximum.

- Three-phase 400V series model,
  HF6204-A40 to 7A5
  - [Semiconductor Fuses]
    Suitable for use on a circuit capable of delivering not more than 100,000rms symmetrical amperes, 480V 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.

Integral:

- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code, Part 1.
  (For Canada)

■Field wiring conductor size and torque values making for wiring terminal

Model	Screw Size	Required Torque (Nm)	Wire Range (AWG/mm^2)
HF620S-A20	M3.5	1.0	AWG16 (1.3mm^2)
HF620S-A40	M3.5	1.0	AWG16 (1.3mm^2)
HF620S-A75	M4	1.4	AWG12 (3.3mm^2)
HF620S-1A5	M4	1.4	AWG10 (5.3mm^2)
HF620S-2A2	M4	1.4	AWG10 (5.3mm^2)
HF6202-A20	M3.5	1.0	AWG16 (1.3mm^2)
HF6202-A40	M3.5	1.0	AWG16 (1.3mm^2)
HF6202-A75	M3.5	1.0	AWG16 (1.3mm^2)
HF6202-1A5	M4	1.4	AWG14 (2.1mm^2)
HF6202-2A2	M4	1.4	AWG12 (3.3mm^2)
HF6202-3A7	M4	1.4	AWG10 (5.3mm^2)
HF6202-5A5	M5	3.0	AWG6 (13mm^2)
HF6202-7A5	M5	3.0	AWG6 (13mm^2)
HF6204-A40	M4	1.4	AWG16 (1.3mm^2)
HF6204-A75	M4	1.4	AWG16 (1.3mm^2)
HF6204-1A5	M4	1.4	AWG16 (1.3mm^2)
HF6204-2A2	M4	1.4	AWG14 (2.1mm^2)
HF6204-3A7	M4	1.4	AWG12 (3.3mm^2)
HF6204-5A5	M5	3.0	AWG10 (5.3mm^2)
HF6204-7A5	M5	3.0	AWG10 (5.3mm^2)

Temperature rating of field wiring installed conductor:

・For models
HF620S-A20, HF620S-A40, HF620S-A75
HF620S-1A5, HF6202-A40, HF6202-A75,
HF6202-1A5, HF6204-A40, HF6204-A75
HF6204-1A5, HF6204-2A2, HF6204-3A7
- 60 degree C only.

・Except above models - 75 degree C only.

Field wiring terminal marking for wire type:

・Use copper conductors only

■Required protection by Fuse

Model	Non-Semiconductor Fuse			Semiconductor Fuse
	Type	Maximum Rating		Manufacture: Cooper Bussmann LLC
		Voltage	Current	
HF620S-A20	Class J Class CC Class G Class T	600 V	6 A	FWH-15A14F
HF620S-A40			10 A	FWH-15A14F
HF620S-A75			20 A	FWH-60B
HF620S-1A5			30 A	FWH-60B
HF620S-2A2			30 A	FWH-60B
HF6202-A20		600 V	6 A	FWH-15A14F
HF6202-A40			10 A	FWH-15A14F
HF6202-A75			15 A	FWH-25A14F
HF6202-1A5			15 A	FWH-25A14F
HF6202-2A2			20 A	FWH-60B
HF6202-3A7			30 A	FWH-60B
HF6202-5A5			60 A	FWH-150B
HF6202-7A5			60 A	FWH-150B
HF6204-A40		600 V	6 A	FWH-15A14F
HF6204-A75			10 A	FWH-25A14F
HF6204-1A5			10 A	FWH-25A14F
HF6204-2A2			10 A	FWH-25A14F
HF6204-3A7			15 A	FWH-25A14F
HF6204-5A5			30 A	FWH-60B
HF6204-7A5			30 A	FWH-60B

Chapter 2 Outline of this User's Guide Procedure for Operation

2

This chapter describes the applicable products, the knowledge required to read this Guide, the target readers of this Guide, the purpose of this Guide, the structure of the chapters in this Guide, and an outline of the procedure (flowchart) for operating the inverter.

2.1 What is written in this user's guide

・The contents of this Guide apply to HF-620 main unit. Refer to the corresponding guide or manuals for other products and optional parts.

・This 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. This Guide is written in SI units.

・This inverter can use the second control function to switch some parameters used for motor control from the 1st control parameter [**1**] (e.g. [AA101]) to the 2nd control parameter [**2**] (e.g. [AA201]) by turning on the "2nd-motor control [SET]" input terminal.
In this user's guide, the descriptions of various functions basically refer to parameters [**-**] (e.g. [Ab-01]) that are not subject to the second control function and the 1st control parameter [**1**], but when the second control function is enabled, the first control parameter [**1**] is read as the second control parameter [**2**].
For details on the second control function and the applicable parameters, refer to "9.7.13 Switching between Two Motors".

・This Guide is intended to provide the following necessary information:
(a) Installation and wiring of the product.
(b) Parameter settings.
(c) Conducting test run and operation.
(d) Maintenance and inspection.

2.2 Overview of each chapter

・This guide consists of the following chapters:
Refer also to the chapter to be referred to the various part of the inverter appearance drawing on the next page.

Chapter	Description
Chapter 1 Safety Instructions/Risks	Describes safety precautions for installation, wiring, operation, maintenance, and inspection.
Chapter 2 Outline of This User's Guide Procedure for Operation	Describes the people who will read this Guide and the purpose of this Guide. Also describes the overall flow from installation to test run, the flow chart for driving the motor, and related reference points.
Chapter 3 Main Body of the Product	Describes the contents of the inspection at the time of purchase, the package, the product model, the contents of the specification label, and the appearance of the product.
Chapter 4 Installation	Describes the installation of the inverter, installation environment and precautions for installation.
Chapter 5 Wire Connection	Describes the wiring of the inverter and input power supply, the motor and applicable peripheral equipment, and the wiring of the I/O signals for control.
Chapter 6 Operation Check/Residual Risk	Describes the residual risk checklist for inverter operation.
Chapter 7 Keypad and Related Functions	Describes how to operate the main unit keypad and related functions.
Chapter 8 Mandatory Setting for Motor Drive and Test Run	Describes the settings required to drive the motor and test run.
Chapter 9 Inverter Functions	Describes the functions available with the inverter.
Chapter 10 Monitor Functions	Describes various data that can be monitored by keypad, remote operator, etc.
Chapter 11 Modbus Communication	Describes the communication function using Modbus-RTU(RS485) communication. For the coil/register number used by communication function, refer to "Chapter 18 List of Parameters".
Chapter 12 PC Software	Describes the outline what can be done by connecting HF-620 to a computer.
Chapter 13 Communication Option	Describes applicable communication option.
Chapter 14 Safety Function STO	Describes an overview of using the safety function STO.
Chapter 15 Troubleshooting	Describes the inverter error status, warning status, and troubleshooting.
Chapter 16 Maintenance and Inspection	Describes how to perform maintenance and inspection.
Chapter 17 Specifications	Describes the specifications and dimensions of this product and current derating characteristics.
Chapter 18 List of Parameters	Describes the monitor and parameter list. Coil/register numbers for Modbus communication are also described in this chapter.

■What this guide explains.

Chapter 7 Keypad and Related Functions
・Explains how to operate the inverter.

Chapter 8 Mandatory Setting for Motor Drive and Test Run
・Describes the settings required to drive the motor and test run.

Chapter 9 Inverter Functions
・Describes the functions that can be performed with the inverter.

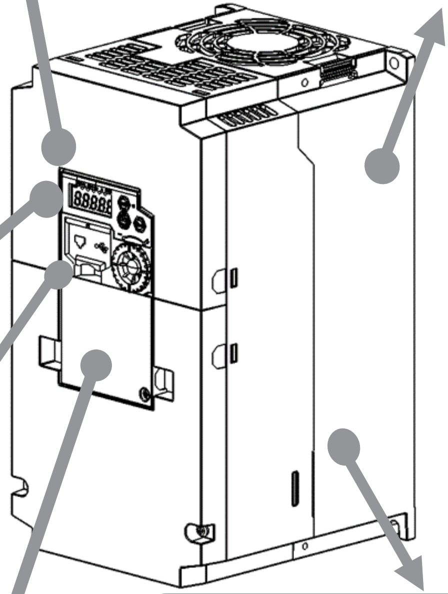
Chapter 10 Monitor Functions
・Describes various data that can be monitored by the inverter.

Chapter 12 PC Software
・Provides an overview of what can be done by connecting to a computer.

Chapter 13 Option Board
・Describes the supported option boards.

Chapter 3 Main Body of the Product
・Describes the package, specification label, appearance, and name of each part of the product.

Chapter 4 Installation
・Describes the installation of the product.



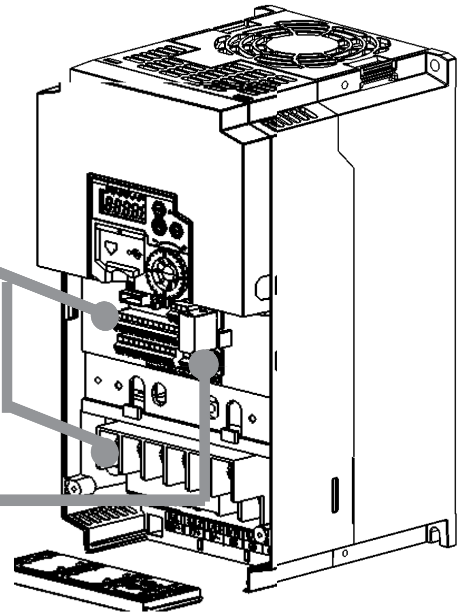
Chapter 17 Specifications
・Describes the inverter specifications, external dimensions and current derating

Chapter 5 Wire Connection
・Describes the wirings of the power line, motor line and optional device such as reactor and braking resistor to the main circuit terminal block.
・Also describes the wiring of the I/O contacts, relay output, analog I/O and so on to the control circuit terminal block.

Chapter 11 Modbus Communication
Chapter 14 Safety Function STO
・Describes detailed information when Modbus communication and safety function STO are used.
・For the wiring, also refer to "5.4 Control Circuit Terminal".

Chapter 15 Troubleshooting
・Describes the countermeasures for trip and warning occurrence.

Chapter 16 Maintenance and Inspection
・Describes maintenance and inspection, such as daily inspection.



Chapter 6 Operation Check/Residual Risk
・Describes residual risks during operation and the items to be checked.

2.3 Procedure for operation (flowchart)

- The flowchart below shows an outline of the procedures of installing, wiring, test run and various settings in case installing a HF-620.
  The overview of each item in the flowchart and the main sections that describe the details are shown in the right column.

For installation		Overview of the checks and main reference section
1	Confirmation of safety	Check the precautions necessary for handling the inverter. "Chapter 1 Safety Instructions/Risks"
2	Checking the inverter	Check that there are no problems with the model, enclosed items, appearance, etc. of the inverter you purchased. "3.1 Confirmation at the Time of Purchase"
3	Installation of inverter	Check the status and environment of the inverter installation. "Chapter 4 Installation"
4	Wiring and checking main circuit terminals	Wire the power supply, motor, applicable peripheral device (work only when necessary), etc. to the main circuit terminal of the inverter and check if the wiring to the inverter is correct. "5.2 Main Circuit Terminal" "5.3 Applicable Peripheral Device"
5	Wiring and checking the control circuit terminals	Wire I/O signals and analog I/O signals to the control terminal of the inverter and check if the wiring to the inverter is correct. "5.4 Control Circuit Terminal" "9.15 Functions with External Signal Input" "9.16 Functions with External Signal Output"
6	Checking how to use keypad	Check how to use keypad, and then change the parameter settings or monitor in the following steps. "7.1 How to Use Keypad"
7	Setting mandatory parameters for operating the motor and inverter	Set the load rating of the inverter according to the load. Set the basic data of the motor and protection settings such as electronic thermal, etc. according to the motor specifications to be driven. "8.1 Mandatory Setting for Operation"
8	Selecting control mode	Set the control mode according to the characteristics of the load machine. "9.5 Selecting Control Mode for the Motor and Load"

To next page

From previous page

9	Test run without load	To check if there is a basic problem with the inverter or motor, connect only the motor and rotate it with no load to check if it rotates properly. "8.2.2 Test Run by Connecting Only the Motor"

10	Check if auto-tuning is required.	It is necessary to perform auto-tuning when using automatic torque boost, sensorless vector control, or when using a motor whose motor constant is unknown. "8.3 Carrying Out Motor Auto-tuning"

11	Test run with actual load	Perform a test run to confirm that there is no problem with the operation by connecting the mechanical system. "8.2.3 Perform a Test run With a Machine Load"

12	**Selecting RUN command source** (a) Running with keypad's RUN-key (b) Running with Forward/Reverse signal input (c) Running with push button (automatic return contact) (d) Select other RUN commands	Set RUN command source of the inverter. Refer to the following sections respectively: (a) "9.1.2 Operation by RUN Key on the Keypad" (b) "9.1.3 Operation by Forward/Reverse Input Terminals" (c) "9.1.4 Operation by Pushbutton (Momentary Switch) Input" (d) For other RUN commands and related functions, refer to "9.1.1 Types of RUN command" and refer to the section in which the run command method suitable for the purpose is described.

13	**Selecting the frequency command source** (a) Set the frequency with keypad (b) Set the frequency with analog voltage input by connecting a variable resistor (c) Set the frequency with analog current input (d) Switch the frequency in multi-speed by combinations of signal input ON/OFF (e) Select other frequency reference	Set the frequency command source of the inverter. Refer to the following sections respectively: (a)"9.2.2 Setting Frequency Command by Keypad" (b), (c) "9.2.3 Setting Frequency Command by Analog Inputs (Voltage/Current)" (d) "9.2.4 Setting Frequency Command by Multi-Speed Operation Function" (e) For other frequency commands and related functions, refer to "9.2.1 Types of Frequency Command" and refer to the section in which the frequency command method suitable for the purpose is described.

14	Setting various parameters for operation	Set various parameters related to the required functions by referring to "Chapter 9 Inverter Functions".

Tips for setting parameter

・If the parameter you want to set is not displayed or the parameter cannot be changed, refer to "7.2 Functions Related to Keypad" to check if any restrictions have been applied.
・If the inverter does not operate as intended after setting several parameters, refer to "15.4 How to Check When Something Is Wrong" to deal with it.
・If possible, consider initializing the parameters. In this case, see "7.2.2 Initialize the Parameters". (However, it is recommended to back up parameters with inverter configuration PC software, etc. prior to parameter initialization.)

Chapter 3 Main Body of the Product

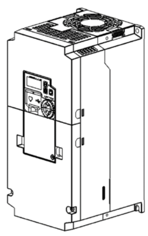
3

This chapter describes the main body of the product. The inspection at the time of purchase, the items included in the product, the explanation of the product model name, the details of the specification label, the appearance of the product and the names of each part are described.

3.1 Confirmation at the time of purchase

3.1.1 Checking the product and the included items

・The following items are included in the package.
・If you find any faults or defects in the product or have any question about the product, please contact your supplier.



Inverter HF-620: 1 Unit

・1 × HF-620 Manual
・1 × HF-620 Safety Function Guide Caution
・1 × HF-620 Caution reminder stickers (multilingual)
(Others, which are a correction error table/supplementary instruction manual, etc., may be included.)

Confirmations at unpacking
When unpacking, check that the package contains ·1 inverter main unit, ·1 Manual, and other included items.
Check the specification label again to confirm that the product is the one you have ordered.
Check the product for damage (including falling of parts and dents in the inverter body) caused during transportation.

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.

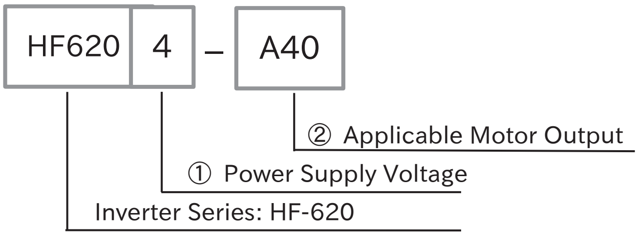
DO

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

・The User's Guide (this document) is not included in the product. To get the latest version of the HF-620 User's Guide, please contact the supplier where this device was purchased.
When you use the inverter with optional products, you should also read the manuals enclosed with those products.
・Note that the HF-620 manual and optional products manuals to be used should be delivered to the end user of the inverter. For the User's Guide and manuals, contact your supplier.

3.1.2 Model of the inverter and nameplate

・The model of the product is as follows. Check that the model is same as you ordered.

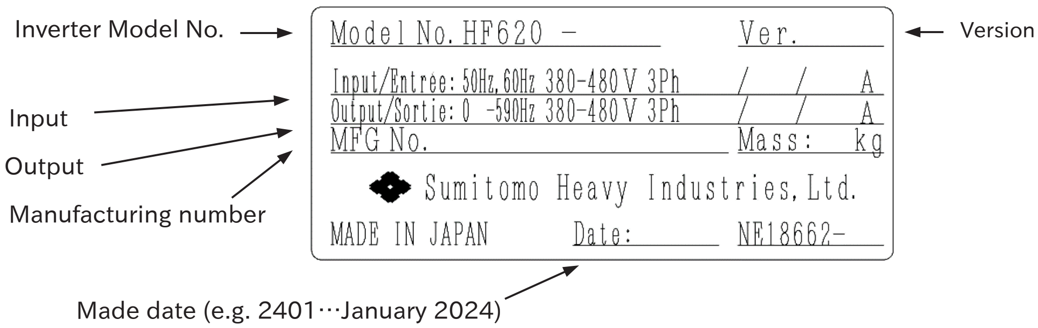


Symbol ①	Power Supply Voltage
S	Single-phase 200V class
2	Three-phase 200V class
4	Three-phase 400V class

Symbol ②	Applicable Motor Output
A20	0.2kW
A40	0.4kW
A75	0.75kW
1A5	1.5kW
2A2	2.2kW
3A7	3.7kW
5A5	5.5kW
7A5	7.5kW

■Nameplate for the Inverter

(e.g.) Three-phase 400V class



・In this Guide, some indications may be omitted from the model name. In that case, the omitted indications are not concerned with the description.

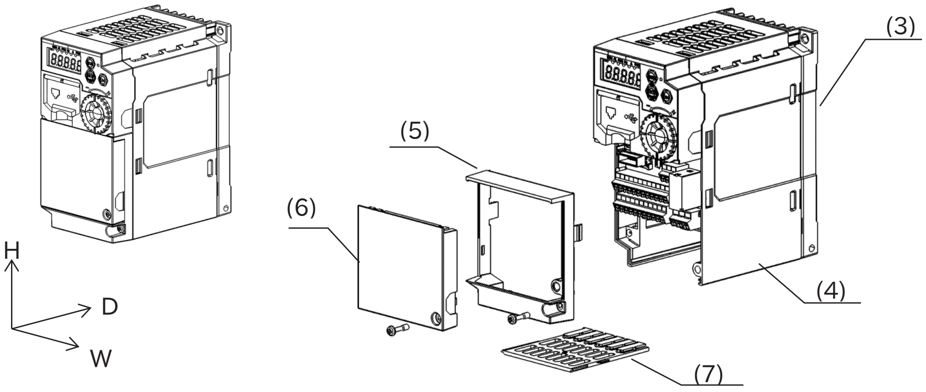
・The input and output currents on the specification label are UL certified current values. The " *** " part of the label above shows the product-specific values.

3.2 Appearance of the product and part names

3.2.1 Appearance of each model

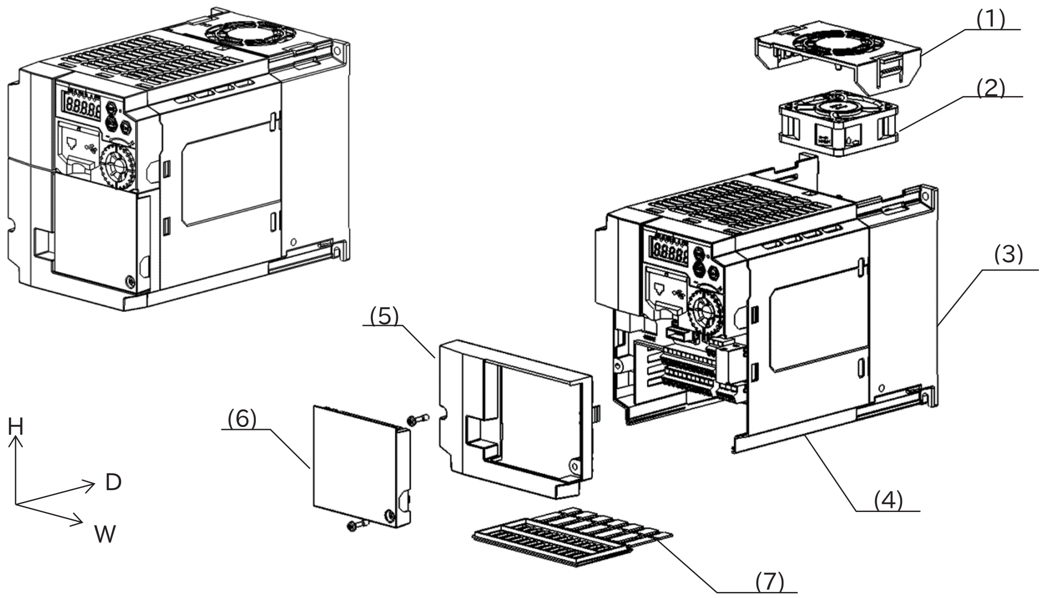
・The appearance of the product and the names of its parts are shown below for each model.

■Single-phase 200V class : HF620S-A20/A40
Three-phase 200V class : HF6202-A20/A40/A75



Note: The W and H dimensions are the same, but the D dimensions differ depending on the model due to the difference of the cooling fin.

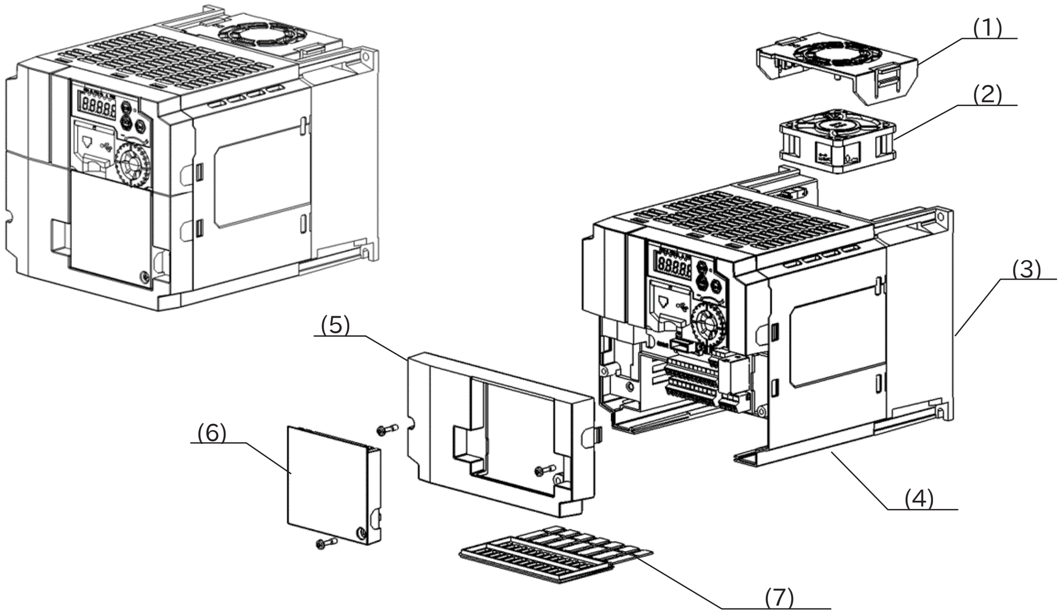
■Single-phase 200V class: HF620S-A75/1A5/2A2
Three-phase 200V class: HF6202-1A5/2A2
Three-phase 400V class: HF6204-A40/A75/1A5/2A2



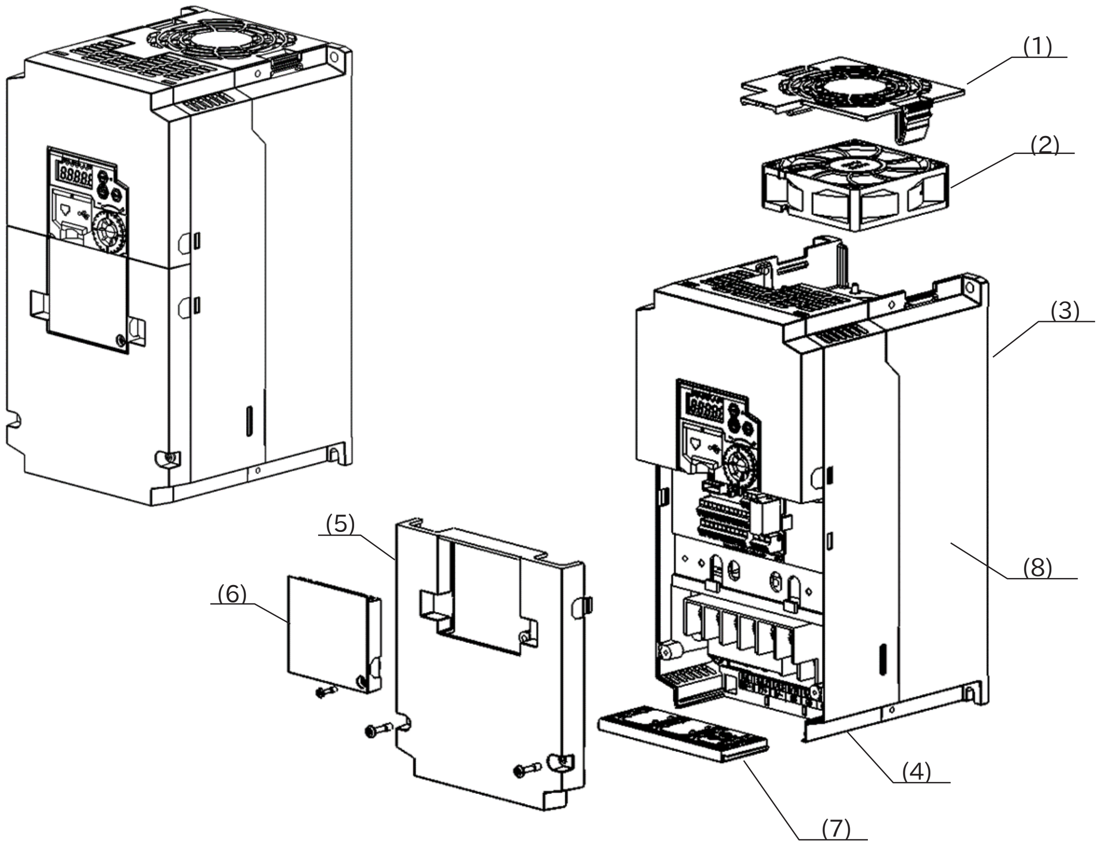
Note: The W and H dimensions are the same, but the D dimensions differ depending on the model due to the difference of the cooling fin.
HF620S-A75 and HF6204-A40 do not have a cooling fan and a cooling fan cover.

(1) Cooling fan cover (2) Cooling fan (3) Cooling fin (4) Main body cover
(5) Terminal block cover (6) Control terminal cover (7) Backing plate

■Three-phase 200V class: HF6202-3A7
Three-phase 400V class: HF6204-3A7



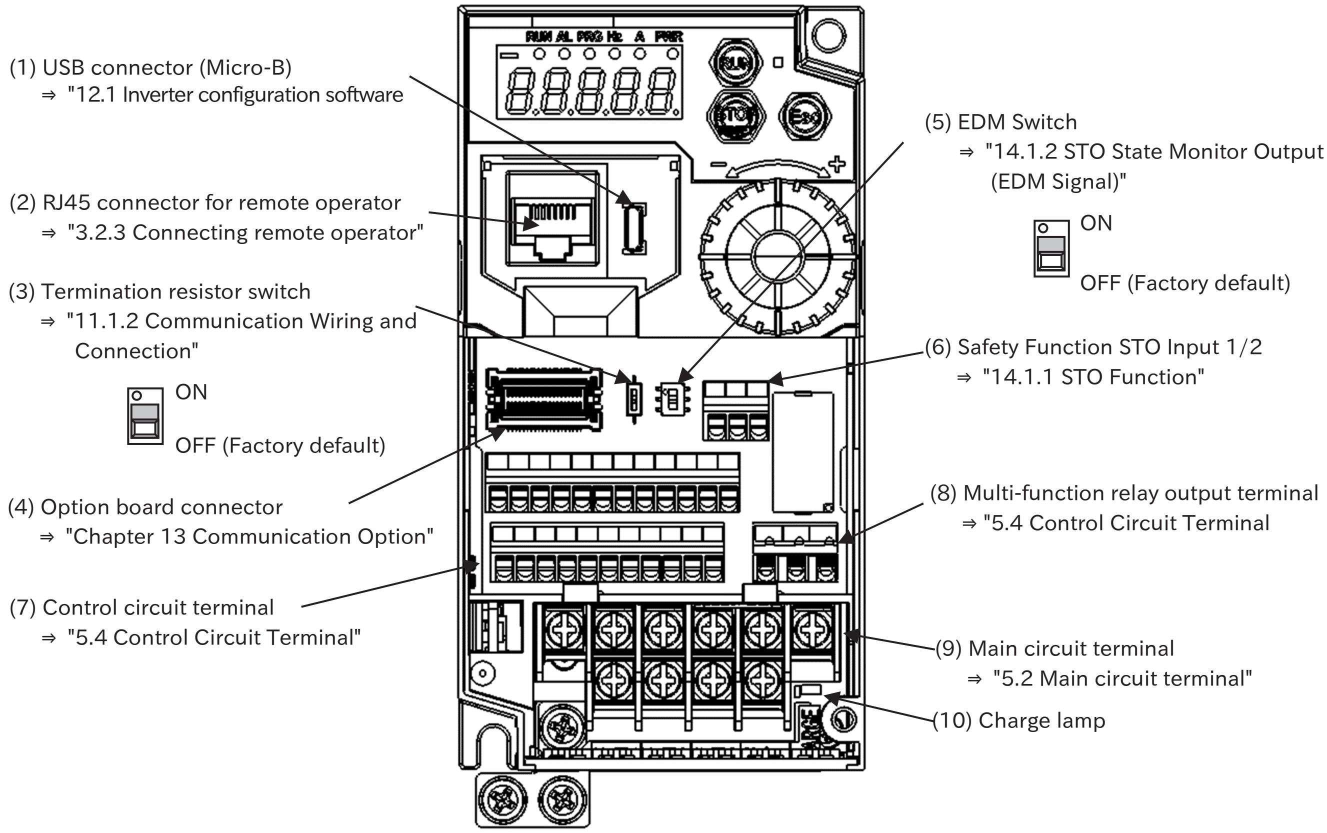
■Three-phase 200V class: HF6202-5A5/7A5
Three-phase 400V class: HF6204-5A5/7A5



(1) Cooling fan cover (2) Cooling fan (3) Cooling fin (4) Main body cover
(5) Terminal block cover (6) Control terminal cover (7) Backing plate (8) Main body case

3.2.2 Part names and descriptions on the front of the product

・The appearance from the front of the product without the terminal cover and the names of the parts are shown below.

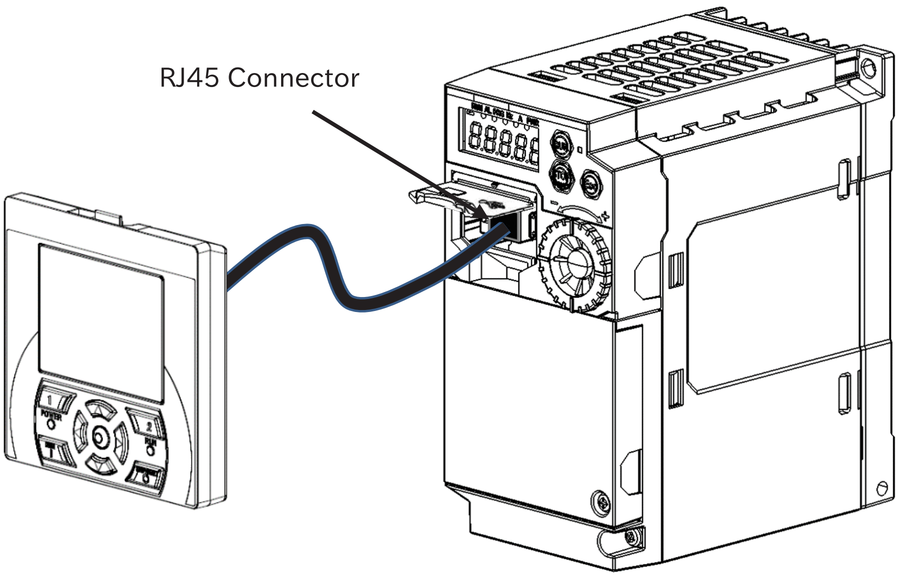


Name	Description
(1) USB connector	USB connector (Micro-B) for connecting to a PC. (Only when inverter configuration software is used.)
(2) RJ45 connector for remote operator	Connector for connecting the optional remote operator(OS-44: ver.2.0 onwards).
(3) Termination resistor switch	Termination resister switch for the RS485 communication terminal on the control terminal. When turned on, the built-in resistor (120Ω) is connected.
(4) Option board connector	Connector for mounting option board.
(5) EDM function switch	Turn ON in case of using the [EDM] signal of the safety function. Be sure to turn off the power before switching ON/OFF. (Refer to section "14.1.2 STO State Monitor Output (EDM Signal)")
(6) Safety function STO input 1/2	Terminals block for input signals of safety function. (Refer to section "14.1.1 STO Function")
(7) Control circuit terminal	Terminal block for connecting various digital/analog Input/Output signals for inverter control.
(8) Intelligent relay output terminal	1c contact terminal block for intelligent relay output.
(9) Main circuit terminal	Terminal block for connecting the inverter main power supply, motor output, braking resistor, etc.
(10) Charge lamp (Charging indicator lamp)	This lamp lights when the main circuit DC voltage (between terminal [P/+] and [N/-]) is approximately DC45V or more even after the power supply is shut off. The voltage does not necessarily run out even if the charge lamp goes off. When changing the wiring, wait for 10 minutes or more after shutting off the power, and check that there is no residual DC voltage by using a tester or other instrument to confirm safety.

Note: 1. For the displays and keys on the keypad, refer to "7.1 How to Use Keypad".
2. The position of the (10) charge lamp depends on the model. For the positions of each model, refer to "5.2.3 Arrangement of Main Circuit Terminal Block".
3. Note that operation is also possible from the inverter main unit when driving from a PC via USB cable.
4. Disconnect the power supply before connecting or disconnecting the remote operator (OS-44: ver.2.0 onwards) to or from (2) RJ45 connector.

3.2.3 Connecting remote operator

- Connecting the optional remote operator (OS-44: ver.2.0 onwards) enables operation from outside the panel.
- It is recommended to use the connector cable option ICS-1 (1m) or ICS-3 (3m) to connect the inverter main unit and the remote operator.
- Inverter can detect remote operator disconnection and some remote operators can use the data R/W function. For detail, refer to "7.2.9 Remote Operator Functions".



- Use a connector cable within 3m. If the cable is more than 3m, it may cause malfunctioning.
- Do not connect or disconnect the remote operator while the inverter is energized.

Chapter 4 Installation

4

This chapter describes the instruction of the inverter.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

4.1 Installation environment

4.1.1 Installation precautions

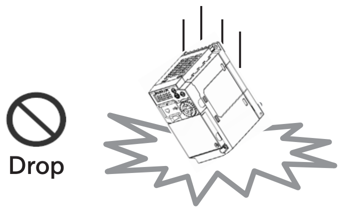
・When installing the inverter, be sure to observe the following precautions.

◆ Transportation

・Plastic parts are used for the inverter. When carrying the inverter, handle it carefully to prevent damage to the parts.

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

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



◆ Ambient temperature

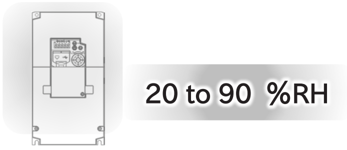
・Avoid installing the inverter in a place where the ambient temperature goes above or below the allowable range, as defined by the standard inverter specification.

Note: Temperature requirements vary depending on the "Load type selection [Ub-03]".
In addition, current derating may be required. For details, refer to "Chapter 17 Specifications".

・Leave sufficient space around the inverter. Measure the temperature in a position about 5cm 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).

◆ Humidity

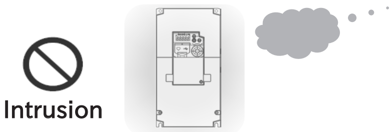
・Avoid installing the inverter in a place where the relative humidity goes above or below the allowable range (20 to 90% RH), as defined by the standard inverter specification. Especially, use the product in a place where there is no condensation.



・Condensation inside the inverter will result in short circuits and malfunctioning of electronic parts. Also avoid installing the product in a place exposed to direct sunlight.

◆ Ambient atmosphere

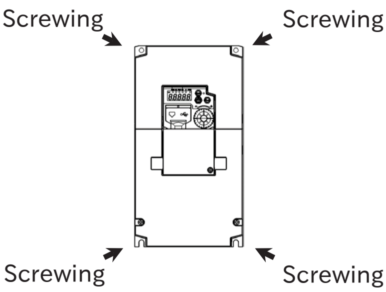
・Avoid installing the inverter in a place where the inverter will be subject to dust, water droplets, corrosive gases, explosive gases, flammable gases, grinding fluid mist, or salt air.



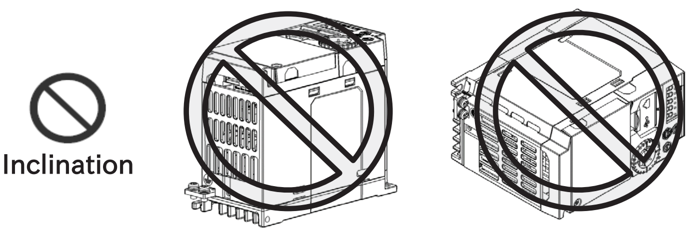
・Foreign particles entering the inverter will cause it to fail. If you use the inverter in a considerably dusty environment, install the inverter inside a sealed enclosure.

◆ Installation method and installation direction

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

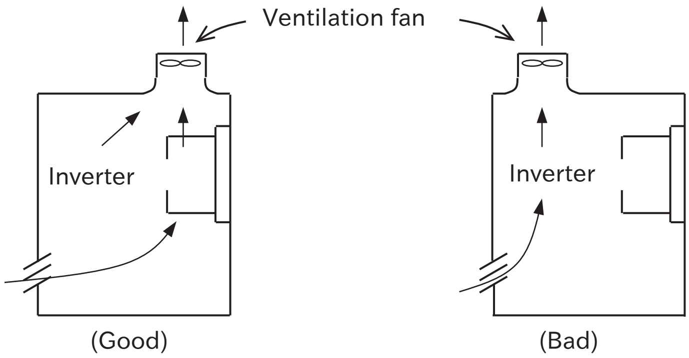


・If the inverter is not installed vertically, its cooling performance may be degraded and tripping or inverter damage may result.



◆ 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. Pay close attention so that the ambient temperature of the inverter is within the allowable operating temperature range.
If a ventilation fan is located directly above the inverter, dust or dirt may drop on it. To prevent this, move the inverter horizontally to a suitable position.



Position of Ventilation fan

Watt loss

・Watt loss data (at 100% load) of the inverter are shown below.

■Single-phase 200V class

Item \ Model No.		HF620S- A20	A40	A75	1A5	2A2
Watt loss (W)	Normal Duty	16	28	50	91	155

■Three-phase 200V class

Item \ Model No.		HF6202- A20	A40	A75	1A5	2A2	3A7	5A5	7A5
Watt loss (W)	Normal Duty	15	25	43	73	109	194	309	296

■Three-phase 400V class

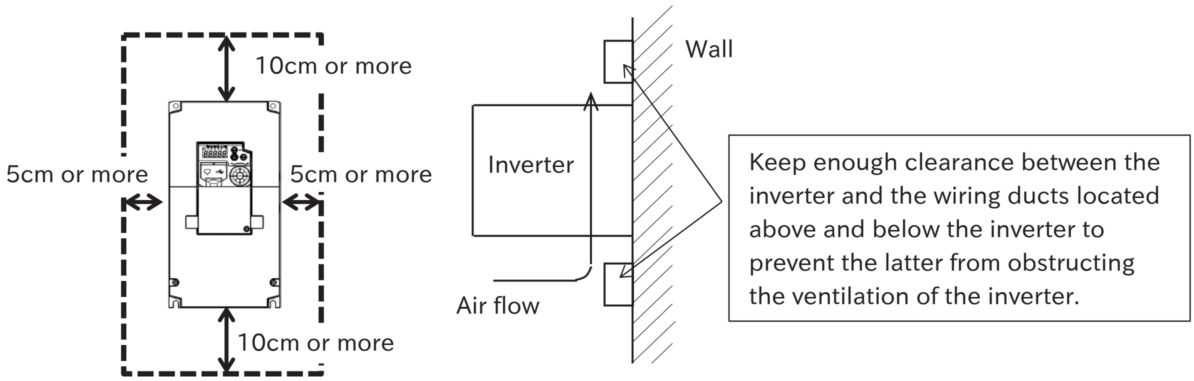
Item \ Model No.		HF6204- A40	A75	1A5	2A2	3A7	5A5	7A5
Watt loss (W)	Normal Duty	29	45	55	64	94	207	220

Note: Watt loss data depend on power supply condition and power factor for the motor.

◆ Surface on which to install the inverter

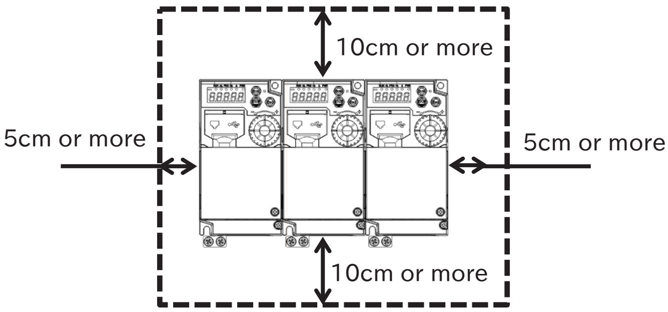
・The inverter will reach a high temperature (up to about 150°C) during operation. Install the inverter on a vertical wall surface made of nonflammable material (e.g. metal) to avoid the risk of fire.

・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.



Note: For the inverter dimensions, refer to "17.2 External Dimensions".

・It is also possible to install multiple inverters side by side in the panel. In this case, derating is required for the carrier frequency and output current. For details, refer to "17.3 Current Derating" for details.



Chapter 5 Wire Connection

5

This chapter describes the wirings of the power supply to the main circuit terminal of the inverter, motor and peripheral options, and the analog and digital input/ output signal wirings to the control circuit terminal. When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

5.1Terminal block cover

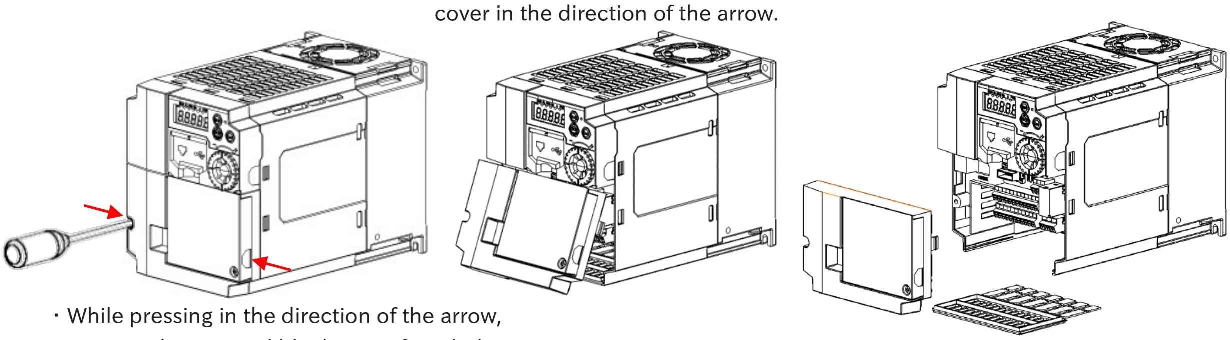
・Control terminal can be checked by removing the terminal block cover. The main circuit terminal block can be checked by removing the backing plate.

■How to remove the terminal block cover

(1) Loosen the terminal block cover fixing screws (one or two locations).

(2) Remove the terminal block cover from the bottom while pressing the lower part of the terminal block cover in the direction of the arrow.

(3) When wiring, slide the backing plate forward and remove it.

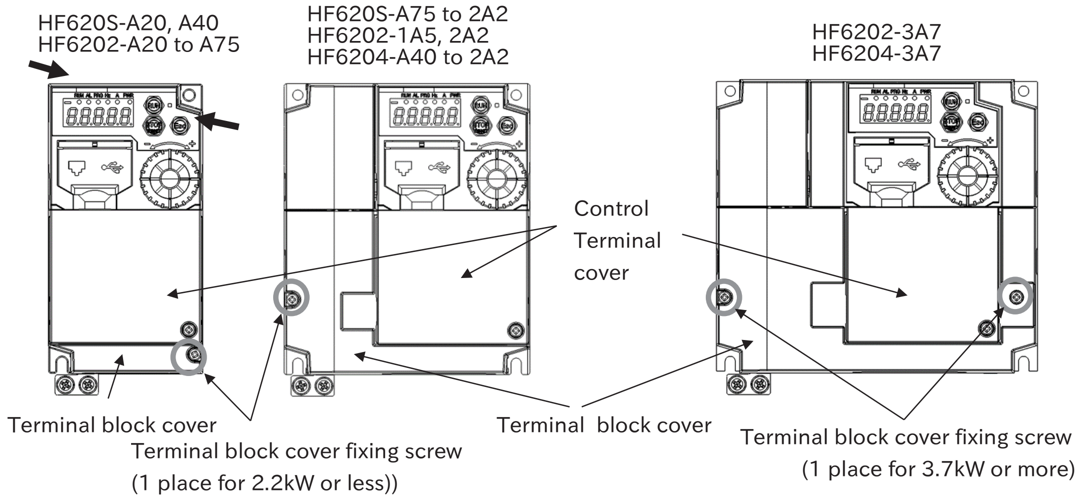


・While pressing in the direction of the arrow, remove the terminal block cover from below.

Note: The terminal block cover fixing screws are provided in one place on the lower right or lower left for models with a capacity of 2.2kW or less, and in two places on both sides for models with a capacity of 3.7kW or more.
Also, the control terminal cover is fixed to the terminal block cover with a screw, but it is not fixed to the main unit. Therefore, the terminal block cover can be removed without removing the control terminal cover.

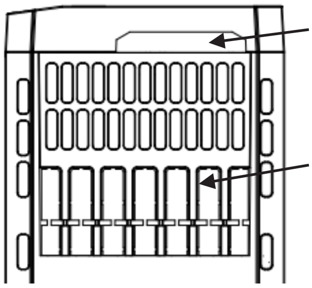
■How to attach the terminal block cover

・Contrary to removing, attach the terminal block cover to the main unit from the upper side first and push it in until it clicks. (Tighten the fixing screws of the control terminal cover and the terminal block cover with a tightening torque of 0.2 to 0.3Nm.)



■How to use the backing plate

HF620S-A20 to 2A2、HF6202-A40 to 7A5、HF6204-A40 to 7A5



Control circuit wiring

・Pull out from the terminal block cover.

Main circuit wiring

・Cut the connection points between the unnecessary part and the backing plate using a nipper or a cutter, to cut off the unnecessary part for wiring.

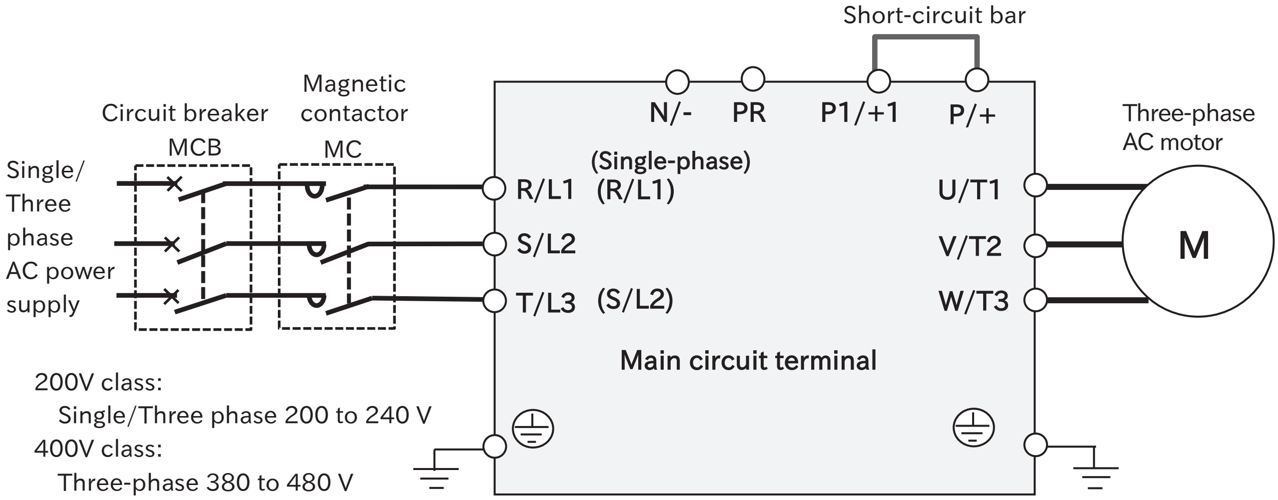
・Cut the connection points between the unnecessary part and the backing plate using a nipper or a cutter, to cut off the unnecessary part for wiring. Be careful not to get injured.
When high voltage is applied to the relay output terminals, etc., pull out the wires separately from the low voltage wires such as the control circuit wires.

5.2 Main circuit terminal

5.2.1 Configuration of main circuit terminal

Short circuit between P and P1 (factory default state)

[P/+] and [P1/+1] terminals are short-circuited at the factory-set.
If these terminals are not connected, power is not supplied to the main circuit, which disables operation.



Terminal symbol	Name	Description
R/L1 S/L2 T/L3	Input terminal for main power supply	Connects to AC power supply. There is no [T/L3] terminal in the single-phase model. In this case, connect AC power supply to [R/L1] and [S/L2] terminals.
U/T1 V/T2 W/T3	Inverter output terminal	Connect a three-phase motor.
P1/+1 P/+	DC reactor connection terminal	Remove the short-circuit bar between [P/+] and [P1/+1] terminal and connect the optional DC reactor for power factor improvement.
P/+ PR	Braking resistor connection terminal	When braking torque is required, connect the optional external braking resistor between [P/+]([+]) and [PR] terminal.
P/+ N/-	Regenerative braking unit connection terminal	When braking torque is required and the built-in braking circuit is insufficient, connect the optional regenerative braking unit between [P/+] and [N/-] terminal. Note: In this guide, the voltage between these terminals is referred to as the DC bus voltage.
G ⏚	Inverter grounding terminal	Ground terminal. Ground to prevent electric shock and reduce noise. Connect according to the applicable local grounding standards. For models of 200V class 3.7kW or less and 400V class 3.7kW or less, connect the grounding bar on the bottom left of the inverter.

Precautions for wiring the main circuit terminals

Electric shock
Fire

DO

● **Risk of electric shock and fire!**

・Be sure to check that the charge lamp is off before making any work such as wiring change after the power is shut off. 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 certain period even after the power is shut off. Check that the input power is turned OFF and wait at least 10 minutes before starting the work. (Check that the charge lamp is off and the DC voltage between [P/+] and [N/-] terminals is DC45V or less.)

5.2.2 Wiring power supply and motor

・Connect [R/L1], [S/L2] and [T/L3] terminal to the AC power supply, and [U/T1], [V/T2] and [W/T3] terminal to the motor.
Pay attention to the following points when wiring.

■Cautions for wiring the main circuit terminal

Danger
Burnout
Prohibited
DO

● **Risk of burnout of the motor!**

・Do not drive a 200V class motor with a 400V class inverter.
・The input power supply should be within the following ranges.
200V class AC200 to 240V (allowable fluctuation range +10%/-15%)
400V class AC380 to 480V (allowable fluctuation range +10%/-15%)
50Hz/60Hz (fluctuation range ±5 %)

■Caution for the main power input terminal

Fire
Damage
DO

● **Risk of fire and damage to machine!**

・For connection between the power supply and the main power input terminal ([R/L1], [S/L2], [T/L3]), use the earth-leakage breaker for protecting the circuit and wiring.
・If the protection function of the inverter is activated, there is a possibility that a failure or an accident is occurring on your system. Connect a magnetic contactor that shuts off the power supplied to the inverter.
・Since the earth-leakage breaker may malfunction due to effects of high frequency noise, please use a model with large high-frequency sensitive current value.

Failure
Prohibited
DO

● **Risk of damage to the inverter!**
・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.
・To start or stop operation using external signals, use the RUN command (FR, RR) of the control circuit terminal block.

Electric shock
Injury
Failure
Prohibited

● **Risk of electric shock, injury and damage to the inverter!**

・Do not operate the inverter when an input phase is lost.
・With the three-phase input model, even if an input phase is missing, the internal capacitor will be charged, which may cause an electric shock or injury. In addition, if an input phase is missing, the inverter may be damaged due to frequent undervoltage and overcurrent errors due to single-phase operation.
・With a single-phase input model, power will not be supplied due to a single-wire disconnection. However, contact with the power line on the unbroken side may cause electric shock or injury.

Failure
Prohibited

● **Risk of damage to the inverter!**

・Do not use the following types of power supplies. Otherwise, the internal converter module may be damaged.
(a) Unbalance of the power supply voltage is 3% or more.
(b) The power supply capacity is 10 times or more than the inverter capacity and 500kVA or more.
(c) When the power supply change suddenly for reason such as the following example.
(e.g. 1) When two or more inverters are installed and connected each other with a short cable.
(e.g. 2) When the inverter and the thyristor converter are connected to each other with a short cable.
(e.g. 3) When a phase advance capacitor is inserted or shut off.

Failure

Prohibited

● **Risk of damage to the inverter!**

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

■Cautions for inverter output terminals

DANGER
Fire

DO

● **Risk of fire, malfunction and damage to machine!**

・Use wires with a thickness equal to or above the applicable wire. Otherwise, the output voltage may drop between the inverter and the motor. Especially at low speed output, voltage drop caused by wiring reduces the torque of the motor.

Failure

Prohibited

● **Risk of damage to the inverter!**

・Do not install a phase advance capacitor or surge absorber between the inverter and the motor, as they may cause inverter errors or damage to the capacitor or surge absorber.

Burnout

DO

● **Risk of burnout of the motor!**

・When connecting multiple motors, install thermal relays for each of them.

Burnout

DO

● **Risk of burnout of the motor!**

・When the wire length exceeds 20m, due to the stray capacitance or the inductance of the wire, surge voltage may be generated on the motor terminals (especially on 400 V class), which may cause the motor to burnout.

Burnout

DO

● **Risk of burnout of the motor!**

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

■Cautions for ground terminal for inverter

Electric shock

DO

● **Risk of electric shock!**

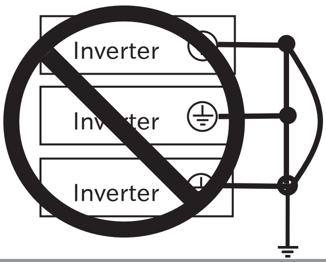
- Be sure to ground the inverter and motor for use in accordance with the applicable local grounding standards.
- Use grounding wires whose thickness is thicker than that of the applicable wires and make them short as much as possible.

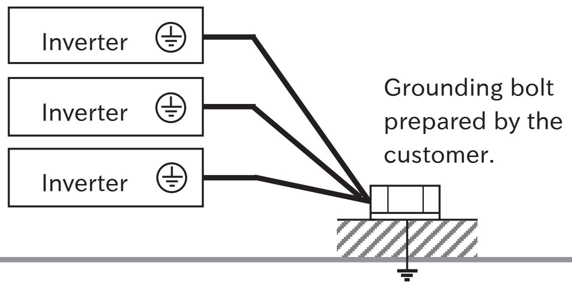
Malfunction

Prohibited

● **Risk of malfunction of the inverter and peripheral control devices!**

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



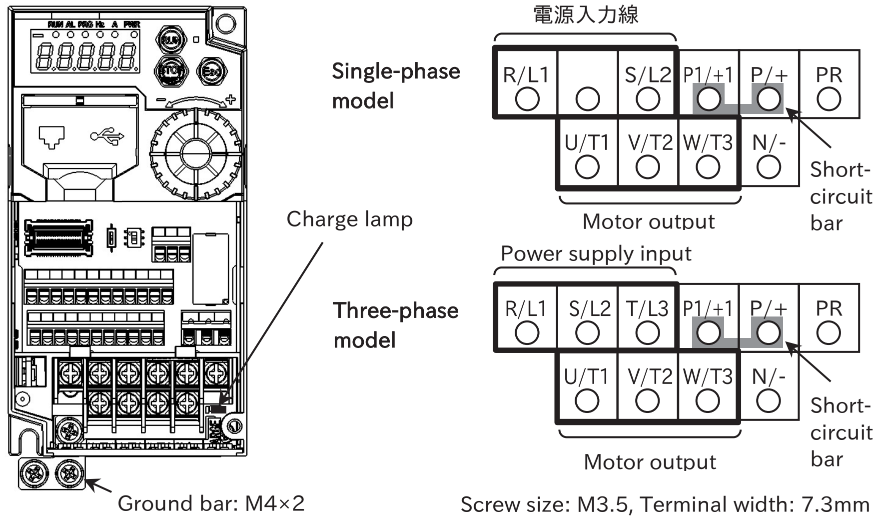
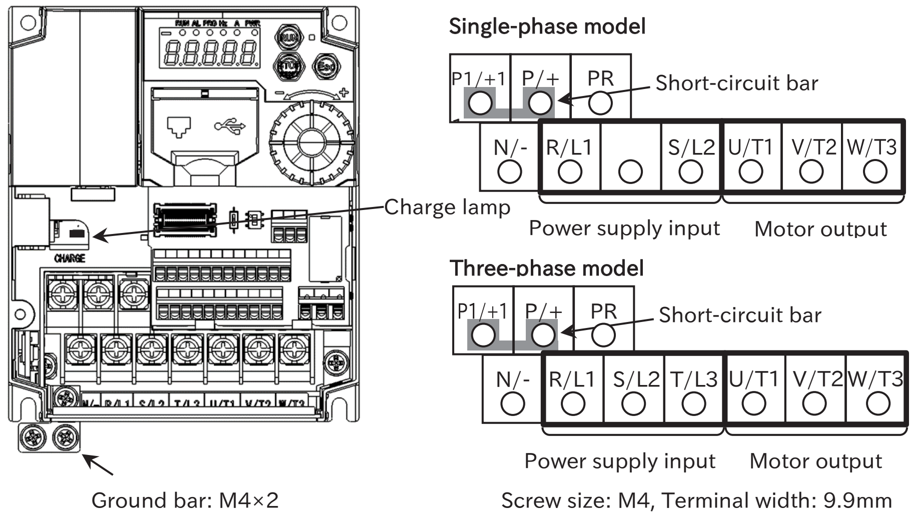
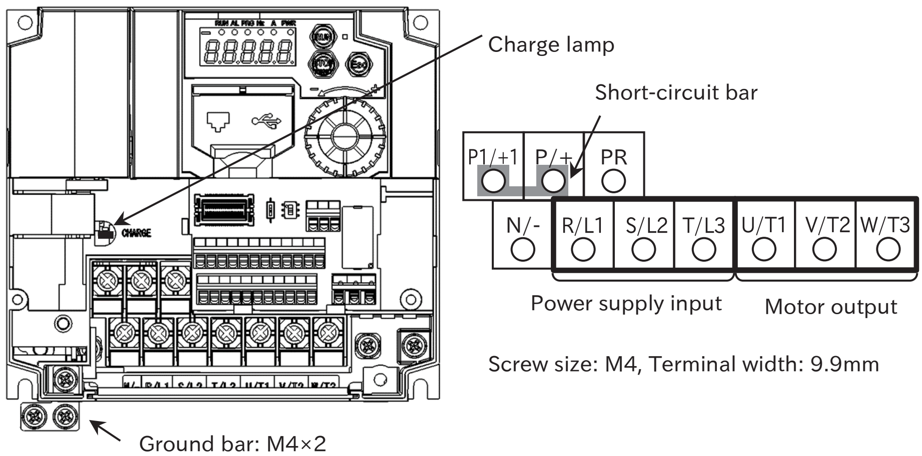


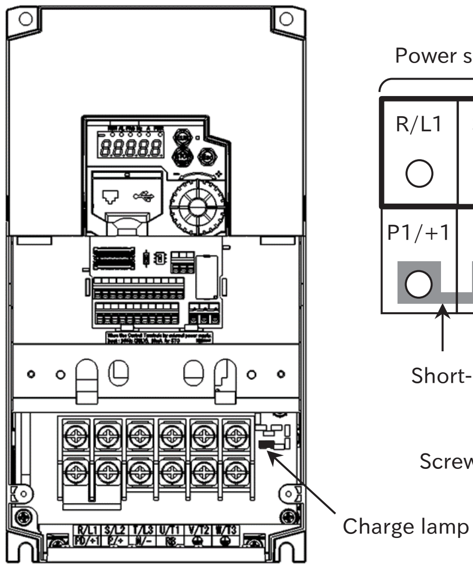
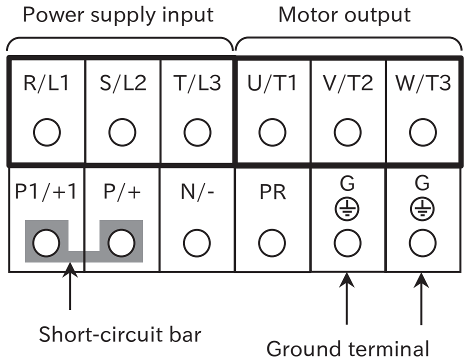
Other cautions

- For details on compliance with CE and UL standards, refer to "1.3 Compliance to European Directive (CE)" and "1.4 Compliance to UL Standards".
- If exports to the U.S. or Canada, or compliance with UL, cUL standards is required, the wires and circuit breakers specified in the UL, cUL standards must be used. When connecting wires to the main circuit terminal block, use round crimping terminals (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.
- Screw size may differ depending on the terminal. For the screw sizes of the main circuit terminal and the ground terminal, refer to "5.2.3 Arrangement of Main Circuit Terminal Block".
- For the wiring to the inverter and the tightening torque of the crimp terminal and terminal screw, refer to the table in "5.3.2 Recommended Wire Diameter, Wiring Equipment, Crimp Terminal".

5.2.3 Arrangement of main circuit terminal

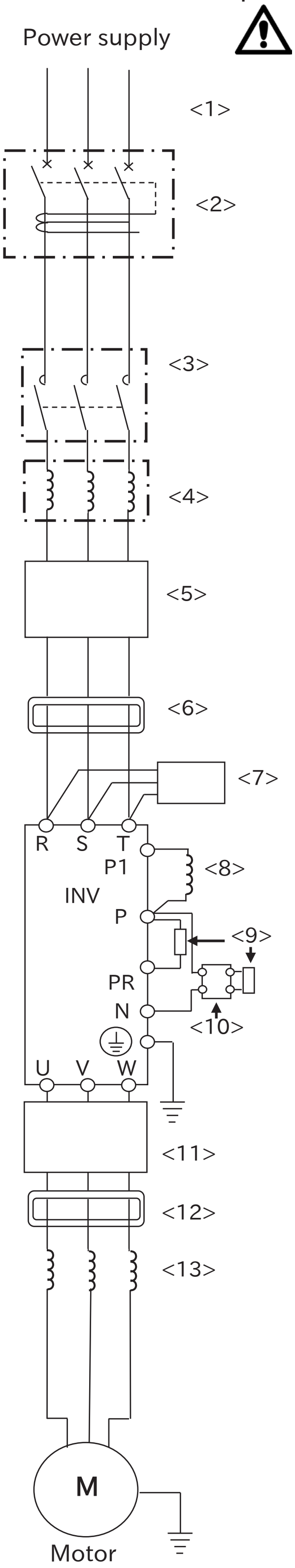
・The arrangement of the main circuit terminal of the inverter is shown in the figure below.

Model	Terminal arrangement
Single-phase 200V class 0.2 to 0.4kW HF620S-A20 HF620S-A40 Three-phase 200V class 0.2 to 0.75kW HF6202-A20 HF6202-A40 HF6202-A75	 Screw size: M3.5, Terminal width: 7.3mm
Single-phase 200V class 0.75 to 2.2kW HF620S-A75 HF620S-1A5 HF620S-2A2 Three-phase 200V class 1.5 to 2.2kW HF6202-1A5 HF6202-2A2 Three-phase 400V class 0.4 to 2.2kW HF6204-A40 HF6204-A75 HF6204-1A5 HF6204-2A2	 Screw size: M4, Terminal width: 9.9mm
Three-phase 200V class 3.7kW HF6202-3A7 Three-phase 400V class 3.7kW HF6204-3A7	 Screw size: M4, Terminal width: 9.9mm

Model	Terminal arrangement
Three-phase 200V class 5.5/7.5kW HF6202-5A5 HF6202-7A5 Three-phase 400V class 5.5/7.5kW HF6204-5A5 HF6204-7A5	  Screw size: M5, Terminal width: 13mm

5.3 Applicable peripheral device

5.3.1 Overview of peripheral device



Cautions

- The applicable devices shown in this chapter are those when Hitachi standard 3-phase 4-pole induction motor is used.
- For the circuit breaker, choose an appropriate device by taking breaking capacity into consideration. (Use an inverter-compatible type.)
- To ensure safety, use an earth-leakage breaker (ELB).
- Use a 75°C copper wire (HIV wire). (For details, refer to "1.4.1 UL Cautions".)
- When the wiring length exceeds 20m, a thick power line needs to be used.
- Use 0.75 mm^2 wire for relay output terminals.
- Tighten the terminal screws at specified torques. Loose tightening may cause a short circuit or fire. Excessive tightening 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 the power supply and between the inverter and the motor. Also, use an inverter-compatible type earth-leakage breaker. High-speed type products may malfunction.
- Leakage current is approx. 30mA/km when XLPE wire is used and wired with a metal tube.
- As relative permittivity of HIV 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 right. When the total wiring length exceeds 100m, use a XLPE wire.

Total wiring length	Sensitivity current (mA)
100m or shorter	30
300m or shorter	100

No.	Name	Function
<1>	Wire	Refer to "5.3.2 Recommended Wire Diameters, Wiring Equipment and Crimp Terminal".
<2>	Earth-leakage breaker Circuit breaker	
<3>	Magnetic contactor	
<4>	Input-side AC reactor	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 500 kVA 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 conducted noise generated from the inverter and transmitted through the wires. Connected to the primary side (input side) of the 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 primary side (input side) of inverter. This is used for reducing the noise (reducing radiation noise).
<7>	Radio noise filter (XY 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 input side and output side.)
<13>	Output-side AC reactor	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, the vibration of motor can be reduced. Also, if the wiring length between the inverter and motor is long (10m or longer), by inserting a reactor, malfunctioning of the thermal relay caused by harmonic attributable to switching of inverter can be prevented. It is also possible to use a current sensor instead of a thermal relay.

5.3.2 Recommended wire diameter, wiring equipment, crimp terminal

・The following table shows the recommended wiring to the inverter, crimp terminals and tightening torque of the terminal screws.

■Single-phase 200V class

Model	Main circuit terminal wiring AWG (mm^2)	Crimp terminal Power/Ground	Terminal screw size (Terminal width)	Tightening torque (N m) Power/Ground (max. value)
HF620S-A20	AWG16 (1.3mm^2)	R2-3.5/R2-4	M3.5 (7.3mm)	0.9 to 1.2/ 1.3 to 1.5 (1.4/1.8)
HF620S-A40				
HF620S-A75	AWG12 (3.3mm^2)	R5.5-4/R5.5-4	M4 (9.9mm)	1.4/1.3 to 1.5 (1.6/1.8)
HF620S-1A5	AWG10 (5.3mm^2)			
HF620S-2A2				

■Three-phase 200V class

Model	Main circuit terminal wiring AWG (mm^2)	Crimp terminal Power/Ground	Terminal screw size (Terminal width)	Tightening torque (N m) Power/Ground (max. value)
HF6202-A20	AWG16 (1.3mm^2)	R2-3.5/R2-4	M3.5 (7.3mm)	0.9 to 1.2/ 1.3 to 1.5 (1.4/1.8)
HF6202-A40				
HF6202-A75				
HF6202-1A5	AWG14 (2.1mm^2)	R2-4/R2-4	M4 (9.9mm)	1.4/1.3 to 1.5 (1.6/1.8)
HF6202-2A2	AWG12 (3.3mm^2)	R5.5-4/R5.5-4		
HF6202-3A7	AWG10 (5.3mm^2)			
HF6202-5A5	AWG6 (13mm^2)	R14-5/R14-5	M5 (13mm)	3.0/3.0 (3.0/3.0)
HF6202-7A5				

■Three-phase 400V class

Model	Main circuit terminal wiring AWG (mm^2)	Crimp terminal Power/Ground	Terminal screw size (Terminal width)	Tightening torque (N m) Power/Ground (max. value)
HF6204-A40	AWG16 (1.3mm^2)	R2-4/R2-4	M4 (9.9mm)	1.4/1.3 to 1.5 (1.6/1.8)
HF6204-A75				
HF6204-1A5				
HF6204-2A2	AWG14 (2.1mm^2)			
HF6204-3A7	AWG12 (3.3mm^2)	R5.5-4/R5.5-4		
HF6204-5A5	AWG10 (5.3mm^2)	R5.5-5/R5.5-5	M5 (13mm)	3.0/3.0 (3.0/3.0)
HF6204-7A5				

・The wire size in the above table shows the designed values based on HIV cables (with thermal resistance of 75˚C).
・When the wiring length exceeds 20m, a thick power line needs to be used.
・When connecting wires to the main circuit terminal block, use round crimping terminals (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.
・Use a ground wire with a diameter equal to or thicker than that indicated on the power line.
・It is recommended to tight screws at the "maximum value" of the tightening torque in the above table.

5.3.3 Applicable breaker

■Single-phase 200V class (Standard load rating [ND]: Initial setting)

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF620S-A20	0.2	NV32-SV	NF32-SV	5	SC-03
HF620S-A40	0.4	NV32-SV	NF32-SV	10	SC-03
HF620S-A75	0.75	NV32-SV	NF32-SV	20	SC-N1
HF620S-1A5	1.5	NV32-SV	NF32-SV	30	SC-N2
HF620S-2A2	2.2	NV63-SV	NF63-SV	40	SC-N2

■Single-phase 200V class (Light load rating [LD])

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF620S-A20	0.2	NV32-SV	NF32-SV	10	SC-03
HF620S-A40	0.4	NV32-SV	NF32-SV	15	SC-4-0
HF620S-A75	0.75	NV32-SV	NF32-SV	20	SC-N1
HF620S-1A5	1.5	NV32-SV	NF32-SV	30	SC-N2
HF620S-2A2	2.2	NV63-SV	NF63-SV	40	SC-N2

■Three-phase 200V class (Standard load rating [ND]: Initial setting)

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF6202-A20	0.2	NV32-SV	NF32-SV	5	SC-03
HF6202-A40	0.4	NV32-SV	NF32-SV	5	SC-03
HF6202-A75	0.75	NV32-SV	NF32-SV	10	SC-03
HF6202-1A5	1.5	NV32-SV	NF32-SV	15	SC-4-0
HF6202-2A2	2.2	NV32-SV	NF32-SV	20	SC-N1
HF6202-3A7	3.7	NV32-SV	NF32-SV	30	SC-N2
HF6202-5A5	5.5	NV63-SV	NF63-SV	50	SC-N2S
HF6202-7A5	7.5	NV125-SV	NF125-SV	60	SC-N3

■Three-phase 200V class (Light load rating [LD])

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF6202-A20	0.4	NV32-SV	NF32-SV	5	SC-03
HF6202-A40	0.75	NV32-SV	NF32-SV	10	SC-03
HF6202-A75	1.5	NV32-SV	NF32-SV	15	SC-4-0
HF6202-1A5	2.2	NV32-SV	NF32-SV	20	SC-N1
HF6202-2A2	3.7	NV32-SV	NF32-SV	30	SC-N2
HF6202-3A7	5.5	NV63-SV	NF63-SV	40	SC-N2S
HF6202-5A5	7.5	NV125-SV	NF125-SV	60	SC-N3
HF6202-7A5	11	NV125-SV	NF125-SV	75	SC-N3

■Three-phase 400V class (Standard load rating [ND]: Initial setting)

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF6204-A40	0.4	NV32-SV	NF32-SV	5	SC-03
HF6204-A75	0.75	NV32-SV	NF32-SV	5	SC-03
HF6204-1A5	1.5	NV32-SV	NF32-SV	10	SC-03
HF6204-2A2	2.2	NV32-SV	NF32-SV	15	SC-4-0
HF6204-3A7	3.7	NV32-SV	NF32-SV	20	SC-N1
HF6204-5A5	5.5	NV32-SV	NF32-SV	30	SC-N2
HF6204-7A5	7.5	NV32-SV	NF32-SV	30	SC-N2

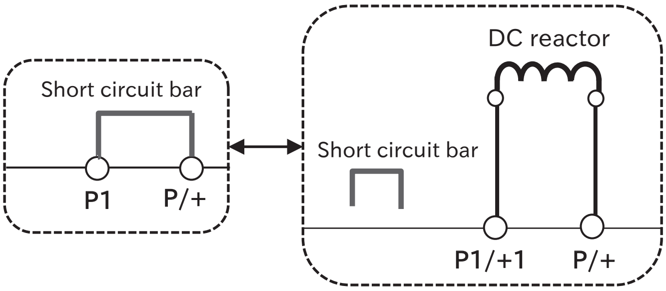
■Three-phase 400V class (Light load rating [LD])

Model	Applicable Motor (kW)	Earth-leakage breaker (ELB) (Mitsubishi electric)	Breaker (MCB) (Mitsubishi electric)	Rated current (A)	Magnetic contactor (Fuji electric)
HF6204-A40	0.75	NV32-SV	NF32-SV	5	SC-0-3
HF6204-A75	1.5	NV32-SV	NF32-SV	10	SC-0-3
HF6204-1A5	2.2	NV32-SV	NF32-SV	10	SC-0-3
HF6204-2A2	3.7	NV32-SV	NF32-SV	20	SC-N1
HF6204-3A7	5.5	NV32-SV	NF32-SV	30	SC-N2
HF6204-5A5	7.5	NV63-SV	NF63-SV	40	SC-N2
HF6204-7A5	11	NV63-SV	NF63-SV	50	SC-N2S

- Applicable motor capacity is based on Sumitomo 200V (for 200V class)/400V (for 400V class), 60Hz, 4 pole IE3 motor.
- When exports to the U.S. or Canada, or compliance with UL, cUL standards is required, the wires and circuit breakers specified in the UL, cUL standards must be used. For details, refer to "1.4 Compliance to UL Standards".
- Device model name on above table shows example selection. The device selection should be based on rated current, short circuit current capability and accordance to the local electrical legislation.
- For the wire diameter, refer to the "Main circuit terminal wiring AWG (mm^2)" column in "5.3.2 Recommended Wire Diameters, Wiring Instruments, Crimp Terminal".
- The electrical endurance of the class AC-1 magnetic contactor is 500,000 times, but when using for emergency stops during motor drive, the electrical endurance is 25 times.
- When using a MC for emergency stop during motor drive, select a MC of the class AC-3 rated current depending on the inverter input current.
- When selecting oversize inverter capacity compared to motor rating, select magnetic contactor according to the inverter capacity.

5.3.4 DC Wiring of DC reactor

- When using a DC reactor, connect it after removing the short circuit bar between [P1/+1] and [P/+] terminals.
- The power factor can be improved, and harmonic noises can be reduced by using DC reactor.



Cautions for DC link choke connection terminals ([P1/+1], [P/+])

Caution

- When the short-circuit bar between [P1/+1] and [P/+] terminals is removed and the DC reactor is not connected, power is not supplied to the main circuit part of the inverter and the inverter cannot be operated.

Prohibited

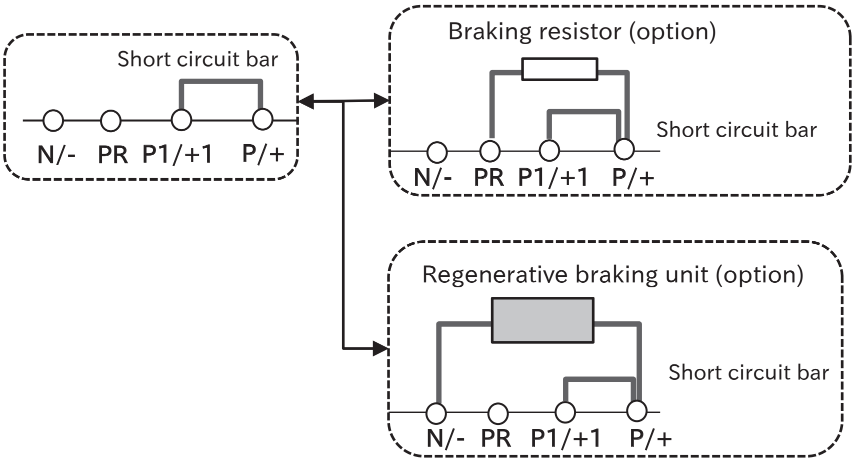
- When the DC reactor is not used, do not remove the short-circuit bar between [P1/+1] and [P/+] terminals.

DO

- The wiring length to DC reactor should be within 5m. Otherwise, it may not perform efficiently.
- When installing the DC reactor, please make sure that its heat does not affect the inverter.

5.3.5 Wiring of braking resistor and regenerative braking unit

- In HF-620, a braking resistor circuit is built-in as standard.
- By installing optional braking resistor or regenerative braking unit, the braking force can be improved and the overvoltage can be suppressed, and it can be used even with large regenerative loads (lowering load or load applied at high-speed rotation).
- For details of the setting when connecting a braking resistor, refer to "9.9.5 Suppressing Overvoltage with Braking Resistor". When connecting the regenerative braking unit, set "Dynamic brake activation selection [bA-61]" to "Disable (00)".



Cautions for the brake resistor connection terminals ([P/+], [PR]) and regenerative brake unit connection terminals ([P/+], [N/-])

Failure Burnout

Prohibited

DO

● **Risk of damage to the inverter and burnout of the braking resistor!**

- Do not connect items other than the braking resistor between [P/+] and [PR] terminals.
- Do not short-circuit [P/+] and [PR] terminals.
- Do not attach a resistor whose resistance is lower than the predefined value. Otherwise, the braking resistor (DBTR) circuit or the regenerative braking unit may be damaged.
- Wiring to the braking resistor and regenerative braking unit (DBTR) should be within 5m, and the wires should be twisted.
- Arrange devices so that the heat generated by the braking resistor and regenerative braking unit does not affect the inverter.

■Selection and wiring of regenerative braking resistor

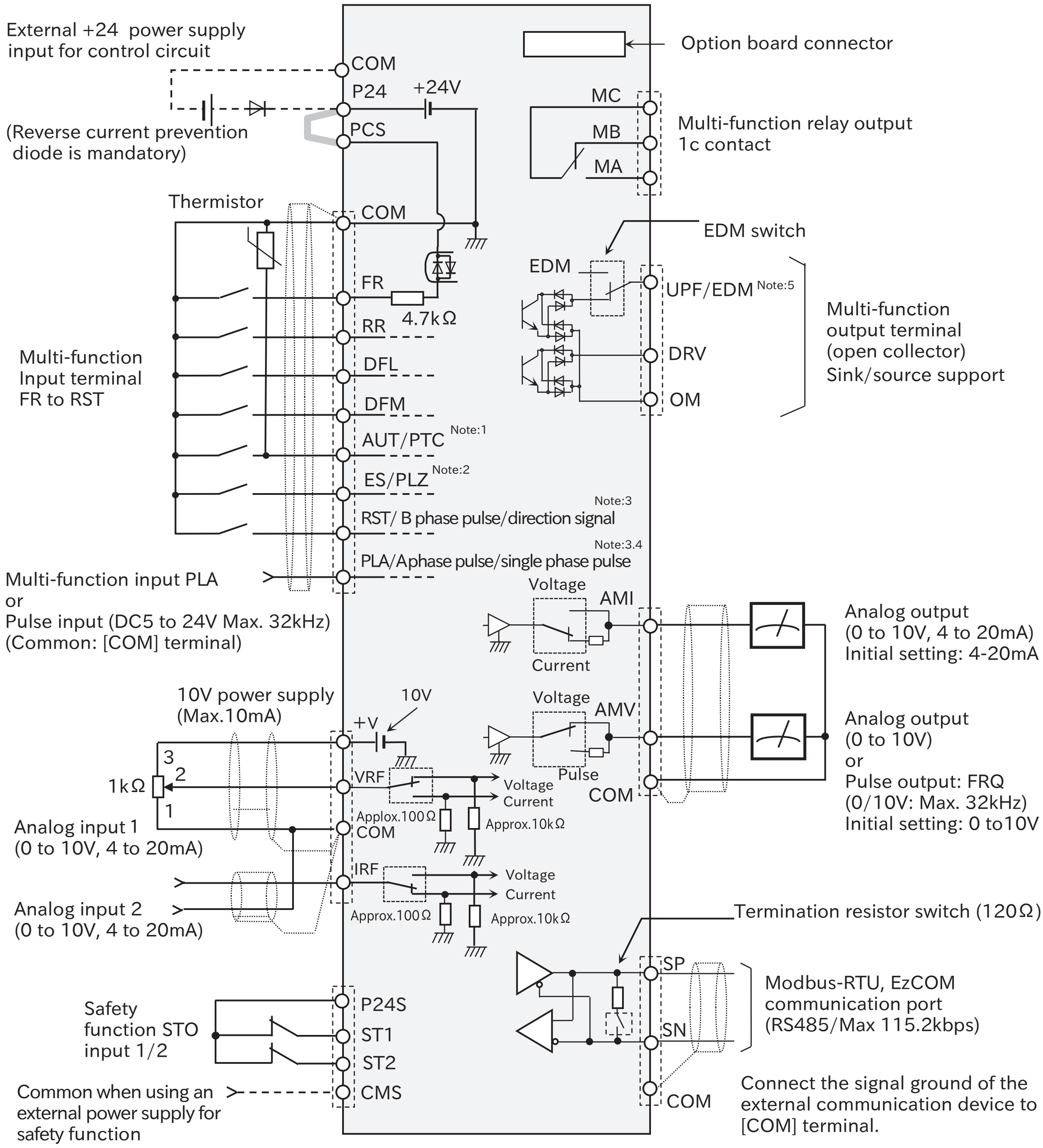
Power supply	Model	Applicable motor capacity (kW)	Regenerative braking torque without resistor (%)	Connectable minimum resistor	
				Resistor value (Ω)	Use ratio (%)
Single phase 200V class	HF620S-A20	0.2	50	100	10
	HF620S-A40	0.4	50	100	
	HF620S-A75	0.75	50	50	
	HF620S-1A5	1.5	50	50	
	HF620S-2A2	2.2	20	35	
Three phase 200V class	HF6202-A20	0.2	50	100	10
	HF6202-A40	0.4	50	100	
	HF6202-A75	0.75	50	50	
	HF6202-1A5	1.5	50	50	
	HF6202-2A2	2.2	20	35	
	HF6202-3A7	3.7	20	35	
	HF6202-5A5	5.5	20	20	
	HF6202-7A5	7.5	20	17	
Three phase 400V class	HF6204-A40	0.4	50	180	10
	HF6204-A75	0.75	50	180	
	HF6204-1A5	1.5	50	180	
	HF6204-2A2	2.2	20	100	
	HF6204-3A7	3.7	20	100	
	HF6204-5A5	5.5	20	70	
	HF6204-7A5	7.5	20	70	

5.4 Control circuit terminal

5.4.1 Configuration of control circuit terminal

・Control circuit terminal wires are shown in the figure below. Check the cautions, functions, and electrical specifications of the control circuit terminal wiring in this section and pay sufficient attention to wiring so that there is no incorrect wiring.

Note: For details when switching the sink/source logic and using external devices or external power supply, refer to "5.4.3 Switching Sink/Source Logic and Connecting External Power Supply/Programmable Controller".



Note: 1. When "Thermistor type selection [Cb-40]" is set to "PTC (01)", input terminal [AUT] becomes a terminal for connecting an external thermistor (PTC).

2. When using "Pulse input Z [PLZ]" input terminal, assign it to input terminal [ES].
3. When "Pulse input target function selection [CA-90]" is set to anything other than "Disable (00)", input terminal [RST] is automatically switched to the terminal for B-phase pulse input or direction signal, and input terminal [PLA] is automatically switched to the terminal for A-phase pulse input or single-phase pulse input. For details, refer to "9.5.11 Using Encoder Feedback.
4. The electrical specifications of input terminal [PLA] differ from those of other input terminals [FR] to [RST]. For details, refer to "Functions and electrical specifications of control circuit terminals" in this section.
5. When the EDM switch on the board is turned ON, output terminal [UPF] switches to "STO state monitor [EDM]". When the switch is turned back to OFF, output terminal [UPF] becomes "Not use [no]".

Cautions for wiring control circuit terminals

Electric Shock Failure

Prohibited

● **Risk of electric shock and damage to the inverter!**

- [COM] terminal and [OM] terminal are common terminals for input and output signals. They are isolated from each other. Do not short-circuit or ground these common terminals.
- Also, do not ground them through external devices. (Check the grounding condition of the external devices.)
- Do not short-circuit between [+V] terminal (10V power supply) and [COM] terminal, [P24] terminal (+24V power supply) and [COM] terminal.

Failure

DO

● **Risk of damage to the inverter!**

- Switching the dip switch on the board while the power is on may cause a failure. Turn off the power, check that Power LED [PWR] on the keypad is off, and then switch.
- Difference of the switch status and the actual input/output specifications may cause a failure. Be sure to check that the characteristics of the input/output and the switch are correct.
- When connecting a relay to the intelligent output terminal, connect a diode for surge absorption in parallel with the coil. Surge-voltage at switching the relay may cause a failure of the internal circuit.
- By supplying external +24V to [P24] terminal, it is possible to operate only the control circuit and parameters can be read/written. When an external +24V power supply is connected, be sure to connect a reverse current prevention diode. Also, be careful not to shut off the external +24V power supply when writing parameters in this state.

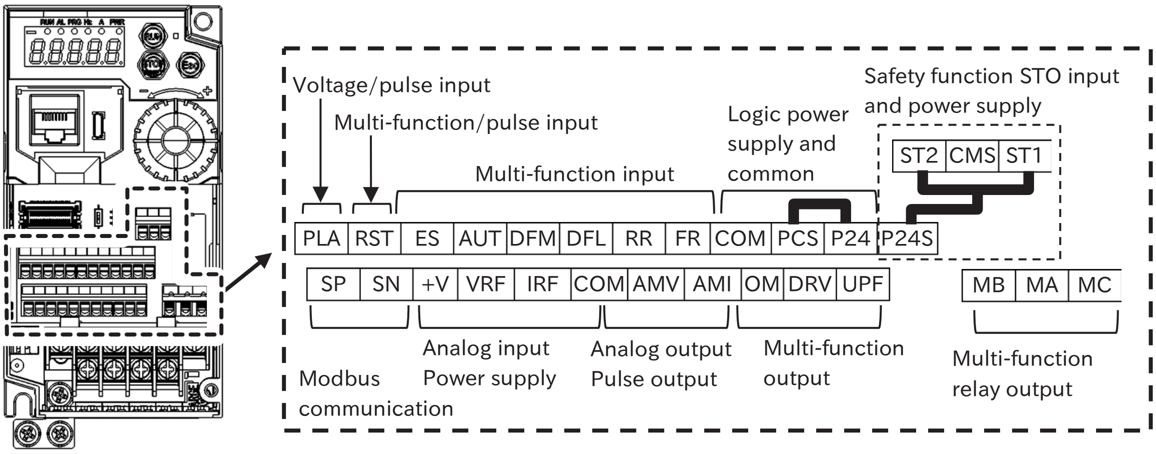
Malfunction

DO

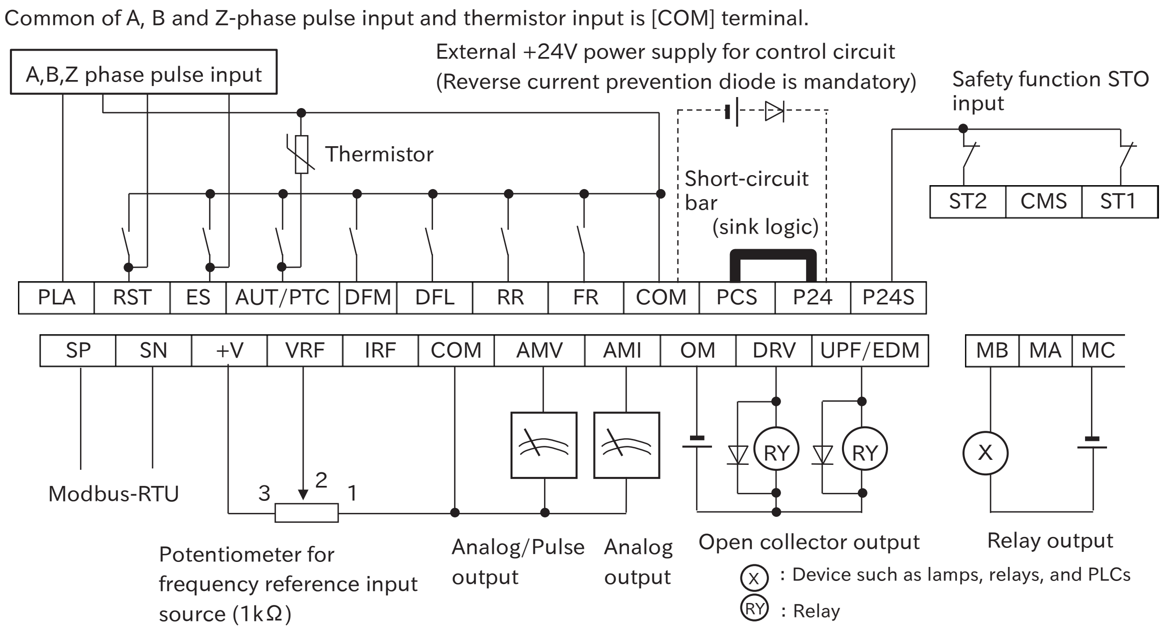
● **Risk of malfunction of the inverter!**

- Separate the wiring to the control circuit terminal from the wiring of the main circuit line (power line) or relay control circuit. when it is unavoidable to do so, make them positioned at right angles to each other.
- For wiring to the control circuit terminal, use twisted shield wires, and connect the shield films to each common terminal.
- The wiring length to the control circuit terminal shall be within 20m. When the connecting wire exceeds 20m, sufficient characteristics may not be obtained due to the effects of voltage drop. When 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.
- When "Thermistor type selection [Cb-40]" is set to "PTC (01)", input terminal [AUT] becomes a terminal for connecting an external thermistor (PTC). In this case, the connection to the input terminal [AUT] should be twisted to the individual common wire to terminal [COM] and separated from the other common wires. In addition, the power supply to the thermistor should be separated from the power line because of the weak current. The wire connected to the thermistor should be within 20m.
- For wiring to "External thermistor [PTC]", twist it together with [COM] terminal common wires individually, and separate it from the other [COM] common wires. Since the power supply flowing through the thermistor is a weak current, separate it from the power line. The wiring length to the thermistor should be within 20m.
- When connecting contacts to the control circuit terminals, use crossbar twin contacts, etc. that do not easily cause contact failure even with a weak current/voltage.
- After wiring, pull the wire lightly to check that it is securely connected.

Arrangement of control circuit terminal



■Wiring example of control circuit terminal



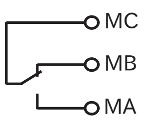
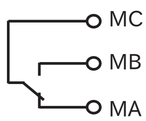
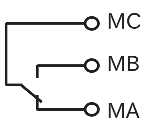
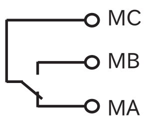
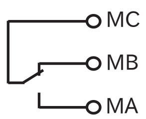
- When "Thermistor type selection [Cb-40]" is set to "PTC (01)", input terminal [AUT] becomes the terminal for connecting an external thermistor (PTC). When a thermistor is used, the common is [COM] terminal regardless of the sink/source logic.
- When "Pulse input target function selection [CA-90]" is set to anything other than "Disable (00)", input terminal [RST] is automatically switched to the terminal for B-phase pulse input or direction signal, and input terminal [PLA] is automatically switched to the terminal for A-phase pulse input or single-phase pulse input. For details, refer to "9.5.11 Using Encoder Feedback.
- When using "Pulse input Z [PLZ]" input terminal for home return function or orientation function, assign it to input terminal [ES].
- Output terminal [UPF] switches to the "STO state monitor [EDM]" by turning on the EDM switch on the board.

Functions and electrical specifications of control circuit terminals

Item	Symbol	Name	Description	Electrical characteristics
Analog input/output				
Power supply	COM	Common for input signal	Common terminal for internal power supply, input terminal [FR] to [PLA], analog input/output and pulse input/output terminals.	-
	+V	Power supply for frequency reference	10V power supply. Used when inputting a frequency reference by analog voltage input with a potentiometer.	Maximum allowable current: 10mA
Analog input	VRF	Analog input 1 (Voltage/Current)	[VRF] and [IRF] terminals are terminal for analog input. Both terminals can be switched between voltage input and current input by parameter setting. - Analog voltage input 0 to 10V voltage input. It is adjusted at the factory to reach the maximum frequency at 9.8V input. - Analog current input 4 to 20mA current inputs. It is adjusted at the factory to reach the maximum frequency at 19.8mA input.	Analog voltage input: Input impedance: Approx. 10kΩ Allowable input voltage range: -0.3 to 12V Analog current input: Input impedance: Approx. 100Ω Allowable input current range: 0 to 24mA
	IRF	Analog input 2 (Voltage/Current)		
Thermistor input	AUT [PTC]	External thermistor input	When "Thermistor type selection [Cb-40]" is set to "PTC (01)", input terminal [AUT] becomes the terminal for connecting an external thermistor (PTC). An external thermistor is connected between this terminal and [COM] terminal to trip the inverter due to a temperature error. (Trip at approx. 3kΩ or more.) Regardless of the sink or source logic, the common is [COM] terminal.	PTC type
Digital input				
Power supply	COM	Common for input signal	Common terminal for internal power supply, input terminal [FR] to [PLA], analog input/output and pulse input/output terminals.	-
	P24	Power supply terminal for input signal	+24V internal power supply terminal for contact input. Common for source logic input. By supplying external +24V to this terminal, it is possible to operate only the control circuit and parameters can be read/written. When an external +24V power supply is connected, be sure to connect a reverse current prevention diode.	Maximum allowable current: 10mA
	PCS	Sink/Source logic switching terminal for input signal	Sink logic: short-circuit to [P24] terminal Source logic: short-circuit to [COM] terminal When driving the contact input with an external power supply, remove the short-circuit wire. For details, refer to "5.4.3 Switching Sink/Source Logic and Connecting External Power Supply/ Programmable Controller".	-
Contact input	FR RR DFL DFM AUT	Multi-function input	Each terminal function can be selected by parameter setting for each terminal. Both sink and source logic are supported. For details, refer to "5.4.3 Switching Sink/Source Logic and Connecting External Power Supply/ Programmable Controller".	Voltage between each terminal and [COM] terminal ON voltage: min. 18V OFF voltage: Max. 3V Maximum allowable voltage: 27V Load current: 5mA (at 24V) Internal resistance：4.7kΩ

Item	Symbol	Name	Description	Electrical characteristics
Contact input or Pulse input	ES	Multi-function input or Z-phase pulse input	Assign "Pulse input Z [PLZ]" to input terminal [ES] when inputting Z-phase pulses in order to use the home return function or orientation function.	Input pulse: min. 0.3Hz to Max. 32kHz [ES]/[RST] - [PLC] voltage: ON voltage: min. 18V OFF voltage: Max. 3V Maximum allowable voltage: 27V Load current: 8mA (at 24V) Internal resistance: 3.0kΩ
	RST	Multi-function input or B-phase pulse input/Direction signal	When "Pulse input target function selection [CA-90]" is set to other than "Disable (00)", the input terminal [RST] is a terminal for B-phase pulse input or direction signal in single-phase pulse input. When [CA-90] is set to "Disable (00)", it becomes an intelligent input terminal.	
	PLA	Multi-function input (Voltage input) or A-phase pulse input/Single-phase pulse input	When "Pulse input target function selection [CA-90]" is set to other than "Disable (00)", the input terminal [PLA] become 0/5 to 24V pulse input terminal. When [CA-90] is set to "Disable (00)", it becomes an intelligent input terminal. In this case, use the source logic or provide an external power supply between this terminal and the [COM] terminal. (Note that the internal circuit differs from the input terminals [FR] through [RST].)	Input pulse: min. 0.3Hz to Max. 32kHz [PLA] - [COM] voltage: ON voltage: min. 4V OFF voltage: Max. 1V Maximum allowable voltage: 27V Internal resistance: 11kΩ
Digital output				
Open collector Output	UPF DRV	Multi-function output	Each terminal function can be selected with the parameter setting of each terminal. Both sink and source logic are supported. For details, refer to "5.4.3 Switching Sink/Source Logic and Connecting External Power Supply/Programmable Controller".	Open collector output Between each terminal and [OM] Max. allowable voltage: 27V Max. allowable current: 50mA Voltage drop when turned on: 4V or less
	OM	Common for Multi-function output	Common terminal for output terminal [UPF] and [DRV].	Maximum allowable current: 100mA
Relay output	MC MA MB	Multi-function relay output	1c contact output. Output terminal function can be selected by parameter setting. (The factory default setting is alarm output.)	Maximum contact capacity [MA] - [MC]: AC250V 2A (Resistance) 0.2A (Inductive load) DC30V 3A (Resistance) 0.6A (Inductive load) [MB] - [MC]: AC250V 1A (Resistance) 0.2A (Inductive load) DC30V 1A (Resistance) 0.2A (Inductive load) Minimum contact capacity AC100V, 10mA, DC5V, 100mA

■Logic for relay output operation

	Power ON		Power OFF
CC-17	01 (normally close)	00 (normally open) Initial setting	-
Normal			
Alarm			

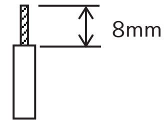
Item	Symbol	Name	Description	Electrical characteristics
Monitor output	AMI	Analog output (Voltage/Current)	Terminal [AMI] can be switched between analog voltage output and analog current output by parameter setting. - Analog voltage output Output any monitor as a 0 to 10V voltage signal. - Analog current output Output any monitor as a 4 to 20mA current signal.	Analog voltage output: Maximum allowable current: 2mA Output voltage accuracy: ±10% (Ambient temp.: 25℃±10℃) Analog current output: Allowable load impedance: 250Ω or less Output voltage accuracy: ±20% (Ambient temp.: 25℃±10℃)
	AMV	Analog voltage output or Pulse output	Terminal [AMV] can be switched between analog voltage output and pulse output by parameter setting. - Analog voltage output Output any monitor as a 0 to 10V voltage signal. - Pulse output Output any monitor as a 0/10V pulse signal or PWM signal.	Analog voltage output: Maximum allowable current: 2mA Output voltage accuracy: ±10% (Ambient temp.: 25℃±10℃) Pulse output: Maximum allowable current: 2mA Maximum output frequency: 32kHz
Communication				
Serial communication	SP SN	Modbus communication	RS485 ports for Modbus-RTU/ EzCOM. To connect the signal ground of the external control device, use [COM] terminal.	Maximum baud rate: 115.2kbps Built-in termination resistor: 120Ω (Switched by dip switch) SP: RS485 differential (+) signal SN: RS485 differential (-) signal
Safety function				
Safety function	P24S	+24V output	+24V power supply dedicated for [ST1]/[ST2] input.	Maximum output current: 100mA
	CMS	Common for +24V output	Common terminal for [P24S].	-
	ST1 ST2	STO input 1 STO input 2	Input terminal for STO signal. For details, refer to "14.1 Using the Safety Function STO (Safe Torque Off)".	Between [ST1]/[ST2] and [CMS] ON voltage: Min. 15V OFF voltage: Max. 5V Max. allowable voltage: 27V Load current: 5.8mA (at 27V) Internal resistance: 4.7kΩ
	UPF [EDM]	STO state monitor	When EDM switch is turned ON, output terminal [UPF] becomes "STO state monitor output [EDM]". For details, refer to "14.1 Using the Safety Function STO (Safe Torque Off)".	Open collector output Between [EDM] and [CM2] Max. allowable voltage: 27V Max. allowable current: 50mA Voltage drop when turned on: 4V or less

5.4.2 Recommended wire diameter and wiring method for control circuit terminals

- The control circuit terminal block of HF-620 is a spring clamp type terminal.
- For the convenience of wiring and improvement of connection reliability, it is recommended to use ferrule terminals with the following specifications.
- When mounting the option board, use ferrules without a sleeve and wire it so that they do not hit the option case.

Recommended wire diameter

Item	Applicable wire		
	Solid wire mm^2 (AWG)	Stranded wire mm^2 (AWG)	Ferrule terminal mm^2 (AWG)
Control terminal	0.2 to 1.5 (AWG 24 to 16)	0.2 to 1.0 (AWG 24 to 17)	0.25 to 0.75 (AWG 24 to 18)
Relay output terminal	0.2 to 1.5 (AWG 24 to 16)	0.2 to 1.0 (AWG 24 to 17)	0.25 to 0.75 (AWG 24 to 18)

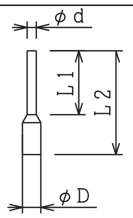


Stripped length for solid wire and stranded wire: approx. 8 mm

Recommended terminal

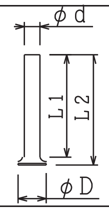
■Ferrule with sleeve

Wire size mm^2 (AWG)	Ferrule model Note	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	8	12.5	0.8	2.0
0.5 (20)	AI 0,5-8WH	8	14	1.1	2.5
0.75 (18)	AI 0,75-8GY	8	14	1.3	2.8



■Ferrule without sleeve

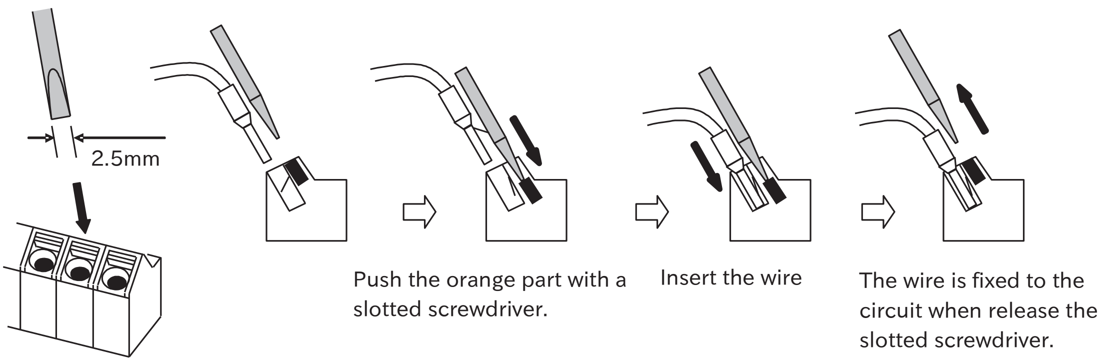
Wire size mm^2 (AWG)	Ferrule model Note	L1 [mm]	L2 [mm]	ϕd [mm]	ϕD [mm]
0.5 (20)	A 0,5-8	7.3	8	1.0	2.1
0.75 (18)	A 0,5-8	7.3	8	1.2	2.3



Note: Manufacturer: Phoenix Contact GmbH & Co. KG Crimping tool: CRIMPFOX 6

Method of wiring/detaching wires

(1) Push the orange part on the control terminal with a slotted screwdriver (with a wide of 2.5mm or less). (Insertion hole will open)
(2) Plug in the wire or ferrule terminal to the wire insertion hole (round hole) while pressing the orange part with a slotted screwdriver.
(3) The wire is fixed to the circuit when release the screwdriver.

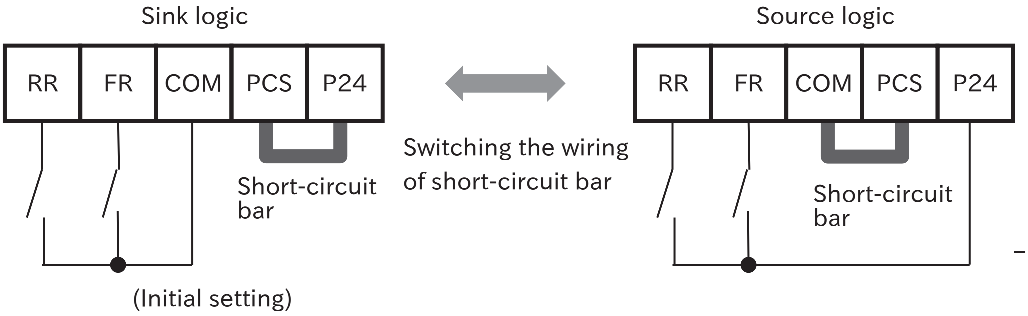


- When pulling out the wire, press the orange part with a slotted screwdriver.

5.4.3 Switching sink/source logic and connecting external power supply/programmable controller

Method of switching sink/source logic for intelligent input terminals

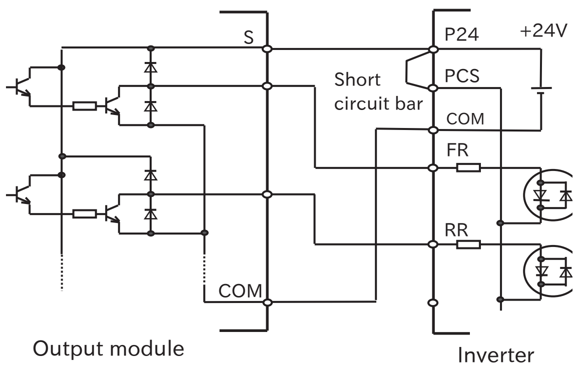
- To switch the logic of the input terminals to source logic, remove the short-circuit bar between [P24] and [PCS] terminal on the control circuit terminal and connect it between [PCS] and [COM] terminal. (The factory default of the logic depends on the destination.)
- Refer to the figure below for wiring when using an external power supply and wiring with external devices such as programmable controllers.

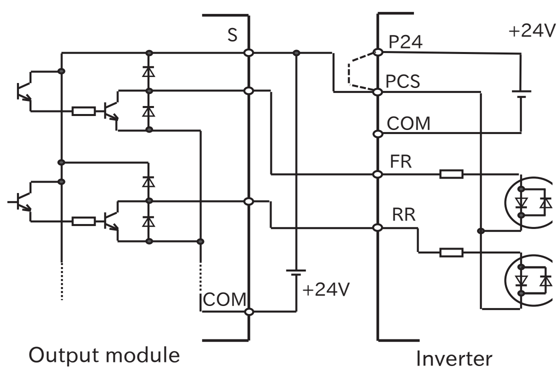


Connecting the intelligent input terminals to a programmable controller

■Sink logic

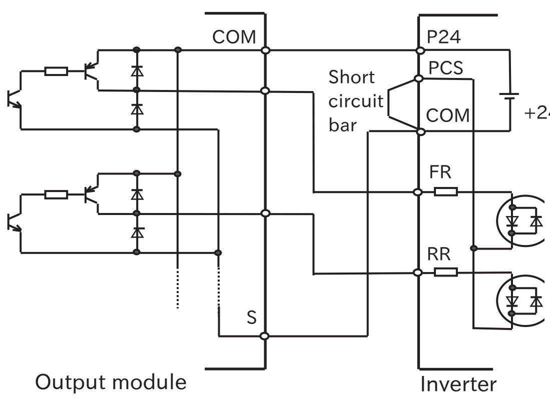
When using the inverter's internal power supply	When using an external power supply (Remove the short-circuit bar from the control terminal.)

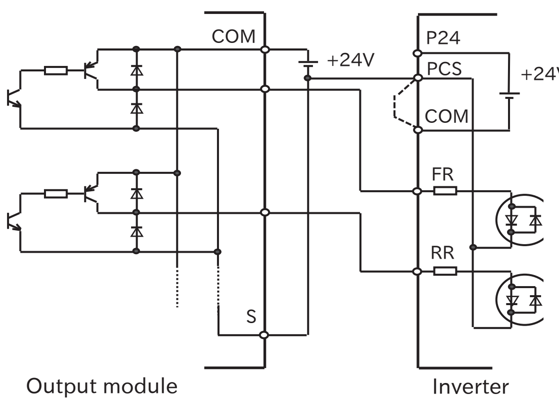




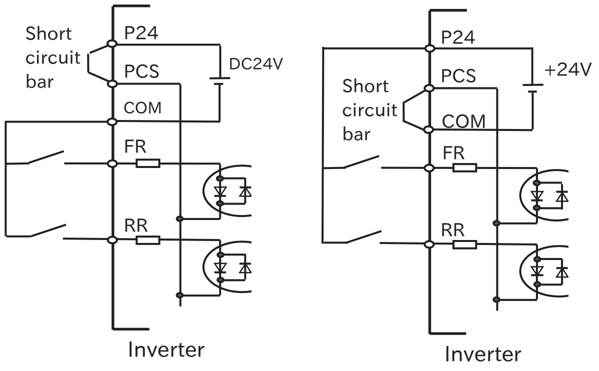
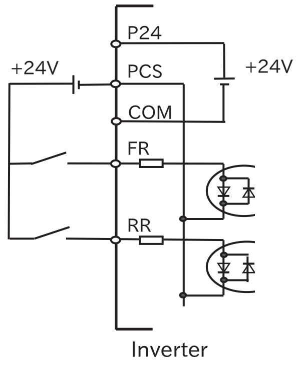
■Source logic

When using the inverter's internal power supply	When using an external power supply (Remove the short-circuit bar from the control terminal.)

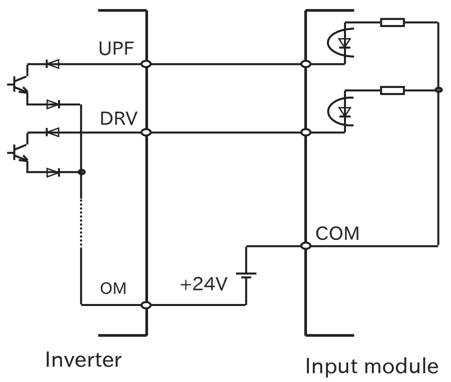
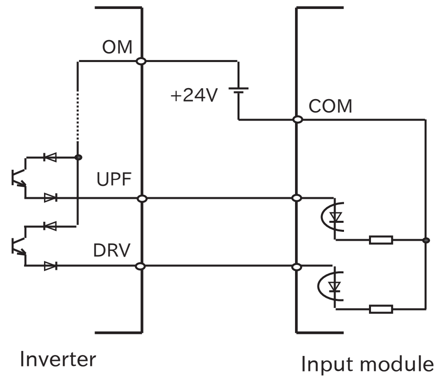




■No-voltage switch

When using the inverter's internal power supply	When using an external power supply (Remove the short-circuit bar from the control terminal.)
	

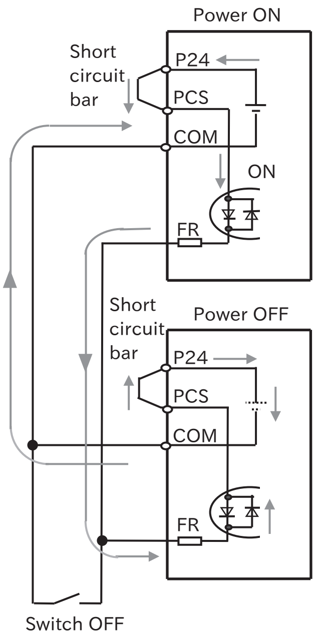
Connecting the intelligent output terminals to a programmable controller

Sink logic	Source logic
	

Cautions when using multiple inverters

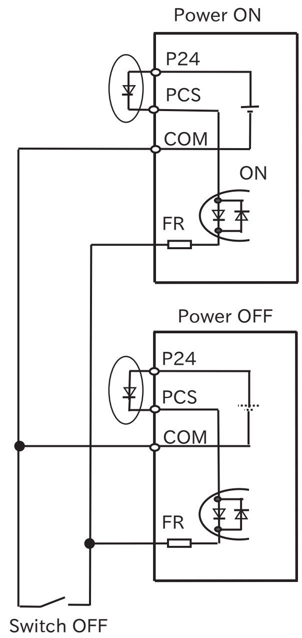
・When a common input (switch, etc.) is used for multiple inverters and the timing of power-on is different, the current may run around as shown in the figure below, and it may be recognized as ON even if the input is OFF. In that case, be sure to insert a diode (rated 50V/0.1A) in the positions shown in the figure to prevent the sneak current.

■Sink logic



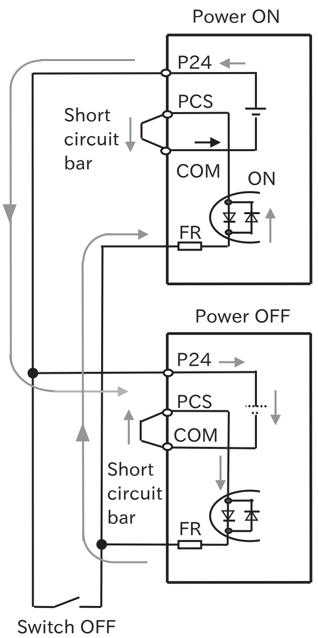
When there is no diode, the current will flow round and the input will turn on even though the switch is off.

Diode added



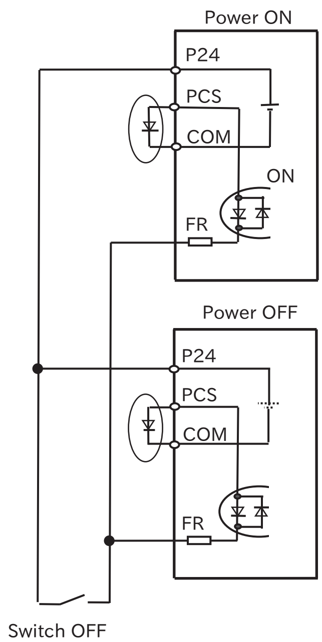
Diodes are installed instead of the short-circuit wires to prevent the sneak current.

■Source logic



When there is no diode, the current will flow round and the input will turn on even though the switch is off.

Diode added



Diodes are installed instead of the short-circuit wires to prevent the sneak current.

Chapter 6 Operation check/Residual

6

This chapter describes residual risks during operation and items to be checked.
The customer who uses the product should appropriately conduct risk assessment before trial run and using the product, and properly 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. Be sure to conduct risk assessment of the system equipped with this product.
Also carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

6.1 Overview of residual risk checklist

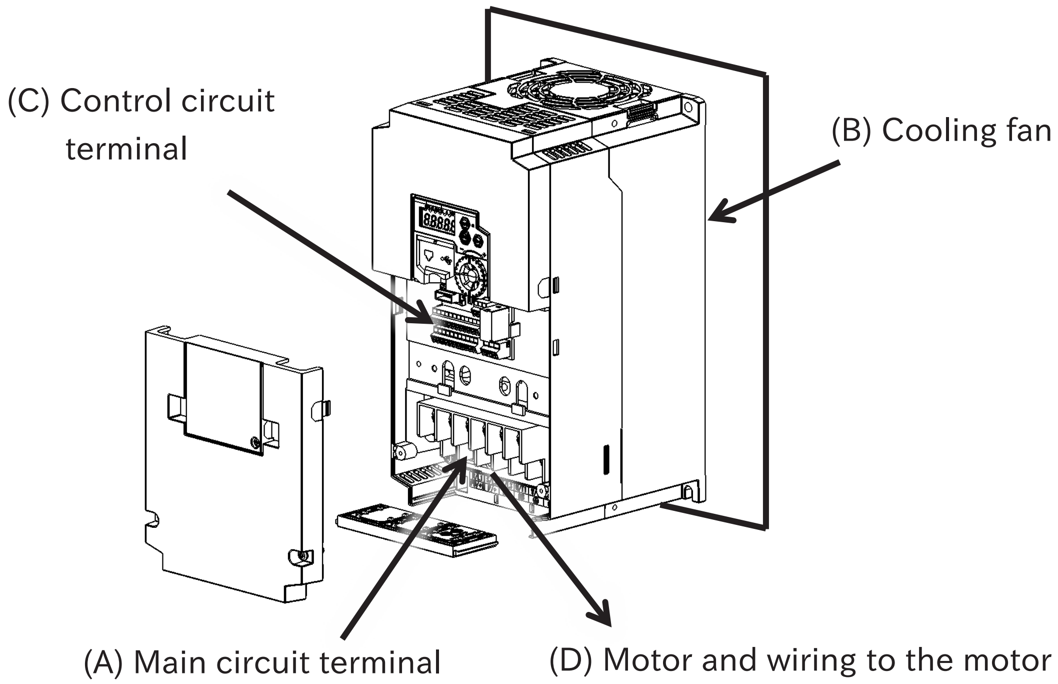
・The residual risk checklist is classified according to the following two definitions based on "Chapter 1 Safety Instructions/Risks".

⚠ DANGER	Indicates that incorrect handling may cause hazardous situations, which have a high possibility of resulting 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 only physical loss or damage.

・Even the content described as "⚠CAUTION" may lead to serious danger depending on the situation. They all contain important information. Be sure to follow these instructions.
・Other notes are also described with "⚠". Pay attention to this information and be sure to observe it.

Check points for residual risk

・Please check for residual risks before turning on the power supply upon completion of the installation.



6.2 Residual risk checklist

No.	Process	Work	Target section	Residual risk	Details of hazard	Protection measures	✓
1	Installation	Installation	(B)	CAUTION	Damage caused by careless carrying.	Do not drop the product. Do not carry the inverter in a manner that applies force to the cover or the keypad.	☐
2	Installation	Installation	General	CAUTION	Reduction of component life due to use in a location exposed to direct sunlight or at a temperature outside of the specification range.	Ensure that the ambient temperature is within the standard specification range in the whole year by means of cooling and ventilation.	☐
3	Installation	Installation	General	CAUTION	Short-circuit failure due to use in a location with humidity or condensation outside of the specification range.	Ensure that the 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 ignites a flammable wall.	Install the inverter on an inflammable metal wall.	☐
5	Installation	Installation	General	CAUTION	Component failure due to ingress of dust, corrosive gas, or other substances.	Install the inverter inside a totally enclosed panel.	☐
6	Installation	Installation	General	CAUTION	Reduction of a component life due to degradation of cooling capability by horizontal installation.	Install the inverter vertically.	☐
7	Installation	Installation	General	CAUTION	When the fin of the inverter is installed outside of cabinet, the cooling fan fails due to droplet, oil mist, etc.	When the fin of the inverter is installed outside of cabinet, install it in a location free from droplet, oil mist, etc.	☐
8	Installation Maintenance	Wiring	(A)	DANGER	The arc discharge due to screws loosened by vibration and ignites the internal components.	Check screws are appropriately tightened on a regular basis.	☐
9	Installation Maintenance	Wiring	General	DANGER	The arc discharge due to screws loosened by vibration and ignites the flammable materials.	Check screws are appropriately tightened on a regular basis. Do not place flammable materials around the installed inverter.	☐
10	Use Maintenance	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	Use Maintenance	Wiring Inspection	(C)	DANGER	When the operator removes the cover, electric shock is caused when a tool ouches 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.	☐

No.	Process	Work	Target section	Residual risk	Details of hazard	Protection measures	✓
12	Installation	Wiring	(D)	DANGER	Due to long wiring length, the insulation of the motor degraded by surge(400V class motor), which eventually burns the motor.	If the wiring length exceeds 20 m, shorten the motor wiring length. Or install the optional noise filter and output-side AC reactor.	☐
13	Installation	Wiring	(D)	DANGER	By connecting a motor to the different voltage class inverter, insulation of the motor degraded, which eventually burns the motor.	Match the voltage class of the inverter and the motor.	☐
14	Installation	Wiring	(A)	DANGER	Due to unstable output caused by imbalance of power supply voltage, undervoltage, extreme voltage drop or 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.	☐
15	Use Maintenance	Wiring Inspection	(D)	DANGER	The short circuit failure caused by degradation of motor insulation, cracking of aged wires or other causes will eventually cause the inverter fails.	Check there is no cracking of wires and the screws are not lost by inspection.	☐
16	Installation Use	Setting	(D)	DANGER	By performing inappropriate parameter settings, high current flows in the motor, causing it to burn.	Set appropriate values for parameters related to output to the motor, such as parameters described in "Chapter 8 Mandatory Setting for Motor Drive and Test Run" (load type, base frequency, motor rated voltage, motor constants, and electronic thermal), control method, torque boost ([AA121], [Hb140] to [Hb142], [HC101] to [HC102]), and DC braking setting ([AF101] to [AF109]).	☐
17	Use	Operation	(D)	DANGER	The stopped motor automatically starts running.	To restart the motor after stopping it by a function, define it in the system.	☐
18	General	General	General	DANGER	Damage and injury caused by hidden risks.	Conduct risk assessment on the system, and check that the fail-safe function is incorporated into the system.	☐
19	General	General	General	DANGER	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 user as necessary.	☐

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

Chapter 7 Using the Control Panel

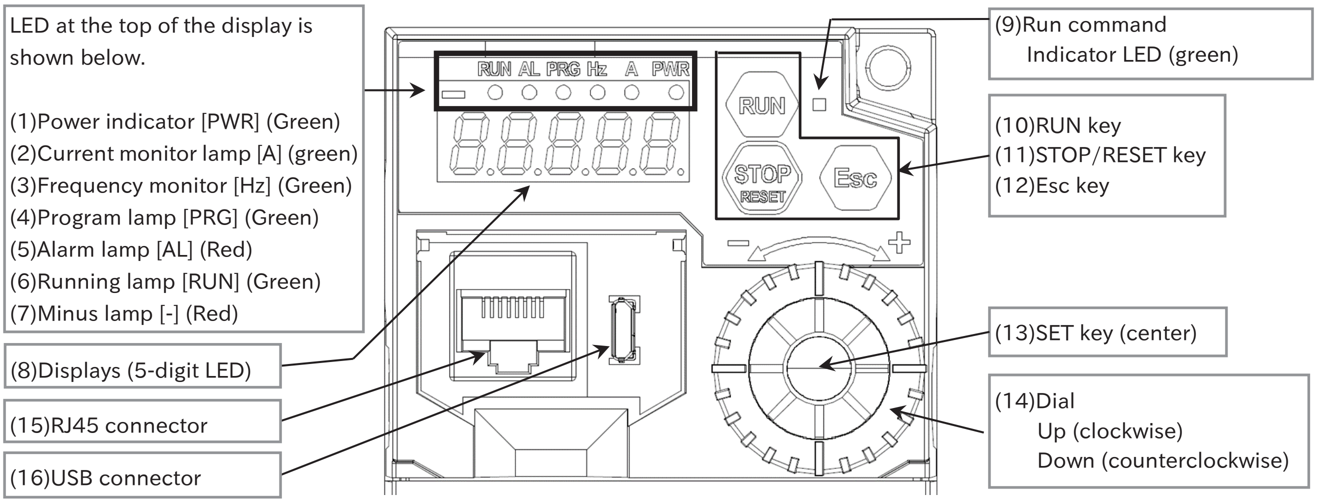
7

This chapter describes the details of the operation panel and related functions of the inverter.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

7.1 Keypad of use

7.1.1 Part names and descriptions

・The names and descriptions of each part of the operation panel are shown below.

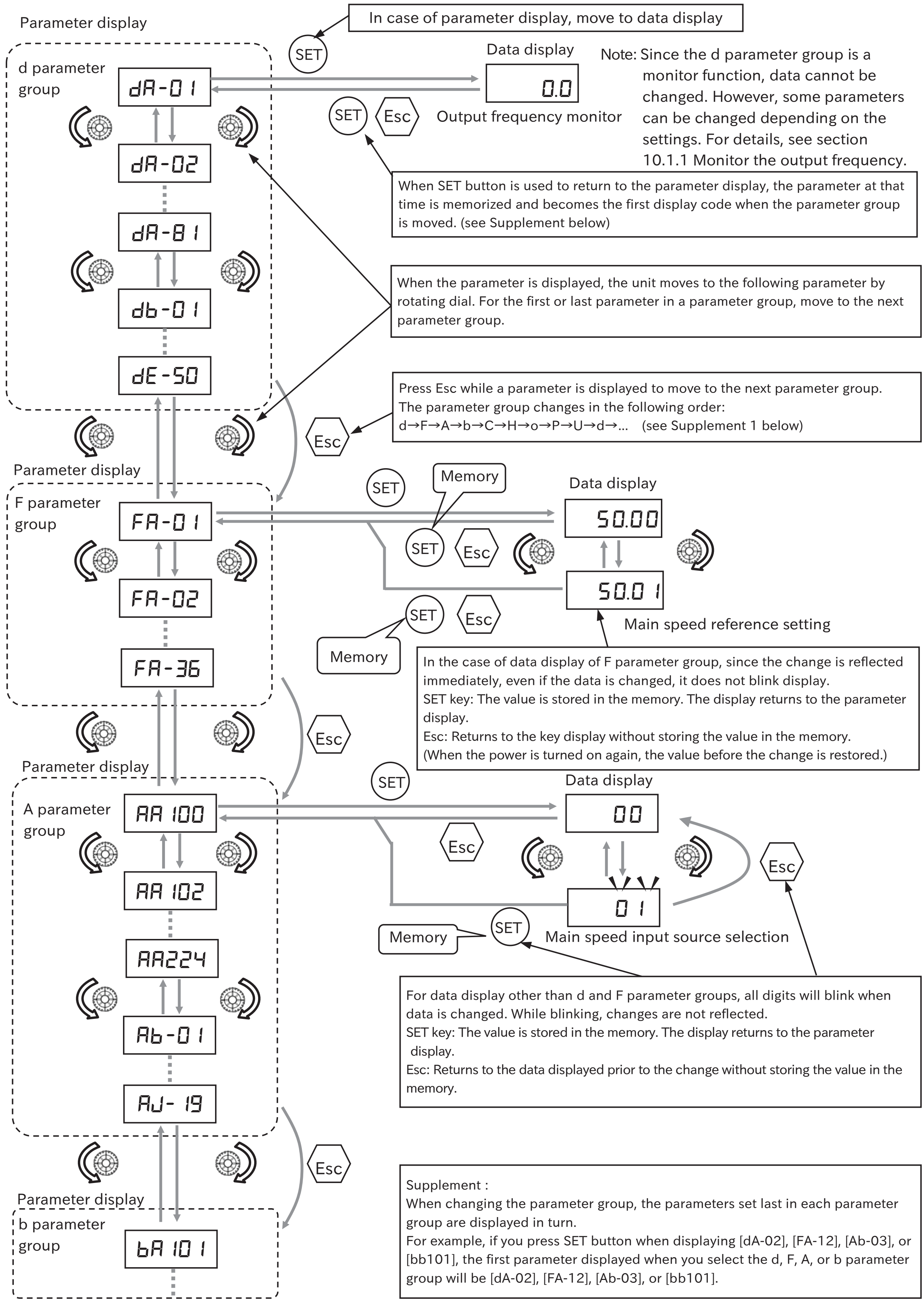


Name	Description
(1) Power Indicator [PWR] (Green)	Lights up (green) while the inverter is supplying power.
(2) Current monitor lamp [A] (Green)	Lights (green) when the data of the display unit is current.
(3) Frequency monitor lamp [Hz] (Green)	Lights up (green) when the data in the display unit is frequency.
(4) Program lamp [PRG] (green)	Lit (green) when the display shows changeable data (set value). Flashes if the setting value is inconsistent. 『15.3 See "Troubleshooting the Warning Function".
(5) Alarm lamp [AL] (Red)	Lights up (red) when the inverter trips. Refer to "Chapter 15 Troubleshooting" for more information on tripping actions.
(6) Running lamp [RUN] (Green)	Lights up (green) when the inverter is running. (This lamp lights in OR of [With operation command] and [Inverter output in progress]. This lamp also lights during deceleration after operation command OFF or when an operation command is input at 0 Hz of the set frequency.)
(7) Minus lamp [-] (Red)	Lights up (red) when the display data is negative.
(8) Displays (5-digit LED)	Displays data (red) such as various parameters and frequency setting values.
(9) Run command lamp (Green)	Lit (green) when the operation command destination is "Operation panel". (RUN button on the control panel is enabled.) Even if the operation command destination is RUN key on the operation panel, this lamp blinks when RUN key is pressed while operation is disabled due to some function. For details, refer to section 10.3.7, Checking Inverter Warning Conditions.
(10) RUN key	Run the inverter. However, it is effective when the operation command destination is "operation panel". Operation direction is set by "RUN key Operation direction selection [AA-12]".

Name	Description
(11) STOP/RESET key	Decelerates and stops the inverter. Use the "STOP key selection [AA-13]" to enable/disable the operation stopping function. Resets (recovers from trip state) when the inverter is tripping.
(12) Esc key	In case of parameter display, it moves to the next parameter group and displays the parameter set at the end of each group. Even after the power is turned off, the memory of the last set parameter is maintained. When displaying data, cancel setting and return to parameter display. Regardless of the screen, press and hold (about 3 seconds) to display the data (output frequency) of "output frequency monitor [dA-01]". When a remote operator (OS-44 ver.2.0 onwards) is connected, pressing and holding Esc key for 1 second enables the remote operator. Press and hold Esc key again to return to the remote operator.
(13) SET key	When displaying parameters, move to data display. When displaying the data, the setting is determined and stored, and the display returns to the parameter display. You can also memorize the last parameter that you pressed SET and view that parameter when the power is turned on. For details, refer to "7.2.6 Setting Initial Screen of Operation Panel". For each parameter group, the last parameter set is stored and becomes the first parameter displayed when Esc key is used to move the parameter group.
(14) Dial	Change the parameter or increase/decrease the set data. Rotate clockwise to increase or rotate counterclockwise to decrease. The degree of increase/decrease and carry of parameters and setting data with respect to the speed of turning dial can be set with "Dial sensitivity [UA-76]" and "Dial carry sensitivity [UA-77]".
(15) RJ45 Connector	Connector for optional remote operator connection (dedicated for RS-422). When a remote operator is connected, the keys on the main unit do not work. The data to be displayed on the (8) display unit at this time is set in the main unit display [UA-95] when the operator is connected. Caution: The remote operator should be connected or disconnected with the power supply disconnected.
(16) USB connector	This is a connector (USB 2.0 Micro-B connector) for connecting a personal computer. Used to connect to PC software.

7.1.2 Key Operation System

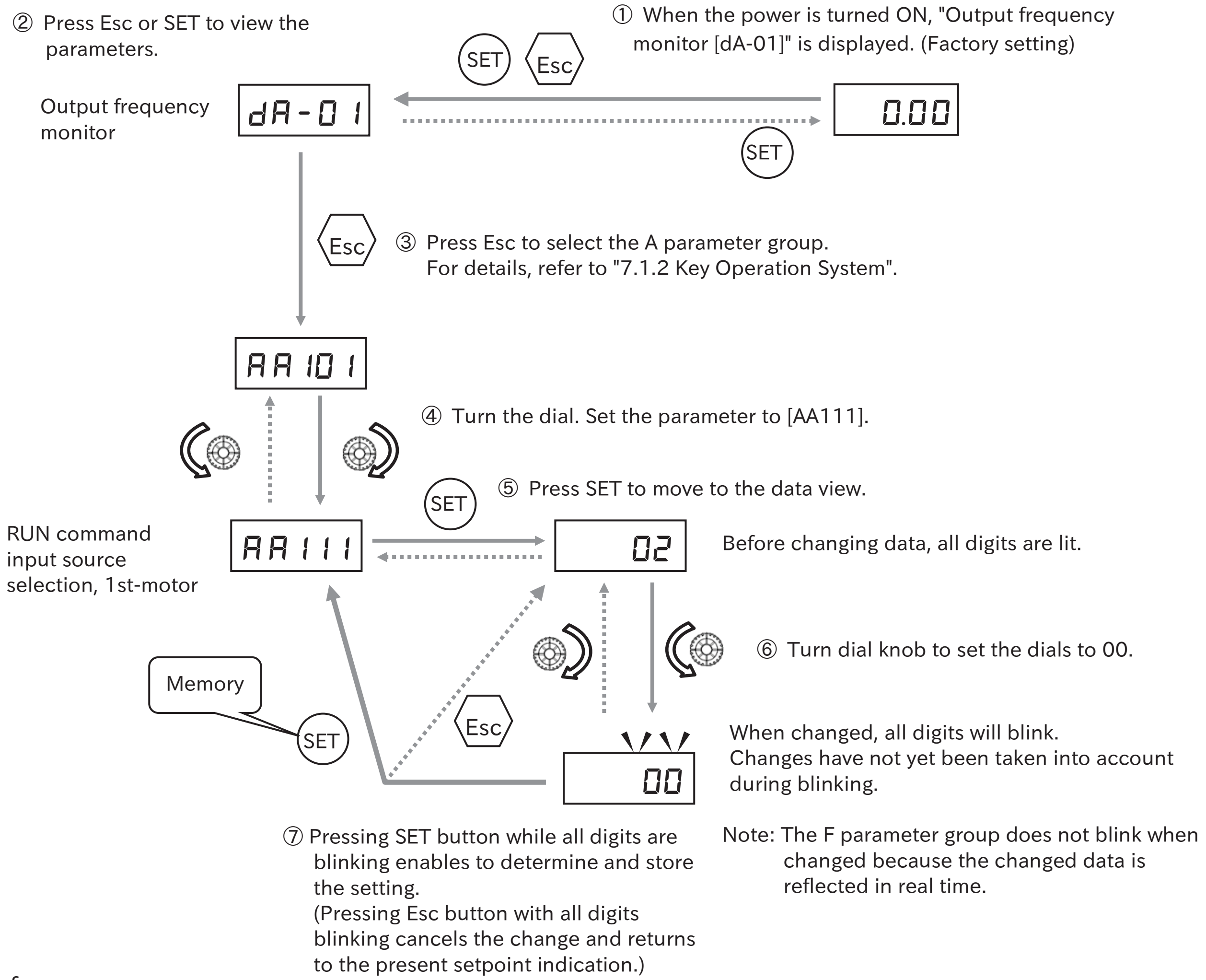
How to display and change data using the operation panel



7.1.3 Example of parameter setting key operation

Operation example when changing the parameter setting value

・The following shows an operation example in which the indication when the power is turned ON is changed from "0.00" (factory-default status) in the data section of "Output frequency monitor [dA-01]" to "[FR]/[RR] terminal (00)" from "RUN key (02)" on the operation panel for "Operation command selection [AA111]".



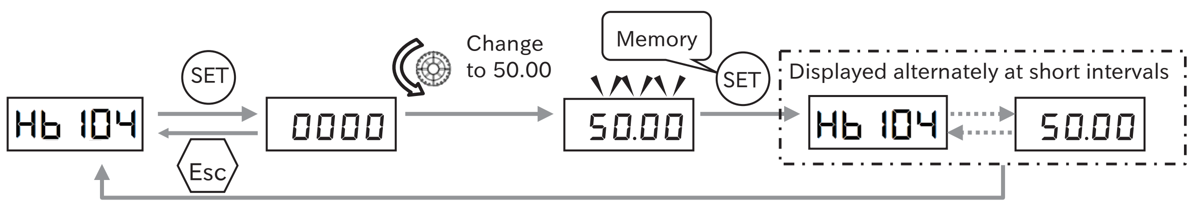
Reference:

・Pressing and holding Esc button (about 3 seconds) enables you to jump to the display of the output frequency monitor [dA-01].

・If there are parameters that cannot be displayed or changed, "Display selection [UA-10]" or "Soft lock selection [UA-16]" may be set. For details, refer to "7.2 Functions Related to Operation Panel".

■Display when changing setting data

・When the setting is changed and SET button is pressed, parameters and data are alternately displayed for a short time so that it can be confirmed that the data has been changed, and then the display returns to the parameter display.



Changing parameters/data for each digit (Individual input mode)

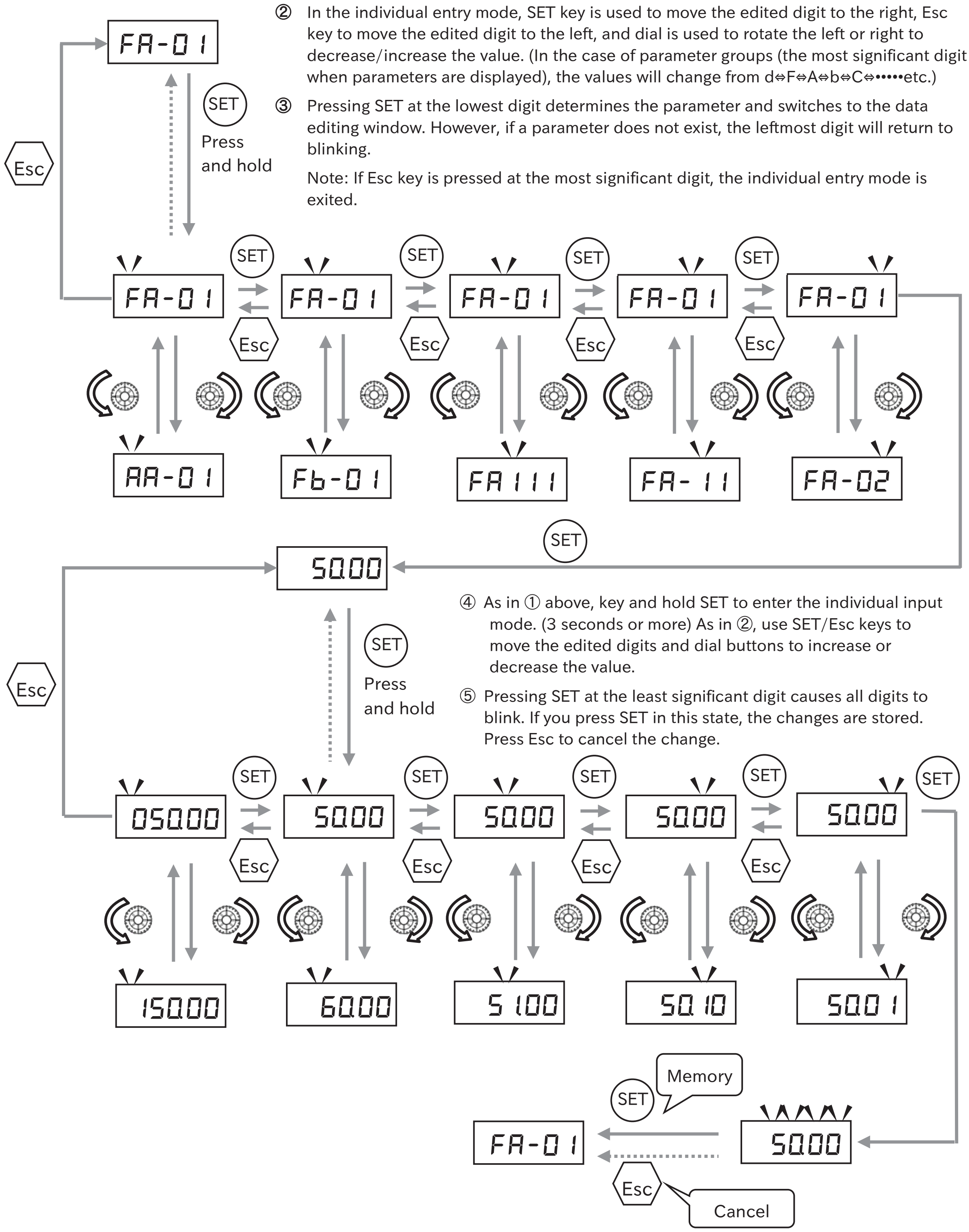
・Parameter selection and data change can also be made in the individual input mode, in which the value is increased or decreased by one digit after specifying the digit to be increased or decreased. It is effective for changing setting value with large number of digits etc.

① Press and hold SET button (for 3 seconds or longer) to enter the individual entry mode. The most significant digit starts flashing. (Press and hold SET again to exit Individual Entry mode.)

② In the individual entry mode, SET key is used to move the edited digit to the right, Esc key to move the edited digit to the left, and dial is used to rotate the left or right to decrease/increase the value. (In the case of parameter groups (the most significant digit when parameters are displayed), the values will change from d⇔F⇔A⇔b⇔C⇔•••••etc.)

③ Pressing SET at the lowest digit determines the parameter and switches to the data editing window. However, if a parameter does not exist, the leftmost digit will return to blinking.

Note: If Esc key is pressed at the most significant digit, the individual entry mode is exited.



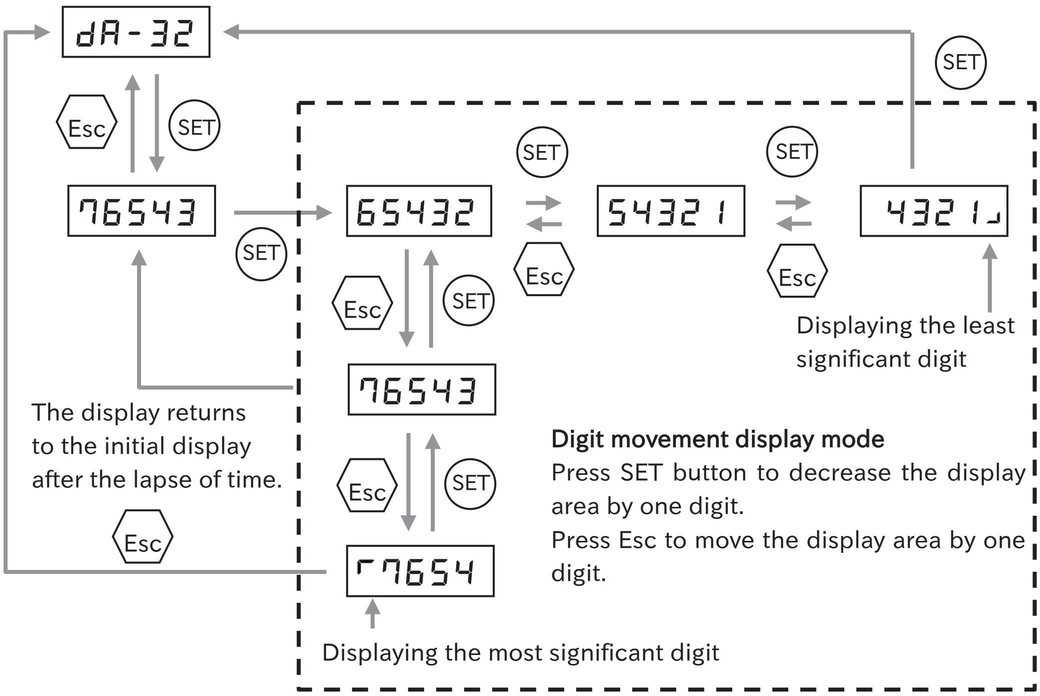
④ As in ① above, key and hold SET to enter the individual input mode. (3 seconds or more) As in ②, use SET/Esc keys to move the edited digits and dial buttons to increase or decrease the value.

⑤ Pressing SET at the least significant digit causes all digits to blink. If you press SET in this state, the changes are stored. Press Esc to cancel the change.

・Individual input mode is valid for parameter display and when the setting range is numeric. It is invalid when the setting range is a number selection such as 01, 02, 03...

■Digit movement display mode

・The display section of the main unit operation panel basically displays the upper five digits at all times, but it is possible to check the hidden part temporarily by carrying out the following operation.



・You can adjust the amount of increase or decrease when you turn dial using the following parameters. Adjust the value if necessary.

Code	Item	Contents	Data	Initial value
UA-76	Dial sensitivity	Sets the amount of increase or decrease by dialing. The larger this setting is, the more dialing rotations are required to increase or decrease the setting.	1 to 24	1
UA-77	Dial carry sensitivity	Sets the degree of carry (carry down) performed when increasing or decreasing with the dial. The smaller this setting is, the easier it is to carry (carry down).	1 to 100	20

7.2 Functions related to operation panel

7.2.1 Limit parameter display

- Parameters displayed on the control panel can be partially hidden by setting "Display selection [UA-10]". Refer to the table in this section for the parameters that are displayed at each setting.
- When the 2nd control function is not used, the number of displays can be reduced by setting "2nd setting parameter display selection [UA-21]" to "Hide (00)". Refer to "9.7.13 Switching between Two Motors" for the 2nd control function and the target parameter.
- When the communication option is not used, the number of displays can be reduced by setting "Optional parameter display selection [UA-22]" to "Hide (00)". For details of communication options, see "Chapter 13 Communication Option".
- [UA-10] settings can also be password-protected. For details, see "7.2.5 Protecting data with password".

Code	Item	Contents	Data	Initial value
UA-10	Display restriction selection	All indications (initial value)	00	00
		Function-specific display	01	
		User Settings	02	
		Data comparison display	03	
		Monitor only	04	
UA-21	2nd-motor parameter display selection	Hide the second setting parameter [** 2].	00	00
		The second setting parameter [** 2] is displayed.	01	
UA-22	Option parameters display selection	Hide the optional parameter [o ****].	00	00
		The optional parameter [o ****] is displayed.	01	
UA-31 to UA-62	User-parameter 1 selection to User-parameter 32 selection	No registration	no	no
		Register the parameter to be displayed. Up to 32 parameters can be registered.	UA-31 to UA-62 Other parameters	

■Detailed information on the settings of "View selection [UA-10]"

Setting for "View selection [UA-10]"	Details
Full display (00)	Displays all parameters.
Function-specific display (01)	Use this when you want to hide the parameters of a function that you are not using to reduce its display. If a specific function is not selected, the parameters related to that function are hidden. For more information on display conditions, refer to "Conditions and Displayed Parameters of Function Individual Display ([UA-10]=01)" in this section.
User Settings (02)	Use this when you want to display only the parameters that are set by the user. Up to 32 parameters can be registered in "User parameters 1 to 32 ([UA-31] to [UA-62]". When "User setting (02)" is set after registration, only the parameters registered in [UA-31] to [UA-62], "Output frequency monitor [dA-01]", "Main speed command setting (monitor) [FA-01]", "Display selection (UA-10) password [UA-01]" and "Display selection [UA-10]" are displayed. The user parameter can also be set to automatically store the changed parameter. For details, refer to "7.2.7 Automatic Registration of Changed Parameter History".
Data comparison display (03)	This is used when you want to know the changed parameter from the factory setting, etc. All monitor displays [d ****] and [F****], the display selection (UA-10) password [UA-01], and the display selection [UA-10] are displayed at all times.
Monitor only (04)	Only the monitor displays [d ****] and [F****], the display selection (UA-10) password [UA-01], and the display selection [UA-10] are displayed.

■Conditions and parameters displayed for Individual function display ([UA-10]=01)

・” in the table below indicates the parameters subject to the second setting function. If * is 1, it will be the first setting, and if * is 2, it will be the second setting.

IM control parameter
Display conditions: [AA121]≦10 or [AA221]≦10

Code	Item
Hb*02	* IM Motor Capacity Selection
Hb*03	*No. of IM motor poles
Hb*04	Base frequency, *IMst-motor
Hb*05	Maximum frequency, *IMst-motor
Hb*06	IM Motor Rated Voltage
Hb*08	IM Motor Rated Current
Hb*10	IM Motor Constant R1
Hb*12	IM Motor Constant R2
Hb*14	IM motor parameter L
Hb*16	IM Motor Constant I0
Hb*18	IM motor constant J
Hb*30	Minimum frequency adjustment, *st-motor
Hb*31	Reduced voltage start time setting, *st-motor
Hb*40	Manual torque boost operation mode selection, *st-motor
Hb*41	Manual torque boost value, *-motor
Hb*42	Manual torque boost peak speed, *-motor
Hb*45	Eco drive enable, *st-motor
Hb*46	Eco drive response adjustment, *st-motor
Hb*50	Free-V/f frequency *setting, 1-motor
Hb*51	Free-V/f voltage *setting, 1-motor
Hb*52	Free-V/f frequency *setting, 2-motor
Hb*53	Free-V/f voltage *setting, 2-motor
Hb*54	Free-V/f frequency *setting, 3-motor
Hb*55	Free-V/f voltage *setting, 3-motor
Hb*56	Free-V/f frequency *setting, 4-motor
Hb*60	Free-V/f frequency *setting, 6-motor
Hb*61	Free-V/f voltage *setting, 6-motor
Hb*62	Free-V/f frequency *setting, 7-motor
Hb*63	Free-V/f voltage *setting, 7-motor
Hb*70	Slip compensation P-gain with encoder, *nd-motor
Hb*71	I compensation P-gain with encoder, 2nd-motor
Hb*80	Output voltage gain, *-motor
HC*01	Automatic torque boost voltage compensation gain, *st-motor
HC*02	Automatic torque boost slip compensation gain, *st-motor
HC*11	*Start-up boost (SLV(IM)/CLV(IM))
HC*13	Secondary Resistance Correction Yes/No Selection
HC*14	Direction reversal protection, *st-motor
HC*20	Torque current reference filter time constant, *st-motor
HC*21	Speed feedforward compensation gain, *st-motor
HC*37	Flux settling level, *st-motor
HC*41	* threshold, 1-motor
HC*42	* threshold 2, -motor

SM(PMM) control parameter
Display conditions: [AA121]>10 or [AA221]>10

Code	Item
Hd*02	* SM(PMM) Motor Capacity Selection
Hd*03	* SM(PMM) Motor pole selection
Hd*04	* SM(PMM) Base frequency
Hd*05	* SM(PMM) Maximum frequency
Hd*06	* SM(PMM) Rated Motor Voltage
Hd*08	* SM(PMM) Rated motor current
Hd*10	* SM(PMM) Motor parameter R
Hd*12	* SM(PMM) Motor constant Ld
Hd*14	* SM(PMM) Motor constant Lq
Hd*16	* SM(PMM) Motor constant Ke
Hd*18	* SM(PMM) Motor constant J
Hd*30	* SM(PMM) Minimum frequency (switching)
Hd*31	*S Sync. Motor no-Load current
Hd*32	* SM(PMM) Start mode selection
Hd*33	* SM(PMM) Number of times of initial-position estimation 0V wait
Hd*34	*S Sync. Motor IMPE detect wait number
Hd*35	*S Sync. Motor IMPE detect number
Hd*36	*S Sync. Motor IMPE voltage gain
Hd*37	* SM(PMM) Initial position estimation magnetic pole position offset

Note: This parameter is SM(PMM) motor related function.

Position control parameter
Display conditions: [AA123]≠00 or [AA223]≠00

Code	Item
AE-04	Positioning completed range setting
AE-05	Positioning completed delay time setting

Orientation function
Display conditions: [AA123]=01 or [AA223]=01

Code	Item
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

Absolute position control function
Display conditions: [AA123]>01 or [AA223]>01

Code	Item
AE-20 to AE-50	Position reference 0 to 15
AE-52	Position control range (forward)
AE-54	Position control range (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-70	Homing function selection
AE-71	Homing direction selection
AE-72	Low-speed homing speed setting
AE-73	High-speed homing speed

Internal DC braking function
Display conditions: AF*01=01, 02

Code	Item
AF*03	DC braking frequency, *st-motor
AF*04	DC braking delay time, *st-motor
AF*05	DC braking force setting, *st-motor
AF*06	DC braking active time at stop, *st-motor
AF*07	DC braking operation method selection, *st-motor
AF*08	DC braking force at start, *st-motor
AF*09	DC braking active time at start, *st-motor

Acceleration/deceleration function
Display conditions: AC-02=00

Code	Item
AC*15	Acceleration/deceleration change trigger, * -motor
AC*16	Accel1 to Accel2 frequency transition point, [#2]-motor
AC*17	Decel1 to Decel2 frequency transition point, [#2]-motor
AC*20	Acceleration time 1, *-motor
AC*22	Deceleration time 1, *-motor
AC*24	Acceleration time 2, *-motor
AC*26	Deceleration time 2, *-motor

Acceleration/Deceleration function
Display conditions: AC-02=01

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

Brake control (forward/reverse common setting)
Display conditions: AF*30=01, 02

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

Brake control (Reverse)
Display conditions: AF*30=02

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

Free electronic thermal

Display conditions: bC*11=02

Code	Item
bC*20	* electronic thermal frequency-, 1-motor
bC*21	* electronic thermal current-, 1-motor
bC*22	* electronic thermal frequency-2, -motor
bC*23	* electronic thermal current-2, -motor
bC*24	* electronic thermal frequency-3, -motor
bC*25	* electronic thermal current-3, -motor

Gain mapping 1
Display conditions: HA*20=00

Code	Item
HA*21	ASR gain switching time setting, *st-motor
HA*27	* gain mapping P control P-gain, 1-motor
HA*30	* gain mapping P control P-gain 2, -motor

Gain mapping 2
Display conditions: HA*20=01

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

Instantaneous power failure non-stop
Display conditions: bA-30≠00

Code	Item
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

Overvoltage Suppression Function
Display conditions: bA*40≠00

Code	Item
bA*41	Overvoltage suppression active level, *st-motor
bA*42	Overvoltage suppression active time, *st-motor
bA*44	Constant DC bus voltage control P gain, *st-motor
bA*45	Constant DC bus voltage control I gain, *st-motor

Overexcitation function
Display conditions: bA*40≠00

Code	Item
bA*47	Over-magnetization function output filter time constant, *st-motor
bA*48	Over-magnetization function voltage gain, *st-motor
bA*49	Over-magnetization function level setting, *st-motor

Simulation mode
Display conditions: PA-20=01

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

PID function in general
Display conditions: AH-01=01, 02 or AJ-01=01, 02

Code	Item
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

PID function
Display conditions: AH-01=01, 02

Code	Item
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 (after calculation)
db-44	PID1 feedback data monitor (after calculation)
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 feed-forward input source monitor
FA-30	PID1 target setpoint 1 setting (monitor)
FA-32	PID1 setpoint 2 setting (monitor)
FA-34	PID1 setpoint 3 setting (monitor)
AH-02	PID1 deviation inversion
AH-03	PID1 unit selection
AH-04	PID1 scale adjustment (0%)
AH-05	PID1 scale adjustment (100%)
AH-06	PID1 scale 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 Data 1 Destination Select
AH-52	PID1 Feedback Data 2 Destination
AH-53	PID1 Feedback Data 3 Destination Select
AH-54	PID1 Feedback Data Operator Selection

PID function (continued)
Display conditions: AH-01=01, 02

Code	Item
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

PID2 function
Display conditions: AJ-01=01, 02

Code	Item
db-36	PID2 feedback value [#2] monitor
db-55	PID2 output monitor
db-56	PID2 deviation monitor
FA-36	PID2 target setpoint (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 [#2] 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

Trace function
Display conditions: Ud-01=01

Code	Item
Ud-02	Trace start
Ud-03	Number of trace data setting
Ud-04	Number of trace signals setting
Ud-10 to Ud-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 I/O selection
Ud-24	Trace signal 1 input terminal selection
Ud-25	Trace signal 1 output terminal selection
Ud-26	Trace signal 2 I/O selection
Ud-27	Trace signal 2 input terminal selection
Ud-28	Trace signal 2 output terminal selection
Ud-29	Trace signal 3 I/O selection
Ud-30	Trace signal 3 input terminal selection
Ud-31	Trace signal 3 output terminal selection
Ud-32	Trace signal 4 I/O selection
Ud-33	Trace signal 4 input terminal selection
Ud-34	Trace signal 4 output terminal selection
Ud-35	Trace signal 5 I/O selection
Ud-36	Trace signal 5 input terminal selection
Ud-37	Trace signal 5 output terminal selection
Ud-38	Trace signal 6 I/O selection
Ud-39	Trace signal 6 input terminal selection
Ud-40	Trace signal 6 output terminal selection
Ud-41	Trace signal 7 I/O 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

7.2.2 Initialize the parameters

・After setting "Initialize selection [Ub-01]", you can clear the trip history or reset the parameters to the factory-shipped condition by setting "Initialize execution selection [Ub-05]" to "Initialize execution (01)".

Code	Item	Description	Data	Initial value
Ub-01	Initialize mode selection	Initialize mode disable	00	00
		Trip clear	01	
		Parameter initialize	02	
		Trip history clear + parameter initialization	03	
		*1 for initializing all data except for I/O pin settings	05	
		Initialization Note:1 for all data except communication basic settings	06	
		Initialization Note:1 for all data except for I/O terminal settings and basic communication settings	07	
		Registered in "User parameter 1 to 32 selection [UA-31] to [UA-62]" Parameter initialize	10	
		Registered in "User parameter 1 to 32 selection [UA-31] to [UA-62]" Initialization parameters and data other than "View selection [UA-10]"	11	
Ub-02	Initialize data selection Note:2	Mode 0 (Japan/USA)	00	00
		Mode 1 (Europe)	01	
		Mode 3 (China)	03	
Ub-05	Enable initialization	Initialization disabled (initial value)	00	00
		Execute initialization	01	

Note: 1. When "Initialization selection [Ub-01]" is "other than terminal function (05)", "other than communication function (06)", and "other than terminal & communication function (07)", the "I/O terminal setting" and "communication basic setting" are the parameters in the table below.

2. The setting of "Default selection [Ub-02]" (Pattern 0/Pattern 1/Pattern 3) is determined by HF-620 destination. Normally, [Ub-02] should not be changed from the factory-shipped condition. For the default settings, see "18.2 Parameter /Modbus Holding Registers".

	Code	Item	Code	Item
I/O terminal setting	CA-01 to CA-08	Input terminal function	CC-01 to CC-07	Output terminal function
	CA-21 to CA-28	Input terminal active state	CC-11 to CC-17	Output terminal active state
	CA-41 to CA-48	Input terminal response time	CC-20 toCC-33	Output terminal delay time
	Cb-40	Thermistor type selection	CC-40 to CC-48	Logical operation function

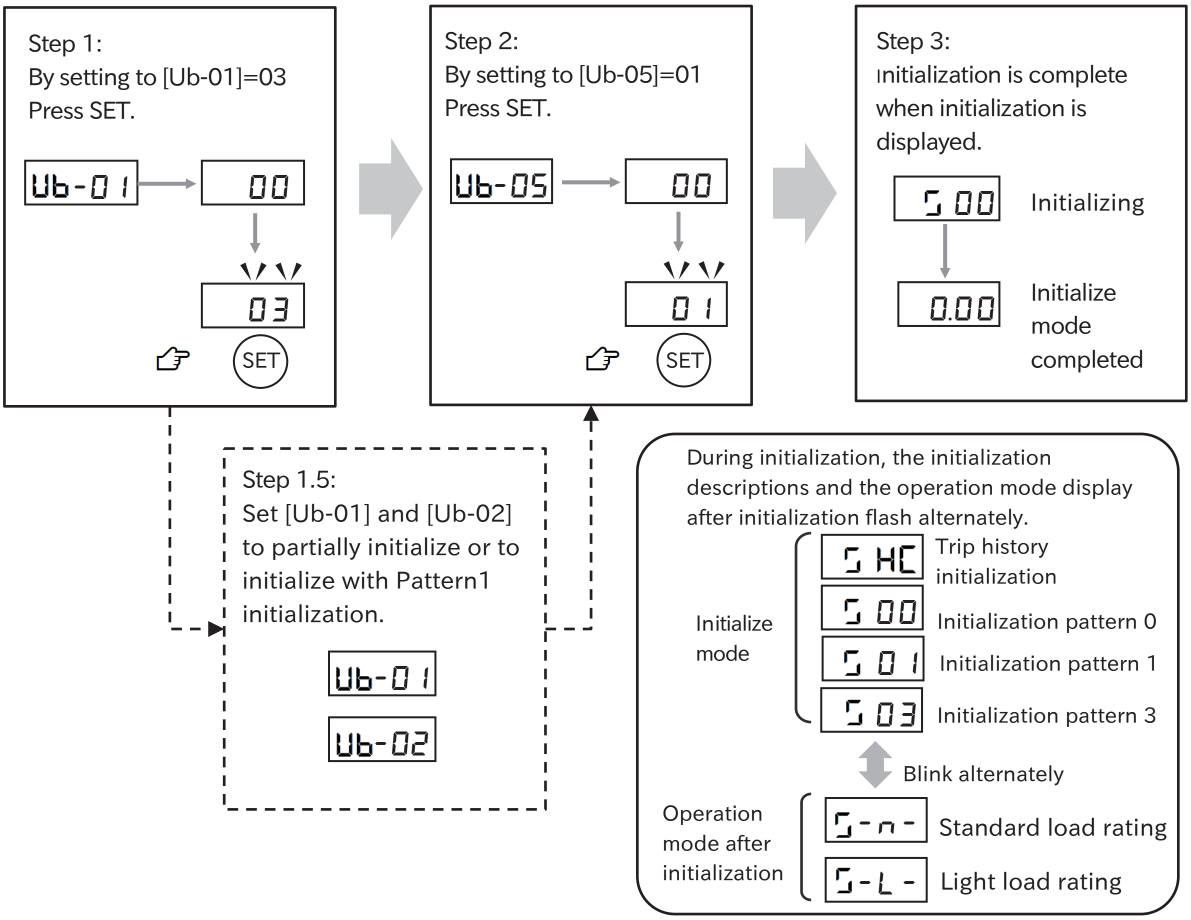
	Code	Item	Code	Item
Communication Preferences	CF-01 to CF-08	Parameters related to RS485 communication	CF-20 to CF-38	EzCOM function related parameters

・Set "Initialization Execution (01)" to "Initialization Execution Selection [Ub-05]" and press SET button. Initialization starts immediately. Note that the data cannot be restored after initialization.

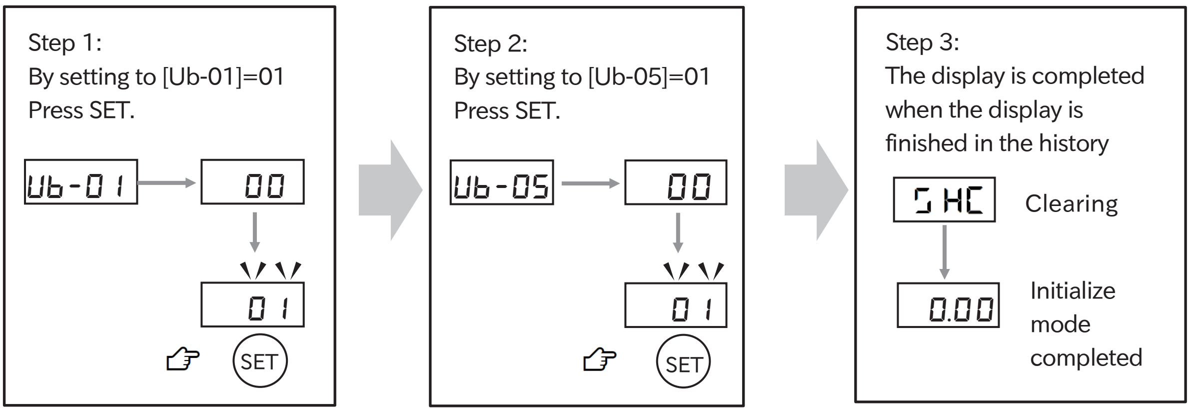
・"Cumulative time during RUN monitor [dC-22]", "Cumulative power ON time monitor [dC-24]", "Initial value selection [Ub-02]", "Load specification selection [Ub-03]", "Operation system selection [Ub-04]" are not initialized.

・When "Display selection [UA-10]" or "Soft lock selection [UA-16]" is set, initialization is not possible because the settings of initialization parameters cannot be changed. Cancel display selection or soft lock before initializing.

Initialization (Trip history clear + data initialization)



Trip clear method



- To prevent accidental initialization, the "Initialization Selection [Ub-01]" and "Initialization/Mode Selection [Ub-05]" settings will return to "Disabled (00)" upon completion of initialization or power cycle. Set these parameters each time initialization is performed.
- Refer to "8.1.2 Changing Inverter Load Specification" or "8.1.6 Changing Inverter Operating System" for the parameters "Load Specification Selection [Ub-03]" and "Operation System Selection [Ub-04]" that are not initialized even after the initialization setting.

7.2.3 Restart communication settings

- In HF-620, the settings of communication-related parameters can be reflected without turning the power off and then on again.
- When "Communication restart selection [Ub-06]" is changed to "Restart execution (01)", the changes of communication-related parameters shown in the table below are reflected in the operation.
- Even if the communication-related parameters in the table below are changed, the power is turned OFF and ON again or this function is used. It will not be reflected to the operation unless the communication settings are restarted.
- When this operation is performed, the communication settings are reflected immediately.

Code	Item	Description	Data	Initial value
Ub-06	Restart communication	Disable	00	00
		Execute restart: Applies the changes of communication-related parameters.	01	

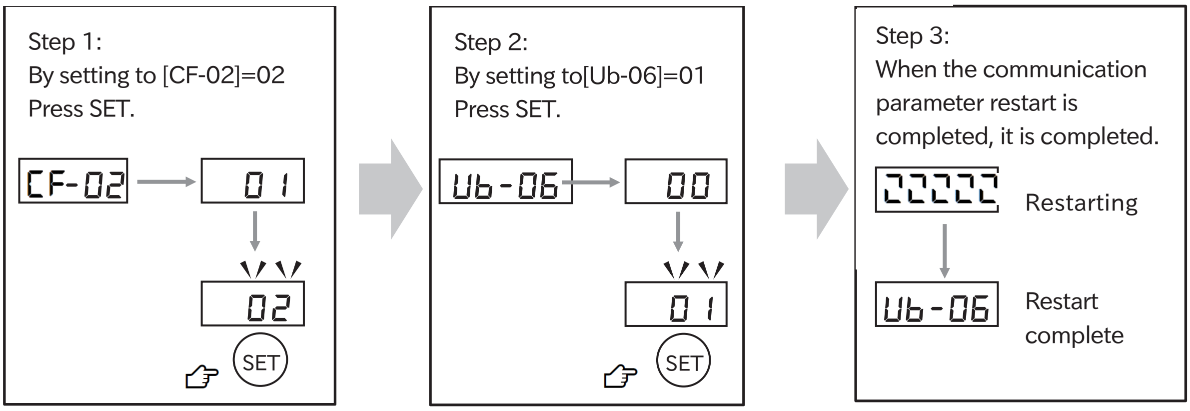
■Communication-related parameters

Code	Item	Description	Data	Initial value
CF-01	RS485 communication baud rate selection (baud rate selection)	Set the communication transmission speed.	03 (2400bps) 04 (4800bps) 05 (9600bps) 06 (19.2kbps) 07 (38.4kbps) 08 (57.6kbps) 09 (76.8kbps) 10 (115.2kbps)	05
CF-02	RS485 communication node address	Assign the inverter station number.	1 to 247	1
CF-03	RS485 communication parity selection	No parity	00	00
		Even parity	01	
		Odd parity	02	
CF-04	RS485 communication stop bit selection	1 bit	01	01
		2 bit	02	
CF-08	RS485 communication mode selection	Modbus-RTU	01	01
		Inter-inverter communication (EzCOM)	02	
		Inter-inverter communication (EzCOM control)	03	
CF-11	Register data	Sets the response data unit to A (current) and V (voltage).	00	00
		Set the response data unit as a percentage of the rated value.	01	
CF-12	RS485 endianness selection	Big endian	00	00
		Little Endian	01	
		Special endian	02	
CF-20 to CF-38	EzCOM function	Parameters related to EzCOM function	『11.4 Refer to "Inter-inverter communication EzCOM function".	
CF-50	USB communication node address	Assign the station number used in PDN.	1 to 247	
CG-01 to CG-80	Register mapping function	Parameters related to the register mapping function (Modbus mapping function)	See About 11.3 Modbus Mapping Feature.	
oA-10 to oA-13	Optional communication	Parameters related to optional communication function	Refer to "Chapter 13 Communication Option".	
oJ-01 to oJ-20	Flexible command	Parameters Related to Flexible Command Function		

Operation procedure

・When communication is not established normally with the external control device and the inverter or communication setting is changed, the setting can be reflected by the operation of communication restart selection after setting the communication-related parameters.

Example: Apply changes to "Communication station number selection [CF-02]"



・Note that the communication between the external control device and the inverter is cut off when the operation with the relevant parameter is performed.

7.2.4 Prohibit parameter changes

- Various data changes can be prohibited by the soft lock function. This function is used to prevent data rewriting due to erroneous operation. You can select the software lock function and its method from the following options. When using in conjunction with the intelligent input terminal, assign "Soft-lock [SFT](036)" to one of the "Input terminal function selection ([CA-01] to [CA-08])".

Code	Item	Description	Data	Initial value
UA-16	Soft-Lock selection	[SFT] Soft-lock operation when the input terminal is ON	00	00
		Soft-lock function always active	01	
UA-17	Soft-Lock target selection	All data cannot be changed during soft lock operation	00	00
		Parameters other than the frequency setting cannot be changed during soft lock operation	01 Note	
CA-01 to CA-08	Input terminal function	Soft Lock [SFT]: Used when the soft lock function is performed at the input terminal.	036	-

Note: For parameters that are not subject to soft-lock when selected, refer to the table below "Parameters not subject to change other than the set frequency" when data change is disabled.

- The setting of "Soft lock selection [UA-16]" can also be password-protected. For details, see "7.2.5 Protecting data with password".
- When the parameter is write-protected by the soft-lock function, the parameter cannot be batch-written (Write) by the remote operator with the data R/W function. However, parameter batch read is possible. For details of the data R/W function, see "7.2.9 Functions of Remote Operator".

■Parameters that are not applicable when data change other than the set frequency is not selectable

Code	Item
FA-01	Main speed reference setting (monitor)
FA-02	Sub speed reference setting (monitor)
AA104	Sub speed setting, 1st-motor
AA204	Sub speed setting, 2nd-motor
Ab110	Multi-speed 0, 1st-motor
Ab-11 to Ab-25	Multi-speed 1 speed to 15 speed
Ab210	Multi-speed 0, 2nd-motor
bA102	Upper frequency limit, 1st-motor
bA103	Lower frequency limit, 1st-motor
bA202	Upper frequency limit, 2nd-motor
bA203	Lower frequency limit, 2nd-motor
CE-10	Arrival frequency 1 value setting during acceleration
CE-11	Arrival frequency 1 value setting during deceleration
CE-12	Arrival frequency 2 during acceleration
CE-13	Arrival frequency 2 during deceleration
UA-02	Password for soft lock
UA-16	Soft Lock selection

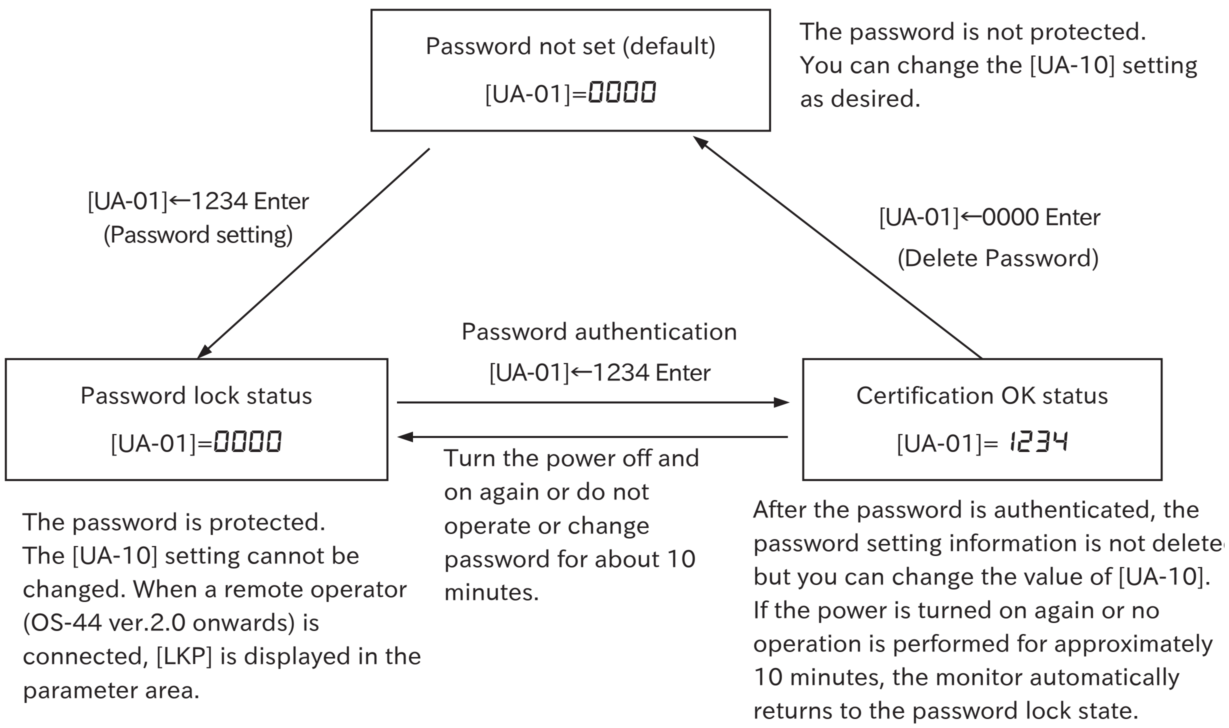
7.2.5 Protecting data with passwords

- The password function can be used to protect the settings of "Select [UA-01]", "Soft lock selection [UA-16]" and "Soft lock selection [UA-17]". Prevents the display and setting of parameters from being changed on your own.
- If you forget the password you set, there is no way to unlock the password. Also, our factory or service station cannot check the password, so please be careful when setting the password.

Code	Item	Description	Data	Initial value
UA-01	Password for view select [UA-10]	Parameter for password A authentication.	0000 to FFFF	0000
UA-02	Password for soft lock [UA-16]	Parameter for password B authentication.		

Note: You cannot specify 0000 for the password.
0 to 9, A, b, C, d, E, F number of characters that can be set in passwords is 16 (hexadecimal).

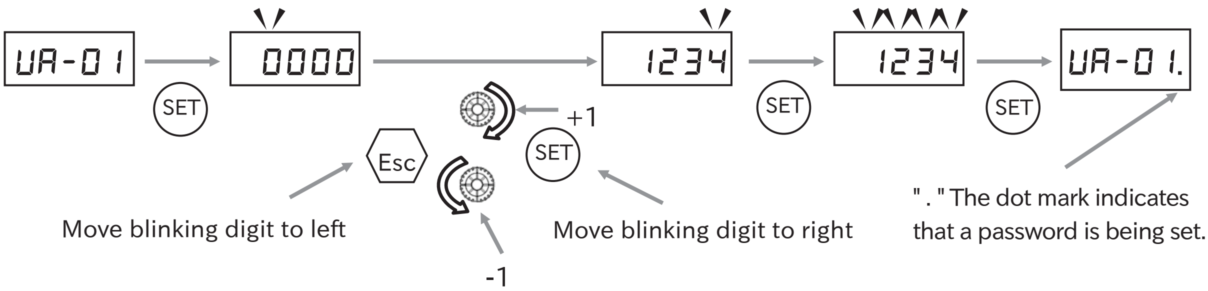
■Outline of password function (Sample password setting for "View selection [UA-10]")



■Setting a Password

(1) Set "View selection [UA-10]", "Soft lock selection [UA-16]" and "Soft lock selection [UA-17]" according to the content to be protected.

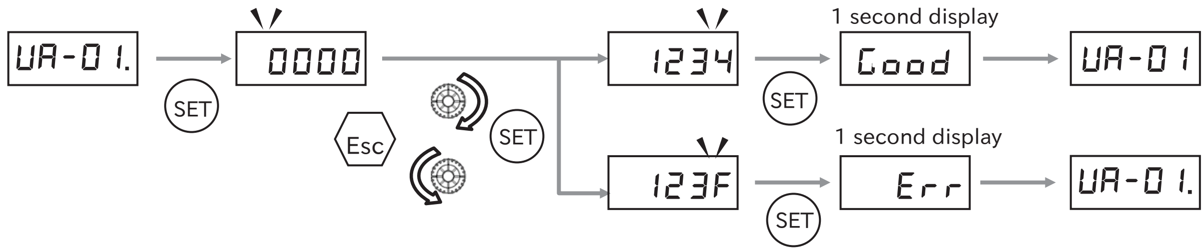
(2) Enter a password of your choice in the password parameter ([UA-01]/[UA-02]).
(Note that 0000 cannot be used.)



(3) The password is locked. [UA-10]/[UA-16]/[UA-17] cannot be changed.

■Password approval

(1) Enter the password in the password parameter ([UA-01]/[UA-02]).

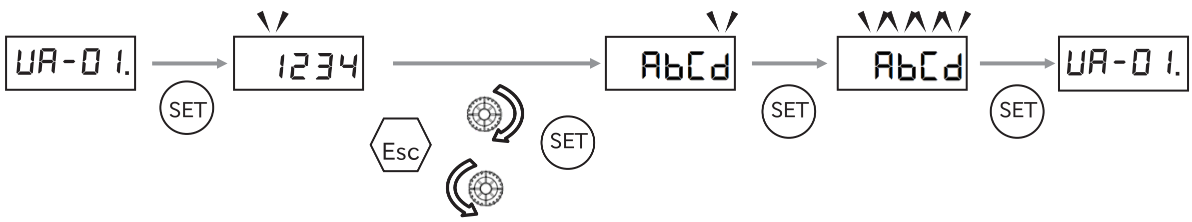


(2) If the password is correct, "Good" is displayed and the [UA-10]/[UA-16]/[UA-17] can be changed. If the password is incorrect, "Err" is displayed and the display returns to the original status (password locked status). If no operation is performed for 10 minutes or the power is turned on again, the machine automatically returns to the password lock state.

■Change password

(1) Authenticate your password.
(The password cannot be changed when the password is locked (0000 is displayed).)

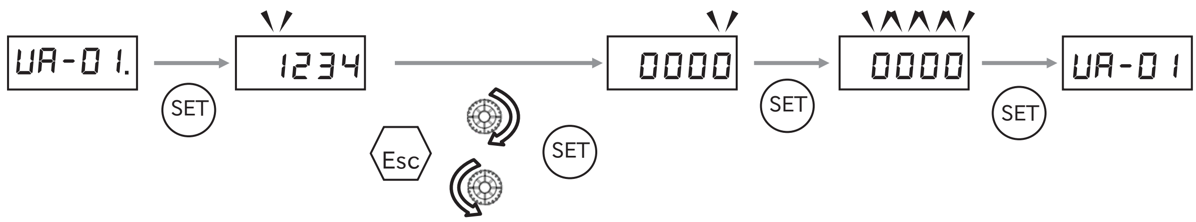
(2) Enter a different password in the password parameter ([UA-01]/[UA-02]).



(3) Changing the password automatically transits to the password lock state.

■Deleting a password

(1) Authenticate your password.
(The password cannot be changed when the password is locked (0000 is displayed).)
(2) Enter 0000 in the password parameter ([UA-01]/[UA-02]).
(3) The password is reset to the default setting and all password information is cleared.



7.2.6 Setting the initial display of the operation panel

- With the "Initial screen selection [UA-91]", the display of the control panel at power-on can be selected from the following. (001 (output frequency [dA-01]) is selected as the default.)
- When "Initial screen auto transition function [UA-92]" is set to "Enable (01)", if there is no control panel operation for 10 minutes, the screen is automatically displayed as set in "Initialization screen selection [UA-91]".

Code	Item	Description	Data	Initial value
UA-91	Initial display selection (Display at power-on)	The last parameter set is set as the initial screen. (including when SET button is pressed in the [d ****] window) When [d ****] is selected, the default parameter is displayed. Otherwise, the default parameter is displayed.	no	dA-01
		All parameters except [UA-31] to [UA-62]	dA-01 to	
UA-92	Enable auto-return to the initial display	Disable (no automatic transition)	00	00
		Enabled (automatic transition)	01	

- When a remote operator (OS-44 ver.2.0 onwards) is connected, you cannot select (no) for "Default window selection [UA-91]". When selecting, use the control panel of the main unit.

7.2.7 Automatic registration of changed parameter history

- When "User parameter auto setting selection [UA-30]" is "Enable (01)", parameters that have been changed from the default are automatically stored in the order of "User parameter 1 to 32 selection ([UA-31] to [UA-62])". It can also be used as a change history.
- Parameters are memorized at the timing of pressing SET button. [UA-31] is the most recent parameter and [UA-62] is the oldest change parameter.
- If the same parameter is changed, the old memories are erased and new changes are remembered. If the number of parameters exceeds 32, it will be deleted from the [UA-62] of the older memory.

Code	Item	Description	Data	Initial value
UA-30	User-parameter auto setting function enable	Disable: The changed parameter history is not retained.	00	00
		Enable: The changed parameters are saved as user parameters in the order in which they were changed.	01	

- When [UA-30] is changed from "Disable (00)" to "Enable (01)", all parameters registered in "User parameter 1 to 32 selection ([UA-31] to [UA-62])" are initialized ("no" setting).

7.2.8 Fixed indication (DISP) function

・If "Display fixed [DISP](102)" is assigned to one of the "Input terminal function selection ([CA-01] to [CA-08])" and that terminal is turned ON, the operator's display is fixed by the data display of the parameter set in "Initial screen selection [UA-91]", and other parameter display becomes impossible.

Code	Item	Description	Data	Initial value
UA-91	Initial display selection (Display at power-on)	The last parameter set is set as the initial screen. (including when SET button is pressed in the [d ****] window)	no	dA-01
		All parameters except [UA-31] to [UA-62]	dA-01 to	
CA-01 to CA-08	Input terminal function	Indication fixed [DISP]: Fix the display of the control panel to the display set in "Initial screen selection [UA-91]".	102	-

・When a remote operator (OS-44 ver.2.0 onwards) is connected, you cannot select (no) for "Default window selection [UA-91]". When selecting, use the control panel of the main unit.

7.2.9 Function of remote operator

- This section describes the details of various functions that operate when a remote operator(OS-44 ver.2.0 onwards) is connected.
- When a remote operator is connected, the operation on the operation panel of HF-620 main unit is disabled. However, pressing and holding Esc key on the main unit operation panel (approx. 3 seconds) will temporarily switch to the operation on the main unit. Press and hold Esc key again to return to the remote operator.

Data copy using remote operator

- The optional OS-44 (ver.2.0 onwards) is a remote operator with the capability of copying parameter setting data or backed up between models.
- Copying and backup of parameter setting data can be done by using PC software . For more information, see section 12.1 PC software.

Detect disconnection of remote operator

- You can set the operation when the remote operator is disconnected. The wire is judged to be disconnected approximately 5 seconds after communication with the remote operator is interrupted.
- Operation at disconnection can be changed by setting of "Operation selection at disconnection [UA-20]".

Code	Item	Description	Data	Initial value
UA-20	Action selection at keypad disconnection	When disconnection occurs, trip will be made with "Operation panel communication error [E040]".	00	02
		When the wire is broken, the motor trips due to "Operation panel communication error [E040]" after decelerating and stopping.	01	
		Ignores disconnection detection.	02	
		Free-run stop is performed when the wire is disconnected. No error occurs.	03	
		Decelerates and stops when the wire is broken. No error occurs.	04	

Detect the remote operator's low battery

- HF-620 allows a remote operator OS-44 (ver.2.0 onwards) with a built-in RTC(Real Time Clock to connect. RTC operates according to the battery. However, if HF-620 fails to correctly read this RTC, it is judged that the battery is exhausted, and a warning or trip can be generated.
  When "Low battery alert selection [UA-19]" is set to "Warning (01)", the output terminal function "Battery out [LBK]" will ON when the low battery is detected. When "Error (02)" is set, trip occurs due to "RTC error [E042]" in addition to ON of the [LBK] signal.
- If OS-44 is removed and no longer detectable, the battery is not judged as running out. However, the retained time data is cleared.
- To set "Low battery alert selection [UA-19]" to other than "Disabled (00)", insert the battery into the control panel VOP and set [UA-19] after setting the time.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Operator-panel battery depleted [LBK]: When the remote operator (VOP) is connected, the built-in RTC operation is monitored and it is turned ON when it is judged that the batteries are exhausted.	080	002 001 017
UA-19	Low battery warning enable	Disable	00	00
		Warning : ON [LBK] as a warning.	01	
		Error: ON the [LBK] signal. At the same time, "RTC error [E042]" is outputted.	02	

Prevent unnecessary data from being written

- With "Data R/W selection [UA-18]", you can enable or disable batch parameter read (Read)/write (Write) by the remote operator (OS-44 ver.2.0 onwards) with the data copy function. This is useful for securing backup data and preventing unnecessary read/write operations after determining parameters.
- Even if "Data R/W selection [UA-18]" is set to "R/W enabled (00)", parameter batch write is not possible when soft-lock is applied (batch read is possible). For details on the soft lock function, see "7.2.4 Disabling Parameter Changes".

Code	Item	Description	Data	Initial value
UA-18	Data R/W selection	Enable batch read/write of parameters	00	00
		Disable batch read/write of parameters	01	

Changing the parameters displayed on the main unit when connecting to the remote operator

- When a remote operator is connected, the operation on the operation panel of HF-620 main unit is disabled. At this time, the monitor data set in the main unit display when the operator is connected [UA-95] is displayed on the main unit screen.
- While the remote operator is connected, press and hold Esc key on the main unit operation panel (for about 3 seconds) to temporarily switch to the operation on the main unit. Press and hold Esc key again to return to the remote operator.

Code	Item	Description	Data	Initial value
UA-95	Ex. operator Main unit display	Set the display of the main unit when the remote operator is connected. [dA-**],[db-**], [dC-**],[FA-**] Parameters can be set.	[dA-**]/[db-**] [dC-**]/[FA-**] Parameter	dA-01

Chapter 8 Parameter Setting and Test Run

8

This chapter describes the mandatory setting items, setting procedures, and test operation to operate the motor and inverter.
Before actual operation, be sure to make the settings described in this chapter and perform a trial run.
Refer to the corresponding chapters for details of the installation, wiring and various inverter functions.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters, and pay attention to safety.

8.1 Essential sets for operation

8.1.1 Outline of required setting items

- This section describes the necessary parameter settings and procedures to drive the inverter and motor correctly.
- It also describes the electronic thermal function to protect the motor.
- Perform trial run and adjustment after setting the parameters appropriately according to the sections in the table below.

Item	Description
8.1.3 Setting Motor Nameplate Data to Parameters	Set the load specifications according to the application. Select from standard load ratings suitable for elevators, conveyors, etc. and light load ratings suitable for fans, pumps, etc.
8.1.4 Setting Electronic Thermal	Set the motor specifications to be driven to the inverter. Set the motor type, base frequency, maximum frequency, motor capacity, number of motor poles, motor receiving voltage, motor rated current, etc. before starting operation.
8.1.5 Setting Motor Constant	The electronic thermal function protects the motor or inverter from burnout. Be sure to set this according to the environment and system to be used.
8.1.6 Changing the inverter operation system	When using automatic torque boost/sensorless vector control, the motor constant must be set. If the motor constant is unknown, obtain it from the motor manufacturer or measure the motor constant referring to "8.3 Performing Auto-tuning of Motor".
8.2 Test run	To confirm that the inverter and the motor operate correctly, perform a test run with the motor alone and a test run with the actual load connected. When using automatic torque boost or sensorless vector control, set the motor constant referring to "8.1.5 Setting the Motor Constant" or "8.3 Auto-tuning the Motor".
8.3 Performing auto-tuning of the motor	This section explains how to perform auto-tuning. When using a motor other than Sumitomo standard or an unknown motor, measure the motor constant using the auto-tuning function.

- When to change max. frequency, change [Hb106] .
- When load inertia is large and motor speed fluctuates, adjust to increase motor constant J [Hb118].

8.1.2 Load specification of the inverter

- The load specifications of the inverter can be selected from the standard load rating (ND) and the light load rating (LD).
- The rated current, overload current rating, temperature rating, etc. of the inverter differ depending on the difference in load specifications.
  Choose either one according to your load.

■Features of standard load rating/light load rating

Item	Standard load rating (ND)	Light load rating (LD)
Features	Suitable for loads requiring high torque at starting, acceleration/deceleration, etc.	Suitable for loads with less drive than the rated torque, etc. It may be possible to drive the motor on one frame.
Application Examples	Elevators, cranes, conveyors, etc.	Fans, pumps, air conditioners, etc.
Rated output current (example)	25.0A (three-phase 200V, 5. 5kW inverter)	30.0A (three-phase 200V, 5.5kW inverter)
Overload current rating	150%/1min, 200%/3s	120%/1min, 150%/0.5s

- The load rating is set in "Load spec. selection [Ub-03]". When [Ub-03] is changed and SET is pressed, the mode is changed immediately. The setting range/default value is switched by some parameters as shown in the table below. Note that the setting value at that time is also initialized or changed.

Code	Item	Description	Data	Initial value
Ub-03	Load type selection	Light Duty Rating (LD: Light Duty)	01	02
		Normal Duty Rating (ND: Normal Duty)	02	

■List of parameters to be changed when changing from LD to ND

Code	Item	Data-range for ND selection	During ND selection Initialization data initial value	LD⇒ND Value at the time of change	Initial value
AF136	Brake release current motor (Forward)	(0.00 to 2.00)× Inverter rated output current A	1.00×Inverter rated output current A	Converted value	1.00×Rated output current
AF143	Brake release current motor (Reverse)				
bA123	Stall prevention 1 active level	(0.20 to 2.00)× Inverter rated output current A	1.50×Inverter rated output current A	Converted value	1.50×Rated output current
bA127	Stall prevention 2 active level				
bb-43	Active frequency matching restart level	(0.00 to 2.00)× Inverter rated output current A	1.00×Inverter rated output current A		
bb101	Carrier frequency	2.0 to 15.0 kHz	2.0(kHz) [pattern 0] 10.0(kHz) [pattern 1] 2.0(kHz) [pattern 3]	No change	2.0
bC110	Electronic thermal level	(0.00 to 3.00) × Inverter rated output current A	Inverter rated output current A	Converted value	1.00×Rated output current
bC121 bC123 bC125	Free electronic thermal current 1 to 3	(0.00 to 3.00) × Inverter rated output current A	0.00 A	Converted value	0.00
CE102	Low current detection level 1	(0.00 to 2.00)× Inverter rated output current)	Inverter rated output current A	Converted value	1.00×Rated output current
CE103	Low current detection level 2				
CE106	Overload warning level 1	(0.00 to 2.00)× Inverter rated output current A	1.15×Inverter rated output current A	Converted value	1.15×Rated output current
CE107	Overload warning level 2				
PA-23	Optional output value setting for the output current monitor	(0.00 to 3.00) × Inverter rated output current A	0.00 A	Converted value	0.00

■List of parameters to be changed when changing from ND to LD

Code	Item	Data range for LD selection	During LD selection Initialization data initial value	ND⇒LD Value at the time of change	Initial Setting
AF136	Brake release current motor (Forward)	(0.00 to 2.00)× Inverter rated output current A	1.00× Inverter rated output current A	Converted value	1.00×Rated output current
AF143	Brake release current Motor (Reverse)				
bA123	Overload restriction 1 active level	(0.20 to 2.00)× Inverter rated output current A	1.50× Inverter rated output current A	Light load Initial value	1.50×Rated output current
bA127	Overload restriction 2 active level				
bb-43	Active frequency matching restart level	(0.00 to 2.00)× Inverter rated output current A	1.00× Inverter rated output current A		
bb101	Carrier frequency	2.0 to 15.0 kHz	2.0(kHz) [pattern 0] 10.0(kHz) [pattern 1] 2.0(kHz) [pattern 3]	2.0kHz	2.0
bC110	Electronic thermal level	(0.00 to 3.00) × Inverter rated output current A	Inverter rated output current A	Converted value	1.00×Rated output current
bC121 bC123 bC125	Free electronic thermal current-1 to 3	(00.00 to 3.00) × Inverter rated output current A	0.00 A	Converted value	0.00
CE102	Low current detection level 1	(0.00 to 2.00)× Inverter rated output current A	LD Inverter rated output current (A)	Converted value	1.00×Rated output current
CE103	Low current detection level 2				
CE106	Overload warning level 1	(0.00 to 2.00)× Inverter rated output current A	1.15×Inverter rated output current (A)	Converted value	1.15×Rated output current
CE107	Overload warning level 2				
PA-23	Optional output value setting for the output current monitor	(0.00 to 3.00) × Inverter rated output current A	0.00 A	Converted value	0.00

- The parameter described as "Converted Value" converts the current set value by the rated current ratio of ND and LD.
  (e.g.) When ND rated output current = 8.0A/LD rated output current = 10.0A, the set 4.0A at the time of ND is converted as shown below when it is changed to LD.
  (10/8)×4.0A = 5.0A
  (For conversion from LD to ND, it is converted by the inverse ratio shown above.)
- When the load specifications are changed, the parameters may need to be reconfigured. Refer to the above table to recheck each parameter. Also recheck the parameters related to inverter heat generation and cooling, such as torque and current setting related parameters, automatic carrier reduction function, and cooling fan operation selection.
- The currently selected load specification can be checked in "Inverter load specification selection status monitor [dC-01]".

8.1.3 Setting motor nameplate data to parameters

・To control and protect the motor, set the basic parameters of the motor in the table below.
・Set the motor type/motor capacity/number of motor poles/motor rated voltage/motor rated current/base frequency (motor rated frequency) according to the specifications of the motor (value indicated on the motor specification nameplate). Set the highest frequency required for the highest frequency setting. However, please set so as not to exceed the specification of the maximum rotational speed of the motor.

■For induction motor

Code	Item	Description	Data	Initial value
Hb101	IM Motor type	Set the induction motor type	00：Reserved 01：Sumitomo AF motor 02：Sumitomo d2G4 motor 03：Sumitomo IE3 motor	03
Hb102	IM Motor Capacity Select	Set the capacity of the induction motor.	0.01 to 11.00 kW	Factory setting
Hb103	IM motor pole selection	Set the number of poles of the induction motor.	00 to 23 (2 to 48 poles)	01
Hb104	IM Base frequency	Sets the base frequency of the induction motor.	30.00 to Max. frequency Hz	60.00
Hb105	IM Maximum frequency	Set the maximum frequency of the induction motor.	Base frequency to 590.00 Hz	60.00
Hb106	IM motor rated voltage	Set the rated voltage of the induction motor.	1 to 1000 V	200/400
Hb108	IM Motor Rated Current	Set the rated current of the induction motor.	0.01 to 10000.00 A	Depend on the motor

Caution
Burnout

・If the base frequency is set below the rated frequency of the motor, the motor may burn out. (For standard-type induction motors, the rated frequency is 50/60Hz.)
・Do not set the maximum frequency and motor rated voltage exceeding the motor specifications. The motor may burn out.
・When initialization is performed, set the basic parameters of the motor again. Continued use after initialization may cause motor burnout.
・When setting the maximum frequency exceeding 60Hz, check with the motor manufacturer for the maximum allowable frequency.

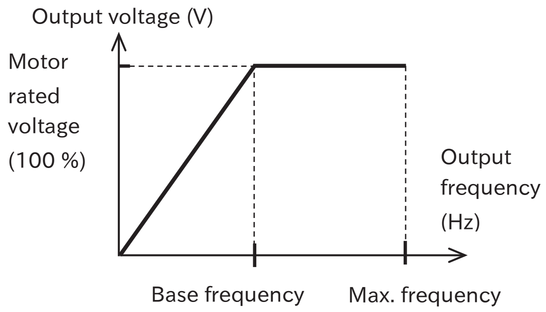
DO

■Motor capacity and number of poles

- For induction motors, if "IM motor capacity selection [Hb102]" or "IM motor pole selection [Hb103]" is changed, the motor constant parameter setpoint will change to the motor constant of Hitachi Standard Motor stored in advance. Accurately setting the capacity and number of poles may prevent motor nuisance or stabilize the motor drive. Refer to "8.1.5 Setting Motor Constant" for details of the motor constant parameter.
- When setting the control method to V/f control (constant torque characteristic (VC), reduced torque characteristic (VP1.7 power) or free V/f characteristic) and driving two or more motors with one drive, set the total motor capacity to [Hb102].
- For details on setting the motor constant, refer to "8.3 Auto-tuning of Motor".

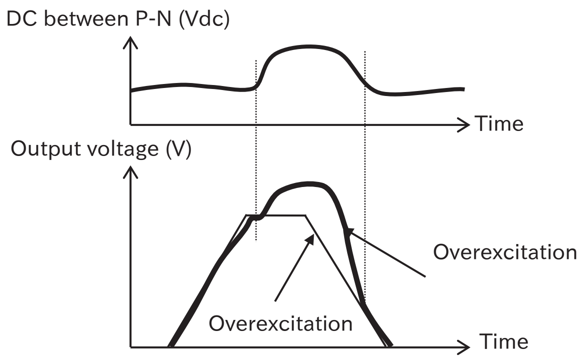
■Frequency-voltage relation during typical V/f control (induction motor)

- When the base frequency and rated voltage are set, the voltage is output in typical V/f control (constant torque characteristic (VC)) as shown in the diagram.
- The output voltage from the base frequency to the highest frequency is the motor rated voltage at the maximum. The maximum frequency setting is the maximum value of the analog external input (for example, 0 to 10V for analog voltage input).
- When an induction motor is used by setting the base frequency to a value exceeding 60Hz, a special motor is used. With a special motor, the rated current may be larger than the inverter even if the motor capacity is the applicable capacity of the inverter. In this case, increase the inverter capacity.



■Overexcitation function

- The overexcitation function suppresses overvoltage errors by increasing the loss of the motor and reducing the energy that is regenerated. Operates when "V/f control (00) to (03)" is selected in "Control method [AA121]".
- When the over-excitation function is disabled in the Overexcitation Function Selection (V/f)[bA146], the relation between the output voltage and the output frequency selected in [AA121]. For example, when constant-torque characteristic (VC) is selected, control is performed as shown in "Relation between frequency and voltage in common V/f control (induction motor)" above. For other characteristics, refer to "9.5.1 Selecting Control Mode".
- Even if this function is used, voltage exceeding AC voltage equivalent to DC voltage between P-N cannot be outputted.
- For the output voltage to the motor, refer to "9.9.4 Controlling the Output Voltage to Avoid Overvoltage".



■Output current

- If the motor rated current is set beyond the inverter rated current, the desired characteristics may not be met. In addition, inverter protection may be applied to the tip.

8.1.4 Setting the electroniic thermal

Basic characteristics of electronic thermal

- The electronic thermal function provides thermal protection based on the output current, output frequency, and electronic thermal characteristics. Two types of motor and inverter operate separately.
- Electronic thermal for motor is set according to "Electronic thermal level [bC110]" to the motor rated current. If a current exceeding the rated current continues to flow through the motor, it will be protected. If you want to apply protection earlier, set it lower than the motor rated current. In addition, the duration until the protective function is applied also varies depending on the "Electronic thermal accumulated gain [bC115]" setting. See "Changing the Heat Dissipation Characteristics of Electronic Thermal" in this section.
- By setting "Electronic thermal characteristic selection [bC111]", you can set the thermal characteristic (reduction rate by operating frequency) according to the motor to be used. For details, refer to the following pages.
- The operation level and thermal characteristics of the inverter electronic thermal cannot be changed from the contents in the table below.
- The basic characteristics (time characteristics) of the electronic thermal depends on the setting of "Load-specification selection [Ub-03]". Each basic characteristic (time limit characteristic) is shown in the figure below.
- If the motor current becomes unstable due to disturbance, etc., the motor may trip earlier than the specified time.

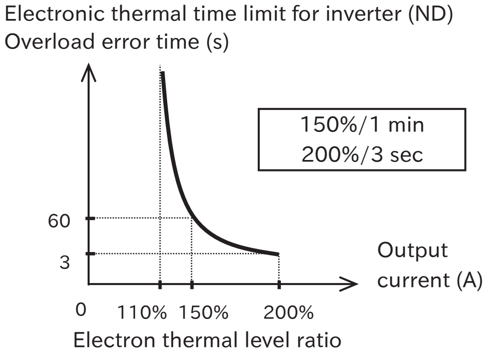
Code	Item	Description	Data	Initial value
bC110	Electronic thermal level	If a current exceeding the set value continues to flow, protection is applied and "Motor overload error [E005]" occurs.	(0.00 to 3.00)× inverter rated output current A	1.00×Rated output current
bC115	Electronic thermal accumulation gain	The load factor for each calculation cycle of the electronic thermal for the motor is multiplied by this setting value to be integrated as the load factor. The default value is 100%, multiplied by 1. When the initial value is less than 100.0%, the protection becomes slower and the motor burns out easily.	1.0 to 200.0 %	100.0

Electronic thermal	Time characteristic	Electronic thermal level	Thermal characteristics	Trip
Motor electronic thermal	Properties of ND standards (Refer to the figure below.)	Calculate the accumulated loading factor from [bC110] and [bC115].	Select with [bC111]	E005
Inverter electronic thermal	Characteristic by ND/LD (Refer to the figure below.)	ND/LD rated power current of the inverter	Constant torque (Reduced magnification Note: in low-speed range)	E039

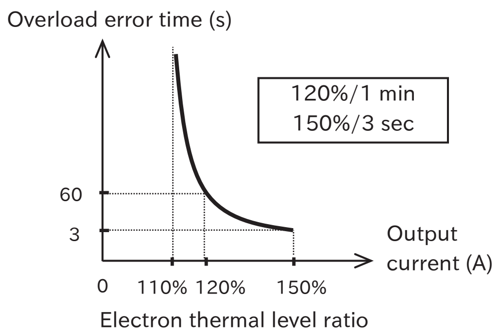
Note: The thermal characteristics (constant torque characteristics) of the electronic thermal for the inverter are different from those of the electronic thermal for the motor. Refer to "Constant Torque Characteristics" in this section for details.

■Electronic thermal time characteristics

- Electronic thermal time characteristics for the motor
  Electronic thermal time limit for inverter (ND)



- Electronic thermal time limit for inverters (LD)



- This setting is necessary for motor protection. If the correct value is not input, the motor may burn out.
- Even if "Electronic thermal level [bC110]" is set larger, "Overcurrent error [E001]" may occur before "Motor overload error [E005]" if the current grows steeply.
- If overload occurs in the extremely low speed range below 0.2Hz, "Low speed range overload error [E038]" will occur. Refer to "Chapter 15 Troubleshooting" for the corrective actions to be taken when an overload error [E005]/[E038]/[E039] occurs.
- If "Controller overload error [E039]" and "Electronic thermal subtraction function selection [bC112]" are set to "Disabled (00)", [E005] that occurs will not accept a trip reset for about 10 seconds after it occurs. When [E038] or [bC112] is set to other than "Disabled (00)", [E005] can be canceled immediately after tripping. For more information on [bC112], see "Changing the Heat Dissipation Characteristics of Electronic Thermals" in this section.

Changing the electronic thermal characteristics

- By setting "Electronic thermal characteristics [bC111]", you can set the electronic thermal characteristics for the motor according to the motor to be used. It is possible to set the protection characteristics in consideration of the decrease in the cooling capacity of the motor at low speed.

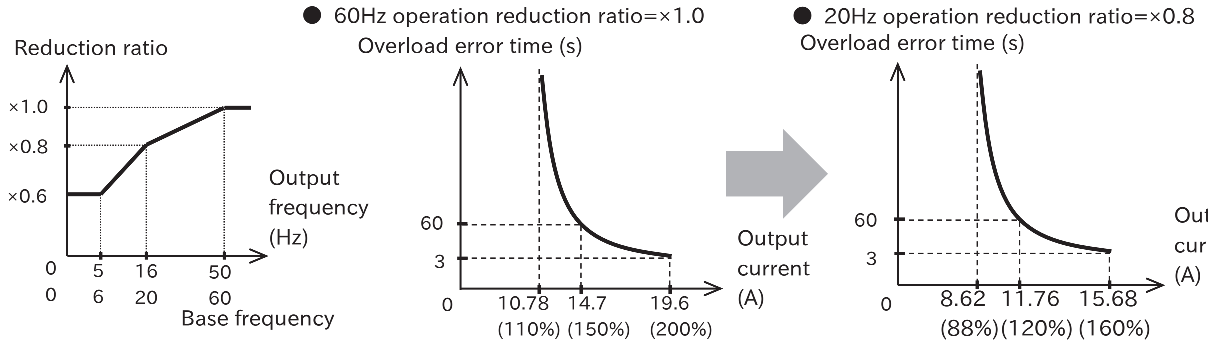
Code	Item	Description	Data	Initial value
bC111	Electronic thermal characteristic selection	Reduction characteristics: This pattern corresponds to a decrease in cooling function in the low-speed range.	00	00
		Constant torque characteristics: This pattern considers constant output.	01	
		Free setting: The pattern can be changed according to the motor characteristics.	02	

■Reduction characteristics

- By setting "Electronic Thermal Characteristic Selection [bC111]" to "Reduced Torque Characteristic (00)", it is possible to make the protective characteristic considering the cooling capacity reduction of the motor at low speed.
- A general-purpose motor (self-cooling type motor) must be used with a reduced load (current) because the cooling function of the self-cooling fan decreases when the motor speed decreases. (When the frequency decreases, the reduction magnification also decreases, and the thermal level (current) also decreases.)
- The reduced torque characteristics are matched to the heat generated by the self-cooling motor.
- The figure below (e.g. 1) shows an example of the reduced-torque characteristics when the "electronic thermal level [bC110]" is 9.6A at the light-load rating.

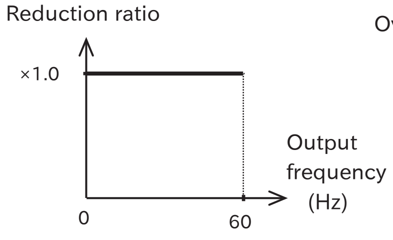
(e.g. 1) Example of reduced torque characteristics

Three-phase 200V 1.5kW, Light duty rating, Electronic thermal level[bC110]=9.8A
Base frequency[Hb104]=60Hz
Since the reduction ratio is 1.0 times for 60Hz operation, tripping occurs after 60 seconds of continuous flow of 14.7A (9.8A×150%).
20 Since the reduction ratio is 0.8 times when operating in Hz, 11.76A (9.8A×150% ×0.8) will be tripped after 60 seconds of continuous flow.

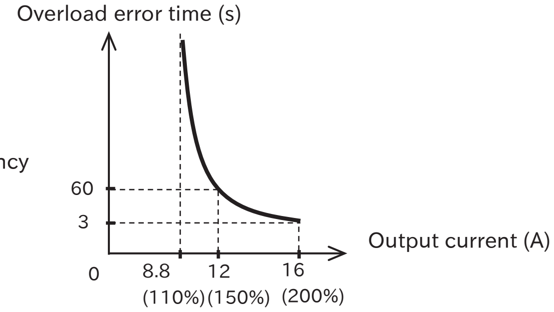


■Constant torque

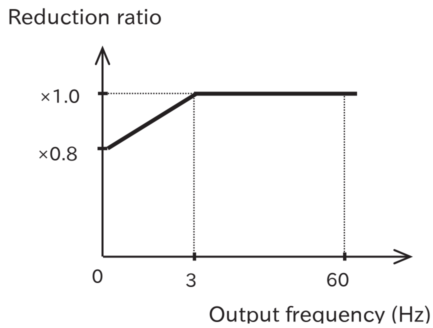
- When using a constant torque motor, set "Electronic Thermal Characteristics Selection [bC111]" to "Constant Torque Characteristics (01)".
- When the constant torque characteristic is selected, the reduction ratio does not apply to the electronic thermal for the motor as shown in the figure below.
  (e.g. 2) Constant torque characteristics three-phase 200V 1.5kW standard-load constant time,
  Electronic thermal level = 8.0A



● 60Hz Reduction ratio=×1.0



- Regardless of the "Electronic thermal level [bC110]", the inverter electronic thermal operates at a constant-torque characteristic based on ND/LD inverter-output current. However, to protect the inverter main unit, the reduction ratio is applied in the low-speed range below 3Hz as shown in the diagram.
- When using a self-cooling motor that reduces motor cooling in the low-speed range, pay attention to motor heat generation. Depending on the motor's heat generation characteristics, use with the reduction characteristics or free setting.



■Free electronic thermal setting

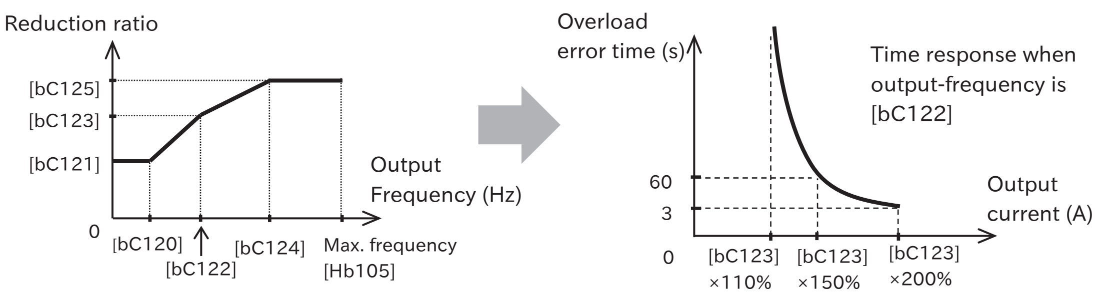
- By setting "Electronic thermal characteristic selection [bC111]" to "Free setting (02)", you can freely set the electronic thermal characteristic (reduction magnification characteristic) with the aim of protecting the motor according to the loads at every speed.

Code	Item	Description	Data	Initial value
bC120	Free electronic thermal frequency-1	Set the frequency at each segmental point. Be sure to set each frequency to the relationship shown below. [bC120]<[bC122]<[bC124]	0 to 590.00 Hz	0.00
bC122	Free electronic thermal frequency-2			
bC124	Free electronic thermal frequency-3			
bC121	Free electronic thermal current-1	Set the current value at each segmental point.	(0.00 to 3.00)× Inverter rated current A	0.00
bC123	Free electronic thermal current-2			
bC125	Free electronic thermal current-3			

(e.g. 3) Electronic thermal free setting three-phase 200V 1.5kW, standard-load, electronic thermal level [bC110]=8.0A

● Reduction ratio of the free electronic thermal

● Free electronic thermal characteristics



- If [bC121]/[bC123]/[bC125] is set to the default 0.0A and "Electronic Thermal Response Selection [bC111]" is set to "Free setting (02)", a [E005] occurs immediately after the setting is changed.
- Set the Free Electron Thermal frequency in the order of [bC124]→[bC122]→[bC120].

Changing the Heat Dissipation Characteristics of Electronic Therml

- When "Electronic thermal subtraction function selection [bC112]" is set to other than "Disabled (00)", the electronic thermal counter subtraction function is enabled, and the electronic thermal loading rate for the motor is subtracted when the output current is less than 110% of the electronic thermal level (when the reduction magnification is ×1.0).
- Subtraction property can be selected by "Electronic thermal subtraction function selection [bC112]". Set according to the heat radiation characteristics of the motor.

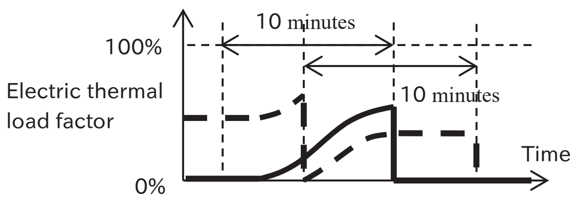
Code	Item	Description	Data	Initial value
bC112	Electronic thermal Decrease function enable	Invalid: The doubled counters are cleared every 10 minutes. In addition, the clearing timing is shifted by 5 minutes and is performed alternately.	00	01
		Enabled (linear): Subtracts from 100% to 0% at the [bC113] setting.	01	
		Enabled (time constant): The [bC113] setting time is treated as a time constant and is subtracted.	02	
bC113	Electronic thermal Subtraction time	Subtraction time setting when [bC112] is set to "Enable (Linear) (01)" or "Enable (Time Constant) (02)". Please note that if the setting is less than the default 600.00s, the protective function becomes slower and the motor tends to burn out.	1 to 65535 s	600
bC115	Electronic thermal Accumulation gain	The load factor for each calculation cycle of the electronic thermal for the motor is multiplied by this setting value to be integrated as the load factor. 100.0% of the initial value is multiplied by 1. Note that if the setting is less than 100.0% of the initial value, the protection becomes slow and the motor tends to burn out.	1.0 to 200.0 %	100.0

- 「Electronic thermal decreasing time[bC113] Use to set the subtraction rate. Check the thermal time constant of the motor with the motor manufacturer. In addition, set a larger value with sufficient margin for the characteristics of the motor used.
- Regarding "Electronic thermal accumulated gain [bC115]", if the overload withstand value of the motor is available, adjust it to a larger value as possible based on [(Trip time of electronic thermal time limit characteristic)/ (Motor overload withstand time)]×100%.
- Even if the setting value of [bC113]/[bC115] is larger than the default value, the motor may burn out if the value is inappropriate for the motor characteristic value. For these settings, set a value larger than the motor characteristic value with sufficient margin.
- If the motor characteristic value is not available, set [bC112] to "Disabled (00)" for use.
- Use [bC113] to set the subtraction rates for the individual patterns. Set a larger value with sufficient margin to the characteristics of the motor used.

■Subtraction function selection

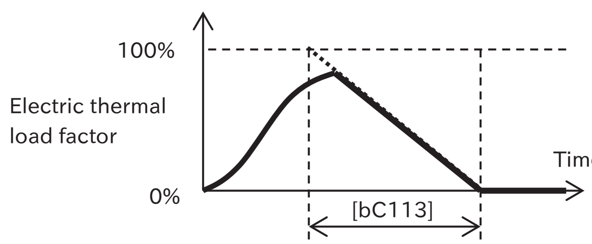
Disabled (00)

- Clears the load factor every 10 minutes. When one of the duplicated counters reaches 100%, the motor trips due to "Motor overload error [E005]".



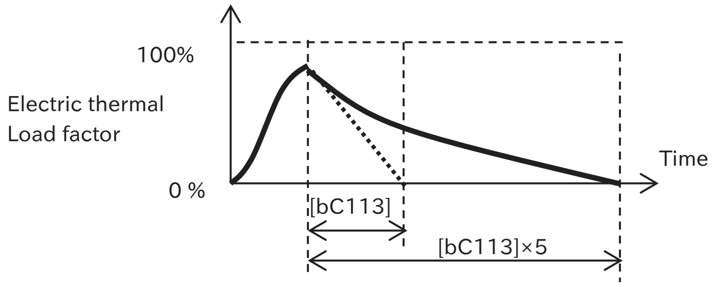
Enabled (linear) (01)

- The electronic thermal load ratio is subtracted at the rate where the load ratio changes from 100% to 0% at the setting time of [bC113].



■When subtraction function selection = enabled (time constant)

・The electronic thermal loading ratio at the point when the output current falls below the electronic thermal level is subtracted by the primary filter with the time constant set in [bC113]. Thermal-load factor becomes 0% in approximately five times longer than [bC113].



During power shutdownSaving the accumulated value of the electronic thermal

・The accumulated value of the electronic thermal is saved when the power is turned off, and can be read when the power is turned on the next time.

Code	Item	Description	Data	Initial value
bC-14	Power-off Electronic thermal counter memory selection at	Invalid: Integrated amount is set to zero when the power is turned on.	00	01
		Enabled: Displays the accumulated value saved when the power was shut off.	01	

Related functions

・The electronic thermal load factor for the motor can be checked in "Electronic thermal load factor monitor (motor) [dA-42]", and the electronic thermal load factor for the inverter can be checked in "Electronic thermal load factor monitor (inverter) [dA-43]".

・If you want to output a warning signal when the electronic thermal load factor exceeds a certain level, set the output terminal function "Electronic Thermal Warning (motor) [THM](026)", "Electronic Thermal Warning (inverter) [THC](027)" and "Electronic Thermal Warning Level (motor) [CE-30]" and "Electronic Thermal Warning Level (inverter) [CE-31]". For details, refer to "9.11.5 Outputting Warning Before Electronic Thermal Protection of Motor" or "9.11.6 Outputting Warning Before Electronic Thermal Protection of Inverter".

Code	Item	Description	Data	Initial value
dA-42	Electronic thermal load factor monitor (motor)	Displays the accumulated value of the electronic thermal for the motor. If this monitor reaches 100%, "Motor overload error [E005]" will occur.	0.00 to 100.00 %	-
dA-43	Electronic thermal load factor monitor (inverter)	Displays the accumulated value of the electronic thermal for inverter. When this monitor reaches 100%, "Controller overload error [E039]" occurs.		-
CC-01 CC-02 CC-07	Output terminal function	Electronic Thermal Warning (Motor) [THM]: When the [dA-42] value reaches the level set to [CE-30], this signal turns ON.	026	002 001 017
		Electronic Thermal Warning (Inverter) [THC]: When the [dA-43] value reaches the level set to [CE-31], this signal turns ON.	027	
CE-30	Electronic thermal warning level (Motor)	[THM] Sets the overload level that turns the signal ON.	0.00 to 100.00 %	85.00
CE-31	Electronic thermal warning level (Inverter)	[THC] Sets the overload level that turns the signal ON.		

8.1.5 Set the motor constant

- When using the automatic torque boost function or sensorless vector control with an induction motor, the motor constant must be set according to the motor to be used. There are three methods for setting the motor constant as follows.

(1) Sumitomo standard motor
When using a Sumitomo standard motor, if "IM motor type selection [Hb101], IM motor capacity selection [Hb102]" or "IM motor pole selection [Hb103]" is changed, the motor constant parameter setpoint will automatically change to the motor constant of the Sumitomo standard motor (IE3).

(2) Measured by auto-tuning function
This function is used to measure the motor constant when a motor whose motor constant is unknown is used. Even when using a Hitachi standard motor, if the moment of inertia is large or the wiring length is long, it may be better to perform auto-tuning. For details, refer to "8.3 Auto-tuning of Motor".

(3) You set arbitrarily.
Values obtained from the motor manufacturer, etc. can be set directly to the parameters in the table below. Or, after (1) or (2), change the parameters in the table below for fine adjustment.

- Sumitomo Standard Motor Constant Setting in the table below is the data for one phase of Y-connected motor converted to 200V/400V, 50Hz input.
- The motor constant parameters in the table below can also be adjusted and changed manually. However, note that changing the motor capacity or number of motor poles will change to the Hitachi standard motor constant. If you have an optional remote operator (VOP), it is recommended that you back up the motor constants with the data R/W function.
- When using a motor with unknown motor constants, inquire about the motor constants from the motor manufacturer or measure the motor constants using the auto-tuning function. For details, refer to "8.3 Auto-tuning of Motor".
- Refer to "Moving with 9.5.5 V/f Control Automatic Torque Boost" or "9.5.10 Moving with Sensorless Vector Control" for the tuning of the Automatic Torque Boost function or Sensorless Vector Control when the satisfactory performance cannot be obtained.

■When using a Sumitomo standard induction motor

Code	Item	Description	Data	Initial value
Hb110	Async. Motor constant R1 (Primary resistance)	Parameter for setting the motor constant of an induction motor. Changing "IM motor capacity selection [Hb102]" or "IM motor pole selection [Hb103]" initializes the motor constants to the corresponding Hitachi standard. It can also be adjusted and changed manually. In addition, when the motor constant is measured by the auto-tuning function, this parameter will be overwritten.	0.000001 to 1000.000000 Ω	Depend on the motor capacity
Hb112	Async. Motor constant R2 (Secondary resistance)			
Hb114	Async. Motor constant L (Leakage inductance)		0.000001 to 1000.000000 mH	
Hb116	Async. Motor constant I0 (no-load current)		0.01 to 10000.00 A	
Hb118	Async. Motor constant J (Moment of inertia)		0.00001 to 10000.00000 kgm^2	

- The base (maximum) frequency is obtained from the rated speed (min^{-1}) and number of poles of the motor as shown below.

$$\text{Base (Max.) frequency (Hz)} = \frac{\text{Rated speed } (\text{min}^{-1}) \times \text{poles}}{120}$$

8.2 Test run

8.2.1 Simulation mode

- If "Simulation mode selection [PA-20]" is set to "Enabled (01)" and the power is turned on again, the simulation mode is entered and no longer outputting to the motor.
- To cancel the simulation mode, set [PA-20] to "Disabled (00)" and turn the power off and then on again.
- Operation operates in the same manner as normal except that the output to the motor is not present. Therefore, it is possible to check the terminals and communication operation, etc.
- Although the output to the motor is not performed, internal data such as output current and output voltage can be specified by parameters or analog input. It is possible to simulate the internal data during actual operation.
- [P24] Operation can be checked even when power is supplied to the terminals with an external ＋24V power supply.
- In simulation mode, if you set any error code (1 if "Overcurrent error [E001]") to "Alarm test error code selection [PA-21]", a trip of the error code set at the time you set will be issued. To cancel the trip, use the reset operation (press ON or STOP/RESET key of the "Reset [RST]" input terminal) as normal. After resetting, [PA-21] automatically returns to 0.
- The motor cannot be driven in simulation mode.
- To check the actual operation by connecting the motor, set "Simulation mode selection [PA-20]" to "Disabled (00)" and turn the power on again.
- To operate the simulation mode, leave the input with ＋24V power supply if ＋24V power supply is supplied, or leave the main power input if the main power supply is input, and turn off the power at the state of termination.
- The simulation mode simulates the terminal operation, and the function by the motor control operation does not operate.
- If an error code that does not exist in the "Alarm test error code selection [PA-21]" is inserted in the simulation mode, no error will occur and [PA-21] will automatically return to 0.
- In the simulation mode, if an error code judged as a major failure is inserted in [PA-21], the power must be turned on again to cancel the trip.
  (Error codes judged as serious failure: [E008], [E011], [E014], and [E030])

■Enable simulation mode.

(1) Set "Simulation mode selection [PA-20]" to "Enable (01)".
(2) Shut off the power and turn on the power again.
(3) The simulation mode starts.

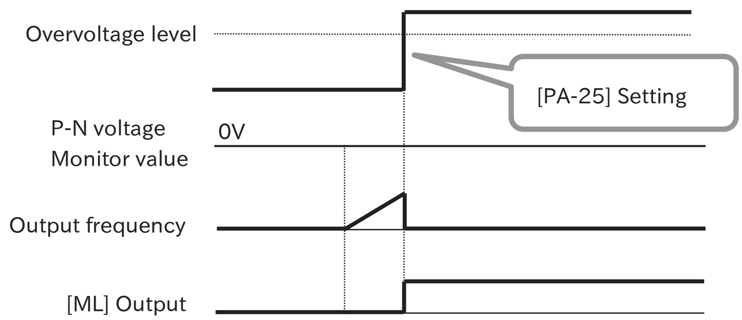
■Disable simulation mode.

(1) Set "Simulation mode selection [PA-20]" to "Disable (00)".
(2) Shut off the power and turn on the power again.
(3) The simulation mode is canceled.

Code	Item	Description	Data	Initial value
PA-20	Simulation mode enable	Disable	00	00
		Enable	01	
PA-21	Error code selection for alarm test	Set the error code to be issued. An error that does not exist does not occur.	0 to 255	0
PA-22	Simulation mode: Optional output selection for the output current monitor	Invalid: Although the detected value is displayed as usual, it is virtually zero because the output is shut off.	00	01
		Enabled (set by parameter [PA-23])	01	
		Enabled (set from [VRF])	02	
		Enabled (set from [IRF])	03	
PA-23	Optional output value setting for the output current monitor	The set value is treated as the internal output value.	0.0 to 3.00× Inverter rated output current A	0.00
PA-24	Simulation mode: Optional output selection for the DC bus voltage monitor	Disable: Displays the detection value as usual. +24V power feed will be zero.	00	01
		Enabled (set by parameter [PA-25])	01	
		Enabled (set from [VRF])	02	
		Enabled (set from [IRF])	03	
PA-25	Optional output value setting for the DC bus voltage monitor	The set value is treated as the internal output value.	200V class: DC0.0 to 450.0 V 400V class: DC0.0 to 900.0 V	200V class 270.0 400V class 540.0
PA-26	Simulation mode: Optional output selection for the output voltage monitor	Invalid: Displays the output voltage expected for control.	00	01
		Enabled (set by parameter [PA-27])	01	
		Enabled (set from [VRF])	02	
		Enabled (set from [IRF])	03	
PA-27	Optional output value setting for the output voltage monitor	The set value is treated as the internal output value.	200V class: 0.0 to 300.0 V 400V class: 0.0 to 600.0 V	0.0
PA-28	Simulation mode: Optional output selection for the output torque monitor	Invalid: Displays the output torque assumed in control.	00	01
		Enabled (set by parameter [PA-28])	01	
		Enabled (set from [VRF])	02	
		Enabled (set from [IRF])	03	
PA-29	Optional output value setting for the output torque monitor	The set value is treated as the internal output value.	-500.0 to 500.0 %	0.0
PA-30	Simulation mode: Optional frequency matching start enable setting	Invalid: Restart from the output frequency when a retry cause occurs.	00	01
		Enabled (set by parameter [PA-31])	01	
		Enabled (set from [VRF])	02	
		Enabled (set from [IRF])	03	
PA-31	Optional frequency matching start setting value	The set value is treated as the internal output value.	0.00 to 590.00 Hz	0.00

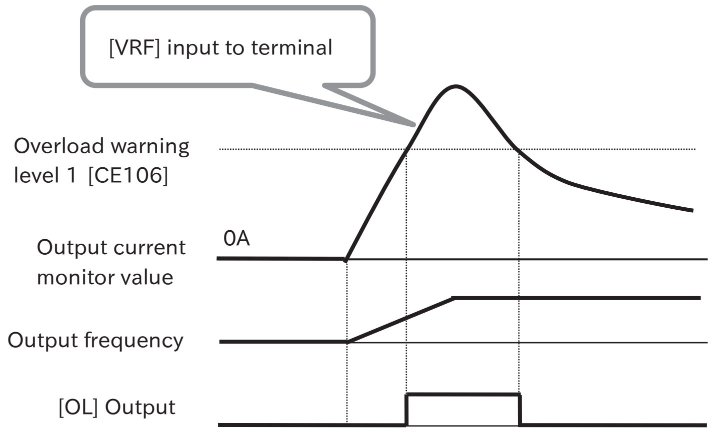
■(e.g.1) Check the operation when the output terminal function "Alarm [ML]" is output.

・Make sure that "Voltage monitor between P-N arbitrary output selection [PA-24]" is set to "Enable (Parameter setting) (01)" and "Voltage monitor between P-N arbitrary output selection [PA-25]" is within the normal operation range. Then, start operation.
・After starting operation, set "Voltage monitor between P-N arbitrarily output selection [PA-25]" to the max.
・[PA-25] After setting, an "overvoltage error [E007]" occurs and the "alarm signal [ML]" is turned ON.



■(e.g. 2) Check the signal output level of the output terminal function "Overload warning [OL]".

・Set "output current monitor optional output selection [PA-22]" to "Enabled (set from VRF) (02)".
・Set "Overload notice level1 [CE106]" to begin operation.
・[VRF] Increase or decrease the voltage/current input to the terminal and change the value on the "Output current monitor [dA-02]".
・If the value displayed in [dA-02] exceeds [CE106], "Overload notice [OL]" is ON.



8.2.2 Motor test run at no load

・To confirm that there are no basic problems with the inverter, motor, wiring, etc., carry out a test run with no load with only the motor connected in the procedure described in the next section.
『8.1 Perform the necessary settings for the motor to be used in the trial operation according to the Mandatory Settings for operation, and then perform the trial operation with no load to confirm that the motor can be turned forward, backward, or stopped without any problems.

Caution
Burnout

DO

・Be sure to read "Chapter 1 Safety Precautions/Risks" carefully before starting operation.
It is recommended that the control method be used as V/f control in the test run of the motor only.
・Do not operate the motor with an extremely small capacity than the inverter capacity.
Also, when performing a trial run with a motor of capacity under several frames, set the control method as V/f control, and set the basic settings of the motor such as motor capacity and electronic thermal level according to the motor used.
・If the setting is incorrect, a current larger than the rated motor current may flow, causing motor burnout.
・STOP/RESET buttons on the control panel can be enabled or disabled using STOP key selection [AA-13]. Prepare an emergency stop/emergency shut-off switch separately in case of a situation.

■Check items for test run at no load

・Check if the machine operation direction is correct, if the machine operates smoothly and there is no abnormal noise or vibration, and if the machine operates normally without abnormal noise or vibration even if the frequency command or operation direction is changed.
・Check that there is no trip during acceleration/deceleration, and that the speed and frequency meter are correct.
・Check that the current and voltage values have a margin to the trip value in "Output current monitor [dA-02]" and "DC voltage monitor [dA-40]."
・If "Overcurrent error [E001]" or "Overvoltage error [E007]" occurs during a trial run, try increasing the acceleration/deceleration times. Refer to "Chapter 15 Troubleshooting" for more information on tripping and corrective actions.

Operation by inputting operation command and frequency command from the operation panel

(1) Before test operation, check that each parameter is set correctly according to "8.1 Mandatory Settings for Operation".

(2) Set "Output frequency setting (monitor) [FA-01]", "RUN key operation direction selection [AA-12]", "1st main speed command selection [AA101]" and "1st operation command selection [AA111]" as shown in the table below. It is recommended that [FA-01] be at a low speed of about 10 Hz for safety at first.
The default setting of "Acceleration time setting (monitor) [FA-10]"/"Deceleration time setting (monitor) [FA-12]" is 10 seconds. Change it as necessary. In the no-load trial operation, the constant-torque property of V/f control is recommended for the first control method [AA121].

(3) Check that "0.00Hz" is displayed in "Output frequency monitor [dA-01]".

(4) When RUN button is pressed, the operation indicator [RUN] on the control panel lights and the motor starts rotating.

(5) Check that there is no abnormality in the output frequency monitor, actual motor rotation speed, motor rotation direction, and inverter. Check the rotating direction of the motor by "Operation direction monitor [dA-03]".

(6) If it is OK, use [FA-01] to gradually increase the output frequency.

(7) After confirming the operation, press STOP button. When the motor starts to decelerate and stops, the operation indicator [RUN] on the control panel turns off.

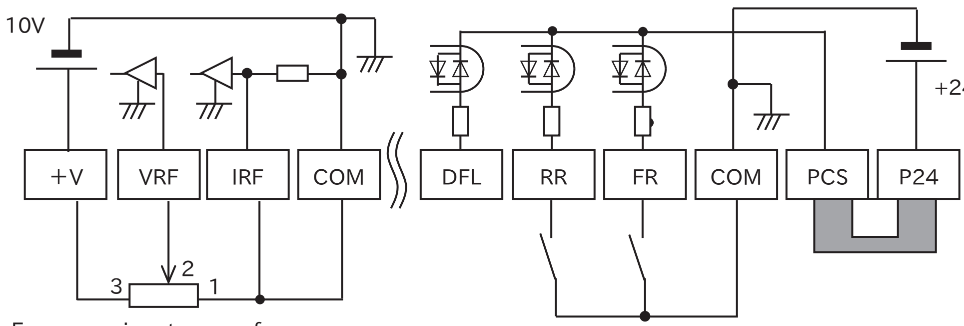
Code	Item	Description	Data	Initial value
dA-01	Output frequency monitor	Displays the inverter output frequency.	0.00 to 590.00 Hz	
dA-03	Rotation direction monitor	Displays the inverter operation direction.	F (Forward) r (Reverse) o (Stop)	
FA-01	Main speed reference setting (monitor)	Set the output frequency command to the motor.	0.00 to Maximum frequency Hz	-
FA-10	Acceleration time setting (monitor)	Set the acceleration time/deceleration time as required. The default settings are both 10.00 s.	0.00 to 3600.00 s	
FA-12	Deceleration time setting (monitor)			
AA-12	RUN-key command rotation direction	Set the rotational direction when operating with RUN switch on the control panel.	00 (Forward) 01 (Reverse)	00
AA101	Main speed input source selection, 1st-motor	Operation is performed with the frequency command set to [FA-01].	07	07
AA111	RUN command input source selection, 1st-motor	Press RUN button to start operation.	02	02
AA121	Control mode selection, 1st-motor	Operation with the constant torque characteristic of V/f control is recommended.	00	00

Operation by inputting operation and frequency command from the control circuit terminal

(1) Before test operation, check that each parameter is set correctly according to "8.1 Mandatory Settings for Operation".
(2) Set "Output frequency setting (monitor) [FA-01]", "First main speed command selection [AA101]", "First operation command selection [AA111]", "Input terminal function [FR] selection [CA-01]", "Input terminal function [RR] selection [CA-02]" as shown in the table below. It is recommended that [FA-01] be at a low speed of about 10 Hz for safety at first.
(3) Check that "0.00Hz" is displayed in "Output frequency monitor [dA-01]".
(4) Check in [FA-01] that the analog voltage is 0V and the frequency command is 0.00Hz. When you ON the "Forward [FR]" input terminal or the "Reverse [RR]" input terminal, the operation indicator [RUN] on the control panel lights.
(5) When the analog voltage, which is a frequency command, is gradually increased, the motor starts to rotate.
(6) Check that there is no abnormality in the output frequency monitor, actual motor rotation speed, motor rotation direction, and inverter. Check the rotational direction of the motor by "Operation direction monitor [dA-03]".
(7) After confirming operation, turn OFF the [FW] input terminal or [RV] input terminal. When the motor starts to decelerate and stops, the operation indicator [RUN] on the control panel turns off.

Code	Item	Description	Data	Initial value
dA-01	Output frequency monitor	Displays the inverter output frequency.	0.00 to 590.00 Hz	-
dA-03	Rotation direction monitor	Displays the inverter operation direction.	F (Forward) r (Reverse)/o (Stop)	
FA-01	Main speed reference setting (monitor)	When the frequency command destination is analog input, it is the main speed command monitor.	0.0 to Max. frequency Hz	10.0
FA-10	Acceleration time 1 setting or monitor, 1st-motor	Set the acceleration time and deceleration time as necessary. The default settings are both 10.00s.	0.00 to 3600.00 s	10.00
FA-12	Deceleration time 1 setting or monitor, 1st-motor			
AA101	Main speed input source selection, 1st-motor	[VRF] The analog input from the terminal is regarded as a frequency command.	01	07
AA111	RUN command input source selection, 1st-motor	Operate with forward rotation [FR]/reverse rotation [RR] of the input terminal.	00	02
AA121	Control mode selection, 1st-motor	Operates with the constant-torque characteristic of V/f control.	00	00
CA-01	Input terminal function [FR] selection	Assign "Forward rotation [FR]".	001	001
CA-02	Input terminal function [RR] selection	Assign "Reverse rotation [RR]".	002	002

■Wire control circuit terminal block example



Frequency input source for use variable resistor (1kΩ)
Reverse rotation [RR] command
Forward rotation [FR] command
This is an example when using a power supply in this wiring diagram inside the inverter

8.2.3 Connect the machine load and test run

・If no problem is found in the no-load operation, perform a test run with the actual load to which the mechanical system is connected, and confirm that there is no problem.

Caution
Burnout
Failure

DO

・Be sure to read "Chapter 1 Safety Precautions/Risks" carefully before starting operation.
Before performing a test run with the mechanical load connected, be sure to perform the test run and operation
・check with the motor alone in accordance with "8.2.2 Connecting the Motor Only and Test Run."
・Be sure to set the motor basic settings such as motor capacity and electronic thermal level according to the motor to be used. Operation with incorrect settings may cause damage to the load machine or burnout of the motor.
・STOP/RESET buttons on the control panel can be enabled or disabled using STOP key selection [AA-13]. Prepare an emergency stop/emergency shut-off switch separately in case of a situation.

■Confirmation during trial operation under actual load

・Confirm that the machine operation direction is correct and that the machine moves smoothly.
・If possible, check that there is no vibration or abnormal noise of the machine even if the frequency command or the operation direction is changed.
・Check that there is no trip during acceleration/deceleration, and that the speed and frequency meter are correct.
・Check if "overcurrent error [E001]", "overload error ([E005], [E038], [E039])" or "overvoltage error [E007]" occurs during trial operation.
・In "Output current monitor [dA-02]", "DC voltage monitor [dA-40]", "Electronic thermal load ratio monitor (motor) [dA-42]", and "Electronic thermal load ratio monitor (inverter) [dA-43]", confirm that there is a margin for the value at which the values of the current, voltage, and load ratio monitor are tripped.
・If operation during V/f control is not stable, adjust it referring to "9.5.9 Stabilizing Motor Hunting".
・If adequate performance is not obtained, such as when starting with automatic torque boost or operation with sensorless vector control, such as when the motor gets shocked or the motor is distorted, refer to "Moving with 9.5.5 V/f Control Automatic Torque Boost" and "9.5.10 Moving with Sensorless Vector Control".
・For more information about tripping and corrective actions, see "Chapter 15 Troubleshooting".

Test Run under Actual Load with Load Machine Connected

(1) After confirming that the motor is completely stopped, connect the mechanical system and confirm that there are no loose mounting screws, etc. If the inverter is connected, wait at least 10 minutes after the power is turned off, use a tester or the like to check that there is no residual voltage between the [P/+] and [N/-] terminals on the main circuit terminal block, and then perform the work after confirming safety.
(2) When using automatic torque boost or sensorless vector control, be sure to set the motor constant of the motor to be used. For details, refer to "8.1.5 Setting Motor Constant" or "8.3 Performing Auto-tuning of Motor". If auto-tuning cannot be performed with the load machinery connected, perform auto-tuning with only the motor connected in advance and calculate the moment of inertia of the load in terms of motor shaft and add it to "IM motor constant J [Hb118]."
(3) Start operation using the operation command as a ON after making the required settings such as frequency command selection and operation command selection. It is recommended to set the frequency command to the low speed of 10Hz level for safety at first.
(4) Check the above items to see if there is no problem in the operating condition.

8.3 Auto-tuning

8.3.1 Procedure for auto-tuning of induction motor

- Auto-tuning is a function that measures and automatically sets the required motor constants in order to increase the accuracy of automatic torque boost and sensorless vector control, etc.
- If you do not know the motor constant, perform auto-tuning to measure the motor constant.
- Auto-tuning can be selected from two methods of "Non-rotation (01)" and "Rotation (02)" in "Auto-tuning selection [HA-01]". Select according to the situation.
- When auto-tuning an induction motor (IM), set "Control method [AA121]" to IM control method "V/f control (IM) ((00) to (03)" and "Sensorless vector control (IM) (08)".
- The measured motor constants are data (including wiring) for one phase of Y-connection.
- In the factory setting, the motor constant of the Sumitomo standard induction motor is set. When using a Sumitomo standard induction motor, characteristics can be obtained without problems in most cases even if auto-tuning is not performed.
- If you change "IM motor capacity selection [Hb102]" or "IM motor pole selection [Hb103]" after auto-tuning, the motor will be initialized to the corresponding Hitachi standard motor constants. [Hb102], Be sure to set [Hb103] prior to performing auto-tuning.
- In the factory default parameter state, performing auto-tuning first enables smooth tuning.
- The motor capacity that can be measured is up to the maximum applicable frame and one lower frame motor. Otherwise, the correct constant may not be obtained. When performing auto-tuning with a one-frame lower motor, set "Overload Limit 1 Select [bA122]" to "Enable at Acceleration/Constant Speed (01)", and set "Overload Limit 1 Level [bA123]" to 1.5 times the rated motor current.

■Parameters related to auto-tuning of induction motor (IM)

Code	Item	Description	Data	Initial value
HA-01	Auto-tuning selection	Disable	00	00
		Enabled: Motor non-rotating	01	
		Enabled: Motor rotation	02	
HA-02	Auto-tuning RUN command source selection	Keypad (RUN-key)	00	00
		Follow the [AA111]/[AA211] setting	01	
Hb102	IM Motor Capacity Select	Set according to the motor specifications.	0.01 to 11.00 kW	Factory setting
Hb103	IM motor pole selection		2/4/6/ to /46/48 pole	01
Hb104	IM Base frequency		30.0 to Max. frequency Hz	60.0
Hb105	IM Maximum frequency		Base frequency to 590.00 Hz	60.0
Hb106	IM motor rated voltage		1 to 1000 V	200/400
Hb108	IM Motor Rated Current		0.01 to 10000.00 A	Depend on the motor capacity
Hb110	IM motor constant R1 (primary resistance)	Parameter for setting the motor constant of an induction motor. When the motor constant is measured with the auto-tuning function, this parameter will be overwritten. It is also possible to adjust and change manually after performing auto-tuning.	0.000001 to 1000.000000 Ω	
Hb112	IM motor constant R2 (secondary resistance)			
Hb114	Async. Motor constant L (Leakage inductance)		0.000001 to 1000.000000 mH	
Hb116	IM motor constant I0 (no-load current)		0.01 to 10000.00 A	
Hb118	IM motor constant J (moment of inertia)		0.01 to 10000.00000 kgm^2	

Auto-tuning execution step

1. Pre-setting of parameters
   (1) Select "IM motor capacity selection [Hb102]" and "IM motor pole selection [Hb103]" according to the motor to be used.
   (2) Set the "IM Base Frequency [Hb104]" and "IM Motor Rated Voltage [Hb106]" according to the specifications of the motor to be measured.
   (3) Set "DC braking selection [AF101]" to disable (00) and "Vector control mode selection [AA123]" to "Speed/torque control mode (00)". If it is not "speed/torque control mode (00)", the correct measurement will not be performed.
   (4) Do not ON "Torque control enable [ATR]" of the input terminal function. [ATR] If the input terminal is ON, the instrument will not measure correctly.

2. Selection of "Motor rotation" and "Motor non-rotation"
   ・Set whether the motor rotates or not during auto-tuning to "Auto-tuning selection [HA-01]." Each of them has the following characteristics.

[HA-01] Setting	Description
Non-rotating (01)	Measure the motor constant without rotating the motor. Use this function when the motor must not rotate. Because the motor does not rotate, the motor constant I0 (no-load current) and motor constant J (moment of inertia) cannot be measured. Even "Non-rotation (01)" may cause the motor to rotate slightly.
Rotation (02)	Measure the motor constant by actually rotating the motor. Use it when there is no problem even if the motor rotates.

Warning
Injury
Failure

・Note the following when "Rotate (02)" is selected.
  - Rotation to around the base frequency of 80% is acceptable.
  - The motor is not driven from the outside.
  - The brake must be open.

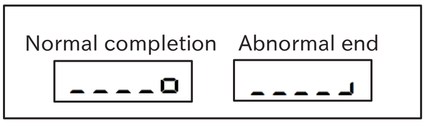
DO

・Since the output torque is not sufficient during auto-tuning, there is a possibility of slipping off in elevators, etc. In such applications, disconnect the motor from the load machine and perform auto-tuning with the motor alone. Since the measured motor constant J (moment of inertia) is a single motor, separately set the value obtained by converting the moment of inertia of the load machine to the motor shaft.
・During auto-tuning, when the moment of inertia of the load machine is large or the receiving voltage is high, the deceleration stop tends to be slow. In this case, increase the deceleration time or perform auto-tuning as the motor alone and set the motor constant J (moment of inertia) separately.
・In a machine (elevator, ball screw, etc.) where the motor shaft rotation amount is limited, the machine may be damaged due to the drive exceeding the allowable rotation amount. Select "Motor non-rotation".

3. Auto-tuning

- When the operation command is turned ON from the operation command destination set in "Operation command selection [AA111]", auto-tuning starts according to the following steps. When the operation command is OFF, auto-tuning can be stopped halfway. However, the tuning data is not memorized.
- If abnormal termination or trip occurs during auto-tuning, refer to "Countermeasures for failure in the middle of auto-tuning" in this section to clear the cause of the error.

(1) AC excitation first time (Motor does not rotate.)
↓
(2) Second time of AC excitation (Motor does not rotate.)
↓
[HA-01]: When "Non-rotation (01)" is selected.
(3) DC excitation 1st time (Motor does not rotate.)
↓
(4) V/f control operation (The motor rotates up to 80 % of the base frequency.) [Note:1]
↓
(5) Sensorless vector control operation (Motor rotates up to X % [Note:2] of base frequency.) [Note:1]
↓
(6) DC excitation 2nd time (Motor does not rotate.)
↓
(7) Displays the tuning result.
The tuning result is displayed as follows.
If abnormal termination occurs, execute auto-tuning again.
The display is released by pressing STOP/RESET.



Note: 1. (4)(5) will not be executed in case of "Motor not rotating".
2. The rotational speed in (5) is as follows when the larger of the acceleration time and deceleration time in (4) is taken as T.
When $0s < T < 50s$: X=40%
When $50s \leqq T < 100s$: X=20%
When $100s \leqq T$: X=10%

4. Setting at the end of auto-tuning

- After normal completion, the measured value will be overwritten in "IM motor constant ([Hb110] to [Hb118])".
- If auto-tuning is performed without rotating the motor, "IM motor constant I0 [Hb116] and "IM motor constant J [Hb118]" are not measured. Make the following settings.
  - No-load current I0: Measure and set the no-load current of the motor itself in advance when operating at an output frequency equal to IM base frequency [Hb104], using "Control method [AA121]" as "V/f constant-torque characteristic (00)". Or, set the motor no-load current confirmed with the motor manufacturer to "IM Motor Constant I0[Hb116".
  - Moment of inertia J: Calculate the moment of inertia of the load in terms of motor shaft and set the sum of the moment of inertia of the motor alone to "IM Motor Constant J [Hb118]."
- After auto-tuning is completed, "Auto-tuning selection [HA-01]" automatically returns to "Disabled (00)" regardless of normal end or abnormal end. To execute auto-tuning again, set it again.

Action to be taken when auto-tuning fails in the middle

・If abnormal termination or trip occurs and forced termination occurs during auto-tuning, refer to the following troubleshooting and "Chapter 15 Troubleshooting" to clear the cause of abnormal termination or trip. Then, set "Auto-tuning selection [HA-01]" to "Non-rotating (01)" or "Rotating (02)" again and perform auto-tuning again.

Possible cause	Example of remedy
The control system does not match the motor.	Set the control method [AA121] to "V/f constant torque characteristic (00)". Otherwise, it may end abnormally.
The motor nameplate data setting is incorrect.	Incorrect parameter settings related to motor nameplate data may cause tripping such as overcurrent. 『8.1.3 Refer to "Setting Motor Nameplate Data to Parameters" and check the parameter settings.
STOP/RESET button was pressed.	Press STOP/RESET key. Auto-tuning is interrupted. Check the auto-tuning setting again and start.
A trip occurred due to external factors such as braking.	The cause of the trip must be removed.
The input pin function was activated.	If the input terminal function operates during auto-tuning, tuning may be hindered. Perform auto-tuning after confirming that the input terminal function is OFF.
The motor capacity is too small for the applicable motor frame of the inverter.	If tuning does not finish normally, you must set the motor constant manually.
"Overvoltage error [E007]" occurred because the machine loading is large or the deceleration duration is short.	・Increase the deceleration time. Return the deceleration time to the original value after completion of auto-tuning. ・Perform auto-tuning as the motor alone.
"Overcurrent fault [E001]" occurred during acceleration or deceleration due to heavy loading.	Increase the acceleration time/deceleration time. After auto-tuning is completed, return the acceleration time/deceleration time to the original value before use.

Chapter 9 Inverter Function

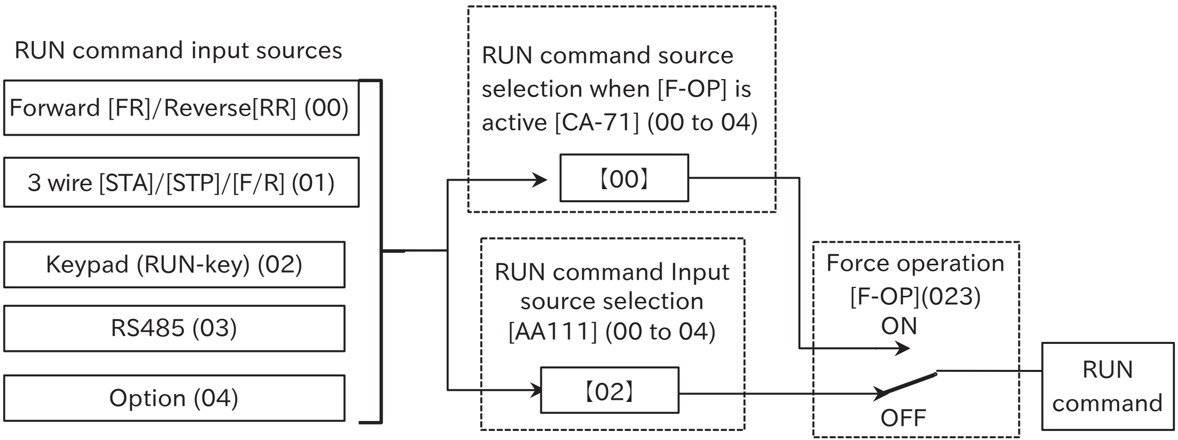
9

This chapter describes the various functions installed in the inverter. Select the function you want to use and perform the setting.
Before you perform any work, carefully read "Chapter 1 Safety Precautions/Risks" and the corresponding chapters to ensure safety.

9.1 Selecting RUN command

9.1.1 Types of RUN command

・The RUN command input source can be set in "RUN command input source selection [AA111]".
For details, refer to the explanation in the following section and beyond.



Note: The values in square brackets and the switch positions shown in the figure are the default values.
All functions not assigned to "Input terminal function ([CA-01] to [CA-08]) are turned off.

Code	Item	Description	Data	Initial value
AA111	RUN command Input source selection	Input terminal function "Forward rotation [FR]", "Reverse rotation [RR]" set in the control circuit terminal as RUN command.	00	02
		Input terminal function "3-wire start [STA]", "3-wire stop [STP]" and "3-wire Forward/Reverse [F/R]" set in the control circuit terminal is regarded as the RUN command.	01	
		Enter the RUN command from the keypad or optional remote operator.	02	
		Enter the RUN command via Modbus communication.	03	
		Enter the RUN command via communication option.	04	

・When "Force operation [F-OP]" is turned ON, the RUN command source switches the one set to "RUN command source selection when [F-OP] is active [CA-71]" regardless of the "operation command selection [AA111]" setting. For details, refer to "9.1.7 Temporarily Changing the RUN Command Input source". At the same time, Speed input source also switches to the input source set to "Speed reference source selection when [F-OP] is enabled [CA-70]" regardless of the "Main speed input source selection [AA101]" setting. For details, refer to "9.2.1 Types of Frequency Command" or "9.2.14 Temporarily Changing the Frequency command input source".
・When an operation command is given from the operation screen of PC software, [AA101] and [AA111] are forcibly overwritten with [AA101] = "Parameter setting (07)" and [AA111] ="RS485 (03)", respectively, when the operation screen is opened. When the operation screen is closed, they return to the setting when the operation screen is opened.

9.1.2 Operation by RUN key on the keypad

- To start or stop the inverter using the RUN and STOP/RESET keys on the keypad or the optional remote operator (OS-44 ver.2.0 onwards), set the "RUN command input source selection [A]" parameter to "Keypad's RUN-key (02)".
- To start operation using the RUN key on the keypad, set the correct direction of operation with "RUN-key command rotation direction [AA-12]".
- When the [AA111] is set to " Keypad's RUN-key (02)", or when the RUN command is switched to the keypad by the input terminal function "Force operation [F-OP]", the output terminal function "Run command = Keypad is selected [REF]" is turned ON. For details of [F-OP], refer to "9.1.7 Changing Operation Command Destination Temporarily".

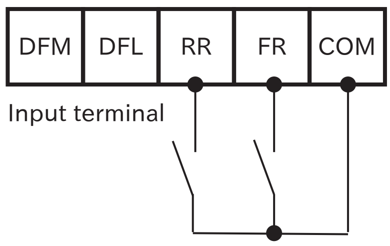
Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	Operation is started and stopped using the RUN and STOP/RESET keys on the keypad or optional remote operator.	02	02
AA-12	RUN-key command rotation direction	Forward rotation operation from the keypad.	00	00
		Reverse rotation operation from the keypad.	01	
CC-01 CC-02 CC-07	Output terminal function	Run command = Keypad is selected [REF] : This output terminal turns on when inverter RUN command can be initiated using the RUN key on the keypad or optional remote operator.	011	002 001 017

- For the inverter to start operation, a frequency command is required in addition to a RUN command.

9.1.3 Operation by forward/reverse input terminals

- To perform forward/reverse rotation and stop operation using the input terminal function "Forward rotation [FR]" and "Reverse rotation [RR]" on the control circuit terminal, set the "RUN command input source selection [AA111]" to "[FR]/[RR] terminal (01)" and assign [FR] and [RR] to "Input terminal function ([CA-01] to [CA-08])".
- In the factory default state, [FR] terminal is assigned to terminal [FR] and [RR] terminal to terminal [RR]. The terminal assignments can be changed by configuring [CA-01] to [CA-08].
- The a/b (NO/NC) contact state can be changed for each terminal by configuring the "Input terminal active state ([CA-21] to [CA-28])".
- When the [FR] and [RR] terminals are both on at the same time, a stop command is issued. The relationship between the [FR]/[RR] terminal input states and the RUN commands is shown in the following table.

■"Forward rotation [FR]"/"Reverse rotation [RR]" states and RUN command



FR	RR	RUN command
OFF	OFF	Stop
ON	OFF	Forward
OFF	ON	Reverse
ON	ON	Stop

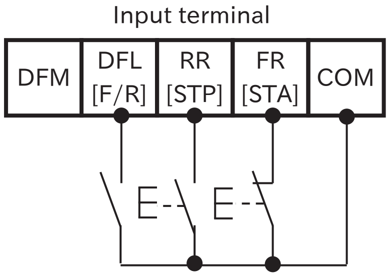
Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	The RUN command from the control terminal is enabled, and inverter operation can be started and stopped using the "Forward rotation [FR]"/"Reverse rotation [RR]" input terminals.	02	02
CA-01 to CA-08	Input terminal function	Forward rotation [FR]: When turned on, operation is in the forward direction.	001	-
		Reverse rotation [RR]: When turned on, operation is in the reverse direction.	002	
CA-21 to CA-28	Input terminal active state	"a" contact state (NO: Normally Open)	00	00
		"b" contact state (NC: Normally Closed)	01	

- For the inverter to start operation, a frequency command is required in addition to a RUN command.

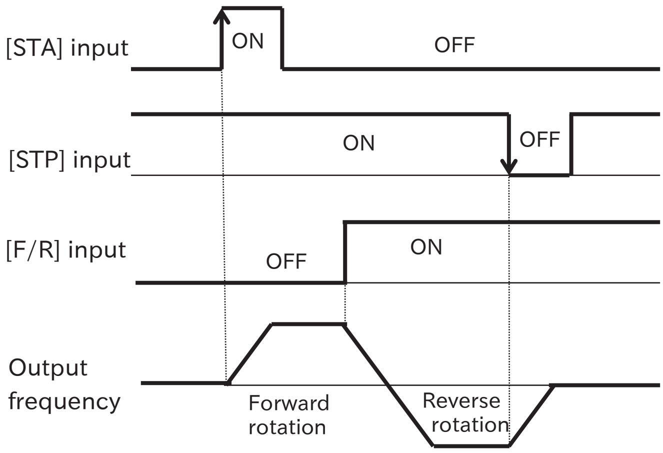
9.1.4 Operation by 3-wire control function

- To perform forward/reverse rotation and stop operation using 3-wire control function, set "RUN command input source selection [AA111]" to "3-wire (01)", and assign "3-wire start [STA](016)", "3-wire stop [STP](017)", and "3-wire forward/reverse [F/R](018)" to "Input terminal function ([CA-01] to [CA-08])".
- When the [STP] terminal is ON, operation is started by a rising-edge input on the [STA] terminal. When the [STP] terminal is turned off while the inverter is running, inverter will stop the operation.
- [STP] terminal is fixed to the b-contact (NC) input regardless of the setting of "Input terminal active state ([CA-21] to [CA-28])" for the corresponding terminal.

■Example of terminal assignment and operation when using 3-wire control function



This example shows a following terminal assignment.
Terminal [FR] = [STA]
Terminal [RR] = [STP]
Terminal [DFL] = [F/R]



Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	RUN and stop is performed using the [STA]/[STP] terminal from the control circuit terminal.	01	02
CA-01 to CA-08	Input terminal function	3-wire start [STA]: The start signal for the 3-wire control function. Operation starts when [STA] is ON while [STP] is ON (circuit is normally open due to the "b" contact state).	016	-
		3-wire stop [STP]: The stop signal for the 3-wire control function. It switches to the "b" (NC) contact state during assignment. The inverter stops when it is OFF state.	017	
		3-wire forward/reverse [F/R]: OFF = Forward rotation, ON = Reverse rotation	018	

- For the inverter to start operation, a frequency command is required in addition to a RUN command.

9.1.5 Operation by Modbus-RTU communication (RS485 communication)

・To perform forward/reverse rotation and stop operation using Modbus-RTU communication (RS485 communication), set the "RUN command input source selection [AA111]" to "RS485 (03)".

Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	Modbus-RTU communication (RS485 communication) commands are used to start and stop inverter operation.	03	02

・For the inverter to start operation, a frequency command is required in addition to a RUN command.
・For more information regarding Modbus-RTU communication (RS485 communication), refer to "Chapter 11 Modbus Communication".

9.1.6 Operation by communication option

・To perform forward/reverse rotation and stop operation using communication option, set the "RUN command input source selection [AA111]" to "Option (04)".

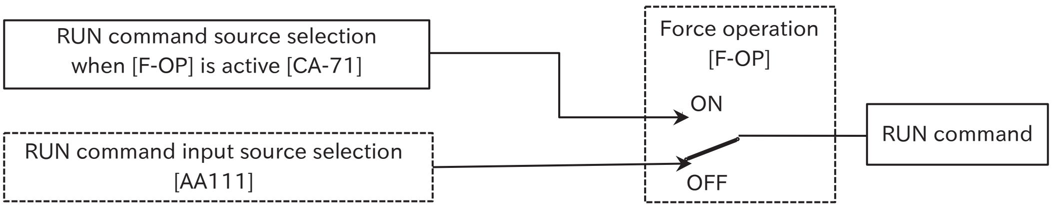
Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	Commands from the communication option are used to start and stop inverter operation.	04	02

・For the inverter to start operation, a frequency command is required in addition to a RUN command.
・For more information regarding communication option, refer to "Chapter 13 Communication Option".

9.1.7 Temporarily changing RUN command input source

・When the "Force operation [F-OP](023)" input terminal is turned ON, RUN command input source set in "RUN command source selection when [F-OP] is active [CA-71]" is switched in preference to RUN command input source set in "RUN command input source selection [AA111]".

■"Force operation [F-OP]" operation



Note: Functions not assigned to input terminals [FR] to [PLA] are OFF.

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Force operation [F-OP] : When [F-OP] input terminal is ON, the RUN command input source and frequency reference input source are switched to the setting of [CA-70]/[CA-71].	023	-
CA-71	RUN command source selection when [F-OP] is active	RUN/stop is performed using the "Forward [FR]"/"Reverse [RR]" input terminals assigned to the control terminal.	00	00
		RUN/stop is performed by the "3-wire start [STA]"/"3-wire stop [STP]" input terminals assigned to the control terminal.	01	
		RUN/stop is performed with RUN key and STOP/RESET key on the keypad.	02	
		RUN/stop is performed by a command from Modbus-RTU communication (RS485 communication).	03	
		RUN/stop is performed according to the command from the communication option.	04	

- When the "Force operation [F-OP]" input terminal is turned ON, the frequency reference input source is also the input source set to "Speed reference source selection when [F-OP] is active [CA-70]" is enabled. For details, refer to "9.2.15 Temporarily Changing the Frequency Reference".
- When the [F-OP] input terminal is turned ON/OFF and the RUN command input source is changed while the inverter is running, the drive will be stopped once. To start operation again, OFF the RUN command and ON it again. If the change by the [F-OP] input terminal is only the frequency reference input source, RUN state is continued.

9.1.8 Disabling the STOP/RESET key on the keypad

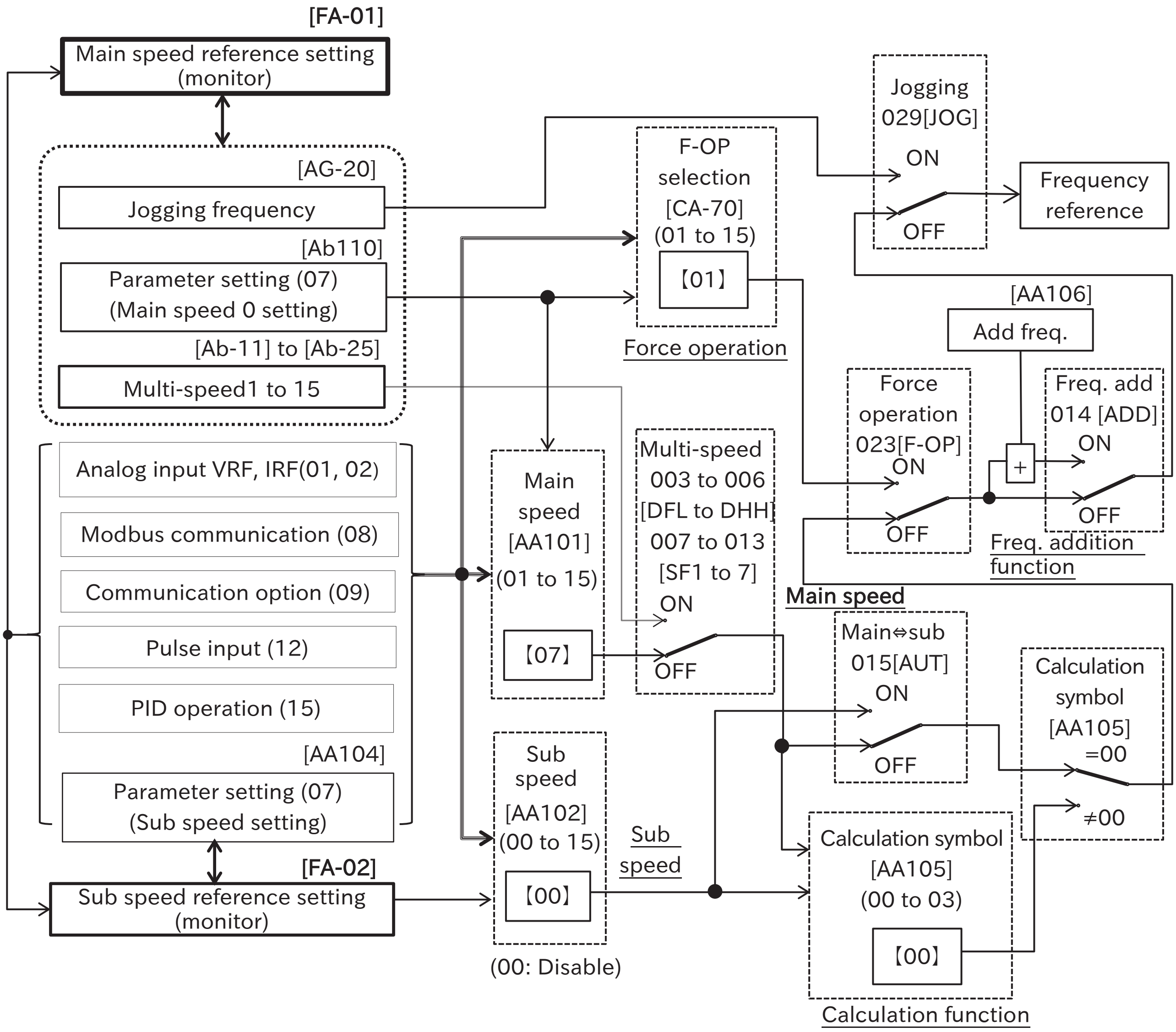
- When the "RUN command input source selection [AA111]" is set to anything other than "Keypad's RUN-key (02)", the inverter stop command from the keypad can be disabled by setting "STOP-key enable [AA-13]" to "Disable (00)" or "Enable at only trip reset (02)".
- To use the STOP/RESET-key only for trip reset, set the "STOP-key enable [AA-13]" to "Enable at only trip reset (02)".
- To issue a stop command from the keypad in an emergency event, set the "STOP-key enable [AA-13]" to "Enable (01)". The STOP/RESET-key can stop output even if the RUN command is issued by a source other than "Keypad's RUN-key (02)".
- When a stop command is issued from the keypad while the "Operation command selection [AA111]" is set to other than "Keypad's RUN-key (02)", the external command must be OFF once and ON again in order to operate again.
- The setting of [AA-13] is enabled when "RUN command input source selection [AA111]" is set to other than "Keypad's RUN-key (02)".

Code	Item	Description	Data	Initial value
AA111	RUN command input source selection	RUN/STOP command by "Forward [FR]"/"Reverse [RR]" input terminal	00	02
		RUN/STOP command by the 3-wire control function	01	
		RUN/STOP command from keypad	02	
		RUN/STOP command from modbus comunication	03	
		RUN/STOP command from communication option	04	
AA-13	STOP-key enable	Disable: The keypad STOP/RESET-key is disabled when the "RUN command input source selection [AA111]" is set to other than " Keypad's RUN-key (02)".	00	00
		Enable: The STOP/RESET-key on the keypad is always enabled.	01	
		Enable at only trip reset : The STOP/RESET-key on the keypad can be used to reset a trip only after the inverter has tripped.	02	

9.2 Selecting frequency reference

9.2.1 Types of frequency reference

- The following diagram shows the parameters and input terminal functions that affect the frequency reference input source selection.
- The frequency reference input source is set according to the "Main speed input source selection [AA101]". Note that when multiple functions are turned on, the frequency reference for each input terminal function is selected with the following order or priority: "Jogging [JOG]", "Force operation [F-OP]" and then "Multi-speed ([DFL] to [DHH])" or "Multi-speed bit ([SF1] to [SF7])".
- When the frequency reference input source is the multi-speed 0, multi-speed 1 to 15, or jogging frequency, the "Main speed reference setting (monitor) [FA-01]" can be used to change the frequency reference. A setting change with the [FA-01] also changes the value of the selected frequency input source parameter.
  (For example, when the frequency reference input source is set to "Multi-speed 1 setting [Ab-11]", [Ab-11] setting is displayed in [FA-01]. When [FA-01] is changed, this is also reflected in [Ab-11].)
- When the frequency reference input source is an analog input or Modbus communication, etc., [FA-01] is used to monitor the output frequency reference value.



Note: The values in 【 】 and the switch positions shown in the figure are the default values. All input terminal functions not assigned to "Input terminal function ([CA-01] to [CA-08])" are turned off.

・The following table shows the details of the frequency input sources that can be selected with the "Main speed input source selection [AA101]".

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	The frequency reference is set using analog input to terminal [VRF] on the control circuit terminal.	01	07
		The frequency reference is set using analog input to terminal [IRF] on the control circuit terminal.	02	
		The frequency reference is set according to the [FA-01] setting using the keypad or remote operator.	07	
		The frequency reference is set using Modbus communication.	08	
		The frequency reference is set using communication option.	09	
		The frequency reference is set using pulse input.	12	
		The frequency reference is set according to the calculation by PID function.	15	

・When issuing a RUN command from the PC software, "Main speed input source selection [AA101]" = "Parameter setting (07)" and "RUN command input source selection [AA101]" = "RS485 (03)" are forcibly written when the operation screen is opened. When the operation screen is closed, these values return to the original values set before the operation screen is opened.

9.2.2 Setting frequency reference by keypad

- To set the output frequency reference from the keypad or optional remote operator, set the "Main speed input source selection [AA101]" to "Parameter setting (07)".
- When [AA101] is set to "Parameter setting (07)", the output frequency is set by "Main speed reference setting (monitor) [FA-01]" or "Multi-speed 0 setting [Ab110]". Similarly, when "Sub speed input source selection [AA102]" is set to "Parameter setting (07)", the output frequency is set by "Sub speed reference setting (monitor) [FA-02]" or "Sub speed setting [AA104]".
  e.g. : When [FA-01] is changed, [Ab110] is also changed to same value.
  When "2nd control [SET]" is ON, "Multi-speed 0 setting, 2nd motor [Ab210]" is changed.
- When [AA101] is set to "Parameter setting (07)", or the frequency reference from the keypad has been switched by the input terminal function "Force operation [F-OP]", the output terminal function "Frequency reference = Keypad selected [FREF]" is ON when the frequency reference from the keypad or the remote operator is accepted. For details of [F-OP] input terminal, refer to "9.2.15 Temporarily Changing the Frequency Reference".
- For details regarding operation when a remote operator is connected, refer to "7.2.9 Remote Operator Functions".

Code	Item	Description	Data	Initial value
FA-01	Main speed reference setting (monitor)	This parameter is used when setting the frequency reference of main speed from the keypad. Changing [FA-01] will also change [Ab110].	0.00 to Max. frequency Hz	-
FA-02	Sub speed reference setting (monitor)	This parameter is used when setting the frequency reference of sub speed from the keypad. Changing [FA-02] will also change [AA104].	0.00 to 590.00 Hz	
AA101	Main speed input source selection	From the keypad, set the main speed with the parameter setting. Use [FA-01] or [Ab110] to set the output frequency of main speed.	07	07
AA102	Sub speed input source selection	From the keypad, set the sub speed with the parameter setting. Use [FA-02] or [AA104] to set the output frequency of sub speed.	07	00
AA104	Sub speed setting	This parameter is used to set the sub speed from the keypad.	0.00 to 590.00 Hz	0.00
Ab110	Multi-speed 0 setting	This parameter is used to set the main speed from the keypad.	0.00 to Max. frequency Hz	10.00
CC-01 CC-02 CC-07	Output terminal function	Frequency reference = Keypad selected [FREF]: Turns on when the output frequency reference can be set from the keypad.	010	002 001 017

- Main speed and sub speed are selected or calculated by ON/OFF of the input terminal function "Main/sub speed reference change [AUT]" and "Speed reference calculation symbol selection [AA105]". For details, refer to "9.2.12 Setting Frequency Reference by selection/calculation two frequency reference ".
- When the input terminal functions "Multi-speed ([DFL] to [DHH])", "Multi-speed Bit ([SF1] to [SF7])", "Jogging [JOG]" or "Force operation [F-OP]" are turned on, those frequency references are given priority regardless of the "Main speed input source selection [AA101]". Note that changing parameter [FA-01] while any of these terminal functions are turned on will also change the frequency setting parameter of each function.
- When [AA101] is set to "Parameter setting (07)" and "Enable frequency changes through monitor display [UA-93]" is set to "Enable (01)", the frequency command can be changed using "Output frequency monitor [dA-01]" or "Output frequency scale conversion monitor [dA-06]". For details, refer to "10.1.1 Monitor the Output Frequency".

9.2.3 Setting frequency reference by analog input (Voltage/Current)

- To set the output frequency reference with analog voltage input or analog current input from the terminal [VRF]/[IRF] on the control circuit terminal, set "Main speed input source selection [AA101]" to "Terminal [VRF] (01)" or "Terminal [IRF] (02)".
- When [AA101] is set to "Terminal [VRF] (01)" or "Terminal [IRF] (02)", "Main speed reference setting (monitor)[FA-01]" becomes the output frequency reference monitor and displays the output frequency setting value corresponding to the selected analogue input value.
- Whether to use analog voltage input or analog current input can be selected by "[VRF] Input selection [Cb-08]" or "[IRF] Input selection [Cb-18]". By default, terminal [VRF] is set to analog voltage input (0 to 10V) and the terminal [IRF] is set to analog current input (4 to 20mA).
- HF-620 is adjusted at factory so that a 9.8V or a 19.8mA input from the terminal [VRF]/[IRF] are the full scale of the input (the maximum frequency setting for frequency command). This can be fine-tuned as necessary. For details regarding adjustment, refer to "9.15.3 Adjusting the Analog Input".

Code	Item	Description	Data	Initial value
FA-01	Main speed reference setting (monitor)	Displays the output frequency set value according to the selected analog input value. When analog input is selected as the frequency reference, this parameter is treated as a monitor and cannot be changed directly.	0.00 to Max. frequency Hz	-
AA101	Main speed input source selection	Set the output-frequency using the analog input to the terminal [VRF] on the control-circuit terminal.	01	07
		Set the output-frequency using the analog input to the terminal [IRF] on the control-circuit terminal.	02	
Cb-08	[VRF] Input selection	Terminal [VRF] use analog voltage input.	01	01
		Terminal [VRF] use analog current input.	02	
Cb-18	[IRF] Input selection	Terminal [IRF] use analog voltage input.	01	02
		Terminal [IRF] use analog current input.	02	

9.2.4 Setting frequency command by multi-speed operation function

- The multi-speed operation function allows switching of several preset frequency references by ON/OFF pattern of the "multi-speed ([DFL] to [DHH]) (003 to 006)" input terminal or the "multi-speed bit ([SF1] to [SF7]) (007 to 013)" input terminal.
- When multi-speed 1 to 15 is selected, priority is given to the multi-speed reference regardless of the "Main speed input source selection [AA101]" setting. However, when input terminal function "Jogging [JOG]" and "Force operation [F-OP]" are ON, the frequency command of every input terminal function will be selected with precedence in this order.
- The following 2 modes can be selected for the multi-speed operation function according to the setting of "Multi-speed operation selection [Ab-03]".
  - Binary operation mode:
    It is possible to switch between up to 16 different speeds from multi speed 0 to 15 according to the ON/OFF pattern of the 4 input terminal functions ([DFL] to [DHH]). The time until the frequency reference is changed at the time of signal input can be set by "Multistage input determination time [CA-55]".
  - Bit operation mode:
    It is possible to switch between up to 8 different speeds from 0 to 7 according to which of the seven input terminal function ([SF1] to [SF7]) is turned on. The setting of "Multistage input determination time [CA-55]" is not applied to the bit operation mode.
- When all multi-speed input terminal functions [DFL] to [DHH] and [SF1] to [SF7] are off, multi-speed 0 operates at the frequency reference value set by the "Main speed input source selection [AA101]".

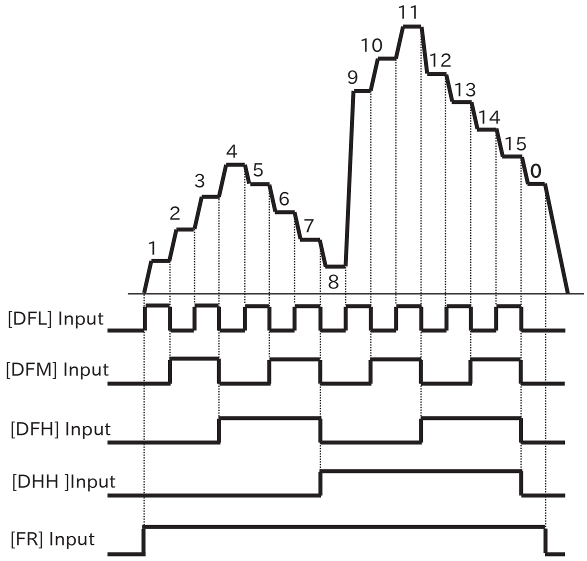
Code	Item	Description	Data	Initial value
FA-01	Main speed reference setting (monitor)	Change the frequency reference of the multi-speed currently selected. (For example, when you change [FA-01] at the time of the multi-speed 2, [Ab-12] will be changed to the same value at the same time.)	0.00 to Max. frequency Hz	-
Ab-03	Multi-speed operation selection	Binary operation mode up to 16 speeds	00	00
		Bit operation mode of up to 8 speeds	01	
Ab110	Multi-speed 0 setting	Multi-speed 0 when "Main speed input source selection [AA101]" is "parameter (07)".	0.00 to Max. frequency Hz	10.00
Ab-11	Multi-speed 1 setting	Parameters for setting frequency reference of multi-speed 1.		20.00
Ab-12	Multi-speed 2 setting	Parameters for setting frequency reference of multi-speed 2.		30.00
Ab-13	Multi-speed 3 setting	Parameters for setting frequency reference of multi-speed 3.		40.00
Ab-14 to Ab-25	Multi speed 4 to 15 setting	Parameters for setting frequency reference of multi-speed 4 to 15.		0.00
CA-01 to CA-08	Input terminal function	Multi-speed selection 1 [DFL] to Multi speed selection 4 [DHH]: Multi-speed input terminal for binary operation (maximum. 16-speeds).	003[DFL] 004[DFM] 005[DFH] 006[DHH]	-
		Multi-speed selection Bit-1 [SF1] to Multi-speed selection Bit-7 [SF7]: Multi-speed input terminal for bit operation (maximum. 8 speeds).	007[SF1] 008[SF2] 009[SF3] 010[SF4] 011[SF5] 012[SF6] 013[SF7]	
CA-55	Multistage input determination time	This is the time until the output frequency reference is determined when the multi-speed switching is performed in the binary operation mode.	0 to 2000 ms	0

Binary operation mode (Maximum 16-speed commands: [Ab-03] = 00)

・Multi-speed 0 to 15 can be switched by assigning "Multi-speed selection ([DFL] to [DHH])" to "Input terminal function ([CA-01] to [CA-08])".

■Bit operation mode control table

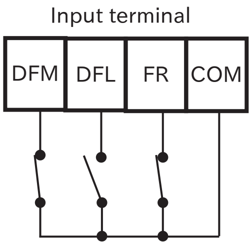
Multi-speed	DHH	DFH	DFM	DFL	Frequency refernece
0 Note	OFF	OFF	OFF	OFF	Ab110
1	OFF	OFF	OFF	ON	Ab-11
2	OFF	OFF	ON	OFF	Ab-12
3	OFF	OFF	ON	ON	Ab-13
4	OFF	ON	OFF	OFF	Ab-14
5	OFF	ON	OFF	ON	Ab-15
6	OFF	ON	ON	OFF	Ab-16
7	OFF	ON	ON	ON	Ab-17
8	ON	OFF	OFF	OFF	Ab-18
9	ON	OFF	OFF	ON	Ab-19
10	ON	OFF	ON	OFF	Ab-20
11	ON	OFF	ON	ON	Ab-21
12	ON	ON	OFF	OFF	Ab-22
13	ON	ON	OFF	ON	Ab-23
14	ON	ON	ON	OFF	Ab-24
15	ON	ON	ON	ON	Ab-25



Note: Multi-speed 0 is the frequency reference set by the "Main speed input source selection [AA101]".

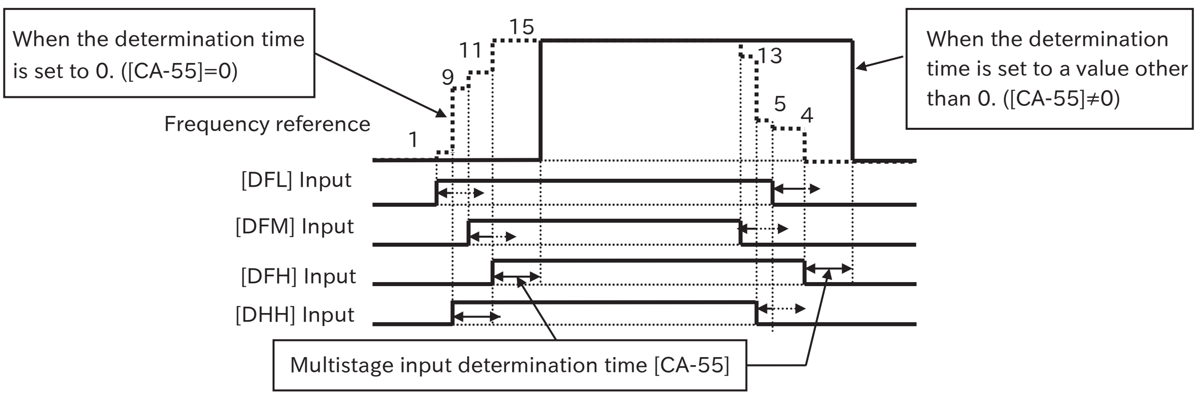
■Example of binary operation mode (When multi-speed 2 is selected)

・[CA-06]="Multi-speed seection 1 [DFL]" and [CA-07]="Multi-speed selection 2 [DFM]" are assigned. [DFH] and [DHH] are not assigned.
When only the input terminal [RST] =[DFM] is ON, the frequency reference will be multi-speed 2, and the setting of "Multi-speed 2 [Ab-12]" will be displayed in the "Main speed reference setting (monitor) [FA-01]".



Multi-speed	DHH	DFH	DFM	DFL
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON

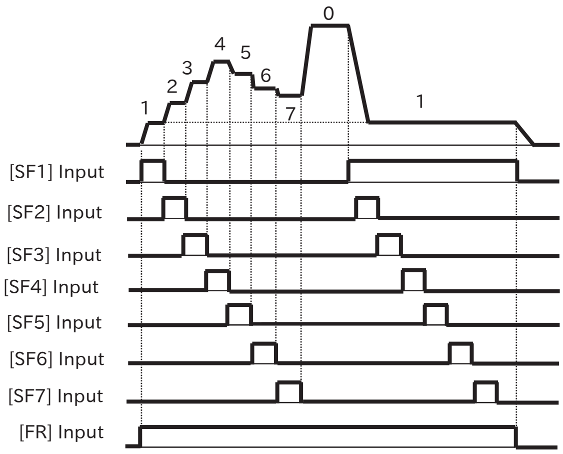
・When using binary operation mode, the wait time until the multi-speed command is determined can be set by "Multistage input determination time [CA-55]". This function can prevent unintended change of multi-speed during multi-speed terminal switching.
・After the last rising/falling edge input to the multi-speed terminal, the multi-speed command is determined after the [CA-55] set time has elapsed. Note that the input response will be slower when the settling time is increased.



Bit operation mode (Maximum 8-speed commands: [Ab-03] = 00)

- Multi-speed 0 to 7 can be switched by assigning "Multi-speed Bit ([SF1] to [SF7])" to "Input terminal function ([CA-01] to [CA-08])".
- When multiple multi-speed bit input terminals are turned on simultaneously, the one with the lowest number is given priority.
- In the cells marked with an "x" in the table below, ON/OFF state of the terminal is ignored.

■Bit operation mode control table



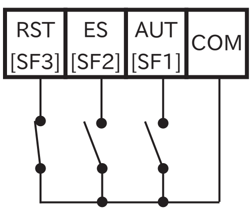
Multi-speed	SF7	SF6	SF5	SF4	SF3	SF2	SF1	Frequency reference
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Ab110 Note
1	×	×	×	×	×	×	ON	Ab-11
2	×	×	×	×	×	ON	OFF	Ab-12
3	×	×	×	×	ON	OFF	OFF	Ab-13
4	×	×	×	ON	OFF	OFF	OFF	Ab-14
5	×	×	ON	OFF	OFF	OFF	OFF	Ab-15
6	×	ON	OFF	OFF	OFF	OFF	OFF	Ab-16
7	ON	OFF	OFF	OFF	OFF	OFF	OFF	Ab-17

Note: Multi-speed 0 is the frequency reference set by the "Main speed input source selection [AA101]".

■Example of bit operation mode (When multi-speed 3 is selected)

- [CA-05]="Multi-speed bit 1 [SF1]", [CA-06]="Multi-speed bit 2 [SF2]" and [CA-07]="Multi-speed bit 3 [SF3]" are assigned. [SF4] to [SF7] are not assigned.
  When only input terminal [RST] = [SF3] is ON, the frequency reference will be multi-speed 3, and the setting of "Multi-speed 3-speed [Ab-13]" will be displayed in " Main speed reference setting (monitor) [FA-01]".

Input terminal



Multi-speed	SF7	SF6	SF5	SF4	SF3	SF2	SF1
1	×	×	×	×	×	×	ON
2	×	×	×	×	×	ON	OFF
3	×	×	×	×	ON	OFF	OFF

- "Multistage input determination time [CA-55]" is valid only when binary operation mode is selected. Not applicable to bit operation mode.

9.2.5 Setting frequency command for Jogging and inching operation

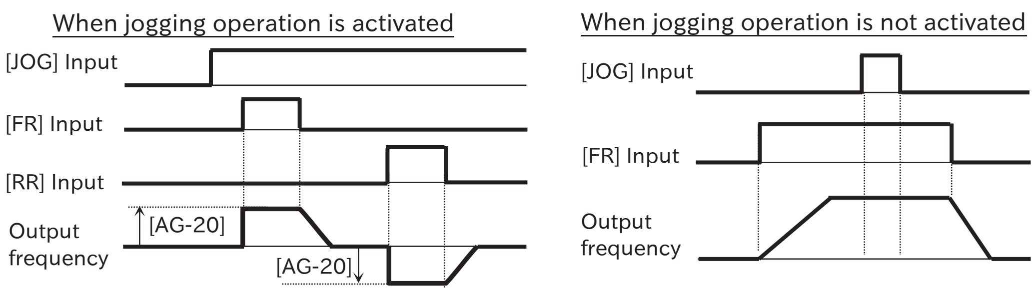
- Jogging operation allows positioning and fine adjustments while the motor is stopped. After the "Jogging [JOG]" input terminal is turned on, jogging operation can be started by giving the RUN command.
- During jogging operation, a frequency reference is set according to "Jogging frequency [AG-20]" setting without including an acceleration time. This can easily lead to issue such as an overcurrent trip. Be sure to appropriately adjust the [AG-20] to avoid a trip.
- Jogging operation is given priority over "Main speed input source selection [AA101]", "Multi-speed selection ([DFL] to [DHH])", "Multi-speed Bit ([SF1] to [SF7])" and "Force operation [F-OP]".

Code	Item	Description	Data	Initial value
AG-20	Jogging frequency	Set the frequency reference value during jogging operation.	0.00 to 10.00 Hz	5.00
AG-21	Jogging stop mode selection	Disable [JOG] input during RUN, free-run when stopped Note:1	00	01
		Disable [JOG] input during RUN, deceleration stop when stopped	01	
		Disable [JOG] input during RUN, DC braking when stopped Note:2	02	
		Enable [JOG] input during RUN, free-run when stopped Note:1	03	
		Enable [JOG] input during RUN, deceleration stop when stopped	04	
		Enable [JOG] input during RUN, DC braking when stopped Not:2	05	
CA-01 to CA-08	Input terminal function	Jogging [JOG]: When the RUN command is ON after this terminal is turned ON, the jogging operation is performed.	029	-

Note: 1. When [AG-21] is "Free run when stopped (00, 03)", operation setting of free-run is required. For details, refer to section 9.7.6, Starting after Stopping Free-run.
2. When [AG-21] is "DC braking when stopped (02, 05)", DC braking must be set. For details, refer to section 9.7.8, "Applying DC Braking to Stop."

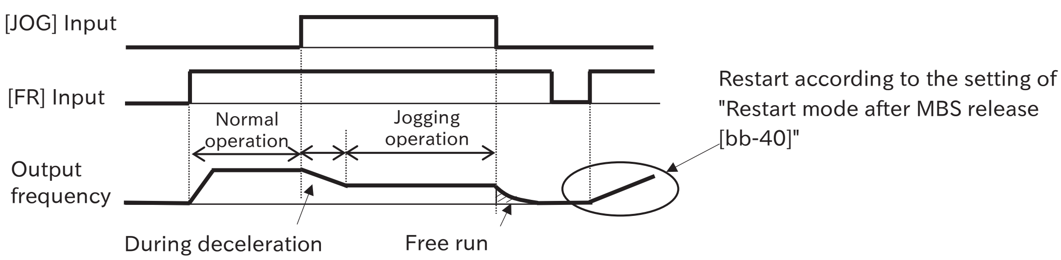
■Jogging operation disable during RUN [AG-21]= Disable at RUN (00, 01, 02)

- When the setting of "Jogging stop mode selection [AG-21]" is "Disabled at RUN (00, 01, 02)", the jogging operation cannot be performed when the RUN command ON first.



■Jogging operation enable during RUN [AG-21]=Enable at RUN (03, 04, 05)

- When the setting of "Jogging stop mode selection [AG-21]" is "Enabled at RUN (03, 04, 05)", the jogging operation can be performed even if the RUN command ON first. However, when [JOG] input terminal OFF first, it will become free-run stop.



9.2.6 Setting frequency reference by Modbus-RTU communication

・To set output-frequency command by Modbus-RTU communication (RS485 communication), set "RS485 (08)" to "Main speed input source selection [AA101]".

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	Sets output-frequency command from Modbus communication (RS485 communication).	08	07

・For details of Modbus communication, "Chapter 11 Modbus Communication".

9.2.7 Setting frequency reference by communication option

・To set the output frequency command using a communication option board, set the " Main speed input source selection [AA101]" parameter to "Option (09)".

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	Set the output frequency reference from the communication option.	09	07

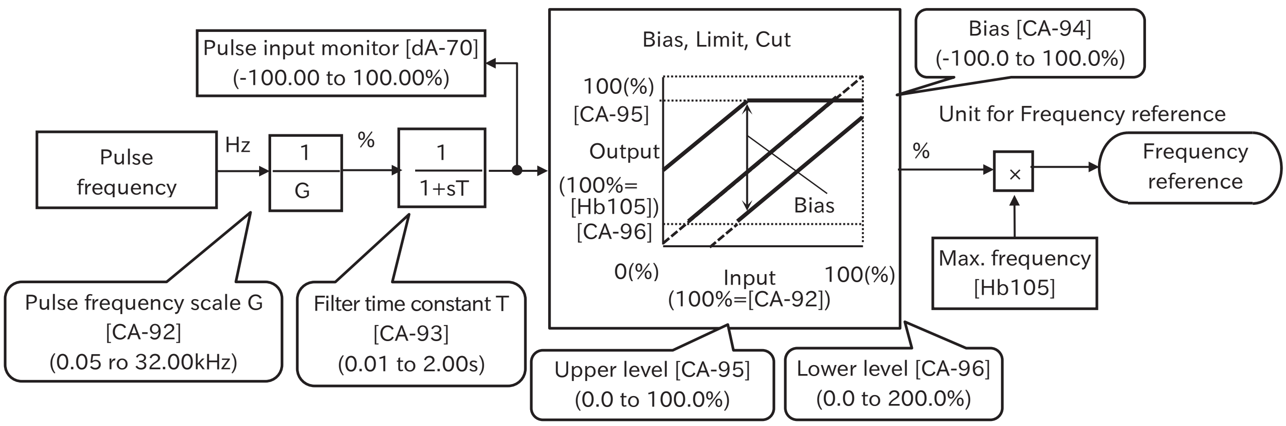
・For details of communication option, "Chapter 13 Communication Option".

9.2.8 Setting frequency reference by pulse input

- To set the output frequency reference by pulse input, set "Main speed input source selection [AA101]" to "Pulse input (12)". At the same time, set "Pulse input target function selection [CA-90]" to "Frequency reference (01)". Depending on the setting of [CA-90], the input terminal [8] becomes the terminal for A-phase pulse input and the input terminal [RST] becomes the terminal for B-phase pulse input.
- Set the input pulse frequency at which the frequency reference corresponds to the "Async. Motor maximum frequency [Hb105]" in "Pulse input frequency scale [CA-92]".
- Pulse input can be monitored by "Pulse input monitor [dA-70]".
- To limit the pulse input frequency reference, set "Pulse input frequency bias value [CA-94]", "Pulse input upper frequency detection level [CA-95]" and "Pulse input lower frequency detection level [CA-96]".
- Attempting to stop the inverter by turning 0Hz the pulse input frequency may cause the deceleration to stagnate. If this happens, turn OFF the operation command to stop.
- When the pulse input frequency falls below [CA-96], it will be processed assuming that 0 Hz is being input.
- When the setting of [CA-96] is large, the start may be slow.

Code	Item	Description	Data	Initial value
dA-70	Pulse input monitor	Monitor the frequency of the input pulse as a percentage with [CA-92] as 100%. This monitor is enabled when [CA-90] is set to "Frequency reference (01)".	-100.00 to 100.00 %	-
AA101	Main speed input source selection	Setting when pulse input is used as frequency reference.	12	07
CA-90	Pulse input target function selection	Setting when pulse input is used as frequency command.	01	01
CA-92	Pulse input frequency scale	Enter the pulse frequency equivalent to the highest frequency.	0.05 to 32.00 kHz	25.00
CA-93	Pulse input frequency filter time constant	Filters the input pulse frequency.	0.01 to 2.00 s	0.10
CA-94	Pulse input frequency bias value	Applies a bias to the input pulse frequency.	-100.0 to 100.0 %	0.0
CA-95	Pulse input upper frequency detection level	Set the upper limit as a percentage of "Async. Motor maximum frequency [Hb105]" to 100% of the input pulse frequency reference.	0.0 to 100.0 %	100.0
CA-96	Pulse input lower frequency detection level	This parameter sets the frequency reference by pulse input to be 0.0% below the frequency set by the ratio that [Hb105] is 100%.	0.0 to 100.0 %	1.0

■Pulse frequency reference processing block diagram



9.2.9 Setting frequency reference by PID control

・To use the calculation result by PID function as the frequency reference input source, set "PID calculation (15)" to "Main speed input source selection [AA101]". In addition, the parameters related to PID function must be set. For details, refer to "Making 9.8 PID Processing Control".

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	Set the output frequency reference in PID function.	15	07

9.2.10 Select and calculate two frequency references

・By setting of " Speed reference calculation symbol selection [AA105]", the following can be selected.
- When [AA105] is "Disable (00)":
  By input terminal function "Main/Sub speed reference change [AUT](015)", the frequency reference input source is switched between "Main speed input source selection [AA101]" and "Sub speed input source selection [AA102]".
- When [AA105] is other than "Disable (00)":
  The frequency reference is the result of the calculation (addition/subtraction/multiplication) specified in [AA105] for the frequency specified in "Main speed input source selection [AA101]" and "Sub speed input source selection [AA102]".

・Only [AA102] can be set to "Disable (00)". The operation when another frequency reference input source is set is the same as the setting of [AA101]. For details of each choice, refer to the description of [AA101].

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	For details, refer to "9.2.1 Types of Frequency Reference".	-	07
AA102	Sub speed input source selection	Disable (Sub speed only)	00	00
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		Parameter setting	07	
		Modbus communication	08	
		Communication option	09	
		Pulse input	12	
		PID control	15	
AA104	Sub speed setting	Parameter for frequency reference input source setting of sub speed when [AA102] is set to "Parameter setting (07)".	0.00 to 590.00Hz	0.00
AA105	Speed reference calculation symbol selection	Disable: Frequency reference = Main speed or Sub speed	00	00
		Addition: Frequency reference = Main speed + Sub speed	01	
		Subtraction: Frequency reference = Main speed - Sub speed	02	
		Multiplication: Frequency reference = Main speed × Sub speed	03	
CA-01 to CA-08	Input terminal function	Main/Sub speed reference change [AUT]: When [AA105] is set to "Disable (00)", it is posible to switch between main speed and sub speed with this input terminal function. ON: Sub speed enabled OFF: Main speed enabled	015	-

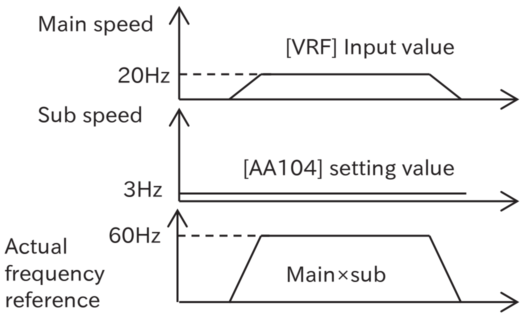
・Input terminal function "Remote control speed-up function [UP]" and " Remote control speed-down function [DWN]" is enabled when the setting (parameter setting, multi-speed setting, or "analog command hold [AHD]" operation in the analog input setting) in which this function is enabled as the main speed input source is selected.

・The same command destination can be selected for "Main speed input source selection [AA101]" and "Sub speed input source selection [AA102]", and can also be calculated by squared by the Multiplication.

■Example of frequency math function

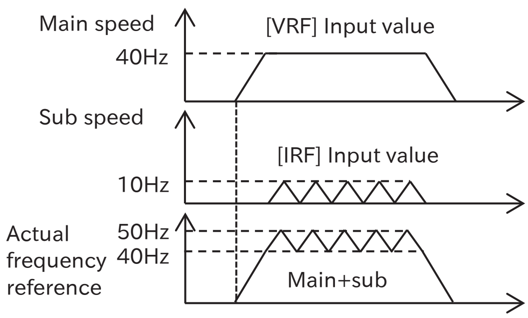
(e.g. 1) Applying gain

[AA101] = Terminal [VRF] (01)
[AA102] = Parameter setting (07)
[AA104] = 3.00Hz
[AA105] = Multiplication (03)



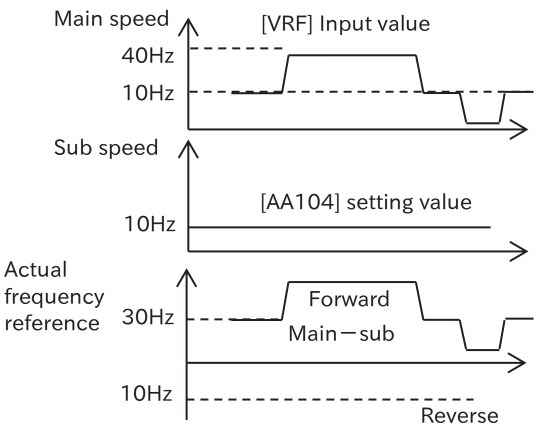
(e.g. 2) Addition

[AA101] = Terminal [VRF] (01)
[AA102] = Terminal [IRF] (02)
[AA105] = Addition (01)



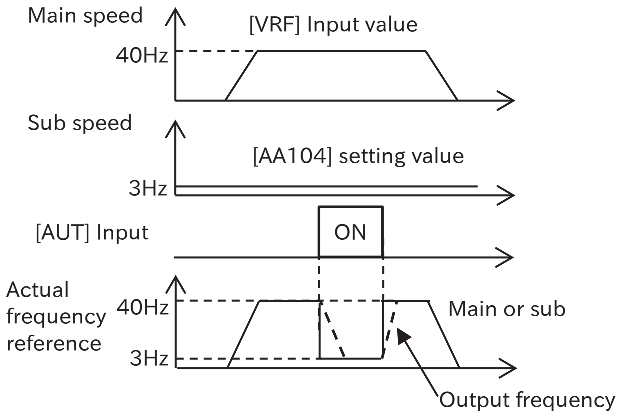
(e.g. 3) High-speed forward rotation and Low-speed reverse rotation

[AA101] = Terminal [VRF] (01)
[AA102] = Parameter setting (07)
[AA104] = 10.00Hz
[AA105] = Subtraction (02)



(e.g. 4) Switching between 2 references

[AA101] = Terminal [VRF] (01)
[AA102] = Parameter setting (07)
[AA104] = 3.00 Hz
[AA105] = Disable (00)



9.2.11 Increasing/Decreasing frequency command

- When the " Trigger for frequency addition [ADD](014)" input terminal is turned ON, the frequency set in the "Add frequency setting [AA106]" is added or subtracted from the frequency reference.
- Addition and subtraction are determined by the sign of "Add frequency setting [AA106]".

Code	Item	Description	Data	Initial value
AA106	Add frequency setting	Sets the frequency to add.	-590.00 to 590.00 Hz	0.00
CA-01 to CA-08	Input terminal function	Trigger for frequency addition [ADD]: When this terminal is turned ON, [AA106] is added to the frequency reference.	014	-

- Frequency addition by "Trigger for frequency addition [ADD]" is performed within the frequency limit range. Therefore, when the upper/lower limit setting or the maximum frequency setting is exceeded, the frequency reference is limited.
- Frequency addition by [ADD] input terminal is disabled for the jogging function.
- "UP/DWN data save enable [CA-61]", the frequency reference value saved in the inverter internal memory does not include the frequency addition by [ADD] input terminal. Note
- When the sign of the frequency reference changes ((-) → (+), (+) → (-)), the rotation direction is reversed. This function is also available for PID targets.

Note: For details, "9.2.14 Increasing/Decreasing Frequency Reference by Remote Control ".

9.2.12 Increasing/Decreasing frequency reference by remote control

Remote control function ([UP]/[DWN]/[UDC] input terminal function)

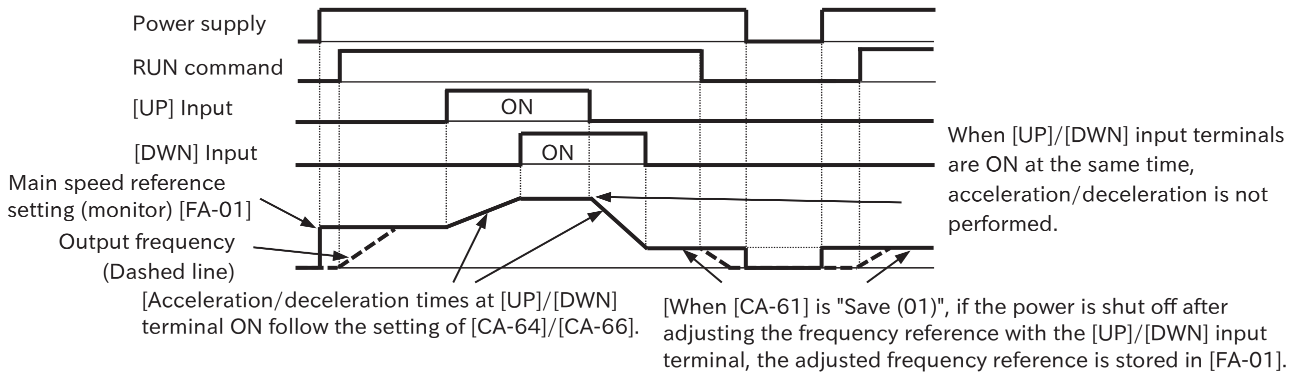
- The remote control function accelerates or decelerates the present frequency reference by turning on "Remote control speed-up function [UP](020)" or "Remote control speed-down function [DWN](021)" input terminals.
- This function is enabled when the frequency reference input source is as follows. It is invalid for the jogging function.
  - When "Main speed input source selection [AA101]" is "Parameter setting (07)".
  - When the frequency reference input source is a multi-speed function.
  - When "Main speed input source selection [AA101]" is the analogue input of "Terminal [VRF] (01)" or "Terminal [IRF] (02)", and "Analog command holding [AHD]" input terminal is ON.
- When "UP/DWN data save enable [CA-61]" is "Save (01)", the frequency reference value after [UP]/[DWN] input is stored in the inverter internal-memory when the power is turned off and when the frequency reference input source is switched.
- The acceleration/deceleration time when [UP]/[DWN] input terminal is ON follows "Acceleration time setting for UP/DWN function [CA-64]"/"Deceleration time setting for UP/DWN function [CA-66]".
- When the "Remote control Speed data clearing [UDC](022)" input terminal is turned ON, the frequency reference value adjusted by the [UP]/[DWN] input terminal will be the original value saved prior to adjustment by the [UP]/[DWN] input terminal or 0 Hz according to the setting of the "UP/DWN/UDC selection [CA-62]".

Code	Item	Description	Data	Initial value
CA-60	UP/DWN overwrite target selection	Overwrite the frequency reference value (multi-speed 0 ([Ab110] or [FA-01]), multi-speed 1 to 15 ([Ab-11] to [Ab-25]) and analog input holding value by [AHD] input terminal).	00	00
		Overwrite PID1 target value 1.	01 Note:1	
CA-61	UP/DWN data save enable	Not save: When the power is turned off or the frequency input source is switched, the frequency reference value that was accelerated/decelerated by [UP]/[DWN] is not saved in the internal memory.	00	00
		Save: When the power is turned off or the frequency input source is switched, the frequency reference value that was accelerated/decelerated by [UP]/DWN] is saved in the internal memory.	01	
CA-62	UP/DWN/UDC selection	0Hz: Cleared to 0Hz	00	00
		Saved data: Change to the data saved before using [UP]/[DWN] input terminals.	01	
CA-64	Acceleration time setting for UP/DWN function	Set the acceleration time when [UP]/[DWN] is turned on.	0.00 to 3600.00 s	10.00
CA-66	Deceleration time setting for UP/DWN function	Set the deceleration time when [UP]/[DWN] is turned on		
CA-01 to CA-08	Input terminal function	Remote control Speed-UP function [UP]: When this terminal is ON, the frequency reference is incleased.	020	-
		Remote control Speed-DOWN function [DWN]: When this terminal is ON, the frequency reference is decreased.	021	
		Remote control Speed data clearing [UDC]: When this terminal is ON, the frequency rederence is cleared. The value at clearing follows the setting of [CA-62].	022	

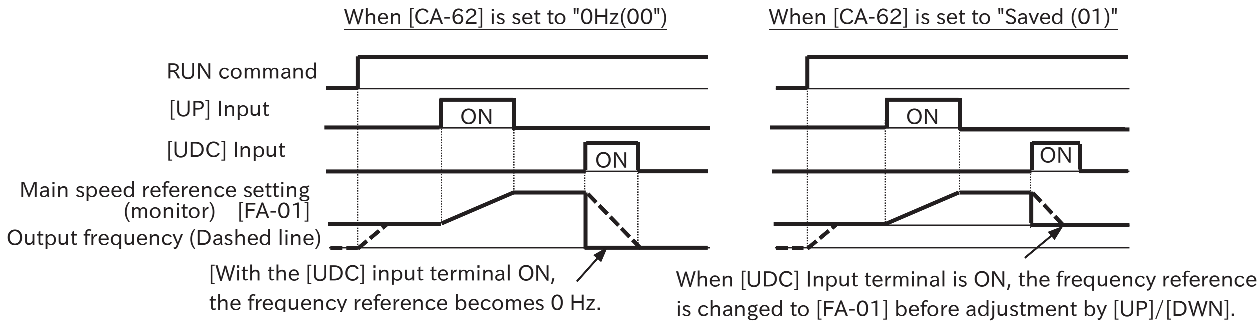
- Do not ON/OFF [UP]/[DWN] input terminal or operate the dial on the keypad immediately after turning off the power. The changed frequency reference may not be memorized correctly.
- When "[UP]/[DWN] data save enable [CA-61]" is set to "Save (01)", [Ab110]/[Ab-11] to [Ab-25], [FA-01], and [dA-01]/[dA-06] Note:2 frequency references can be changed using the dial. In this case, even if SET key is not pressed, the changed values are stored in the inverter's internal memory when the power is turned off.

Note: 1. For details, refer to "9.8.2 Using PID1 control".
2. For details, refer to "10.1.1 Monitor the output frequency".

■[UP]/[DWN] Operation of the remote control function (When the frequency command is [FA-01])



■Operation of "Remote control Speed data clearing [UDC]"

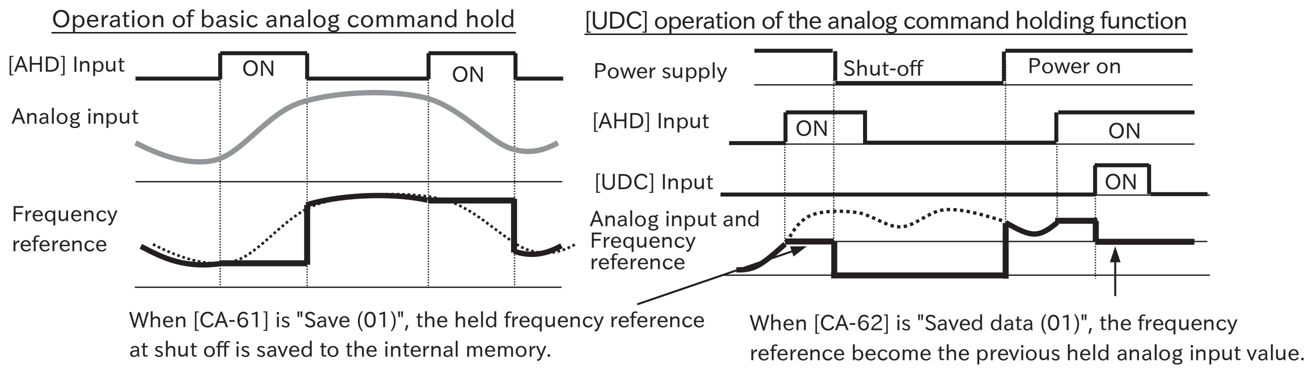


Analog command holding function (Input terminal function [AHD])

- The analog command holding function holds the analog input when the "Analog command holding [AHD](019)" input terminal ON, and returns to the analog command when it OFF.
- While the [AHD] input terminal is ON, [UP]/[DWN] can be used to increase or decrease the analogue input.
- When "[UP]/[DWN] data save enable [CA-61]" is "Save (01)", the analog input value adjusted by [FUP]/[FDN] input terminal is stored in the inverter as "Frequency command value of the analog input held" when the power is cut off.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal funciton	Analog command holding [AHD]: This terminal retains the analog input-value at ON of this terminal for as long as it is ON.	019

■Operation diagram of analog command holding function (Using [AHD] and [UDC] for Analog Frequency Reference)

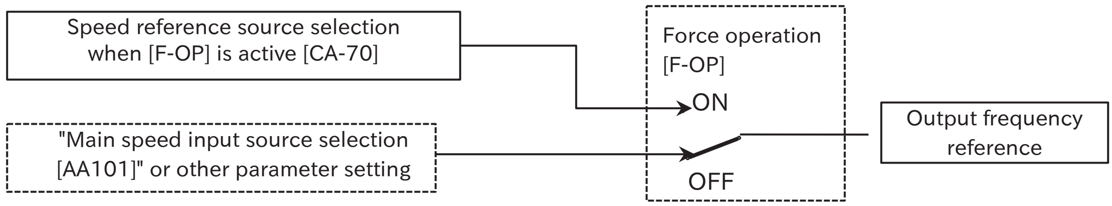


- When the power is turned on with "Analog command holding [AHD]" turned ON or "Reset [RS]" input terminal turned ON → OFF, the data held immediately before is adopted.
- When the 1st/2nd control is switched by the "2nd-motor control [SET]" input terminal while [AHD] input terminal is ON, the held analog input remains as it is. To switch the 1st/2nd control, turn OFF and hold the [AHD] input terminal.

9.2.13 Temporarily changing the frequency reference input source

- When the "Force operation [F-OP](023)" input terminal is turned ON, the frequency reference input source set in the "Speed reference source selection when [F-OP] is active [CA-70]" takes precedence over the frequency command destination set in the "Main speed input source selection [AA101]".

■Operation of "Force operation [F-OP]"



Note: Input terminal functions not assigned to input terminals [FR] to [PLA] are OFF.

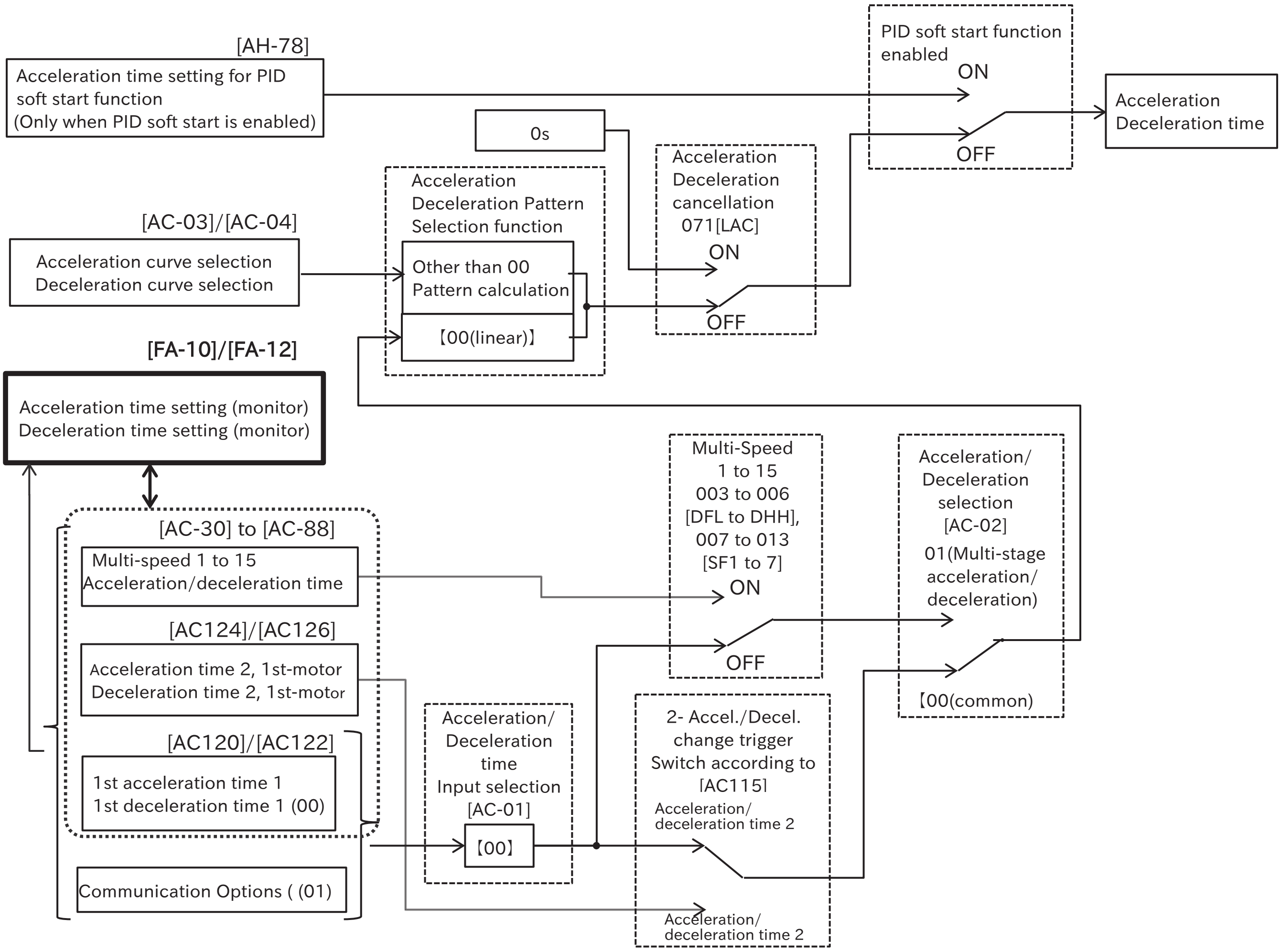
Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Force operation [F-OP]: When this terminal is ON, the RUN command and frequency reference input source are switched to the setting of [CA-70]/ [CA-71].	023	-
CA-70	Speed reference source selection when [F-OP] is active	Set the output-frequency using the analog input to the [VRF] terminal on the control-circuit terminal.	01	01
		Set the output-frequency using the analog input to the [IRF] terminal on the control-circuit terminal.	02	
		From the keypad, set the output frequency using the parameter settings. Use [FA-01] or [Ab110] to set the output frequency.	07	
		Set the output-frequency from Modbus-RTU communication (RS485 communication).	08	
		Set the output-frequency from communication option.	09	
		Set the output-frequency by pulse input to the control terminal.	12	
		Set the target value when PID function is enabled.	15	

- When the "Force operation [F-OP]" input terminal is turned ON, the RUN command source is also set to "RUN command source selection when [F-OP] is active [CA-71]". For details, refer to "9.1.7 Temporarily Changing RUN Command Input Source".
- When [F-OP] input terminal is turned ON/OFF and the RUN command input source is changed while the inverter is running, the drive will be stopped once. To start operation again, OFF the RUN command and ON again. When the change by [F-OP] input terminal is only the frequency reference input source, the operation state is continued.

9.3 Acceleration/Deceleration function

9.3.1 Change the acceleration/deceleration time

- Set the acceleration/deceleration time of the motor. Set a long time for slow acceleration/deceleration and a short time for fast acceleration/deceleration.
- The acceleration/deceleration time sets the time from 0Hz to the maximum frequency setting.
- The acceleration/deceleration time can also be changed during operation according to the command of the two-stage acceleration/deceleration function. For details, refer to "9.3.2 Switching Acceleration/Deceleration Time in Two Stages".
- Acceleration/deceleration can be slowly started by "Acceleration pattern selection [AC-03]", "Deceleration pattern selection [AC-04]". For details, refer to "9.3.4 Changing Acceleration/Deceleration Pattern".
- When the "LAD Cancellation [LAC](071)" input terminal is turned ON, the acceleration/deceleration time becomes 0 seconds and the output frequency instantaneously follows the frequency command. For details, refer to "9.3.5 Momentarily following a frequency to a command".

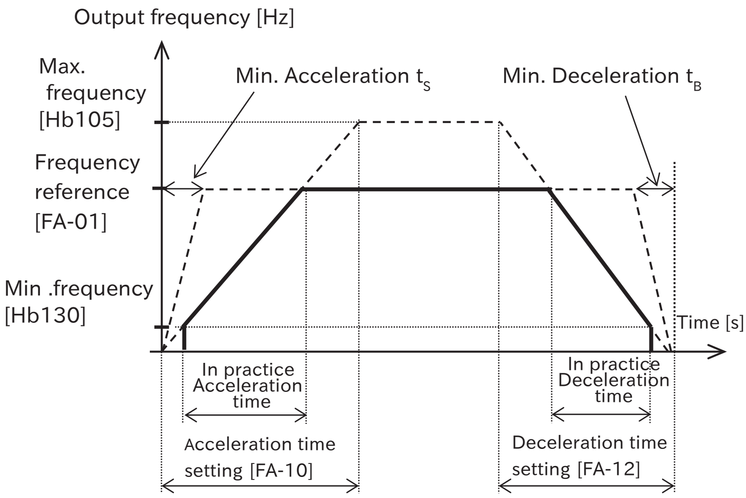


Note: In the figure, [ ] and the position of the switch for each parameter indicates the initial value.
Also, the input terminal functions that are not assigned to "Input terminal function selection [CA-01] to [CA-08]" will be OFF.

- If "Acceleration pattern selection [AC-03]" and "Deceleration pattern selection [AC-04]" are other than linear and the acceleration/deceleration hold function is ON/OFF, the acceleration/deceleration pattern will be recalculated with the frequency command at hold function OFF as the starting point, and the acceleration/deceleration will be re-accelerated/decelerated.

Actual acceleration/deceleration time setting

- To set the acceleration/deceleration time parameter, set the acceleration/deceleration time for 0Hz to maximum frequency setting.
  For example, if the maximum frequency setting is 60Hz and the acceleration time setting is 30 seconds, the actual acceleration time until the frequency command reaches the command in 30 Hz is 15 seconds.
- Even if the acceleration/deceleration time is set as short as possible, the actual motor's acceleration/deceleration time will not be shorter than the shortest acceleration/deceleration time determined by the moment of inertia J of the mechanical system and the motor torque. Setting the acceleration/deceleration time setting shorter than the shortest acceleration/deceleration time may cause "overcurrent error [E001]", "motor overload error [E005]", "overvoltage error [E007]", etc.
  See "Chapter 15 Troubleshooting" for more information.



Speed 0 → Acceleration t_s at N_M

$$t_s = \frac{(J_L+J_M)\times N_M}{9.55\times(T_s-T_L)}$$

Speed N_M → Deceleration t_B at 0

$$t_B = \frac{(J_L+J_M)\times N_M}{9.55\times(T_B+T_L)}$$

J_L : J (kg・m^2) of the load converted into the motor axis
J_M : J (kg・m^2) of the motor
N_M : Motor speed (r/min) <min^{-1}
T_s : Maximum acceleration torque with inverter drive (Nm)
T_B : Maximum. decelerating torque (Nm) with drive
T_L : Load Torque (Nm)

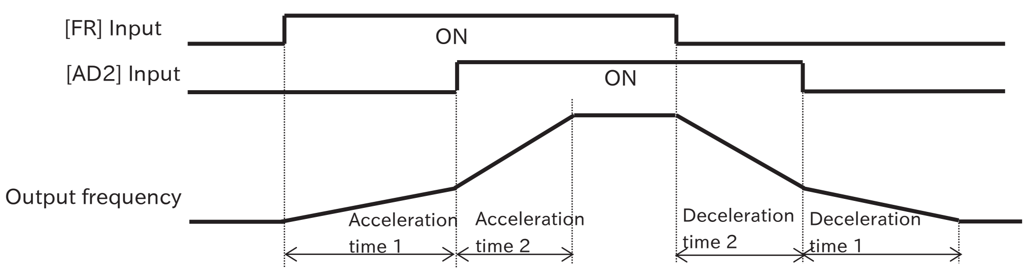
Code	Item	Description	Data	Initial value
FA-10	Acceleration time setting (monitor)	Monitors or changes sets for the currently selected acceleration time.	0.00 to 3600.00 s	-
FA-12	Deceleration time setting (monitor)	Monitors or changes the currently selected deceleration time.		
AC-01	Acceleration Deceleration time input source selection	Parameter setting	00	00
		Communication option	01	
AC120	Acceleration time 1	0 Set the acceleration duration from Hz to the highest frequency.	0.00 to 3600.00 s	10.00
AC122	Deceleration time 1	0 Set the decelerating duration from Hz to the highest frequency.		
CA-01 to CA-08	Input terminal function	Multi speed selection 1 to 4 [DFL] to [DHH]: Operates the multi-speed command.	003[DFL]/ 004[DFM] 005[DFH]/ 006[DHH]	-
		Multi-speed bit1 to 7 [SF1] to [SF7]: The multi-speed bit command is operated.	007[SF1]/ 008[SF2] 009[SF3]/ 010[SF4] 011[SF5]/ 012[SF6] 013[SF7]	
		2-stage Acceleration/Deceleration [AD2]: When [AC115] is "Switching by [AD2] Terminal (00)", acceleration/deceleration times are switched by ON/OFF of this signal.	031	
		LAD Cancellation [LAC]: When this signal is turned ON, acceleration/deceleration is canceled and the output frequency is made to follow the frequency command.	071	
Hb105	IM Max.frequency	Set the highest frequency of the induction motor (IM).	Base frequency to 590.00 Hz	60.00

9.3.2 To switch the acceleration/deceleration time in two steps

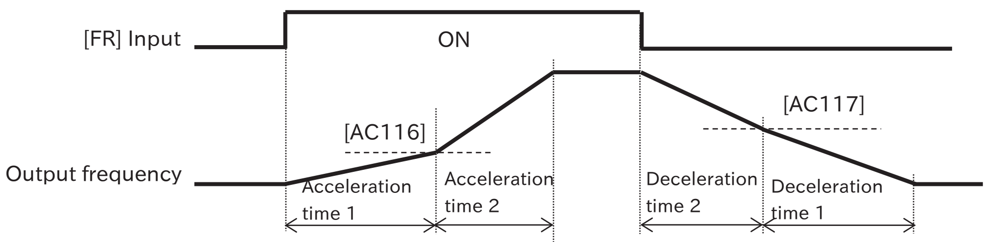
- The 2-step acceleration/deceleration function can be switched during operation by setting "2-step acceleration/deceleration selection [AC115]".
- Assign "2-stage acceleration/deceleration [AD2](031)" to one of the "input terminal function selection ([CA-01] to [CA-08])" when switching by the signal to the control terminal block.

Code	Item	Description	Data	Initial value
AC115	2- Accel/Decel change trigger	[AD2] Acceleration/deceleration time switching by input terminal	00	00
		Acceleration/Deceleration Time Switching by Two-Stage Acceleration/Deceleration Frequency	01	
		Acceleration/deceleration time switching only at forward/reverse rotation switching	02	
AC116	Two-stage acceleration frequency	Set the switching frequency when [AC115] is set to "Switching by setting (01)" and in acceleration mode.	0.00 to 590.00 Hz	0.00
AC117	2-speed reduction frequency	Set the switching frequency when [AC115] is "Switching by setting (01)" and in decelerating status.		
AC120	Acceleration time 1	0 Set the acceleration duration from Hz to the highest frequency.	0.00 to 3600.00 s	10.00
AC122	Deceleration time 1	0 Set the decelerating duration from Hz to the highest frequency.		
AC124	Acceleration time 2	0 Set the acceleration duration from Hz to the highest frequency.		
AC126	Deceleration time 2	0 Set the decelerating duration from Hz to the highest frequency.		
CA-01 to CA-08	Input terminal function	2-stage Acceleration/Deceleration [AD2]: When [AC115] is "Switching by [AD2] Terminal (00)", acceleration/deceleration times are switched by ON/OFF of this signal.	031	-

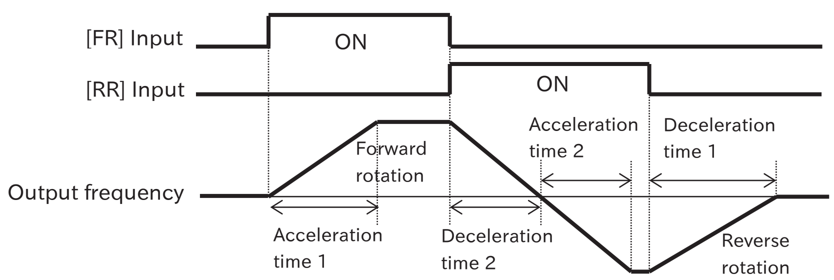
■[AD2] When switching acceleration/deceleration time by input terminal



■When switching the acceleration/deceleration time at the set frequency



■When switching acceleration/deceleration time by rotation command direction



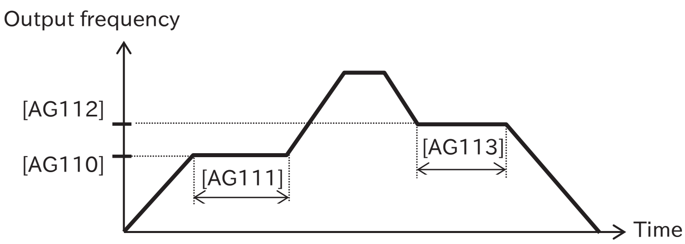
9.3.3 Acceleration/Deceleration hold function

- The acceleration/deceleration hold function temporarily stops acceleration/deceleration and performs constant speed operation at the frequency at that time.
- The hold function is effective when the moment of inertia of the mechanical system is large.
- Acceleration hold can be used for applications such as preventing overcurrent trip at startup by waiting until the slippage of the motor at startup becomes small.
- The deceleration hold can be used for applications such as preventing an overvoltage trip during deceleration by waiting until the slippage of the motor at deceleration becomes small.
- There are the following two methods of acceleration/deceleration stop, both of which can be used together.
    - Automatically stops at any frequency and stop time.
    - Stops when the "Acceleration/Deceleration Stop [HLD](100)" input terminal is ON.
- If the acceleration/deceleration hold function is turned ON when "Acceleration/deceleration pattern selection [AC-03]/[AC-04]" is other than "Linear (00)," the acceleration/deceleration pattern is not cleared and re-acceleration/deceleration is performed in the same acceleration/deceleration pattern at the timing of the hold OFF.

Code	Item	Description	Data	Initial value
AG110	Acceleration stop frequency	Set the frequency to stagnate during acceleration.	0.00 to 590.00 Hz	0.00
AG111	Acceleration stop time	Set the time to stagnate during acceleration.	0.0 to 60.0 s	0.0
AG112	Deceleration stop frequency	Set the frequency to stagnate at deceleration.	0.00 to 590.00 Hz	0.00
AG113	Deceleration stop time	Set the time to stagnate at deceleration.	0.0 to 60.0 s	0.0
CA-01 to CA-08	Input terminal function	Acceleration/deceleration stopping [HLD]: Acceleration/deceleration is stopped once when this signal is ON. When it becomes OFF, it will re-accelerate and decelerate.	100	-

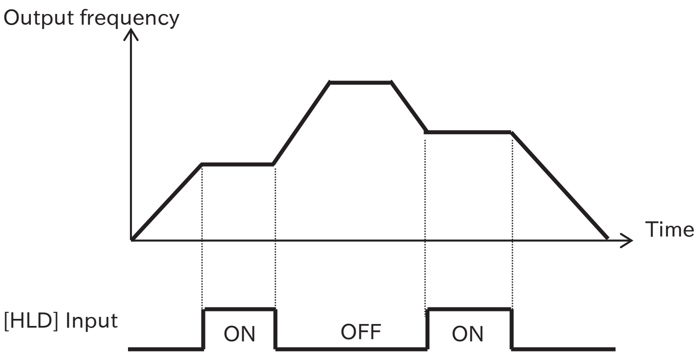
■To hold at any set frequency and time

- When the frequency command set at acceleration or deceleration is reached, acceleration/deceleration stops for the set time. Hold frequency and hold time can be set for acceleration and deceleration respectively.



■ [HLD] Holding at the input terminal

- Acceleration/deceleration stops when the "Acceleration/deceleration stop [HLD]" inputterminal is ON.

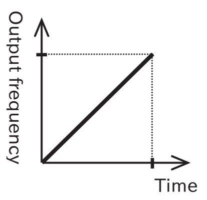
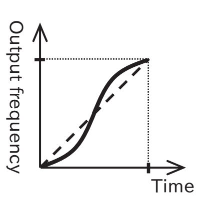
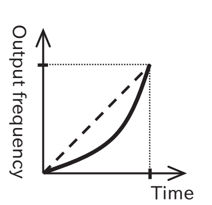
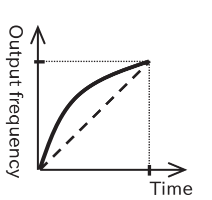
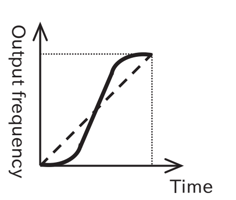
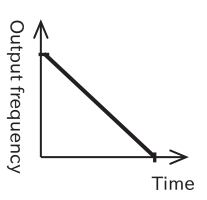
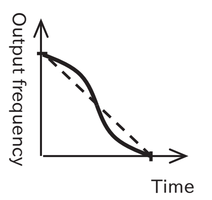
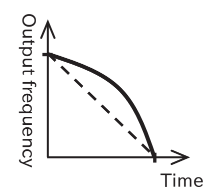
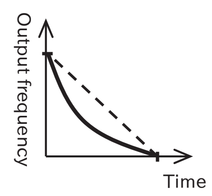
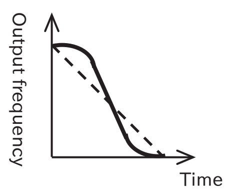


9.3.4 Change the acceleration/deceleration pattern

- The pattern of acceleration/deceleration corresponding to each system can be set.
- In "Acceleration pattern selection [AC-03]" and "Deceleration pattern selection [AC-04]", the pattern can be set individually for acceleration and deceleration.
- Even when the acceleration/deceleration pattern is set, the time from 0Hz to the maximum frequency or from the maximum frequency to 0Hz arrival is the set acceleration/deceleration time.

Code	Item	Description	Data	Initial value
AC-03	Acceleration curve selection	The acceleration pattern is linear.	00	01
		The acceleration pattern is an S-curve.	01	
		The acceleration pattern is a U-shaped curve.	02	
		The acceleration pattern is an inverted U-shaped curve.	03	
		The acceleration pattern is an elevator S-curve (EL-S curve).	04	
AC-04	Deceleration curve selection	Curve pattern selection at deceleration equivalent to acceleration pattern selection.	00 to 04	01
AC-05	Acceleration curve constant Setting	Set the curvature (degree of bulge) in S-curve, U curve and inverted U-curve. When set to 1, the bulge of the curve becomes the smallest. By increasing the set value, the bulge can be increased.	1(small bulge) to 10(bulging)	2
AC-06	Deceleration curve constant Setting			
AC-08	EL-S-curve ratio at start of acceleration	Specifies the ratio of the curved part when using a EL-S character. (for acceleration)	0 to (100 - [AC-09]) %	10
AC-09	EL-S-curve ratio at end of acceleration		0 to (100 - [AC-08]) %	
AC-10	EL-S-curve ratio at start of deceleration	Specifies the ratio of the curved part when using a EL-S character. (for deceleration)	0 to (100 - [AC-11]) %	
AC-11	EL-S-curve ratio at end of deceleration		0 to (100 - [AC-10]) %	

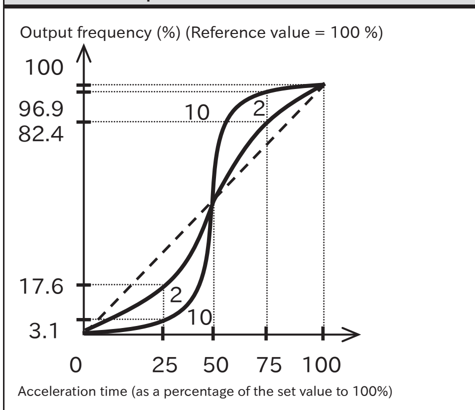
Types of acceleration/deceleration curve patterns and application examples

Pattern Setting	Linear (00)	S-curve (01)	U (02)	Inverted U (03)	EL-S (04)
[AC-03] (acceleration)					
[AC-04] (Deceleration)					
Application Examples	Acceleration/deceleration is performed up to the frequency setting value in a straight line.	Enabled in preventing load collapse in elevators, conveyors, etc.	Effective for tension control of take-up machine, etc. and prevention of breakage of wound material. It can also be used to take-up and feed one shot.		Similar shock-less start/stop as S-shape, but the middle part becomes straight line. Effective for elevator applications, etc.

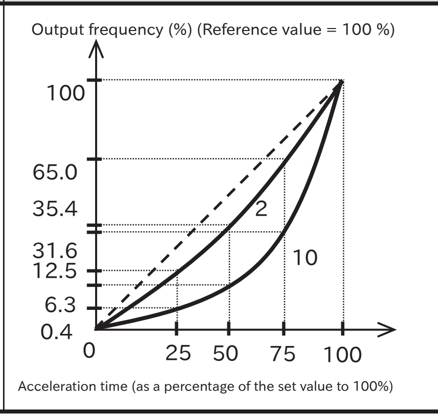
■Setting of curve constant (swelling degree) of acceleration/deceleration pattern (S-shape, U-shape, inverted U-shape curve)

- When S-shape, U-shape or inverted U-shape curve pattern is selected in [AC-03]/[AC-04], the curve swelling condition can be set in [AC-05]/[AC-06].
- The figure below shows an example of an S-shaped, U-shaped, or inverted U-shaped curve and an example in which the curve constant is set to 2 or 10.

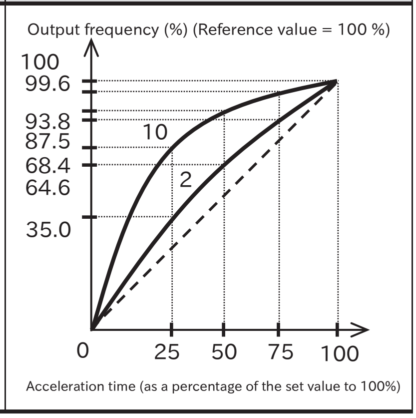
Example of S-curve Acceleration



Example of U-shaped acceleration

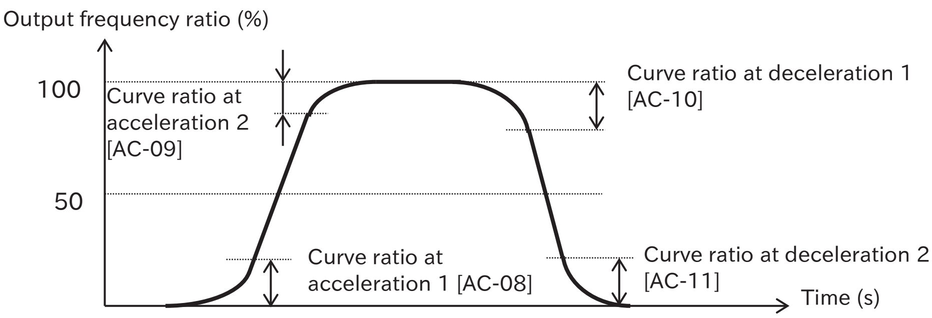


Example of inverted U-shaped acceleration

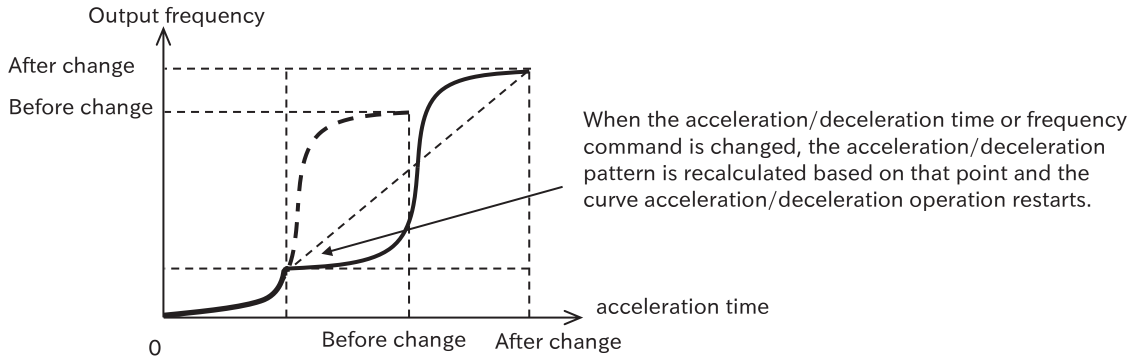


■Setting of curve ratio at acceleration/deceleration (for EL-S curve)

- When using an elevator S-shape (EL-S shape), it is possible to set the curve ratio ([AC-08] to [AC-11]) at acceleration/deceleration.
- [AC-08], [AC-09], [AC-10] and [AC-11] are set by dividing 100%, so the sum of the two parameter settings is 100 % at most (e.g. [AC-09] can be set from 0 to 75% for [AC-08]=25%]).
- When all the curve ratios are set to 50%, the curve is equivalent to an S-shape curve. When either of the curve ratios 1/2 is set to 100%, the curve is equivalent to a U-shape curve or an inverted U-shape curve.



- Note the following when the acceleration/deceleration pattern is set to other than "Linear (00)".
  - The slope of the acceleration/deceleration time becomes partially steep. If overcurrent or overvoltage occurs, it is necessary to adjust the acceleration/deceleration time.
  - Use a frequency command other than the analog input command. If the command value is not stable, the acceleration/deceleration pattern is recalculated and the actual acceleration/deceleration time may be extended.
  - If the frequency command or acceleration/deceleration time is changed during acceleration/deceleration, or the acceleration/deceleration pause is performed by the "Acceleration/deceleration stop [HLD]" input terminal, the acceleration/deceleration pattern will be recalculated based on the time the change was made. Note that an impact may be generated at the changed part as shown in the example below.

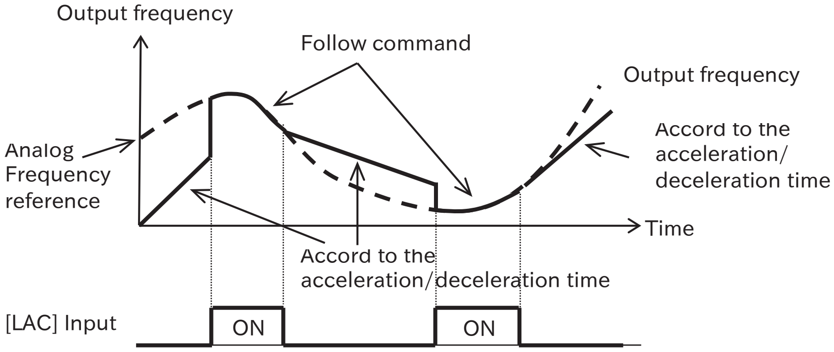


9.3.5 Momentarily cause the frequency to follow a command

- When the "LAD Cancellation [LAC](071)" input terminal is turned ON, the acceleration/deceleration time is ignored and the output frequency instantaneously follows the frequency command value.
- Since the output follows the command when LAD cancellation function is used, if the increase/decrease range of the frequency command becomes large, it becomes a factor such as "overcurrent error [E001]", "overload error ([E005], [E038], [E039])" or "overvoltage error [E007]", so care must be taken.
- The "LAD Cancellation [LAC]" inputterminal is valid for any frequencycommand such as the command from the parameter setting and communication option.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	LAD Cancellation [LAC]: When this signal is turned ON, acceleration/deceleration is canceled and the output frequency is made to follow the frequency command.	071

■Operation of LAD cancel function



9.3.6 Switching acceleration/deceleration time during multi-speed operation

- When this function is set, the acceleration/deceleration times can be changed according to the multi-speed command by the "multi-speed ([DFL] to [DHH]) (003 to 006)" or "multi-speed bit ([SF1] to [SF7]) (007 to 013)" input terminal.
- For details of the acceleration/deceleration time adopted for each multi-speed command, refer to the "Example of multi-speed acceleration/deceleration operation" in this section.
- When switching the multi-speed by the input terminal function, assign "Multi-speed ([DFL] to [DHH])" or "Multi-speed bit ([SF1] to [SF7])" to any of "Input terminal function selection ([CA-01] to [CA-08])" to operate.
- When "Multi-stage acceleration/deceleration selection [AC-02]" is "Multi-stage acceleration/deceleration (01)", the 2-stage acceleration/deceleration function is disabled. For details of the 2-step acceleration/deceleration function, refer to "9.3.2 Switching Acceleration/Deceleration Time in Two Stages".

Code	Item	Description	Data	Initial value
AC-02	Acceleration/Deceleration selection	Acceleration/deceleration times are [AC120]/[AC122] or [AC124]/[AC126] follow (when 2-step acceleration/deceleration function is enabled).	00	00
		The acceleration/deceleration time changes according to the multi-speed command.	01	
Ab-11	Multi-speed 1	The multi-speed command is set in the single speed [Ab-11] to 15 speed [Ab-25] of the multi-speed.	0.00 to Max. frequency Hz	20.00
Ab-12	Multi-speed 2			30.00
Ab-13	Multi-speed 3			40.00
Ab-14 to Ab-25	Multi-speed 4 to 15			0.00
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	Multi-Speed 1 to 15 Acceleration time	Set the acceleration duration from 0Hz to the maximum frequency for each multi-speed command.	0.00 to 3600.00 s	0.00
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	Multi-Speed 1 to 15 Deceleration time	Set the deceleration times from the maximum frequency to 0Hz for each multi-speed command.	0.00 to3600.00 s	0.00
Ab-03	Multi-speed operation selection	16-speed binary operation. Multi-speed operation is performed by "Multi-speed ([DFL] to [DHH])".	00	00
		8-speed bit operation. Multi-speed operation is performed with the "Multi-speed bit ([SF1] to [SF7])".	01	
CA-01 to CA-08	Input terminal function	Multi-speed 1 [DFL] to Multi-speed 4 [DHH]: Multi-speed input terminal for binary operation (maximum. 16-speed).	003 to 006	-
		Multi-speed bit 1 [SF1] to Multi-speed bit 7 [SF7]: Multi-speed input terminal for bit operation (up to 8 speeds).	007 to 013	

・The table below shows the correspondence between the multi-speed and multi-speed acceleration/deceleration times when "Binary operation (00)" is selected for "Multi-speed selection [Ab-03]" and "Bit operation (01)".

■Binary operation mode operation table

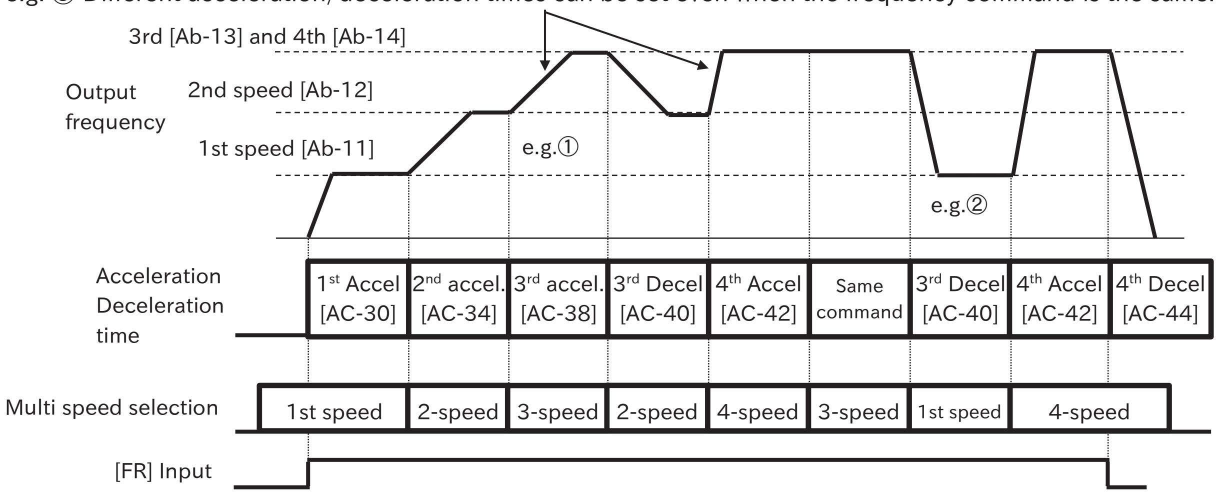
Multi-speed selection	DHH	DFH	DFM	DFL
0 speed	OFF	OFF	OFF	OFF
1st speed	OFF	OFF	OFF	ON
2-speed	OFF	OFF	ON	OFF
3-speed	OFF	OFF	ON	ON
4-speed	OFF	ON	OFF	OFF
5-speed	OFF	ON	OFF	ON
6-speed	OFF	ON	ON	OFF
7-speed	OFF	ON	ON	ON
8 speed	ON	OFF	OFF	OFF
9 speed	ON	OFF	OFF	ON
10-speed	ON	OFF	ON	OFF
11-speed	ON	OFF	ON	ON
12-speed	ON	ON	OFF	OFF
13-speed	ON	ON	OFF	ON
14-speed	ON	ON	ON	OFF
15-speed	ON	ON	ON	ON

■Bit operation mode operation table

Multi-speed selection	SF7	SF6	SF5	SF4	SF3	SF2	SF1
0 speed	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1st speed	-	-	-	-	-	-	ON
2-speed	-	-	-	-	-	ON	OFF
3-speed	-	-	-	-	ON	OFF	OFF
4-speed	-	-	-	ON	OFF	OFF	OFF
5-speed	-	-	ON	OFF	OFF	OFF	OFF
6-speed	-	ON	OFF	OFF	OFF	OFF	OFF
7-speed	ON	OFF	OFF	OFF	OFF	OFF	OFF

■Acceleration/Deceleration operation example

e.g. ③ Different acceleration/deceleration times can be set even when the frequency command is the same.



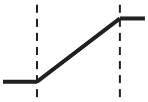
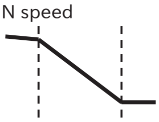
e.g. ① When the multi-speed three-speed gear is engaged, if the actuator is in the acceleration direction, the multi-speed three-acceleration time [AC-38] is valid.

e.g. ② When a multi-speed single speed gear is engaged, if it is in the deceleration direction, the multi-speed three-speed deceleration time [AC-40] of the multi-speed three prior to the entry of the multi-speed one speed gear is enabled.

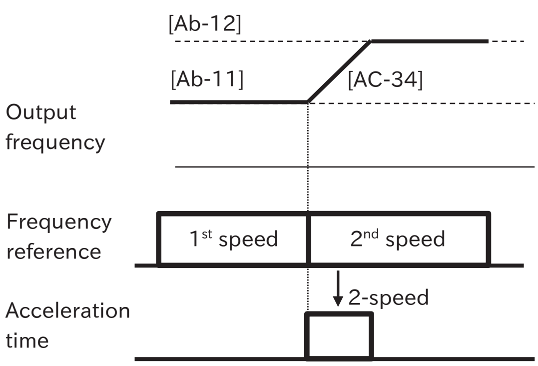
e.g. ③ When the multi-speed 3-speed and multi-speed 4-speed are the same, different settings of the multi-speed 3-acceleration time [AC-38] and multi-speed 4-acceleration time [AC-42] possible different acceleration times to be set for the same frequency command as shown in the above figure.

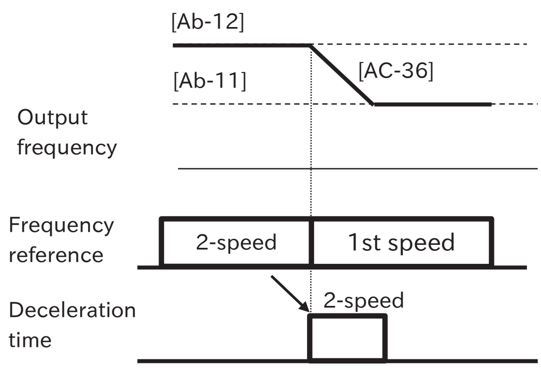
■Acceleration/Deceleration operation example

・The table below shows the correspondence between multi-speed command and acceleration/ deceleration time.

Setting status	Multi-speed command	State of the command	Acceleration/deceleration time to be adopted
Higher frequency after ON To the acceleration state M speed  Multi speed selection M Acceleration time	1-speed ON	Multi-speed 1st speed [Ab-11] > Frequency prior to 1st speed ON	Multi-speed 1st speed acceleration time[AC-30]
	2-speed ON	Multi-speed 2-speed [Ab-12] > Frequency prior to 2-speed ON	Multi-speed 2-speed acceleration [AC-34]
	3-speed ON	Multi-speed 3-speed [Ab-13] > Frequency prior to 3-speed ON	Multi-speed 3-speed acceleration time[AC-38]
	4-speed ON	Multi-speed 4-speed [Ab-14] > Frequency prior to 4-speed ON	Multi-speed 4-speed acceleration time[AC-42]
	5-speed ON	Multi-speed 5-speed [Ab-15] > Frequency prior to 5-speed ON	Multi-speed 5-speed acceleration time[AC-46]
	6-speed ON	Multi-speed 6-speed [Ab-16] > Frequency prior to 6-speed ON	Multi-speed 6-speed acceleration time[AC-50]
	7-speed ON	Multi-speed 7-speed [Ab-17] > 7-speed ON pre-frequency	Multi-speed 7-speed acceleration time[AC-54]
	8-speed ON	Multi-speed 8-speed [Ab-18] > Frequency prior to 8-speed ON	Multi-speed 8-speed acceleration time[AC-58]
	9-speed ON	Multi-speed 9-speed [Ab-19] > Frequency prior to 9-speed ON	Multi-speed 9-speed acceleration time[AC-62]
	10-speed ON	Multi-speed 10-speed [Ab-20] > 10 speed prior to ON	Multi-speed 10-speed acceleration time[AC-66]
	11-speed ON	Multi-speed 11st speed [Ab-21] > 11 speed ON pre-frequency	Multi-speed 11-speed acceleration time[AC-70]
	12-speed ON	Multi-speed 12 speed [Ab-22] > 12 speed prior to ON	Multi-speed 12-speed acceleration time[AC-74]
	13-speed ON	Multi-speed 13-speed [Ab-23] > 13 speed prior to ON	Multi-speed 13-speed acceleration time[AC-78]
	14-speed ON	Multi-speed 14-speed [Ab-24] > 14 speed ON pre-frequency	Multi-speed 14-speed acceleration time[AC-82]
	15-speed ON	Multi-speed 15-speed [Ab-25] > 15 speed prior to ON	Multi-speed 15-speed acceleration time[AC-86]
	Without multi-speed	Other than the above	Acceleration time 1[AC120]
Lower frequency after OFF To the deceleration state N speed  Multi speed selection N Deceleration time	1-speed OFF	Multi-speed 1st speed [Ab-11] > Frequency after 1st speed OFF	Multi-speed 1st deceleration time[AC-32]
	2-speed OFF	Multi-speed 2-speed [Ab-12] > Frequency after 2-speed OFF	Multi-speed 2-speed deceleration time[AC-36]
	3-speed OFF	Multi-speed 3-speed [Ab-13] > Frequency after 3-speed OFF	Multi-speed 3-speed deceleration time[AC-40]
	4-speed OFF	Multi-speed 4-speed [Ab-14] > Frequency after 4-speed OFF	Multi-speed 4-speed deceleration time[AC-44]
	5-speed OFF	Multi-speed 5-speed [Ab-15] > Frequency after 5-speed OFF	Multi-speed 5-speed deceleration time[AC-48]
	6-speed OFF	Multi-speed 6-speed [Ab-16] > Frequency after 6-speed OFF	Multi-speed 6-speed deceleration time[AC-52]
	7-speed OFF	Multi-speed 7-speed [Ab-17] > Frequency after 7-speed OFF	Multi-speed 7-speed deceleration time[AC-56]
	8-speed OFF	Multi-speed 8-speed [Ab-18] > frequency after 8-speed OFF	Multi-speed 8-speed deceleration time[AC-60]
	9-speed OFF	Multi-speed 9-speed [Ab-19] > Frequency after 9-speed OFF	Multi-speed 9-speed deceleration time[AC-64]
	10-speed OFF	Multi-speed 10-speed [Ab-20] > 10 speed after OFF	Multi-speed 10 speed deceleration time[AC-68]
	11-speed OFF	Multi-speed 11st speed [Ab-21] > 11 speed after OFF	Multi-speed 11 speed deceleration time[AC-72]
	12-speed OFF	Multi-speed 12-speed [Ab-22] > 12 speed after OFF	Multi-speed 12 speed deceleration time[AC-76]
	13-speed OFF	Multi-speed 13-speed [Ab-23] > 13 speed after OFF	Multi-speed 13 speed deceleration time[AC-80]
	14-speed OFF	Multi-speed 14-speed [Ab-24] > 14 speed after OFF	Multi-speed 14-speed deceleration time[AC-84]
	15-speed OFF	Multi-speed 15-speed [Ab-25] > 15 speed after OFF	Multi-speed 15-speed deceleration time[AC-88]
	Without multi-speed	Other than the above	Deceleration time 1[AC122]

・Switching timing between frequency command and deceleration time by multi-speed terminal command is different.





9.4 Limiting frequency reference/RUN command

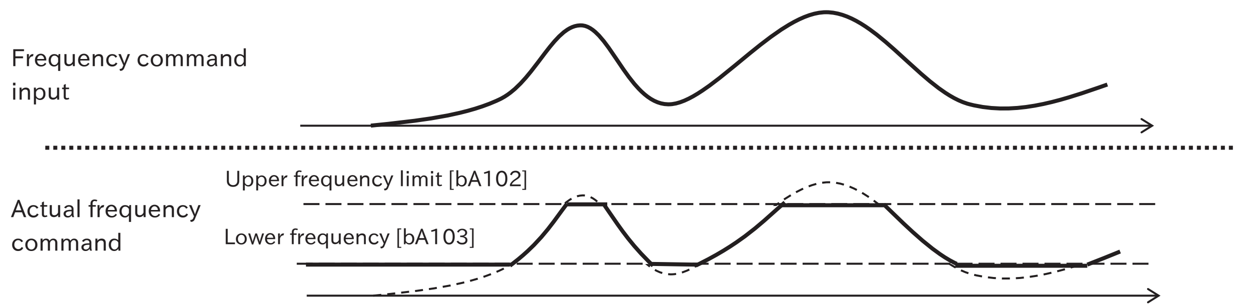
9.4.1 Limiting frequency reference

- The frequency limiter function can limit the frequency reference range. In addition, the upper frequency limiter can be specified with analog input, etc. by setting "Frequency upper limit selection [bA101]".
- Even if a frequency reference outside the frequency upper/lower limiter range is input, it will be limited by this function.
- Upper frequency limit setting can be checked by "Frequency upper limit monitor [dA-14]".

- To enable the upper frequency limiter, set "Upper frequency limit source selection [bA101]" to other than "disabled (00)".
- When [bA101] is set to "Parameter setting (07)", be sure to set "Upper frequency limit [bA102]". Note that the frequency setting upper limit is 0.00Hz because the upper frequency limiter operates even in the default 0.00Hz.
- Be sure to set the frequency limit function so that the upper limit does not exceed "Async. Motor maximum frequency setting [Hb105]". Note that inconsistent settings may trigger a warning message.
- When setting "Lower frequency limit [bA103]", be sure to set [bA103] after setting [bA102] to larger value than lower limiter.
- The lower limit of the frequency command can also be set by "Minimum frequency adjustment [Hb130]". However, note that the operation when [Hb130] is changed is different from the lower frequency limiter. For more information on [Hb130], refer to "9.7.1 Starting with Gradually Increasing Voltage".
- When the remote operator (OS-44 ver.2.0 onwards) is connected, [LIM] icon is displayed during the restriction due to the upper/lower limiter and minimum frequency.

Code	Item	Description	Data	Initial value
dA-14	Frequency upper limit monitor	Monitors the current upper frequency limit.	0.00 to 590.00 Hz	-
bA101	Upper frequency limit source selection	Disable	00	00
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		Parameter setting	07	
		RS485	08	
		Option	09	
		Pulse input	12	
bA102	Upper frequency limit	Set the upper frequency limit when [bA101] set to "Parameter setting (07)".	0.00 to Max. frequency Hz	0.00
bA103	Lower frequency limit	Set the lower frequency limit.	0.00 to Upper frequency limit Hz	
Hb105	Async. Motor maximum frequency setting	Set the maximum frequency of the motor.	Base frequency to 590.00 Hz	60.00

■Example of upper/lower frequency limiter operation for frequency command



9.4.2 Limiting RUN command direction

- By setting the "RUN direction restriction selection [AA114]" parameter, it is possible to limit the RUN command direction to either forward or reverse rotation.
- This function can also limit reverse rotation command that are triggered by the frequency command sign changing to negative.
- When the operation direction limit function is activated, and ooooo is displayed on the inverter display.
- This function works by limiting RUN command direction. Therefore, it is not effective in cases such as when using control methods other than V/f control where control calculations can result in an output that causes reverse operation. To limit the output, enable "Direction reversal protection [HC114]". For details, refer to "9.4.3 Limiting Rotation Output Direction".
- Even when this function is used, the motor may rotate in the reverse direction when subject to external forces. When using this function as a protection against reverse rotation, the system must be free of external forces that are applied in the reverse direction.

Code	Item	Description	Data	Initial value
AA114	RUN direction restriction selection	No restriction	00	00
		Only forward rotation commands are enabled. (Reverse rotation is limited.)	01	
		Only reverse rotation commands are enabled. (Forward rotation is limited.)	02	

9.4.3 Limiting rotation output direction

- In some cases, the control system may result in a output that is in the opposite direction of the RUN command, such as when operating at low speeds. The "Direction reversal protection [HC114]" can be set to limit the rotation output so it keeps the same direction as the command.
- This function should be enabled in cases when reverse rotation of the motor results in equipment damage.
- This function is enabled when "Control mode selection [AA121]" is set to "Sensorless vector control (IM) (08)".
- Even when this function is used, the motor may rotate in the reverse direction when subject to high-load external forces. When using this function as a protection against an improper rotation direction, be sure to thoroughly confirm that the equipment does not rotate in the reverse direction.

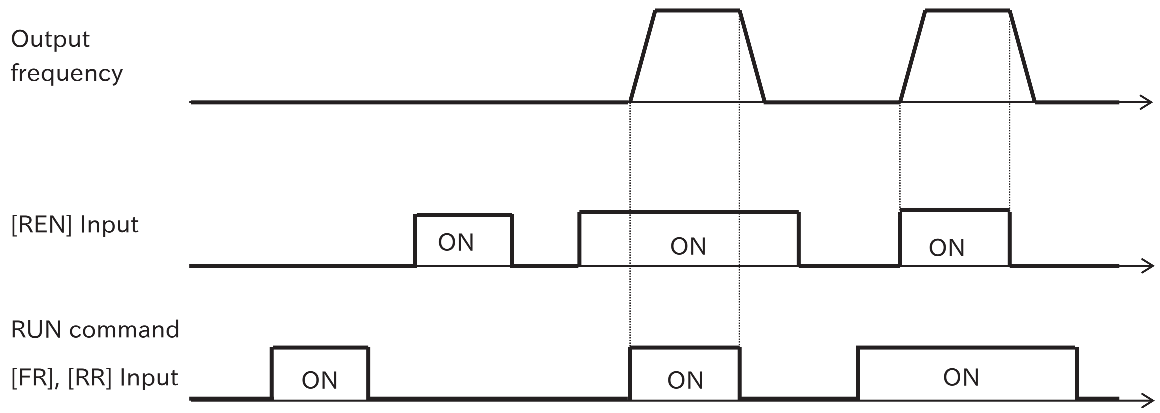
Code	Item	Description	Data	Initial value
AA121	Control mode selection	Sensorless vector control (IM)	08	00
HC114	Direction reversal protection	Disable	00	01
		Enable: Prohibit rotation in the opposite direction.	01	

9.4.4 Disabling output until RUN command permission

- To ensure that the system configuration remains safe, inverter operation can be disabled until an operation permission signal that is separate from the RUN command is input.
- When "RUN enable [REN] (84)" input terminal is assigned to a control circuit terminal, the inverter operation is not permitted until the [REN] input terminal is turned on.
- This function is enabled by assigning "RUN enable [REN]" input termina to one of the control circuit terminals.
- When the [REN] input terminal is assigned and the signal is off, the inverter is prevented from operating. When performing temporary operation such as commissioning, the [REN] input terminal must be set to "No assignment [no]".

Code	Item	Description	Data
CA01 to CA08	Input terminal function	RUN enable [REN] : Control enable/disable of operation. ON: Operation Enable OFF: Operation Disable	101

■Example of the "RUN enable [REN]" operation



9.5 Motor control mode selection

9.5.1 Motor control mode selection

- Set the appropriate control method according to the motor to be driven and the application using the control method [AA121]. For details, refer to the table below and the description of each control method in the following sections.
- When using the sensorless vector control or automatic torque booth, be sure to set the motor constant of the motor to be used. For details, refer to "8.1.5 Setting Motor Constant" or "8.3 Performing Auto-tuning of Motor".
- When driving multiple induction motors (IM) with one inverter, use V/f control other than auto torque boost.
- By feeding back the actual speed of the motor with an external encoder, high accuracy and stable speed control can be achieved. For details, refer to "9.5.8 Moving with Sensor-equipped Speed Control".
- When using synchronous (permanent magnets) motors (SM(PMM)), please contact your supplier.

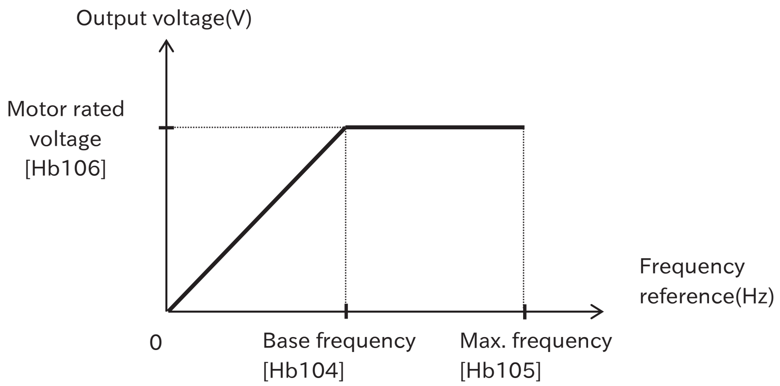
Code	Item	Description		Data	Initial value
		Applicable motor	Control mode selection		
AA121	Control mode selection	Induction motor (IM)	[V/f] Fixed torque characteristics (IM) VC characteristics	00	00
			V/f Control Reduction Torque Characteristics (VP1.7 Power Characteristics)	01	
			V/f controlled free V/f	02	
			V/f control auto torque boost	03	
			Sensorless vector control	08	
		Synchronous (permanent-magnet) motor (SM(PMM)	Synchronous activation type sensorless vector control	11	

■Features of each control mode

Control mode selection	Overview	Manual torque Boost	Automatic energy saving Operation	With sensor Speed control	Multiple motors Drive	Setting a motor constant
V/f control Constant-torque characteristics (VC characteristics)	Suitable for applications that require a certain amount of torque, such as conveyors and buckets, and for applications that want to simplify setting and adjustment, etc.	○	○	○	○	Not required
V/f control Reduced Torque Characteristics (VP1.7 Power Characteristics)	Suitable for applications that do not require large torque, such as fans and pumps, and for applications that want to make setting and adjustment easier.	○	○	○	○	Not required
V/f control Free-V/f	Suitable for applications such as special motors where you want to freely set the output voltage with respect to the output frequency.	×	○	○	○	Not required
V/f control Automatic torque boost	If the torque is insufficient, the frequency and output voltage are automatically adjusted to improve the torque shortage.	×	×	○	×	Mandatory
Sensorless vector control	It is suitable for applications where a large torque is required from a low speed or a high-precision output frequency is required.	×	×	○	×	Mandatory
Synchronous Activation Sensorless Vector Control	Setting for driving a synchronous motor (SM)/permanent-magnet motor (PMM).	×	×	×	×	Mandatory

9.5.2 V/f control constant-torque characteristics (VC characteristics)

- V/f control is a method for controlling a motor by setting the output voltage-characteristics to the frequency output by the inverter. It is not necessary to set the motor constant of the motor to be used, and it can be used easily.
- The output voltage of the constant-torque characteristic is output to be proportional to the frequency command in a straight line connecting 0Hz/0V and the base frequency/rated voltage.
- 0 From Hz to the base frequency, the output voltage is determined in proportion to the frequency, but the output voltage from the base frequency to the highest frequency is constant regardless of the frequency.
- When the manual torque boost function is used, the boost voltage is added to the basic proportional line for output. The manual torque boost function is effective when torque is insufficient at low speeds. For details, refer to "9.5.6 Using the Manual Torque Boost Function".

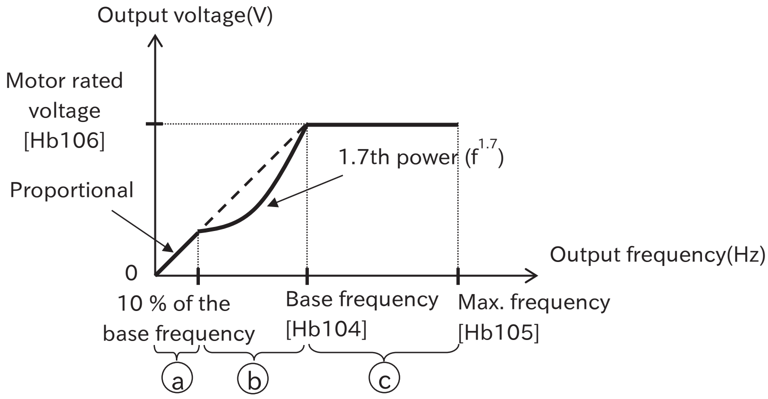


- If the motor humbles or vibrates, it may be improved by adjusting the "V/f, A.bst) [HA110".
- If the motor vibrates when more than one motor is being moved by one inverter, it may be stabilized by adjusting the [HA110] in the downward direction.

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Used in V/f control constant torque characteristics (IM).	00	00
HA110	Stabilization constant	Adjusts the control to suppress the motor hunting when V/f control is selected.	0 to 1000 %	100
Hb104	IM Base frequency	Sets the base frequency of IM motor.	30.00 to IM Max. frequency Hz	60.00
Hb105	IM Maximum frequency	Set the maximum frequency of IM Motor.	IM Base frequency to 590.00 Hz	60.00
Hb106	IM motor rated voltage	Set the rated voltage of IM motor.	1 to 1000 V	200/400

9.5.3 V/f control reduced torque characteristics (VP1.7 power characteristics)

- V/f control is a way of controlling the motor by setting the voltage-characteristics to be output with respect to the frequency output by the inverter. It is effective when you do not need to set the individual motor constant of the motor to be used and you want to use it easily.
- The reduced torque characteristic (VP1.7 power characteristic) is suitable for applications such as fans/pumps that do not require large torque in the low-speed range. In the low-speed range, the output voltage is reduced to improve efficiency, reduce noise, and reduce vibration.
- When the manual torque boost function is used, the boost voltage is added to V/f pattern of the reduced torque characteristic. The boost voltage is then output. The manual torque boost function is effective when torque is insufficient at low speeds. For details, refer to "9.5.6 Using the Manual Torque Boost Function".



Period a: The range from 0Hz to 10% of the base frequency is a constant-torque characteristic.
(e.g.) If the base frequency is 60Hz, the range from 0 to 6Hz is the constant-torque characteristic.

Period b: The range from 10% of the base frequency to the base frequency is the reduced torque characteristic. The voltage is output with a curve of the power of 1.7 with respect to the frequency.

Period c: The voltage from the base frequency to the highest frequency is a constant output characteristic.

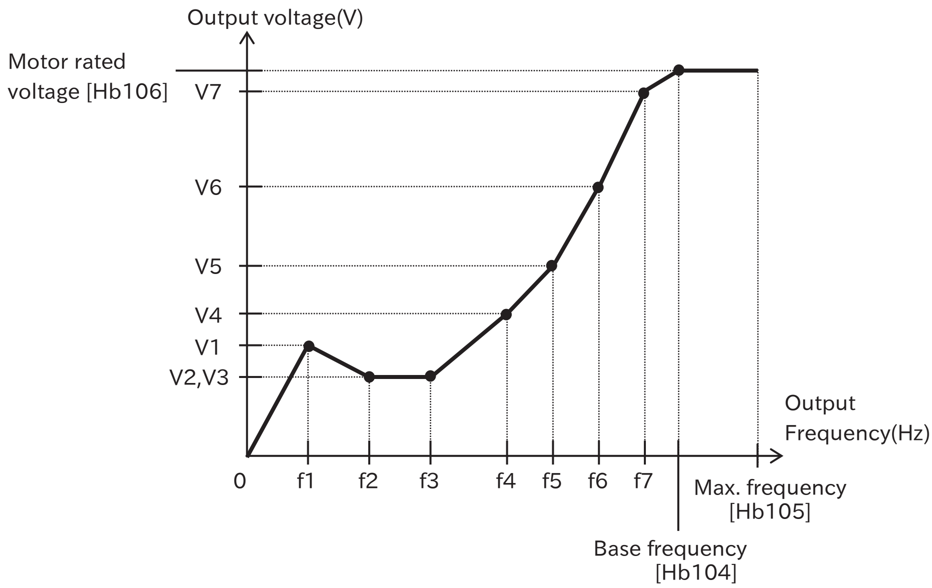
- If the motor humbles or vibrates, it may be improved by adjusting the "V/f, A.bst) [HA110".
- If the motor vibrates when more than one motor is being moved by one inverter, it may be stabilized by adjusting the [HA110] in the downward direction.

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Used in V/f control reduction torque characteristics (IM).	01	00
HA110	Stabilization constant	Adjusts the control to suppress the motor hunting when V/f control is selected.	0 to 1000 %	100
Hb104	IM Base frequency	Sets the base frequency of IM motor.	30.00 to IMMax. frequency Hz	60.00
Hb105	IM Maximum frequency	Set the maximum frequency of IM Motor.	IM Base frequency to 590.00 Hz	60.00
Hb106	IM motor rated voltage	Set the rated voltage of IM motor.	1 to 1000 V	200/400

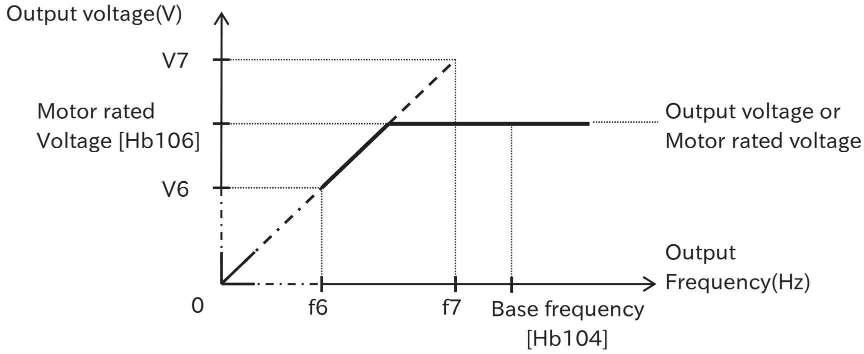
9.5.4 V/f controlled free V/f

- V/f control is a way of controlling the motor by setting the voltage-characteristics to be output with respect to the frequency output by the inverter. It is effective when you do not need to set the individual motor constant of the motor to be used and you want to use it easily.
- The free V/f is suitable for applications in which the load varies greatly depending on a special motor or rotational speed. Therefore, it is suitable for applications in which the output voltage is freely set with respect to the output frequency. It is also effective when adjusting the voltage characteristics optimally manually for energy saving.
- In the free V/f setting, any V/f response can be set by setting 7 output voltageand output frequency.

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Used in V/f control free V/f (IM).	02	00
HA110	Async. Motor stabilization constant (V/f, A.bst)	Adjusts the control to suppress the motor hunting when V/f control is selected.	0 to 1000 %	100
Hb104	IM Base frequency	Sets the base frequency of IM motor.	30.00 to IM Max. frequency Hz	60.00
Hb105	IM Maximum frequency	Set the maximum frequency of IM Motor.	IM Base frequency to 590.00 Hz	60.00
Hb106	IM motor rated voltage	Set the rated voltage of IM motor.	1 to 1000 V	200/400
Hb150	Free-V/f frequency 1	Set the frequency at each segmental point.	0.00 to Hb152 Hz	0.00
Hb152	Free-V/f frequency 2		Hb150 to Hb154 Hz	
Hb154	Free-V/f frequency 3		Hb152 to Hb156 Hz	
Hb156	Free-V/f frequency 4		Hb154 to Hb158 Hz	
Hb158	Free-V/f frequency 5		Hb156 to Hb160 Hz	
Hb160	Free-V/f frequency 6		Hb158 to Hb162 Hz	
Hb162	Free-V/f frequency 7		Hb160 to Base frequency Hz	
Hb151	Free-V/f voltage 1	Set the output voltage at each segmental point.	0.0 to 1000.0 V	0.0
Hb153	Free-V/f voltage 2			
Hb155	Free-V/f voltage 3			
Hb157	Free-V/f voltage 4			
Hb159	Free-V/f voltage 5			
Hb161	Free-V/f voltage 6			
Hb163	Free-V/f voltage 7			



- If the motor humbles or vibrates, it may be improved by adjusting the "V/f, A.bst) [HA110".
- The frequency of the free V/f setting should always be f1≦f2≦f3≦f4≦f5≦f6≦f7 ≦ base frequency. The defaults for the Free V/f setting are all 0Hz. After setting the maximum frequency and the base frequency, set 6, 5, 4, 3, 2, and 1 in order from Free V/f setting 7.
- Even if 1000V is set to the free V/f voltage 1 to 7, the inverter cannot output the input voltage or a voltage higher than the "IM motor rated voltage [Hb106]".
- If the characteristics are not set properly, it may cause overcurrent during acceleration/deceleration or vibration of the motor or machine. Be very careful.



9.5.5 V/f controlled auto-torque boost

- Automatically adjusts the frequency and output voltage to produce torque.
- In automatic torque boost, the frequency and output voltage are corrected in order to control the motor. For this reason, the motor constant must be taken in by auto-tuning, etc.
- If the motor humbles or vibrates, it may be improved by adjusting the "V/f, A.bst) [HA110".
- For automatic torque boost, set the motor capacity, number of motor poles, base frequency, rated voltage, and rated current appropriately to perform motor control.
- If the characteristics are not obtained, perform auto-tuning referring to "8.3 Auto-tuning of Motor". If the characteristics do not appear after auto-tuning, adjust the following page.

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Used for V/f control auto torque boost (IM).	03	00
HA110	Stabilization constant	Adjusts the control to suppress the motor hunting when V/f control is selected.	0 to 1000 %	100
Hb104	IM Base frequency	Sets the base frequency of IM motor.	30.00 to IM Max. frequency Hz	60.00
Hb105	IM Maximum frequency	Set the maximum frequency of IM Motor.	IM Base frequency to 590.00 Hz	60.00
Hb106	IM motor rated voltage	Set the rated voltage of IM motor.	1 to 1000 V	200/400
HC101	Automatic torque boost voltage compensation gain	Adjusts the voltage addition of the automatic torque boost.	0 to 255 %	100
HC102	Automatic torque boost slip compensation gain	Adjusts the frequency addition of the automatic torque boost.		

- If the desired characteristics cannot be obtained even after inputting the motor constant or performing auto-tuning, perform the adjustment referring to the remedy example in the table below.
- If the rotation of the motor is obstructed by brake or motor lock due to foreign matter, overcurrent may occur. If it is not improved by adjustment, it may be improved by checking around the motor.
- If the display of "Output frequency monitor [dA-01]" changes significantly when a load is applied, the overload limit function, instantaneous power failure non-stop function, overvoltage control function, or other function to change the frequency in a moving manner may be activated depending on the setting of the function. Refer to "Chapter 15 Troubleshooting" for more information.

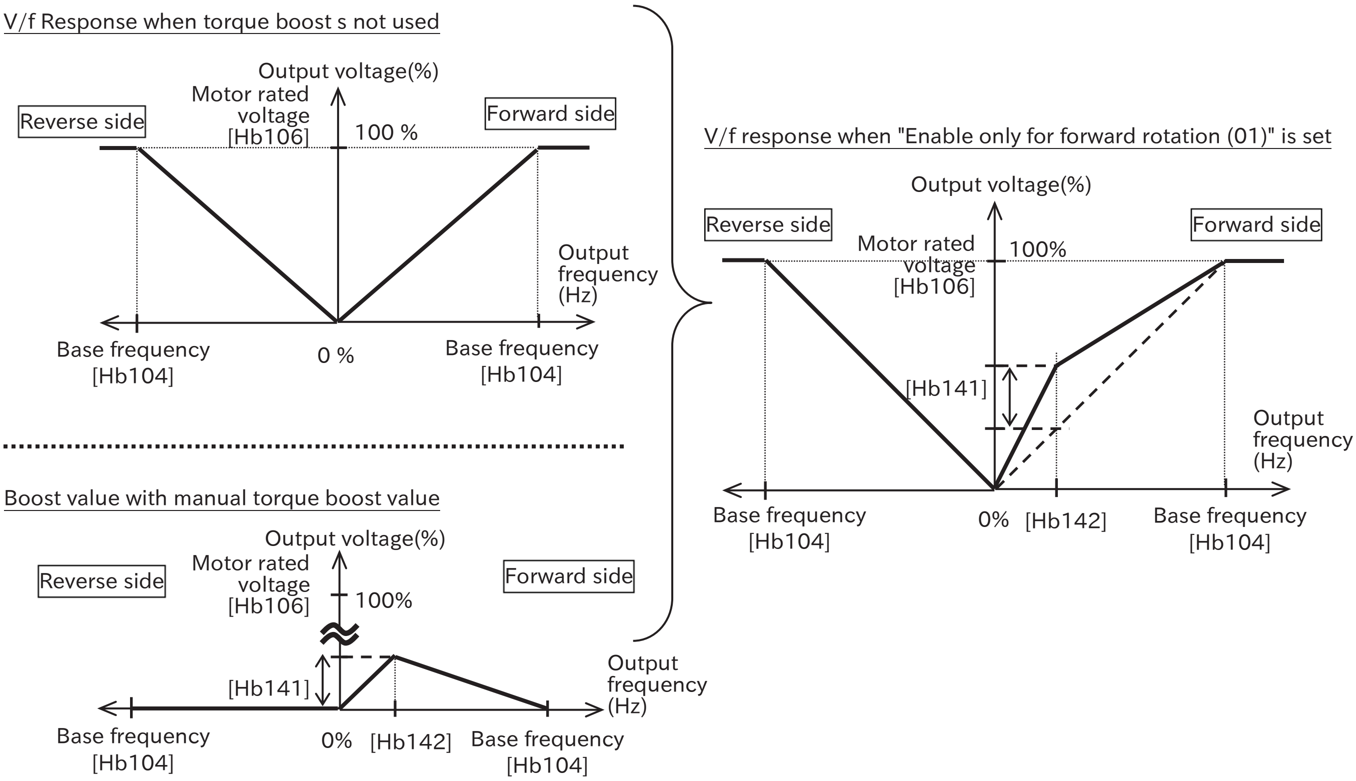
Phenomena	Possible causal	Example of remedy
Slow motor rotation at low speed	Output voltage is insufficient and torque is not output.	Increase the Auto Torque Boost Voltage Compensation Gain [HC101] by 5%.
		Decrease the carrier frequency [bb101].
	The frequency correction is insufficient and the torque is not output.	Increase the Auto Torque Boost Sliding Compensation Gain [HC102] by about 5%.
When the load becomes heavy, the motor rotation frequency decreases.	The frequency correction is insufficient and the torque is not output.	Increase the Auto Torque Boost Sliding Compensation Gain [HC102] by about 5%.
When the load becomes heavy, the motor rotation frequency increases.	Frequency correction is excessive and frequency increases.	Adjust "Auto torque boost slip compensation gain [HC102]" in increments of about 5 %.
Overcurrent error occurs when the load becomes heavy or accelerates.	Excessive voltage correction results in increased current.	Adjust the Auto Torque Boost Voltage Compensation Gain [HC101] in increments of about 5 %.
	Frequency correction is excessive and frequency increases.	Adjust "Auto torque boost slip compensation gain [HC102]" in increments of about 5 %.

9.5.6 Manual torque boost function

- Manual torque boost is a function that adds the outputvoltage so that torque can be produced even at low speeds by V/f control.
- In V/f control, no extra compensation is made to control the motor. For this reason, when the output voltage is low, the voltage applied to the motor drops due to the resistance component inside the motor or the voltage drop caused by wiring. The torque boost function improves the torque drop in the low-speed range by correcting the voltage.
- With this function,When the "Control method [AA121]" is "V/f control constant torque characteristic (00)" or "V/f control reduced torque characteristic (01)", the manual torque boost function is available.
- When increasing the set value of manual torque boost, pay attention to overexcitation of the motor. Boosting may increase the current flow, resulting in motor burnout.
- In "Manual torque boost amount [Hb141]", set the ratio when "Motor rated voltage [Hb106]" is regarded as 100%. The set value is the maximum. addition value at the "manual torque boost segmental point [Hb142]".
- For the manual torque boost break point [Hb142], set the ratio assuming that the "Base frequency [Hb104]" is 100%.

Code	Item	Description	Data	Initial value
Hb140	Manual torque boost operation mode selection	Disable	00	01
		Always enabled	01	
		Valid only for forward rotation	02	
		Valid only in reverse rotation	03	
Hb141	Manual torque boost value	Manual Torque Boost Sets the amount of boost at the break point. Set the ratio assuming that "motor rated voltage [Hb106]" is 100%.	0.0 to 20.0 %	1.0
Hb142	Manual torque boost peak speed	Set the manual torque boost break point (the point at which the summed voltage becomes the maximum). Set "Base frequency [Hb104]" as a percentage (100%).	0.0 to 50.0 %	0.8

■Manual Torque Boost Setting Ex.: [Hb140] = Valid only when in forward rotation (01)



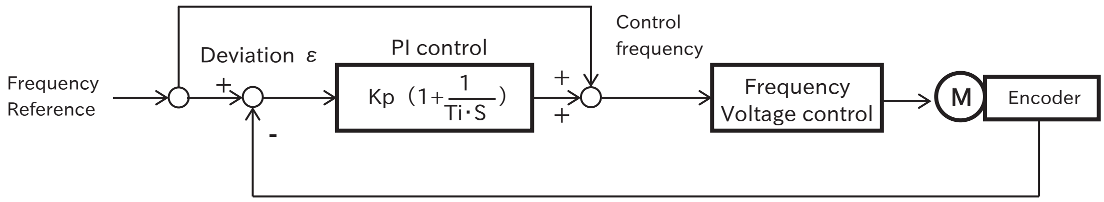
9.5.7 Energy-saving mode

- The automatic energy-saving operation function automatically adjusts the inverter output power so that it is minimized during constant speed operation. Suitable for load with reduced torque characteristics of fan and pump.
- To use this function, set "Energy saving operation selection [Hb145]" to "Enabled (01)". Response and accuracy can be adjusted with Energy Saver Response and Accuracy Adjustment [Hb146].
- This function is available when "Control method [AA121]" is "V/f control constant torque characteristic (00)", "V/f control reduced torque characteristic (01)" or "V/f control free V/f(02".
- Since this function is controlled relatively slowly, if a sudden load fluctuation such as an impact load occurs, the motor may stall and cause an overcurrent trip.

Code	Item	Description	Data	Initial value
Hb145	Eco drive enable	Disable	01	00
		Enable	01	
Hb146	Eco drive response adjustment	Data: 0 ⇔ 100 Response: Slow ⇔ Fast Accuracy: High ⇔ Low	0 to 100 %	50

9.5.8 Speed control with sensor

- The speed control function with sensor is a function that performs high-precision frequency control by using an encoder to feed back the actual speed of the motor. It can be used when "control method [AA121]" is either V/f control or sensorless vector control.
- When velocity feedback is used in sensorless vector control, be sure to set "Vector control mode selection [AA123]" to "Speed/torque control mode (00)".
- In order to control the motor, this function corrects PI control so that the motor revolutions follow the frequency command.
- When "Pulse input detection target selection [CA-90]" is set to other than "Disable (00)", the input terminal [RST] becomes the B-phase input of the encoder signal and the input terminal [PLA] becomes the A-phase input of the encoder signal, regardless of the parameter setting, and a/b(NO/NC) setting is also disabled.
- If the motor operation is unstable or the follow-up to the command is slow, adjustment "Slip Compensation P Gain with Sensor [Hb170]" and "Slip Compensation I Gain with Sensor [Hb171]" by referring to "Adjustment Methods for Velocity Control with Sensor" in this section.
- Refer to "9.5.11 Set Encoder Feedback" for details on settings for performing encoder feedback and the protection function when used.



Kp: Proportional gain setting Ti: Integral time s: Operator ε : Deviation
Ki: Integral gain setting (Ki=Kp/Ti)

Code	Item	Description	Data	Initial value
AA123	Vector control mode selection	Mode of speed control to torque control	00	00
AA124	Speed compensation with encoder selection	Disable	00	00
		Enable	01	
CA-07	Input terminal function [RST] selection	When (01) to (03) are selected for [CA-90], this setting is disabled, and input terminals [RST] and [PLA] become input terminals for encoder-signal.	000 to 110	028
CA-08	Input terminal function [PLA] selection			103
CA-27	Input terminal [RST] active state		00、01	00
CA-28	Input terminal [PLA] active state			
CA-81	Encoder constant setting	Set the number of pulses per revolution of the encoder.	1 to 65535 pls	512
CA-86	Speed feedback filter	Filter time constant for the detection speed by encoder pulse input.	0 to 1000 ms	20
CA-90	Pulse input target function selection	Velocity feedback	02	01
CA-91	Pulse input mode selection	90° phase difference pulse input	00	03
		Forward and reverse command and pulse input	01	
		Single phase pulse input	03	
Hb170	Slip compensation with sensor P gain	Proportional (P) gain for slip compensation of speed control with sensor.	0 to 1000 %	100
Hb171	Slip compensation with sensor I gain	Integral (I) gain for slip compensation of speed control with sensor.		

Adjustment method for speed control with sensor

- If sufficient characteristics cannot be obtained, adjust each item referring to the table below.
- If the rotation of the motor is obstructed by brake or motor lock due to foreign matter, overcurrent may occur. If it is not improved by adjustment, it may be improved by checking around the motor.
- If the "Output frequency monitor [dA-01]" changes significantly when a load is applied, the function that automatically changes the frequency, such as the overload limiting function, instantaneous power failure non-stop function, and overvoltage suppression function, may be working depending on the setting status of the function. Refer to "Chapter 15 Troubleshooting" for more information.

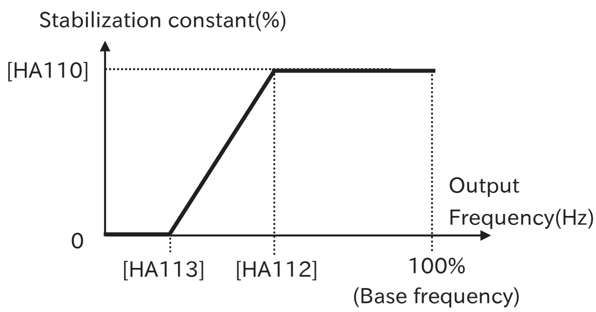
Phenomena	Possible causal	Example of remedy
Slow motor speed follow-up to command.	Slow output response and slow motor speed (feedback value) change.	Increase "Sensor equipped slip compensation P gain [Hb170]".
Motor operation is not stable.	The response to the feedback value is too fast.	Decrease "Slip Compensating P Gain with sensor [Hb170]".
Overshoot and hunting occur.		
Motor speed vibrates gently.	The integral action reacts slowly.	Increase "Slip Compensating I Gain with Sensor [Hb171]".
It takes time for the operation to stabilize.		
The motor speed vibrates and does not match the command speed well.	The integral action reacts quickly.	Increase "Slip Compensating I Gain with Sensor [Hb171]".

9.5.9 Stabilize the motor hunting

- "Stabilization constant (V/f, A.bst)[HA110)" is a function that adjusts to stabilize the motor when the motor is hunting. Find and adjust the point within the setting range where the tuning will stop.
- When driving more than one motor with one inverter, setting [HA110] to 0% may improve the performance.
- When rotating a fan/fan or other highly inertial load, reduce the [HA110] by 10% to improve the performance.
- If the motor capacity is smaller than the rated capacity of the inverter, an improvement may be made by increasing the setting value by 10%. Conversely, if the motor capacity is large, you can improve by decreasing the setting value by 10%.
- [HA110] can be used to set the output-frequency response based on the stabilization end ratio (V/f, A.bst) [HA112) and the stabilization start ratio (V/f, A.bst) [HA113).
- If the motor gets blurred or vibrated, check if the motor capacity, number of motor poles, base frequency, maximum frequency, motor rated voltage, and motor rated current are properly set. For details, refer to "8.1.3 Setting Motor Nameplate Data to Parameters".
- The following methods can be used to suppress hunting. If there is no effect, return the value.
  - Adjust by gradually lowering the "Carrier frequency [bb101]" to 2kHz.
  - Gradually decrease the "Output-voltage gain [Hb180]" to 80%.
- "Stabilization constant (V/f, A.bst) [HA110)" and "Output-voltage gain [Hb180]" are enabled when "V/f control (00 to 03)" is set to "Control method [AA121]".

■Stabilization end/start rate setting

- When "Stabilization End Ratio (V/f, A.bst) [HA112)" and "Stabilization Start Ratio (V/f, A.bst) [HA113)" are set, the characteristics of "Stabilization End Ratio (V/f, A.bst) [HA110)" are as shown in the diagram.
- If the output frequency is [HA113] or less, the stabilization constant will be 0%. If the output frequency is [HA113] to [HA112], the stabilization constant will increase proportionally from 0 % to the [HA110] setting. If the output frequency is [HA112] or more, the stabilization constant will be the [HA110] setting.



Code	Item	Description	Data	Initial value
bb101	Carrier frequency	Change the carrier frequency of PWM out. Decrease the value if you are hunting.	2.0 to 15.0 kHz (ND: Normal duty) 2.0 to 10.0 kHz (LD: Light duty)	2.0
HA110	Async. Motor stabilization constant (V/f, A.bst)	If the motor is distorted, adjust it.	0 to 1000 %	100
HA112	Stabilization end ratio (V/f, A.bst)	Adjusts the output frequency characteristics of the stabilization constant. Set the base frequency as a percentage (100%).	0 to 100 %	30
HA113	Stabilization start rate (V/f, A.bst)			10
Hb180	Output voltage gain	If the motor is distracting, lower it. Decreasing the setting decreases the output voltage.	0 to 255 %	100

9.5.10 Sensorless vector control

- The sensorless vector control system estimates and controls the motor speed and output torque according to the inverter output voltage and current and the set motor constant. High starting torque from the low frequency range (0.5 Hz) and high accuracy operation with little rotational speed variation even if the load varies.
- When using sensorless vector control, be sure to set the specifications and motor constant of the motor to be used. For details, refer to "8.1.3 Setting Motor Nameplate Data to Parameters", "8.1.5 Setting Motor Constant", or "8.3 Auto-tuning Motor".
- The "Speed Response [HA115]" can be used to adjust the follow-up possible of the actual speed in response to a frequency command, such as when a load fluctuates.
- If the motor is shaky or vibrates, it may be improved by adjusting [HA115] or "Torque current command filter time constant [HC120]".
- In the low-speed range (several Hz or less), the motor may rotate in reverse to the operation command direction. If this happens, enabled "Reverse prevention selection [HC114]". For details, refer to "9.4.3 Limiting the Rotation Output Direction".
- If the torque at start is insufficient and the desired performance cannot be obtained, set "Boost at Start (IM-SLV)[HC111)" to a larger value.
- At startup, acceleration starts after the magnetic flux of the level set in "magnetic flux establishment level [HC137]" is established. When [HC137] is set to a large value, the operation at start can be stabilized, but the standby time until acceleration starts is longer.
- The upper level can be adjusted by setting "Modulation ratio level ([HC141], [HC142])".
  If the [HC141]/[HC142] is adjusted to a large value, the output current may be suppressed as the output voltage increases. On the other hand, however, the distortion of the output waveform may increase and the operation may become unstable.
- If the wire length is long (more than the reference 20m) or a motor other than us is controlled, the characteristics may not be satisfactory.
- Sufficient characteristics may not be obtained if a motor of 2 frames or less of the maximum applicable motor is operated.
- In low-speed operation, the Carrier Frequency [bb101] is automatically reduced to 2kHz even if it is set to a value exceeding 2kHz. In addition, since the carrier frequency increases with acceleration, electromagnetic noise, etc. from the motor may change depending on the output frequency.
- Be sure to set the same value when changing the "Modulation rate level ([HC141], [HC142])".

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Sensorless vector control (IM)	08	00
HA115	Async. Motor speed response	Adjusts the response of the control. Increasing the value increases the follow-up ability to the frequency command.	0 to1000 %	100
Hb110	Async. Motor constant R1	For details, refer to "8.1.3 Setting Motor Nameplate Data to Parameters", "8.1.5 Setting Motor Constant", or "8.3 Auto-tuning Motor".	0.000001 to 1000.000000 Ω	Depend on the motor
Hb112	Async. Motor constant R2			
Hb114	Async. Motor constant L		0.000001 to 1000.000000 mH	
Hb116	Async. Motor constant I0		0.01 to 10000.00 A	
Hb118	Async. Motor constant J		0.00001 to 10000.00000 kgm^2	
HC111	Boost value at -motor (IM-SLV)	Adjust the current command at start when the starting torque is insufficient.	0 to 50 %	0
HC114	Direction reversal protection selection	Disable	00	01
		Reverse prevention function is enabled. Limit output to prevent it from being output in the opposite direction.	01	
HC120	Torque current command filter	Adjust the torque current filter.	0 to 100 ms	2
HC121	Speed feedforward compensation -motor	Adjusts the feedforward control of the speed controller.	0 to 1000 %	0
HC137	Flux settling -motor	Adjust the magnetic flux establishment level at start.	0.0 to 100.0 %	80.0
HC141	Modulation factor level 1	Adjust the upper limit level of the output voltage. Be sure to set the same value when adjusting [HC141]/[HC142].	0 to 133 %	115
HC142	Modulation factor level 2			

Adjustment method in sensorless vector control

- If the desired characteristics cannot be obtained, first perform auto-tuning to set the motor constant. Then, perform the adjustment referring to the table below.
- Before adjusting "Velocity Response [HA115]", set "IM Motor Constant J [Hb118]" as the sum of the moment of inertia of the motor shaft conversion and the moment of inertia of the motor.
- If the rotation of the motor is obstructed by brake or motor lock due to foreign matter, overcurrent may occur. If it is not improved by adjustment, it may be improved by checking around the motor.
- If the "Output frequency monitor [dA-01]" changes significantly when a load is applied, the function that automatically changes the frequency, such as the overload limiting function, instantaneous power failure non-stop function, and overvoltage suppression function, may be working depending on the setting status of the function. Refer to "Chapter 15 Troubleshooting" for more information.

Phenomena	Possible causal	Example of remedy
Shock occurs when starting.	The speed response of the control system is high.	Decrease the "Velocity Response[HA115]" by 5%.
		Reduce IM motor parameter J [Hb118] by 5%.
		Reduce the starting boost [HC111] by 5%.
The time from the input of the operation command to the actual start is long.	Large magnetic flux at start.	Reduce the magnetic flux probability [HC137] by 5 %.
Operation at start is unstable.	Started before the magnetic flux becomes large enough.	Increase the Magnetic Flux Establishment [HC137] by 5%.
During start or low-speed operation, the motor rotates in the direction opposite to the commanded rotation direction for a moment.	As a result of the control, a command in the reverse direction is issued for a moment.	Enable "Reverse rotation prevention selection [HC114]".
Rotation is not stable during low-speed operation and unevenness occurs.	The speed response of the control system is low.	Increase the velocity response [HA115] by 5 %.
		Increase IM motor parameter J [Hb118] by 5%.
When the motor is loaded in the direction of rotation (regeneration) during low-speed operation (several Hz), the rotation frequency increases.	Insufficient regenerative torque in low-speed operation.	Increase the "IM motor constant R1 [Hb110]" by 5% in increments of 1.2 times of the set limit.
		Increase the "IM motor constant I0 [Hb116]" by 5% in increments of 1.2 times of the set limit.
The motor is distorted.	The speed response of the control system is high.	Decrease the "Velocity Response[HA115]" by 5%.
		Reduce IM motor parameter J [Hb118] by 5%.
When a load in the stopping direction (power running) is applied to the motor, the rotation frequency decreases.	The motor constant R2 is set low.	Increase 1.2 times of the set value. Increase the "IM motor constant R2 [Hb112" by 5%.
When a load in the stopping direction (power running) is applied to the motor, the rotation frequency increases.	The motor constant R2 is set high.	Adjust "IM motor constant R2 [Hb112]" 0.8 times as small as the limit in increments of 5 %.
The output current value is large during high-speed operation (above the base frequency).	The upper level of the output voltage is low.	Increase the modulation factor ([HC141], [HC142]) by 5%.
Operation at high speed operation (above base frequency) is not stable.	High modulation factor level.	Reduce the modulation factor ([HC141], [HC142]) by 5%.

9.5.11 Encoder feedback

- Speed control function with sensor or position control function can be used by inputting encoder feedback.
- To use the speed control function with sensor or position control function, set "Pulse-input detection target selection [CA-90]" to "Speed Feedback (02)". When [CA-90] is set to other than "Disabled (00)", input terminals [RST] and [PLA] become terminals for pulse input or encoder feedback input. When using encoder feedback, connect the A phase to the input terminal [PLA] and the B phase to the input terminal [RST].
- The detection speed by encoder-feedback can be checked in "Speed detection value monitor [dA-08]". [dA-08] operates by setting "Velocity Feedback (02)" to "Select Pulse-Input Detection Object [CA-90]". Also, when using [dA-08], set "Motor pole count [Hb103]", "Encoder setting ([CA-81] to [CA-84])" and "Pulse-input-mode selection [CA-91]" correctly.
- Set the encoder constant in units of (pulse/revolution) of the motor shaft conversion.
- If the detection speed by the encoder-feedback is not stable, set "Detection speed filter time constant [CA-86]" to larger value.
- In HF-620, pulse input can also be used for pulse input frequency command or pulse counting function. To enable each function, refer to "Combination of related functions and settings using pulse input" in this section, and set each parameter.

Code	Item	Description	Data	Initial value
dA-08	Detect speed monitor	Monitors the feedback detection speed. This item is enabled when "Velocity Feedback (02)" is selected for "Pulse-input Detection Object Select [CA-90]".	-590.00 to 590.00 Hz	-
AA123	Vector control mode selection	Mode of speed control to torque control	00	00
		Absolute position control mode	02	
		High-resolution absolute position control mode	03	
AA124	Speed compensation with encoder selection	Disable	00	00
		Enable	01	
CA-81	Encoder constant setting	Set the number of connected encoder pulses in the number of pulses (multiplied by 1) of motor 1 rotation conversion.	1 to 65535 pls	512
CA-82	Encoder phase sequence selection	Phase A lead	00	00
		B phase lead	01	
CA-83	Motor gear ratio numerator	Set the numerator of motor gear ratio.	1 to 10000	1
CA-84	Motor gear ratio denominator	Set the denominator of the motor gear ratio.		
CA-86	Detecting speed filter time constant	Sets the filter time constant for the detection speed by the input from the encoder.	0 to 1000 ms	20
CA-90	Pulse input target function selection	Disable	00	01
		Pulse input frequency directive	01	
		Velocity feedback	02	
		Pulse count	03	
CA-91	Pulse input mode selection	90° phase difference pulse input	00	03
		Forward and reverse command and pulse input	01	
		Single phase pulse input	03	
Hb103	IM motor pole selection	Set the number of motor poles.	2 to 48 poles	01

■Combination of related functions and settings that use pulse input

Effective function	Setting	Reference
Pulse input frequency command function	[CA-90] = Pulse input frequency command (01)	『9.2.8 Setting Frequency Reference from Pulse Input"
Speed control function with sensor	[CA-90] = Speed feedback (02) [AA123] = Speed/torque control mode (00) [AA124] = Enabled (01)	『9.5.8 Move with Sensor-equipped Speed Control
Pulse count function	[CA-90] =Disabled (00) [CA-01] to [CA-08]=[PLB](103)、[PLA](104) or [CA-90] = Pulse count (03)	『9.15.5 Checking the Number of Pulses Entered"
Position control function	[CA-90] = Speed feedback (02) [AA123] = Absolute position control mode (02) or High-resolution absolute position control mode (03)	『9.14 Performing positioning operation"

Pulse input mode connecting the encoder

・If "Pulse input detection target selection [CA-90]" is set to other than "Disabled (00)", input terminals [RST] and [PLA] are automatically switched to terminals for B-and A-phase input of pulse input, respectively. At this time, the setting of "Input terminal a/b (NO/NC) selection ([CA-21] to [CA-28])" is disabled. Also note that the hardware specifications differ between input terminal [RST] and input terminal [PLA]. Hardware-specific specifications, rotational direction-recognition, and wiring of "Pulse input mode selection [CA-91]" setpoints for input terminals [RST] and [PLA] are shown below.

■Hardware specifications of input terminals [RST]/[PLA]

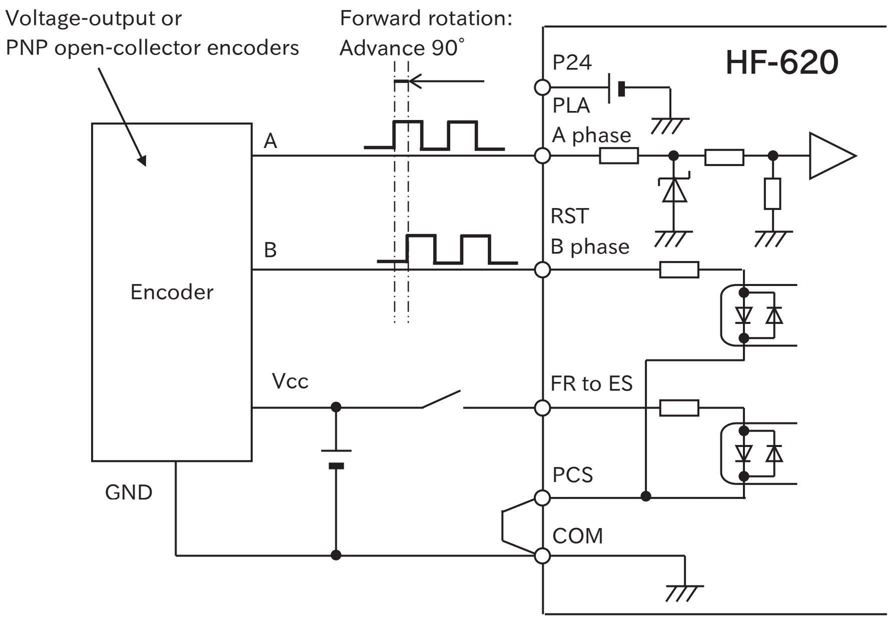
Pulse input mode selection [CA-91]	Input terminal [RST] (24V/ max. 32kHz)	Input terminal [PLA] (5 to 24V/ max. 32kHz)
90° phase difference pulse input (00)	B phase pulse (PNP open-collector or voltage-output encoders)	A phase pulse (PNP open-collector or voltage-output encoders)
Forward/reverse command and pulse input (01)	Direction signal (sink/source transistor or switching switch)	Single phase pulse (PNP open-collector or voltage-output encoders)
Single phase pulse input (03)	-	Single phase pulse (PNP open-collector or voltage-output encoders)

■Feedback rotation direction recognition

Pulse input mode selection [CA-91]	Operation command		Input terminal [RST]	Feedback Rotation direction recognition
	Forward rotation FR	Reverse rotation RR		
90° phase difference pulse input (00)	Either ON		-	Encoder detection (90° phase difference)
Forward/reverse command and pulse input (01)	Either ON		OFF	Forward rotation (according to input terminal [RST])
			ON	Reverse rotation (according to input terminal [RST])
Single phase pulse input (03)	ON	OFF	-	Forward rotation
	OFF	ON	-	Reverse rotation

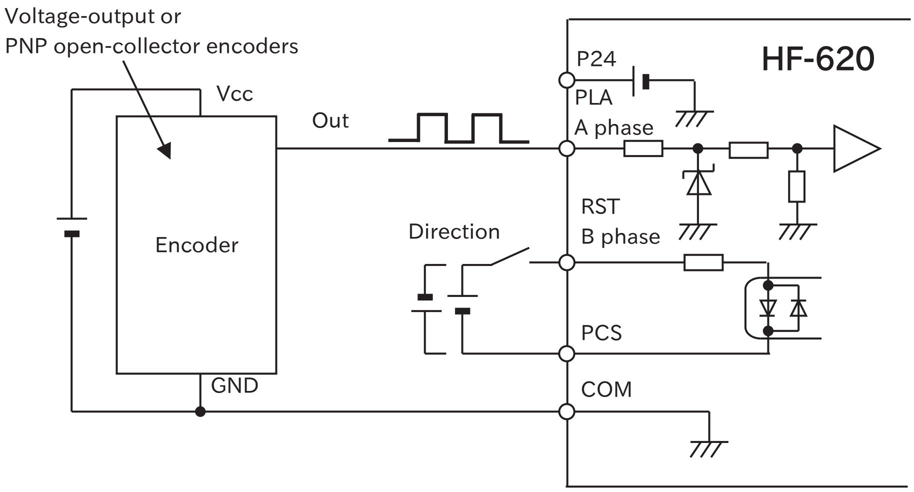
■Wiring of AB phase 90° phase differential pulse. ([CA-91]=00)

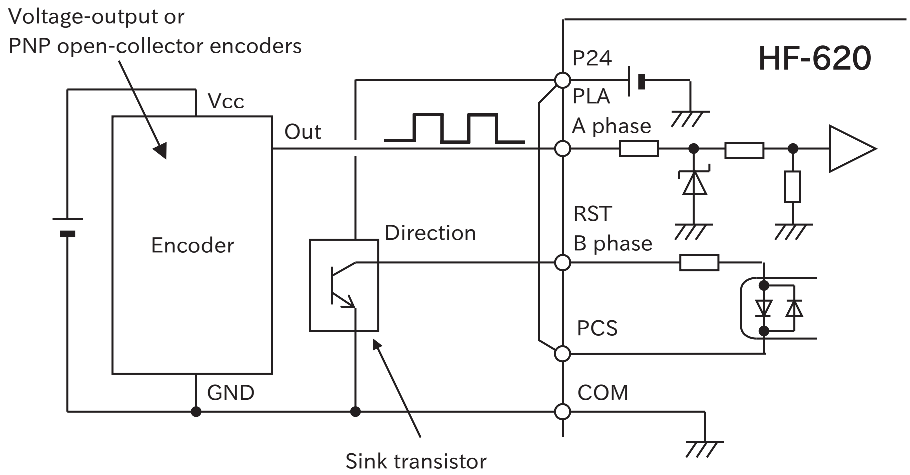
・Wire AB phase 90° phase differential pulses to the input terminals [RST] and [PLA] as shown in the figure below. Input of phase B is from input terminal [PLA], so use all intelligent input terminals including input terminal [PLA] with source logic (voltage-output type encoder or PNP open-collector type encoder). In addition, input-voltage high level must be within the specifications (18 to 24V) of the intelligent input terminal.

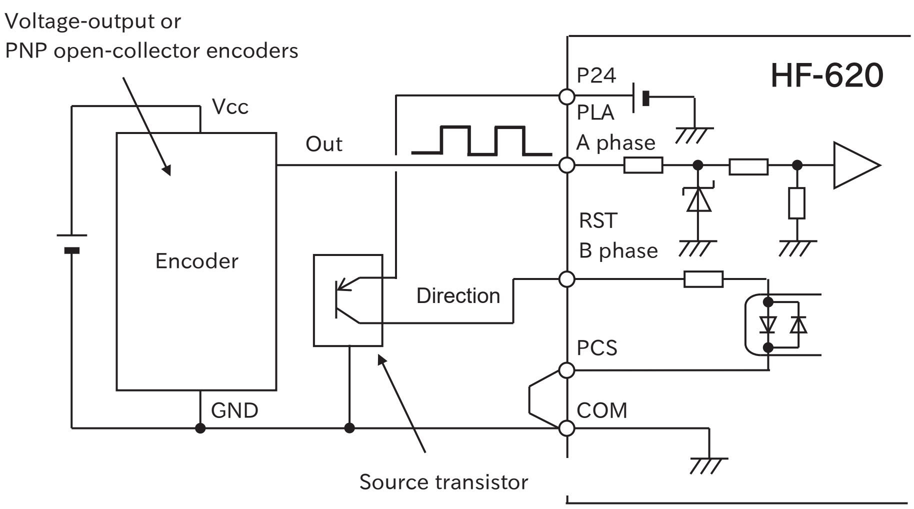


■Wiring of single-phase pulse and forward/reverse command ([CA-91]=01, 03)

・For single-phase pulse or forward/reverse command and single-phase pulse, wire as shown in the figure below.
Input single-phase pulse to input terminal [PLA] and direction signal to input terminal [RST]. The input terminal [PLA] can be used for both synchro logic and source logic by changing the position of the short circuit line. When the input terminal [RST] is OFF, it is forward and inverted when it is ON.







Protection function during encoder feedback

・When encoder feedback is enabled, the following protection functions can be set. Use it according to the application.

■Over speed error detection

・If the feedback-detection speed exceeds "Overspeed-detection-level [bb-80]" and "Overspeed-detection-time [bb-81]" or more has elapsed, the inverter trips due to "Overspeed error [E107]". Set it according to the maximum speed of the application. This function is enabled when pulse input/detection target selection [CA-90] = "Velocity Feedback (02)" and [bb-80]≠0.0%].

■Speed deviation error detection

・During operation, if the absolute value of the speed deviation (output frequency-detection speed) exceeds the "speed deviation error detection level [bb-83]" and exceeds the "speed deviation error detection time [bb-84]" or more, the "speed deviation excess [DSE]" signal is turned ON. If excessive speed deviation is detected by setting of "Operation [bb-82] at speed deviation error", it can also be tripped by "Speed deviation error [E105]". To enable this function, set [bb-83] to a value other than 0.00%.
・If the signal is stopping the output, the "Velocity Error Excessive [DSE]" will not be output.

■Encoder disconnection

・If the output frequency is greater than or equal to the "creep speed setting [AE-15]" and the detection speed is less than the "minimum frequency [Hb130]" for the duration of the "encoder disconnection detection time [CA-85]", the inverter trips due to the "encoder disconnection error [E100]". Adjust [AE-15] and [CA-85] according to the application if false detection occurs due to heavy loads and slow start-up, etc.

Code	Item	Description	Data	Initial value
AE-15	Creep speed setting	Low-speed operation speed before positioning completion of position control and speed of encoder disconnection detection determination.	Min.frequency[Hb130] to 10.00 Hz	5.00
bb-80	Over-speed detection level	Sets the level at which the detection speed is judged to be excessive. Set IM maximum frequency [Hb105] to 100%.	0.0 to150.0 %	115.0
bb-81	Over-speed detection time	Set the duration from when the detection speed exceeds [bb-80] to when tripping at "Overspeed error [E107]".	0.0 to 5.0 s	0.5
bb-82	Speed deviation error mode selection	Even if a speed deviation error is detected, the motor does not trip.	00	00
		If a speed deviation error is detected, the motor trips with "Speed deviation error [E105]".	01	
bb-83	Speed deviation error detection level	Sets the level at which the deviation between the detection speed and the target speed is judged to be excessive.	0.00 to 100.00 %	15.0
bb-84	Speed deviation error detection time	Set the duration from when the velocity error exceeds [bb-83] to when it is judged to be abnormal.	0.0 to 5.0 s	0.5
CA-85	Encoder disconnection Time	Sets the time to detect encoder disconnection. Disconnection detection is disabled when the set value is 0.0.	0.0 to 10.0 s	1.0
CC-01 CC-02 CC-07	Output terminal function	Excessive velocity error [DSE]: This signal is turned ON when the conditions below are met during operation and [bb-84] or longer are continued. |Output Frequency-Detect Speed|≧ [bb-83]	041	002 001 017

Check after setting encoder wiring and related parameters

- After setting the encoder wiring and related parameters, check the wiring and settings by referring to the table below.
- Check whether the inverter is correctly counted by running the inverter in the forward or reverse direction while checking the "Current position monitor [dA-20]".
- If the wiring and setting are correct, [dA-20] will be displayed when the motor rotates one display rotation in the forward direction, and [CA-81] will be added when the motor rotates one full revolution in the reverse direction.
  (When the phase sequence of R, S, T phase of the inverter and U, V, W phase of the motor is correctly wired, and when the encoder-output is a 90° phase-difference pulse, the A-phase is a 90° lead phase during forward rotation.)

Phenomena	Possible causal	Example of remedy
Forward rotation and reverse rotation are reversed.	The motor or encoder wiring is reversed.	Check the motor wiring U, V, W and the wiring of phase A and phase B of the encoder. Re-wire correctly if reversed.
[dA-20] does not count.	A/B phase pulse from the encoders is not outputted correctly.	Measure the voltage waveforms of the A-and B-phase wiring with a tester to check for any abnormalities. If the voltage waveform is abnormal, check the power, wiring, disconnection, etc. of the encoder.
	Inverter setting is not correct.	Refer to this section and set the inverter parameters correctly.
	The inverter input circuit is faulty.	Inverter repair.
[dA-20] does not count only during forward or reverse rotation.	The same reason as the above "[dA-20] does not count" for the A-phase or B-phase only.	Using the above as a reference, check the output of the A-or B-phase of the encoder and the input of the A-or B-phase of the inverter.
	The pulse-input cannot be counted correctly due to the effect of crosstalk of the encoder A/B phase signal-output.	Use a shielded cable for A/B phase distribution cable and connect the shield to the L terminal.

9.6 Torque control

9.6.1 Speed control and torque control

・The following two control modes are used to control the motor with high accuracy using the inverter. Both control modes can be used by setting "control method [AA121]" to "sensorless vector control (IM)(08)".

(1) Speed control: A method of controlling the output so that the motor speed is tracked to the speed command and torque is generated at a constant speed.

(2) Torque control: A method of controlling the output so that the output torque is constant regardless of the speed by following the output torque with respect to the torque command.

・Each function related to torque described in this section is valid only when the control method is sensorless vector control. For details on setting and adjustment of sensorless vector control, refer to "9.5.10 Operating with Sensorless Vector Control".

・The 100% reference value of the torque value for each function is the rated torque of the motor calculated from "IM motor capacity selection [Hb102]", "IM number of motor poles selection [Hb103]", and "IM base frequency [Hb104]" which is set as the output torque at the time of inverter rated current output or the motor constant by the setting of "Torque conversion method selection [HC115]" as 100%. Refer to "9.6.3 Torque Command Operation" for details.

■Difference between speed control and torque control

Control mode selection	Speed control	Torque control
Operation	Speed control is a control method to make the motor speed follow the speed command. Therefore, control is performed so that the speed is kept constant even when the torque of the load fluctuates.	Torque control is a control method that causes the output torque to follow the torque command. Therefore, the rotation speed of the motor fluctuates according to the fluctuation of the torque of the load.

■Related function overview of speed control to torque control

Function	Overview	Control mode
Output torque monitor function	Output torque estimate in sensorless vector control can be monitored by "Output torque monitor [dA-17]". Analog voltage/current output from the [AMI] connector and analog voltage/pulse output from the [AMV] connector are available. For details, refer to "9.16.4 Pulse Output of Monitor Data" and "9.16.5 Analog Output of Monitor Data".	Speed control Torque control
Response gain setting Gain switching Gain Mapping	Adjust the speed control response gain to increase or stabilize speed tracking. Gain switching and gain mapping functions are used when the load inertia changes due to changes in the load characteristics or speed.	Speed control
Drooping control	This function is used to perform load balancing operation, etc., in which one load is driven by multiple motors.	Speed control
Torque limit function	This function controls the motor so that the output torque does not exceed the specified torque limit value even if the load condition changes. Used in applications where force is not applied unnecessarily during pushing operation, etc.	Speed control Torque control
Switching of speed control to torque control	Switching function of speed control ⇔ torque control.	Speed control Torque control
Torque the bias function	In speed control or torque control, the torque bias value is separately added to the command torque.	Speed control Torque control
Torque control operation	Control is performed so that the output torque follows the torque command value. Used for applications that require a constant output torque even when an irregularly fluctuating external force is applied, such as applications that require a constant tension of a take-up machine. In the torque control mode, if the load becomes too light for the torque command, the motor speed continues to increase. Therefore, the speed limit function can be set during torque control.	Torque control

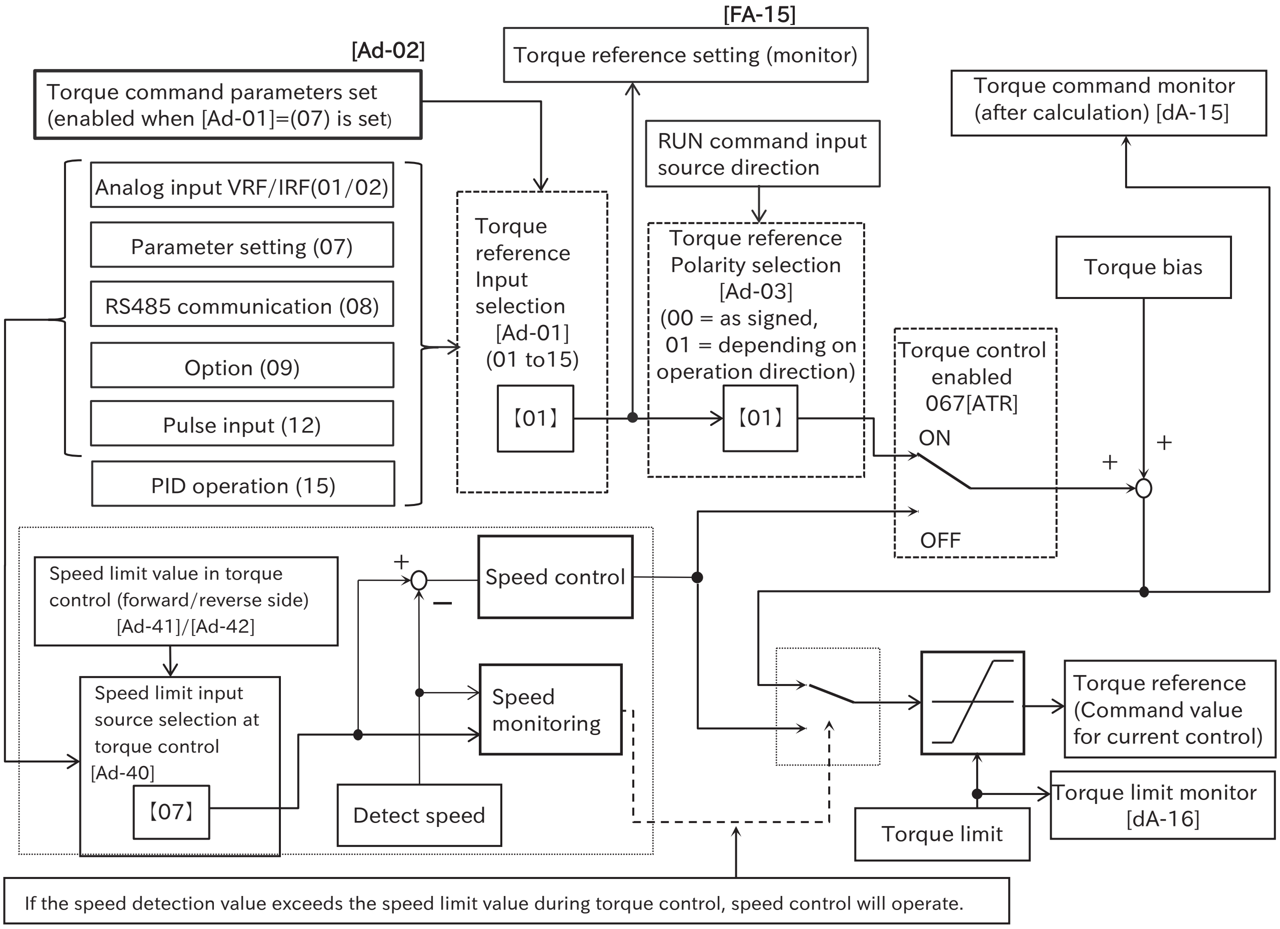
9.6.2 Switching between speed control and torque control

- Torque control and velocity control can be switched for operation by turning ON/OFF the inputterminal function "Torque control enable [ATR](067)".
- Torque control can be used when "Vector Control Mode Selection [AA123]" is set to "Speed/Torque Control Mode (00)" after "Control Method [AA121]" is set to "Sensorless Vector Control (IM) (08)".
- If shock occurs when switching from speed control to torque control, set "Speed/torque control switching time [Ad-04]" longer.
- If the torque command changes stepwise when switching from speed control to torque control, the current may increase instantaneously.

Code	Item	Description	Data	Initial value
AA121	Control mode selection	Sensorless vector control (IM)	08	00
AA123	Vector control mode selection	Mode of speed control to torque control	00	00
Ad-04	Switching time of speed control to torque control	Switches the torque command gently according to the set time when switching from speed control to torque control.	0 to 1000 ms	100
CA-01 to CA-11	Input terminal function	Torque control enable [ATR]: ON: Torque control OFF: Velocity control	067	-

9.6.3 Operate by commanding the torque

- When operating in torque control, assign "torque control enable [ATR](067)" to the input terminal. [ATR] ON the terminal to switch from velocity control to torque control.
- Torque control can be used when "Sensorless Vector Control (IM) (08)" is set in "Control Method [AA121]".
- Input destination of torque command is selected by "Torque command input selection [Ad-01]".
- When [Ad-01] is "Parameter setting (07)", the torque command value is set by "Torque command setting [Ad-02]". In addition, the torque command setting (monitor) [FA-15] can also be changed or saved. This change/save is also reflected in [Ad-02].
- When [Ad-01] is other than "Parameter setting (07)", the [FA-15] is a monitor that displays the torque command currently entered in the way set in [Ad-01].
- It is also possible to add bias to the torque command value. For details, refer to "9.6.5 Operation by Adding Torque Command".
- The present output torque can be checked in "Output torque monitor [dA-17]". The filter can also be set using the "Output torque monitor filter time constant (dA-17 and similar communication data) [CF-62]." For details, refer to "10.1.5 Monitoring Torque Command/Output Torque Related Data".
- When switching between speed control and torque control, a shock may occur in motor operation due to differences in control. It can be adjusted with "Speed/torque control switching time [Ad-04]" to reduce shocks when switching. Longer setting times reduce shock.
- The 100% reference value of the torque value in this function is the rated torque of the motor calculated from the output torque at inverter rated current output or "IM motor capacity selection [Hb102]]", "IM number of motor poles selection [Hb103]", and "IM base frequency [Hb104]" which is set as the motor constant by the setting of "Torque conversion method selection [HC115]" as 100%. Therefore, note that the absolute value of torque changes depending on the combined motor.
- Since the speed in torque control is determined by the balance with the load, the output speed increases when the actual output torque is smaller than the torque command. Therefore, set "Speed Limit Value in Torque Control [Ad-40]" as the speed limit value for preventing runaway.



Note: In the figure, [] and the position of the switch for each parameter indicates the initial value.
Input terminal functions that are not assigned to the input terminal function selection [CA-01] to [CA-08] will be OFF.

Code	Item	Description	Data	Initial value
dA-15	Torque reference monitor (after calculation)	Monitors the current torque command value.	-1000.0 to 1000.0 %	-
dA-17	Output torque monitor	Monitors the output torque value.		
FA-15	Torque reference setting (monitor)	Monitors or changes sets of the currently selected torque command value. When [Ad-01] is set to "Parameter setting (07)", changing/saving [FA-15] will also change/save the setting value of [Ad-02].	-500.0 to 500.0 %	0.0
Ad-01	Torque reference input source selection	[VRF] Input torque command by analog input of terminal. 0 to 100% of analog input is 0 to 500% torque.	01	01
		[IRF] Input torque command by analog input of terminal. 0 to 100% of analog input is 0 to 500% torque.	02	
		The [Ad-02] parameter is used for the torque command.	07	
		Torque command is set by Modbus communication.	08	
		Set the torque command from the communication option.	09	
		Set the torque command by pulse input.	12	
		PID calculation is used for the torque command.	15	
Ad-02	Torque reference value setting	When [Ad-01] is "Parameter setting (07)", set the torque command value.	-500.0 to 500.0 %	0.0
Ad-03	Torque reference polarity selection	Regardless of the direction of the operation command, the torque increases in the forward direction when the value is (+) and in the reverse direction when the value is (-).	00	01
		The sign of the value and the direction in which the torque bias acts change depending on the direction of the operation command.	01	
Ad-04	Switching time of speed control to torque control	Set the switching time of speed control/torque control. The longer the setting time, the lower the shock when switching.	0 to 1000 ms	100
Ad-40	Speed limit input source selection at torque control	[VRF] Input the speed upper limit value at torque command using the analog input of the terminal. 0 to 100% of analogue input. Hz is from 0Hz to maximum frequency.	01	07
		[IRF] Input the speed upper limit value at torque command using the analog input of the terminal. 0 to 100% of analogue input. The frequency is from 0 Hz to maximum frequency.	02	
		The value entered in [Ad-41]/[Ad-42] is used for the upper limit of speed at torque command.	07	
		Set the upper limit of speed at the command of torquecommand by Modbus communication.	08	
		Set the speed upper limit value at torque command from the communication option.	09	
		Set the speed upper limit value at torque command by pulse input.	12	
Ad-41	Speed limit at torque control (Forward)	Set the speed limit value on the forward rotation side in torque control.	0.00 to Max. frequency Hz	0.00
Ad-42	Speed limit at torque control (Reverse)	Set the speed limit value on the reverse side in torque control.		
CA-01 to CA-08	Input terminal function	Torque control enable [ATR]: Switches to torque-control when this signal is ON.	067	-
CF-62	Filter time constant for output torque monitor (dA-17 and similar communication data)	Filters can be set for "Torque output monitor [dA-17]".	0 to 1000 ms	100
HC115	Torque conversion - motor	Torque: The torque reference value (100%) is calculated as follows: Torque reference value = 79.58 x Motor capacity x number of poles/base frequency (Example) Torque reference value = 79.58×5.5(kW)×4(P)/50(Hz)≒35 Nm	00	01
		Current: The torque reference value (100%) is the motor output torque at rated current output.	01	

9.6.4 Torque limit

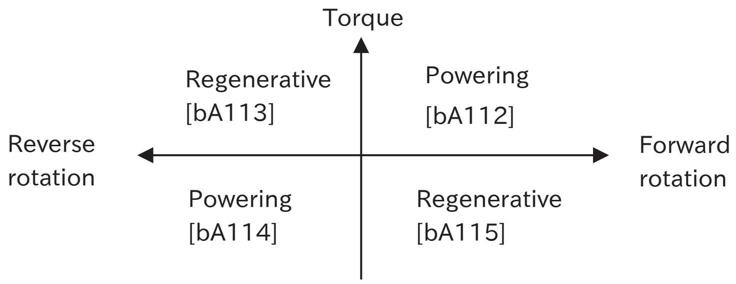
- When "Vector control without sensor (IM) (08)" is set in "Control method [AA121]", and velocity control is performed, the motor output torque is limited.
- Torque limit command destination is set by "Torque limit selection [bA110]".
- The valid torque limit can be checked in "Torque limit monitor [dA-16]".
- If "Torque limit enable [TL](060)" is set to the input terminal, the torque limit function according to the input methods set in [bA110] will be enabled only when the [TL] input terminal is turned ON. For OFF, the torque limit function is disabled.
- When "TRQ1][TRQ2] terminal switching (01)" is set to "Torque limit parameter mode selection [bA111]", four torque limits set to "Torque limit 1 to 4 [bA112] to [bA115]" can be switched and used by combining ON/OFF of "Torque limit switching 1 [TRQ1](061)" and "Torque limit switching 2 [TRQ2](062)".
- If torque pulsation occurs when releasing after torque limit operation, it may be improved by enabling "Torque LAD stop selection [bA116]".
- When "Torque limit in progress [OTQ](019)" is set to the output terminal, the [OTQ] signalturns ON when the output torque exceeds "Over torque level [CE120] to [CE123]".
- If "Torque limit in progress [TRQ](022)" is set to the outputterminal, the [TRQ] signalturns ON when the torque limit function described above operates.
- If "Torque limit enable [TL]" is not assigned, the torque limit function set in "Torque limit select [bA110]" is always enabled.
- If the torque limit function is used in the low-speed range, the motor may not start, resulting in overload protection. In this case, use the overload limit function together. For details of the overload limiting function, refer to "9.9.1 Limiting to Avoid Overload".
- The reference torque in this function is calculated based on the output torque at the time of inverter rated current output or the rated torque of the motor calculated from "IM Motor Capacity Selection [Hb102]", "IM Motor Pole Number Selection [Hb103]" and "IM Base Frequency [Hb104]" which is set as the motor constant by the setting of "Torque Conversion Method Selection [HC115]" as 100%. Refer to "9.6.3 Torque Command Operation" for details.
- Input terminal functions [TL], [TRQ1], [TRQ2] and output terminal functions [TRQ] and [OTQ] are enabled only when "Sensorless Vector Control (IM) (08)" is assigned to "Control Method [AA121]".
- When "Torque limit enable [TL]" is assigned to an input terminal for OFF, or "4 quadrants individual (00)" is set to "Torque limit parameter mode selection [bA111]", "Torque limit monitor [dA-16]" is displayed as 0.0%.

Code	Item	Description	Data	Initial value
dA-16	Torque limit monitor	Displays the currently set torque limit value. If torque limit is disabled or [bA111] is set to "4 quadrants individual (01)", it will be 0.0.	0.0 to 500.0 %	-
dA-17	Output torque monitor	Monitors the estimated output torque.	-1000.0 to 1000.0 %	
bA110	Torque limit selection	Disable	00	07
		[VRF] Set the torque limit value using analog input from the terminal.	01	
		[IRF] Set the torque limit value using analog input from the terminal.	02	
		Torque limit set in [bA112] to [bA115] is used.	07	
		Set the torque limit using Modbus communication.	08	
		Set the torque limit value from the communication option.	09	
bA111	Torque limit parameter mode selection	4 Specify the quadrant individually.	00	00
		[TRQ1]/[TRQ2] Specified by terminal combination.	01	
bA112	Torque limit 1 (4 quadrants: Forward powering)	Set the torque limit value. When [bA110] is set to "Parameter setting (07)" and [bA111] is set to "4-phenomenon individual setting (00)", set the forward powering/reverse powering/reverse powering/forward regeneration individually. When [bA110] is set to "Parameter setting (07)" and [bA111] is set to "[TRQ1][TRQ2] terminal switching (01)", the limit specified by the [TRQ1]/[TRQ2] input terminal combination is applied to all four phenomena.	0.0 to 500.0 %	200.0
bA113	Torque limit 2 (4 quadrants: Reverse regeneration)			
bA114	Torque limit 3 (4 quadrants: Reverse powering)			
bA115	Torque limit 4 (4 quadrants: Forward regeneration)			
bA116	Torque limit LADSTOP selection	Disable	00	00
		Enabled: Stops deceleration temporarily when the output torque reaches the torque limit operation level.	01	
CA-01 to CA-08	Input terminal function	Torque limited [TL]: Enables or disables the torque limit function.	060	-
		Torque limit selection bit 1/2 [TRQ1]/[TRQ2] : If [bA111] is set to "[TRQ1][TRQ2] Terminal Switching (01)", specify the torque limit by combining this signal.	061/062	
CC-01 CC-02 CC-07	Output terminal function	Over torque/Under torque [OTQ]: This signal turns ON when the output torque monitor exceeds [CE120] to [CE123] or falls below.	019	002 001 017
		Torque limit in progress [TRQ]: This signal is turned ON while the torque limit function is operating.	022	
CE120	Over/ Under-torque level (Forward drive)	[OTQ] The output torque level at which the signal is output can be set in each of the four quadrants: Forward powering, Reverse regeneration, Reverse powering, and Forward regeneration. If [CE125] is "Over torque (00)", the [OTQ] output signal turns ON when the output torque monitor value exceeds the respective level-setting value. When [CE125] is "Under Torque (01)", the opposite is true.	0.0 to 500.0 %	100.0
CE121	Over/ Under-torque level (Reverse regenerative)			
CE122	Over/ Under-torque level (Reverse drive)			
CE123	Over/ Under-torque level (Forward regenerative)			
CE124	Over/ Under-torque output signal mode selection	Operation enabled: The [OTQ] signal is detected during operation at all times.	00	01
		Valid only at constant speed: The [OTQ] signal is detected only in constant speed status, and not during acceleration/deceleration.	01	
CE125	Over/ Under-torque selection	Over-torque	00	00
		Under torque	01	
CE-62	Output torque related filter for terminal function	Filters can be set for torque-output-related output terminal functions ([OTQ] signal and [TRQ] signal).	0 to 2000 ms	100

Torque limit set methods

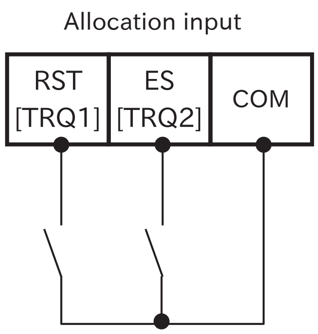
■Torque limit selection [bA110] = "Parameter setting (07)" and "Torque limit parameter mode selection [bA111] = "4 quadrants individual setting (00)"

・In this mode, the torque limit in the four quadrants of forward power running, forward regeneration, reverse power running, and reverse regeneration is individually set by "Torque Limit 1 to 4 [bA112] to [bA115]." (4) The relationship between the quadrant and the torque limit value is shown in the figure below.



■Torque limit selection [bA110] = "Parameter setting (07)" and "Torque limit parameter mode selection [bA111]"="[TRQ1][TRQ2] terminal switching (01)"

・As shown in the figure below, by combining the "Torque limit switching [TRQ1](061)"/"Torque limit switching [TRQ2](062)" input terminal function, the set value of the parameter selected from "Torque limit 1 to 4 ([bA112] to [bA115])" will be the torque limit value in all operating conditions.



TRQ1	TRQ2	Value of torque limit
OFF	OFF	bA112
ON	OFF	bA113
OFF	ON	bA114
ON	ON	bA115

■"Torque limit selection [bA110]"="VRF terminal input (01)" or "IRF terminal input (02)"

・Specify the torque limit using the analogue input applied to the [VRF]/[IRF] terminal on the control terminal block. In the default setting, voltage-input 0 to 10V/ current input 4 to 20mA correspond to torque limit 0 to 500%. The input torque limit value is the torque limit value in all operation status.
・When specifying torque limit value with analog input, be careful not to make other command input such as frequency command become analog input setting.
・For details on adjusting the analog input, see section 9.15.3, Adjusting the Analog Input.

■"Torque limit selection [bA110]"="RS485 setting (08)"

・Setting when torque limit is specified by Modbus communication. For more information, see "Chapter 11 Modbus Communication".

■"Torque limit selection [bA110]" = "Option (09)"

・Setting when torque limit value is specified from communication option. For details, refer to "Chapter 13 Communication Options" and the operation manual of each communication option.

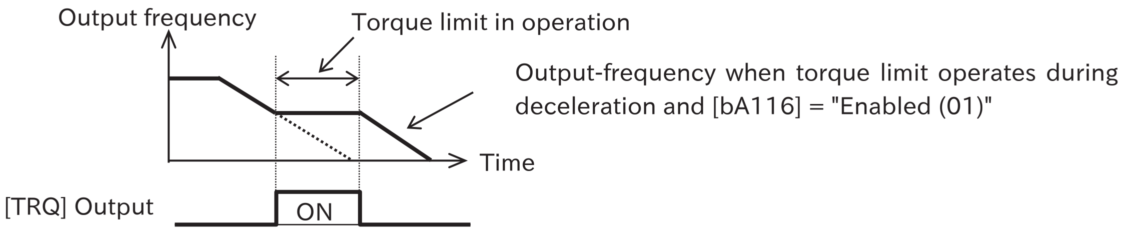
Monitor of torque limit value

・The currently selected torque limit can be checked in the torque limit monitor [dA-16].

Code	Item	Description	Data
dA-16	Torque limit monitor	Displays the currently set torque limit value. If torque limit is disabled or [bA111] is set to "4 quadrants individual (01)", 0.0% will be applied.	0.0 to 500.0 %

Torque LAD stop function

・If the motor is shocked by torque pulsation, etc. when the torque limit function operates or is released during deceleration, it may be improved by setting "Torque LAD stop selection [bA116]" to "Enabled (01)". This function stabilizes the operation of the motor when the torque limit function is activated or released by temporarily stopping the deceleration operation.



Code	Item	Description	Data	Initial value
bA116	Torque limit LAD stop selection	Disable	00	00
		Enable: Stops deceleration temporarily when the output torque reaches the torque limit operation level.	01	
CC-01 CC-02 CC-07	Output terminal function	Torque limit in progress [TRQ]: This signal is turned ON while the torque limit function is operating.	022	02 01 17

Output filter torque-related output signals

・You can set filters for the torque to be used for judgment in response to the judgment of the output terminal function "Over torque/Under torque [OTQ]" and "Torque limit in progress [TRQ]" related to torque output.

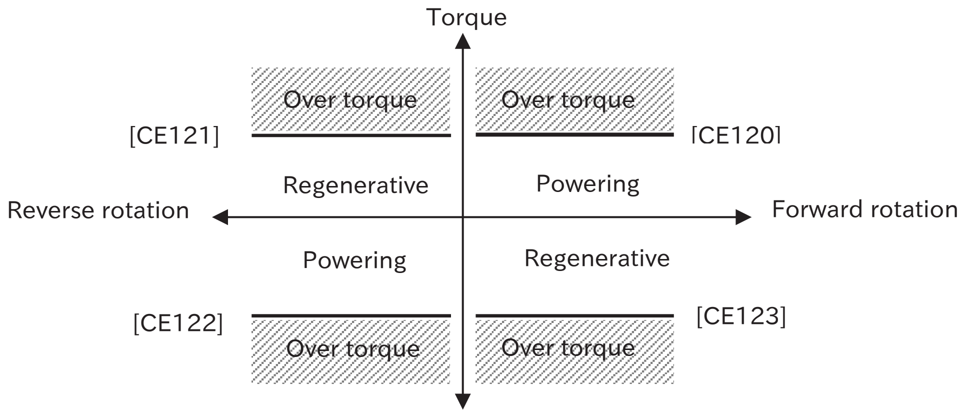
・The time constant of the filter can be adjusted by "Torque output related output terminal function filter time constant (OTQ/TRQ) [CE-62)".

Code	Item	Description	Data	Initial value
CE-62	Output torque related filter for terminal function	Filters can be set for torque-output-related output terminal functions ([OTQ] and [TRQ] signals).	0 to 2000 ms	100

Output signal when the torque rises or fall

- By assigning "Over torque/Under torque [OTQ]" to the output terminal, it is possible to detect when the output torque exceeds or falls below a desired level and output the signal. Use this function to detect a warning before a trip occurs due to an abnormal high load in the system.
- You can set the detection level for each of the four quadrants: Forward powering, Forward regeneration, Reverse powering, and Reverse regeneration.
- It is possible to select whether the detection target is at or above any level (over-torque) or below any level (under-torque) with "Over/Under-torque selection [CE125]."
- By setting "Over/Under torque output signal mode selection [CE124]", it is possible to select whether to always detect the [OTQ] signal during operation or only during constant speed operation.

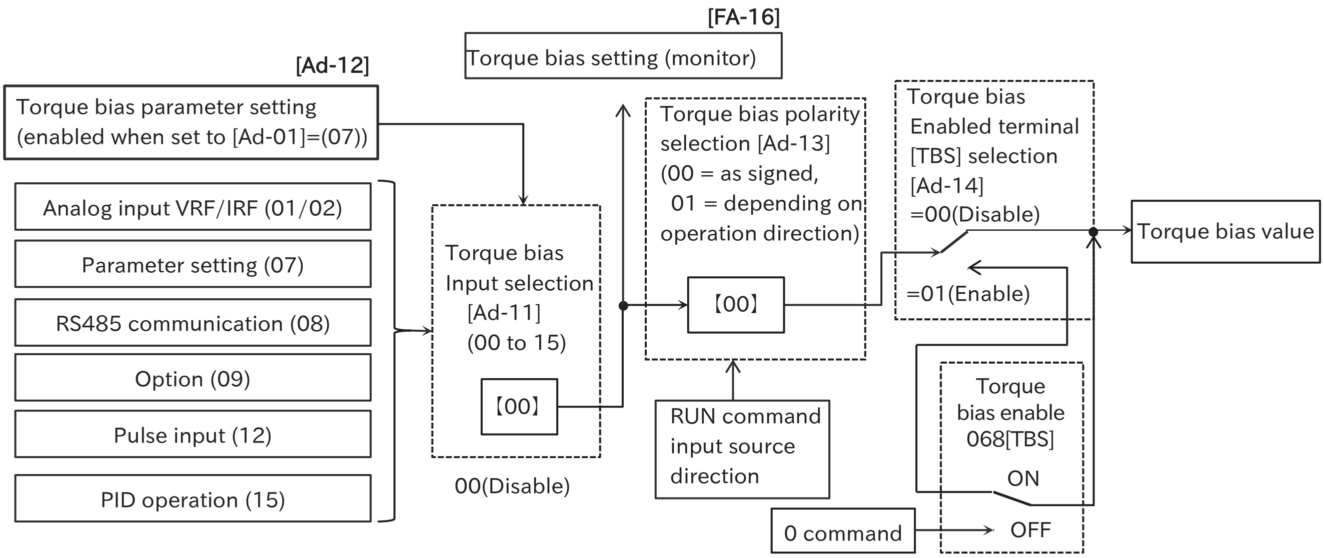
Example: When [CE125] = "Over torque (00)"



Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Over torque/Under torque [OTQ]: This signal turns ON when the output torque monitor exceeds [CE120] to [CE123] or falls below.	019	002 001 017
CE120	Over/ Under-torque level (Forward drive)	[OTQ] The output torque level at which the signal is output can be set in each of the four quadrants: Forward powering, Reverse regeneration, Reverse powering, and Forward regeneration. If [CE125] is "Over torque (00)", the [OTQ] output signal turns ON when the output torque monitor value exceeds the respective level-setting value. When [CE125] is "Under Torque (01)", it is the opposite of the above operation.	0.0 to 500.0 %	100.0
CE121	Over/ Under-torque level (Reverse regenerative)			
CE122	Over/ Under-torque level (Reverse drive)			
CE123	Over/ Under-torque level (Forward regenerative)			
CE124	Over/ Under-torque output signal mode selection	Operation enabled: The [OTQ] signal is detected during operation at all times.	00	01
		Valid only at constant speed: The [OTQ] signal is detected only when operating at constant speed. No detection is performed during acceleration/ deceleration.	01	
CE125	Over/ Under-torque selection	Over torque	00	00
		Under torque	01	

9.6.5 Run by adding torque command

- A torque bias function that adds more torque to the torque command value can be used.
- This function is enabled when "Vector control without sensor (IM) (08)" is set to "Control method [AA121]". It also operates in both speed control and torque control.
- When "Torque bias enable terminal [TBS] selection [Ad-14]" is "enable (01)", torque bias is enabled only when "Torque bias enable [TBS] (068)" is turned ON. For OFF, the torque bias is 0.0. When [Ad-14] is "disabled (00)", the torque bias value is always added to the torque command value.
- When [Ad-11] is "Parameter setting (07)", the torque bias setting is set with "Torque bias setting [Ad-12]". In addition, the torque command can be changed and saved even in "Torque bias setting (monitor) [FA-16]". This change/save is also reflected in [Ad-12].
- When [Ad-11] is other than "Parameter setting (07)", the [FA-16] is a monitor that displays the torque command currently entered in the way set in [Ad-11].
- "Torque command monitor (after calculation) [dA-15]" displays the value obtained by adding the torque bias value to the present torque command.
- Torque bias value can be switched in addition direction of torque by switching forward/reverse direction of operation command by setting of "Torque bias polarity selection [Ad-13]".
  - [Ad-13] = In the case of "code (00)":
    Regardless of the operation direction, the torque increases in the forward direction when the torque bias value is (+), and the torque increases in the reverse direction when it is (-).
  - [Ad-13] = "Depends on operation direction (01)":
    Torque bias value is added with the direction of operation command as (+). When the torque bias value is (+), the torque increases in the operation command direction, and when it is (-), the torque increases in the reverse direction of the operation command.
    Example) When the operation command is reverse: Torque bias value is (+), the reverse torque increases.
    When the torque bias value is (-), the forward rotation torque increases.
- Since the torque bias function adds the torque command, the current increases.
- The 100% reference value of the torque value in this function is the rated torque of the motor calculated from the output torque at the time of the inverter rated current output or the motor capacity [Hb102], the number of motor poles [Hb103], and the base frequency [Hb104], which is set as the motor constant, according to the setting of "Torque conversion method selection [HC115]", as 100%. Therefore, note that the absolute value of torque changes depending on the combined motor.
- The set torque value assumes that the torque equivalent to the rated output current of the inverter is 100%. Therefore, note that the absolute value of torque changes depending on the combined motor.



Note: In the figure, [] and the position of the switch for each parameter indicates the initial value.
Input terminal functions that are not assigned to the input terminal function selection [CA-01] to [CA-08] will be OFF.

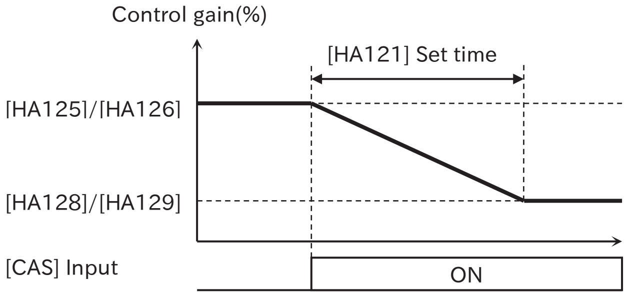
Code	Item	Description	Data	Initial value
dA-15	Torque reference monitor (after calculation)	Monitors the current torque command value.	-1000.0 to 1000.0 %	-
FA-16	Torque bias value setting (Monitor)	Monitors or changes sets for the currently selected torque bias. If [Ad-11] is set to 07 (Parameter) and you change or save [FA-16], the [Ad-12] setting is also changed or saved.	-500.0 to 500.0 %	
Ad-11	Torque bias input source selection	Torque bias function disabled.	00	00
		[VRF] Input torque bias using the analog input of the terminal. 0 to 100% of analog input is 0 to 500% torque.	01	
		[IRF] Input torque bias using the analog input of the terminal. 0 to 100% of analog input is 0 to 500% torque.	02	
		Input of [Ad-12] is used for torque bias.	07	
		Set the torque bias by Modbus communication.	08	
		Set the torque bias from the communication option.	09	
		Torque bias is set by pulse input.	12	
		PID operation is used for torque bias.	15	
Ad-12	Torque bias value setting	Set the torque bias when [Ad-11] is set to "Parameter setting (07)".	-500.0 to 500.0 %	0.0
Ad-13	Torque bias polarity selection	As indicated: Regardless of the operation direction, the torque increases in the forward direction when the value is (+) and in the reverse direction when the value is (-).	00	00
		According to the rotation direction: Torque bias is added by setting the direction of operation command as (+).	01	
Ad-14	Enable terminal [TBS]	Disable: Torque biasing function is enabled regardless of the status of the [TBS] inputterminal.	00	00
		Enable: [TBS] ON/OFF of torque bias function can be selected by input terminal.	01	
CA-01 to CA-08	Input terminal function	Torque bias enable [TBS]: [TBS] When [Ad-14] = "Enabled (01)" is assigned to an input terminal, the enabling/disabling of bias is switched by ON/OFF of the terminal. ON: Enable/OFF: Disable	068	-

9.6.6 Setting the Motor Control Gain

- Speed control gain (ASR(Automatic Speed Regulatr) of motor control can be switched according to terminal input/output frequency.
- When "Gain switching selection [HA120]" is set to "[CAS] terminal switching (00)", two types of control gains can be switched and applied according to ON/OFF of the "Control gain switching [CAS](064)" inputterminal. [CAS] Switching time when inputterminal is ON/OFF can be set by "Gain switching time [HA121]".
- When "Gain switching selection [HA120]" is set to "Switching by setting (01)", the gain mapping function is enabled. With the gain mapping function, it is possible to change the control gain in up to four stages according to the output frequency.
- P control and PI control can also be switched using the "P/PI control switching [PPI](063)" input terminal. For details, refer to "9.6.7 Moving a single load with multiple motors (true-ping control)".
- When this function is used, "control method [AA121]" must be set to "sensorless vector control (IM) (08)".

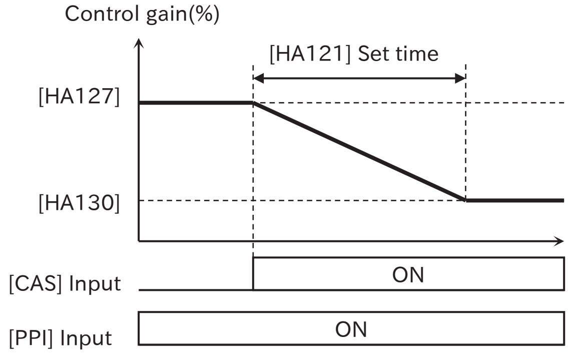
Code	Item	Description	Data	Initial value
HA120	ASR gain switching mode selection	[CAS] Gain 1 and 2 are switched by the input terminal.	00	00
		The speed changes according to the setting.	01	
HA121	Gain change time	[CAS] When the terminal is turned ON/OFF, the gain will change by this setting. Refer to the illustrations in this section for details.	0 to 10000 ms	100
HA122	ASR gain mapping intermediate speed, 1-motor	The frequency to which control gain 2 of the gain mapping function is applied.	0.00 to 590.00Hz	0.00
HA123	ASR gain mapping intermediate speed 2, -motor	The frequency to which control gain 3 of the gain mapping function is applied.		
HA124	ASR gain mapping maximum speed	The frequency to which control gain 4 of the gain mapping function is applied.		
HA125	Mapping P-gain -gain, 1-	[CAS] Set the P gain of PI control when OFF of the input terminals or the 0 (zero) Hz of gain mapping.	0.0 to 1000.0 %	100.0
HA126	Mapping I-gain -gain, 1-	[CAS] Sets the I-gain of PI control at OFF of input pins or 0 (zero) Hz of gain mapping.		
HA127	Gain mapping control P-gain -gain, 1-	[CAS] Set the P gain of P control when OFF of the input terminal or 0 (zero) Hz of gain mapping.		
HA128	Mapping P-gain -gain 2,	[CAS] Sets the input-terminal ON or P-gain for PI control of intermediate velocity 1 of gain mapping.		
HA129	Mapping I-gain -gain 2,	[CAS] Sets the I-gain of the input-terminal ON or PI control of the mid-speed 1 for gain mapping.		
HA130	Gain mapping control P-gain -gain 2,	[CAS] Sets the P gain for P control of the mid-speed 1 of the input-terminal ON or gain mapping.		
HA131	Mapping P-gain -gain 3,	Sets the P gain for PI control of intermediate velocity 2 for gain mapping.		
HA132	Mapping I-gain -gain 3,	Sets the I gain for PI control of intermediate velocity 2 for gain mapping.		
HA133	Mapping P-gain -gain 4,	Sets the P gain of PI control for maximum-speed of gain mapping.		
HA134	Mapping I-gain -gain 4,	Sets the I gain of PI control for maximum-speed of gain mapping.		
CA-01 to CA-08	Input terminal function	P/PI control switching [PPI]: Switches between PI control and P control by ON/OFF.	063	-
		Control gain switching [CAS]: Gain is switched by ON/OFF.	064	

■[CAS] For input-terminal switching ([HA120] ="[CAS] terminal-based switching (00)")



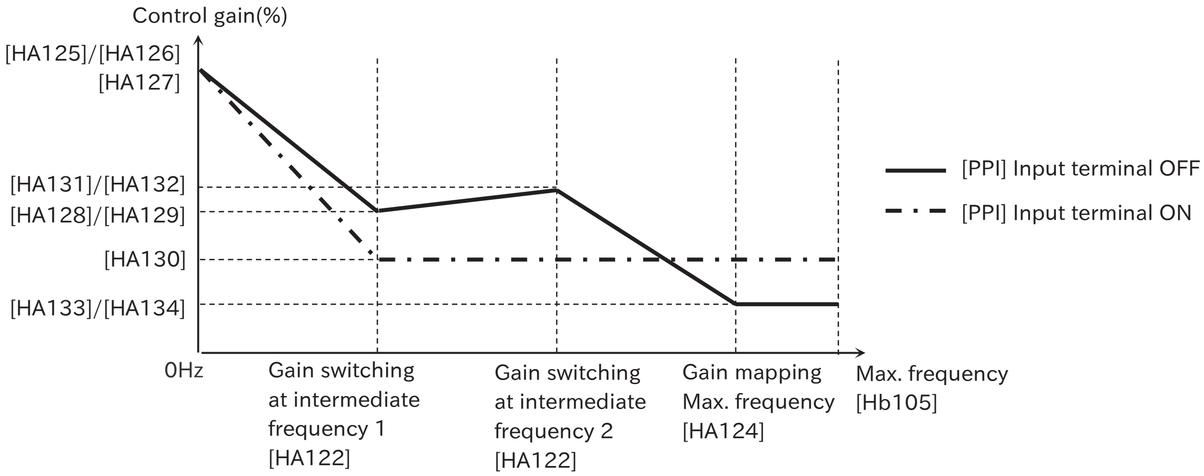
Terminal Functions	[PPI] OFF
[CAS] OFF	PI control P gain 1 = [HA125] PI control I gain 1 = [HA126]
[CAS] ON	PI control P gain 2 = [HA128] PI control I gain 2 = [HA129]

■[PPI] For [CAS] input terminal switching in input terminal ON (Switching by [HA120] ="[CAS] terminal (00)")



Terminal Functions	[PPI] ON
[CAS] OFF	P control P gain 1 = [HA127]
[CAS] ON	P control P gain 2 = [HA130]

■Switching by setting (Gain mapping function) ([HA120] = "Switching by setting (01)")

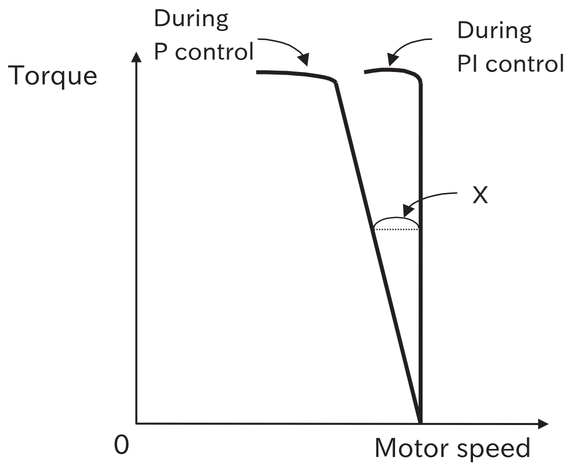


Frequency	Applicable gain	[PPI]OFF	[PPI]ON
0 Speed (Zero Hz)	Gain 1	PI control P gain 1 = [HA125] PI control I gain 1 = [HA126]	P control P gain 1 = [HA127]
Gain switching intermediate frequency 1 [HA122]	Gain 2	PI control P gain 2 = [HA128] PI control I gain 2 = [HA129]	P control P gain 2 = [HA130]
Gain switching intermediate frequency 2 [HA123]	Gain 3	PI control P gain 3 = [HA131] PI control I gain 3 = [HA132]	
Maximum gain mapping frequency [HA124]	Gain 4	PI control P gain 4 = [HA133] PI control I gain 4 = [HA134]	

9.6.7 Moving a single load with multiple motors（Droop speed control）

- When two motors and inverters are used to drive one drive by distributing the torques, ON of the "P/PI control switching [PPI](063)" inputterminal of one inverter switches from PI control to P control.
- By switching the speed-control gain (ASR (Automatic Speed Regulator) of one motor control from PI control to P control, the inverter automatically increases or decreases the frequency according to the output torque of the other motor to balance the load.
- In P control, (X) in the figure below increases when the P control P gain is decreased. Adjust according to the actual system.
- P control P gain can be set in two ways: "P control P gain 1 [HA127]" and "P control P gain 2 [HA130]". P gain is switched by ON/OFF of "Control gain switching [CAS](064)".

- When this function is used, "Control Method [AA121]" must be selected "Sensorless Vector Control (IM)(08)".
- When one load is driven by more than one inverter with PI control, it may be improved by making the inverter that generates "overcurrent error [E001]" or "overvoltage error [E007]" to P control. Set the inverter to be changed to P control and its P control gain adjustment according to the actual system.



■[CAS] Control Gain (Switching by [HA120] ="[CAS] Terminal (00)) that is enabled for terminal switching

Terminal Functions	[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]

■Control gain ([HA120] = "Switching by setting (01)") to be enabled when switching by setting (gain mapping function)

Frequency	Applicable gain	[PPI]OFF	[PPI]ON
0 Speed (Zero Hz)	Gain 1	PI control P gain 1 = [HA125] PI control I gain 1 = [HA126]	P control P gain 1 = [HA127]
Gain switching intermediate frequency 1 [HA122]	Gain 2	PI control P gain 2 = [HA128] PI control I gain 2 = [HA129]	P control P gain 2 = [HA130]
Gain switching intermediate frequency 2 [HA123]	Gain 3	PI control P gain 3 = [HA131] PI control I gain 3 = [HA132]	
Maximum gain mapping frequency [HA124]	Gain 4	PI control P gain 4 = [HA133] PI control I gain 4 = [HA134]	

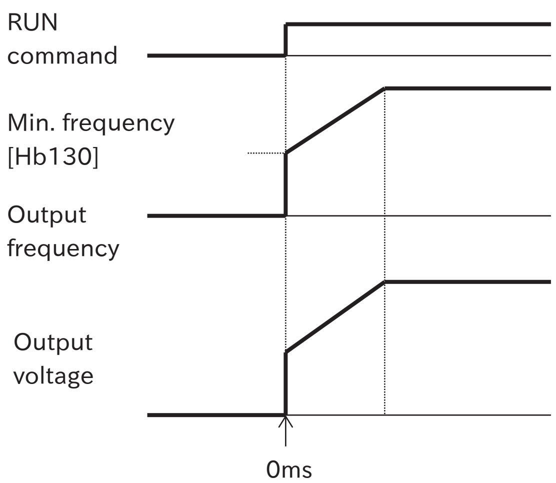
9.7 Changing the start and stop method

9.7.1 Reduced voltage startup

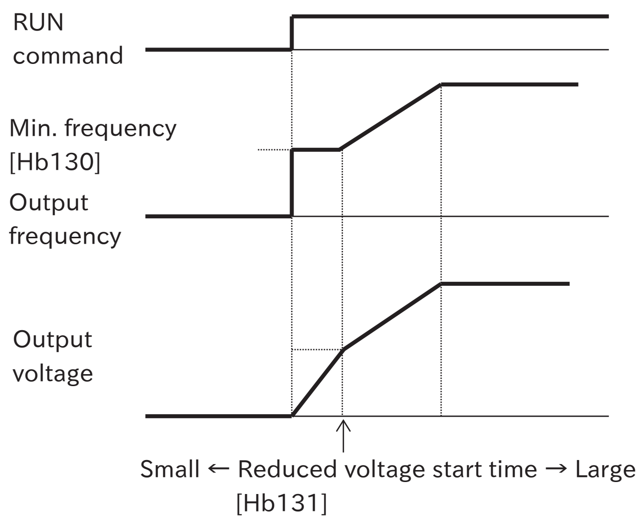
- This function slowly increases the voltage while outputting "Min. frequency [Hb130]" when the motor starts.
- If you want to increase the torque at startup, etc., reduce the setting of "Reduced voltage startup time [Hb131]". However, when the setting is made smaller, it becomes like a direct-on start, so it is easier to trip over current.
- If you want to prevent the current from jumping during startup, or if overcurrent trips during startup, increase the [Hb131] setting. However, the torque at start may be insufficient.
- This function is enabled when the control method is V/f control.

Code	Item	Description	Data	Initial value
Hb130	Minimum frequency	This is the frequency at which the drive starts outputting when an RUN command is ON.	0.01 to 10.00 Hz	0.50
Hb131	Reduced voltage start time	The output voltage is increased over the set time from the start of operation to the voltage command equivalent to the minimum frequency.	0 to 2000 ms	12

■When the voltage reduction start-time setting is 0ms ([Hb131] = 0)



■When the voltage reduction start-up period other than 0ms ([Hb131]≠0)



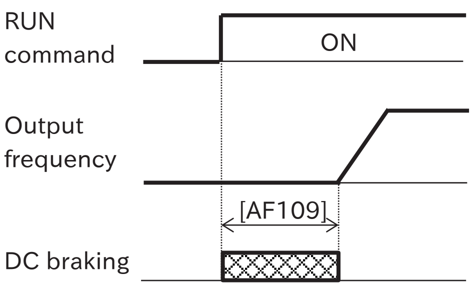
9.7.2 Starting after applying DC braking

- Start the motor after stopping the motor by performing DC braking (DB) before outputting the frequency to the motor.
- The following settings are required to perform DC braking at startup.
  - Set "Internal DC Braking: Enable (01)" in "DC Braking Selection [AF101]."
  - Set the braking force required for the DC braking force at start [AF108].
  - Set other than 0.00 s to the DC Braking Duration at Start [AF109].
- DC braking at startup performs DC braking for the time set in "DC braking time at startup [AF109]" after the operation command is input.
- DC braking is performed with a braking force equivalent to ND rated output current when [AF108] is set to 100% when standard load (ND) is selected.
- DC braking is performed with a braking force equivalent to 70% of LD rated output current when [AF108] is set to 100% when light load (LD) is selected.
- 「Set and operate the DC braking force at start [AF108]" and "DC braking duration at start [AF109]" paying attention to heat generation of the motor.
- When "Enable (Operation with Setting Frequency Only) (02)" is set to "DC Braking Selection [AF101]", DC braking starts when both the frequency command and the output frequency are less than "DC Braking Frequency [AF103]", regardless of start/stop. For details, refer to section 9.7.8, "Applying DC Braking to Stop."
- If "Carrier frequency [bb101]" exceeds 2kHz, the DC braking force is limited. For details, refer to section 9.7.8, "Applying DC Braking to Stop."

Code	Item	Description	Data	Initial value
AF101	DC braking selection Note	Internal DC Braking: Disable	00	00
		Internal DC Braking: Enable	01	
		Internal DC Braking: Enable (Operations with set frequency only)	02	
AF108	DC braking force at start	Adjust the DC braking force at start. The maximum braking force when set to 100%.	0 to 100 %	0
AF109	DC braking active time at start	Set the DC braking duration at start when "Enable (01)" is selected for [AF101].	0.00 to 60.00 s	0.00

Note: Internal DC braking means that DC braking is performed according to the output frequency and operating status by setting parameters, regardless of external signals. When DC braking is performed by an external signal, this is called external DC braking. For details of the external DC braking, refer to "9.7.8 Applying DC Braking to Stop."

■DC Braking at Start ([AF101]=01)



9.7.3 Starting with the frequency matching function

- By HF-620 in the restart function When Frequency Adjustment Restart is selected, the same operation as the frequency retraction restart from the cutoff frequency is executed. (Operation when "Frequency retraction restart" is selected in Restart method selection and "Start frequency selection at frequency retraction restart" [bb-47] is set to "Frequency at shutoff (00)")
- The frequency matching restart function can be set for each of the following functions.
  - Momentary power failure/undervoltage restart (Refer to 9.9.6 "Restarting after Momentary power failure/undervoltage" in [bb-24]=01.")
  - Overcurrent restart (Refer to 9.9.7 "Restarting after Overcurrent" in [bb-28]=01 Setting")
  - Overvoltage restart (Refer to 9.9.8 "Restarting after Overvoltage" in [Set to bb-30]=01")
  - Restart after cancellation of coasting. (Refer to "9.7.6 Start after Coasting Stop" in [Set to bb-40]=01.")
  - Restart after reset release (when power is turned on)
    ([Set to bb-41]=01, see "9.7.5 Start after Trip Reset or Power On"))
- For detailed operation when frequency matching restart is selected for one of the above functions, refer to "9.7.4 Using the Frequency Pull-in Function to Start".
- When "Operation command selection [AA111]" is "Operation panel RUN key (02)", operation command is also OFF when "Free run [MBS]" or "Reset [RS]" input terminal is ON. If restart after cancellation of coasting or resetting is set at this time, the retry operation will start when RUN key on the control panel is pressed to start operation. In the event of instantaneous power failure/undervoltage restart, overcurrent restart, or overvoltage restart, the operation command is maintained in ON status, so retry operation is started without pressing RUN key.
- For the restart function, also refer to "9.9 Using the Tripleless Function".
- When using the frequency matching function in synchronous (permanent magnets) motors (SM(PMM), the operation differs from the above. Contact the place of purchase for details.

9.7.4 Frequency entry function to start

- With the frequency pull-in restart function, the motor can be quickly pulled from the rotation speed of the idling motor to the set frequency and restarted while suppressing the increase in current. Refer to "(Example 1) Restarting frequency retraction" for details of operation.
- The frequency retraction restart function can be set for each of the following functions.
  - Momentary power failure/undervoltage restart (Refer to 9.9.6 "Restarting after Momentary power failure/undervoltage" in [bb-24]=02.")
  - Overcurrent restart (Refer to 9.9.7 "Restarting after Overcurrent" in [bb-28]=02 Setting")
  - Overvoltage restart (Refer to 9.9.8 "Restarting after Overvoltage" in [Set to bb-30]=02")
  - Restart after cancellation of coasting. (Refer to "9.7.6 Start after Coasting Stop" in [Set to bb-40]=02.")
  - Restart after reset release (when power is turned on) ([Set to bb-41]=02, see "9.7.5 Start after Trip Reset or Power On"))
- When restarting after canceling free status or restarting after canceling reset, restarting starts after waiting for "momentary power failure/undervoltage retry wait time [bb-26]" after free run or reset is canceled and the operation command is ON.
- Frequency retraction restart function is available only for induction motor drive.
- When "Operation command selection [AA111]" is "Operation panel RUN key (02)", operation command is also OFF when "Free run [MBS]" or "Reset [RST]" input terminal is ON. If restart after cancellation of coasting or resetting is set at this time, the retry operation will start when RUN key on the control panel is pressed to start operation. In the event of instantaneous power failure/undervoltage restart, overcurrent restart, or overvoltage restart, the operation command is maintained in ON status, so retry operation is started without pressing RUN key.

Code	Item	Description	Data	Initial value
bb-42	Frequency matching minimum restart frequency	If the starting frequency is less than this setting due to the setting of [bb-47], it will be restarted 0Hz.	0.00 to 590.00 Hz	0.00
bb-43	Active frequency matching restart level	Sets the current limit level at restart of frequency retraction.	(0.00 to 2.00) Inverter rated output current A	1.00×rated output current
bb-44	Restart constant (speed) of Active frequency matching	Set the deceleration time when the current is increased.	0.10 to 30.00 s	0.50
bb-45	Active frequency matching restart constant (voltage)	Sets the output voltage increase rate when the frequency pull-in restart. (e.g. 10.00s = output-voltage 0 → 100% for 10s)	0.10 to 30.00 s	1.20
bb-46	OC-suppress level at active frequency matching	If the current increases to the [bb-46] setting when restarting, the over-current suppression function will be activated.	(0.30 to 1.80)× Inverter rated output current A	1.80×rated output current
bb-47	Restart speed Active frequency matching	Start at the frequency at the previous cut-off.	00	00
		Start at the highest frequency setpoint.	01	
		Starts with the current frequency command value.	02	

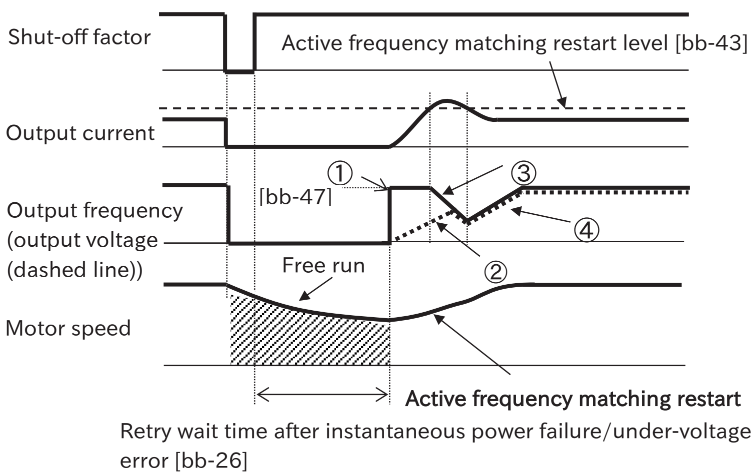
■(e.g. 1) How to restart frequency luffing

①After the retry wait time, it starts outputting at the frequency set in [bb-47].

②At the same time, the output power is gradually increased to prevent an overcurrent or the like from occurring according to the setting in [bb-45]. (dashed line in the right figure)

③If the output current exceeds [bb-43], decelerate the output frequency according to the setting of [bb-44] to suppress the output current.

④When the output frequency and the output voltage are balanced, normal operation takes place.

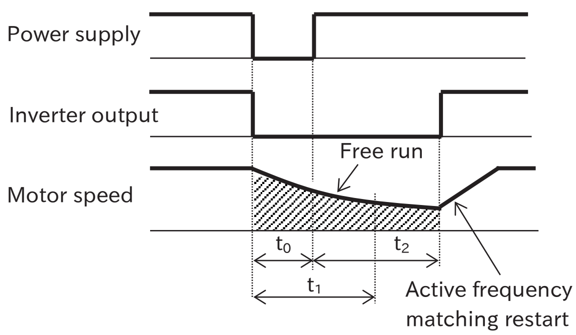


Restart at momentary power loss and undervoltage ([bb-24]=02)

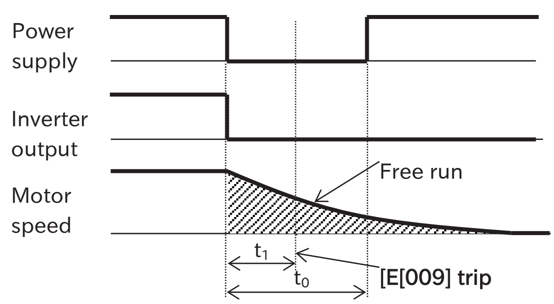
・To restart frequency pull-in when instantaneous power failure or undervoltage occurs, set "Instantaneous power failure or undervoltage retry selection [bb-24]" to "Frequency pull-in restart (02)".
・Even if the frequency-pull-in restart is set, a trip will occur if the instantaneous power failure or undervoltage time exceeds the "instantaneous power failure allowable time [bb-25]".

Code	Item	Description	Data	Initial value
bb-21	Number of retries after under voltage	When the DC voltage between P-N drops to the undervoltage level, it trips immediately without restarting.	0 time	0
		When the DC voltage between P-N drops to the undervoltage level, restart is performed for the set number of times, and the motor trips at the next error. The count of the number of times is cleared by reset input or power shutdown.	1 to 16 times	
		When the DC voltage between P-N drops to the undervoltage level, restart is performed. The number of restarts is unlimited and no trip occurs.	255	
bb-24	Restart mode selection after instantaneous power failure/under-voltage error	Frequency pull-in restart.	02	01
bb-25	Instantaneous power failure allowed time	If the power is restored within this set time, the unit will restart. (Example 2) If the instantaneous power failure or undervoltage time is longer than this setting time, the motor trips. (Example 3)	0.3 to 25.0 s	1.0
bb-26	Retry wait time after instantaneous power failure/under-voltage error	Sets the waiting time from power restoration to restart.	0.3 to 100.0 s	1.0
bb-27	Enable instantaneous power failure/under-voltage error while in stop status	During stoppage, if the DC voltage between P-N drops to the undervoltage level, it will not be judged as an instantaneous power failure or undervoltage.	00	00
		When the DC voltage between P-N drops to the undervoltage level, even when the operation is stopped, it is judged as an instantaneous power failure or undervoltage.	01	
		During stop and deceleration stop, if the DC voltage between P-N drops to the undervoltage level, it will not be judged as an instantaneous power failure or undervoltage.	02	

■ (e.g. 2) When power is restored within "Allowable momentary power failure time [bb-25]"



■(e.g. 3) When power is restored after "Allowable momentary power failure period [bb-25]"



t_0: Instantaneous power failure/undervoltage time t_1: "Instantaneous power failure allowable time [bb-25]"
t_2: "Instantaneous power failure/undervoltage retry standby time [bb-26]"

・Instantaneous power failure or undervoltage trip during selection [bb-27], which disables instantaneous power failure or undervoltage error during inverter stop or deceleration due to operation command OFF. However, even if [bb-27] is set to stop instantaneous power failure/undertrip while stopped, it will trip if the instantaneous power failure/undervoltage time is equal to or greater than the "Instantaneous power failure allowable time [bb-25]."
・Even when restarting is set, "Undervoltage Error [E009]" will occur if the instantaneous power failure/undervoltage status continues for approximately 40 seconds.

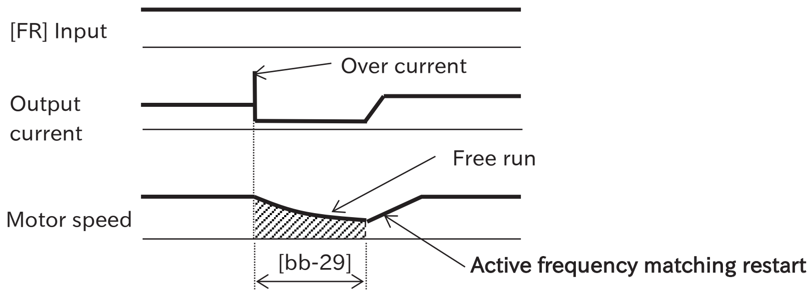
・When the power-off time is long and the inverter-controlled microcomputer is turned off, it operates according to the setting of "Restart after release from reset [bb-41]" instead of "Momentary power failure/undervoltage retry selection [bb-24]" after power restoration.

Restart at frequency when overcurrent occurs ([bb-28]=02)

・To perform frequency retraction restart when overcurrent occurs, set "Overcurrent trip retry selection [bb-28]" to "Frequency retraction restart (02)".
・If Restart is selected when overcurrent occurs, restart is performed for the number of times set in "Overcurrent retry count selection [bb-22]" and trips at the next time. If [bb-22] is set to 0 times, restart is not performed and the motor trips immediately.

Code	Item	Description	Data	Initial value
bb-22	Number of retries after overcurrent	Set the number of retries when overvoltage or overcurrent occurs.	0 to 5 times	0
bb-28	Restart mode selection after an overcurrent error	Frequency pull-in restart.	02	01
bb-29	Retry wait time after an overcurrent error	Sets the wait time between the occurrence of overcurrent or overvoltage and the start of restart.	0.3 to 100.0 s	0.3

■(e.g. 4) Frequency pull-in restart when overcurrent occurs

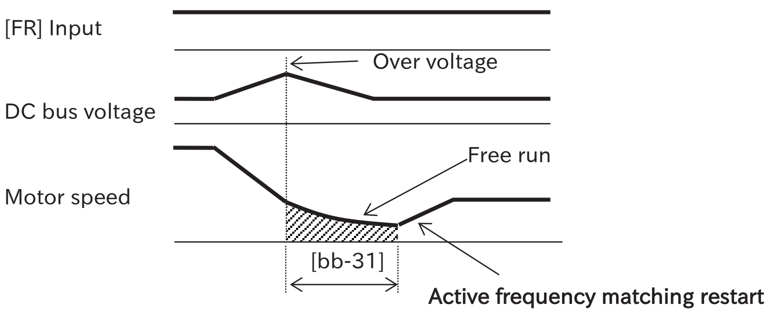


Frequency-pull restart when overvoltage occurs ([bb-30]=02)

・To perform frequency retraction restart when an overvoltage occurs, set "Overvoltage trip retry selection [bb-30]" to "Frequency retraction restart (02)".
・If Restart is selected when an overvoltage occurs, restart is performed for the number of times set in "Overvoltage retry count selection [bb-23]" and tripped at the next time. If [bb-23] is set to 0 times, restart is not performed and the motor trips immediately.

Code	Item	Description	Data	Initial value
bb-23	Number of retries after over voltage	Set the number of retries when overvoltage or overcurrent occurs.	0 to 5 times	0
bb-30	Restart mode selection after an overvoltage error	Frequency pull-in restart.	02	01
bb-31	Retry wait time after an overvoltage error	Sets the wait time between the occurrence of overcurrent or overvoltage and the start of restart.	0.3 to 100.0 s	0.3

■(e.g. 5) Frequency pull-in restart when overvoltage occurs at deceleration



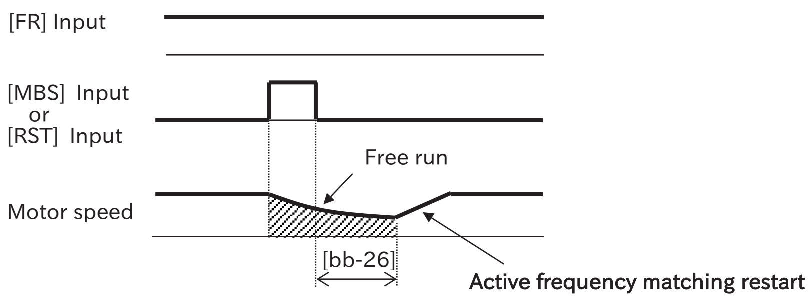
・Even if the retry operation at trip is selected, trip will be detected again if the trip factor has not been cancelled after the retry standby time. In this case, increase the retry wait time.

Frequency retraction restart after cancellation of coasting or reset ([bb-40]/[bb-41]=02)

- To perform frequency retraction restart after releasing free-run stop, set "Restart after releasing free-run [bb-40]" to "Frequency retraction restart (02)".
- To perform frequency retraction restart after reset release, set "Restart after reset release [bb-41]" to "Frequency retraction restart (02)".
- When the retry standby time has elapsed after the "Coasting [MBS]" or "Reset [RST]" input terminal is OFF, frequency retraction restart is performed without stopping the motor.
- If an overcurrent trip occurs when the frequency is retracted and restarted, increase the retry wait time.

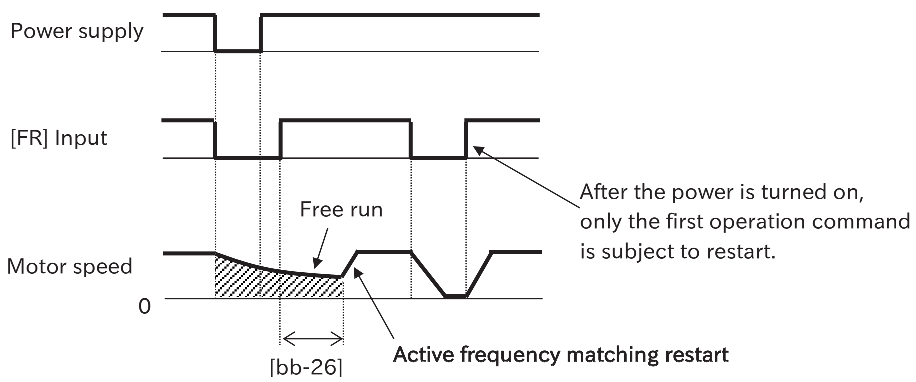
Code	Item	Description	Data	Initial value
bb-26	Retry wait time after instantaneous power failure/under-voltage error	Sets the waiting time from free-run release or reset release to restart start.	0.3 to 100.0 s	1.0
bb-40	Restart mode after MBS release	Frequency pull-in restart.	02	00
bb-41	Restart mode after RS release	Frequency pull-in restart.	02	00

■(e.g. 6) Frequency retraction restart after free-run/reset



- When Restart after reset release [bb-41] is set to "Frequency retraction restart (02)", the first operation after power-on will also be the frequency retraction operation.

■(e.g. 7) Frequency pull-in restart at power-on



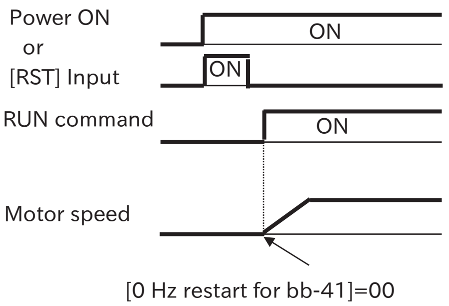
9.7.5 Start after trip reset or power on

- By "Restart after reset release [bb-41]", the starting methods after trip reset and when the power is turned on can be selected from 0 Hz restart, frequency matching restart [Note:1], frequency retraction restart [Note:2], and restart from the detected speed by the encoder feedback.
- The setting of restart after trip reset is valid for any method such as "Reset [RST]" input terminal and STOP/RESET key on the control panel.
- 0 For Hz restart, retry wait time cannot be set.
- The startup method when the power is turned on and the restart when returning from a reset are common settings.
- When frequency retraction restart is performed, the operation command direction at the start of retraction operation is the same as the operation command direction at the reset input.
- If the power supply shutdown time is long and the internal power supply for control of the inverter is turned off, the inverter operates by restarting after releasing the reset, not by instantaneous power failure or undervoltage restart.
- When "Operation command selection [AA111]" is "Operation panel RUN key (02)", the operation command is OFF when the [RST] input terminal is turned ON. In such cases, if the operation is started from the operation panel after the "Reset [RS]" input terminal is turned OFF, the restart set in "Restart after reset release [bb-41]" will be performed.

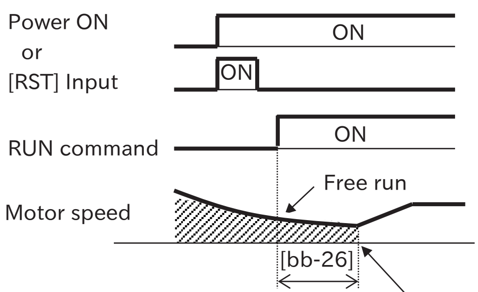
Note: 1. For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.
2. For details, see section 9.7.4, Using the Frequency Pull-in Function to Start.

Code	Item	Description	Data	Initial value
bb-26	Retry wait time after instantaneous power failure/under-voltage error	Sets the waiting time from power-on or recovery to restart.	0.3 to 100.0 s	1.0
bb-41	Restart mode after RST release	0Hz restart is performed.	00	00
		Restart the frequency adjustment (restart the frequency retraction from the cutoff frequency).	01	
		Frequency pull-in restart.	02	
		Restart is performed from the detection speed by encoder feedback.	03	

■(e.g. 1) Example of operation while stopped and after resetting the power ON

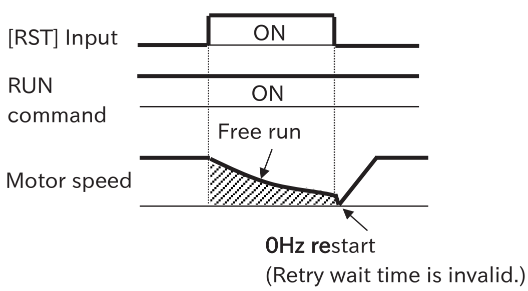


■(e.g. 2) Example of operation while stopped and after resetting the power ON

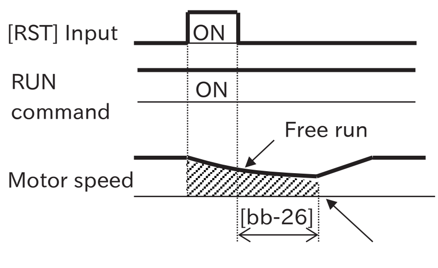


If an operation command is ON after the power is turned on or reset, the actuator will start up with an operation that conforms to the [bb-41] setting.

■(e.g. 3) Example of operation during operation and after OFF of [RST] inputterminal



■(e.g. 4) Example of operation during operation and after OFF of [RST] inputterminal



[bb-41]=01: Frequency-adjusted restart
[bb-41]=02: Active frequency matching restart
[bb-41]=03: Restart from search velocity

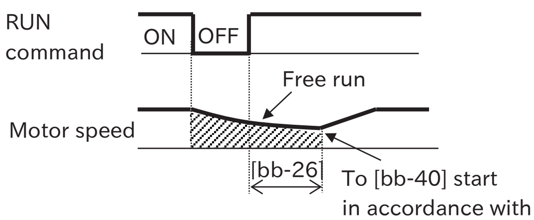
9.7.6 Start after free run stop

- By "Restart after coasting release [bb-40]", you can select the starting method when the "Free run stop [MBS]" input terminal is turned OFF from ON from 0Hz restart, frequency matching restart Note:1, frequency retraction restart Note:2 and restart from the detected speed by the encoder feedback.
- When "Stop method selection [AA115]" is "Free-run stop (01)", the inverter is in the free-run stop status when the operation command is OFF (stop command), and it follows the setting of [bb-40] at the next operation. For more information on [AA115], see "9.7.7 Selecting Stopping Operation".
- 0 For Hz restart, there is no setting for the retry wait period.
- The startup method when the power is turned on and the restart when returning from a reset are common settings.
- When frequency retraction restart is performed, the operation command direction at the start of retraction operation is the same as the operation command direction at the reset input.
- If the power supply shutdown time is long and the internal power supply for control of the inverter is turned off, the inverter operates by restarting after releasing the reset, not by instantaneous power failure or undervoltage restart.
- If the "Operation command selection [AA111]" is "Operation panel RUN key (02)", the operation command will be OFF when the "Free run stop [MBS]" inputting terminal is ON. In this situation, if operation is started from the operation panel after the [MBS] input terminal is turned OFF, the restart set in "Restart after cancellation of coasting [bb-40]" will be performed.

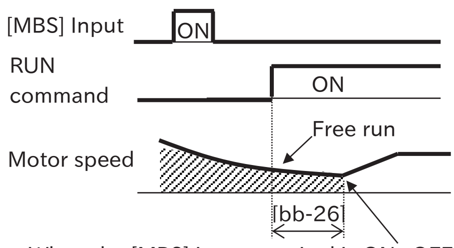
Note: 1. For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.
2. For details, see section 9.7.4, Using the Frequency Pull-in Function to Start.

Code	Item	Description	Data	Initial value
bb-26	Retry wait time after instantaneous power failure/under-voltage error	Sets the waiting time from power restoration to restart.	0.3 to 100.0 s	1.0
bb-40	Restart mode after MBS release	0Hz restart is performed.	00	00
		Restart the frequency adjustment (restart the frequency retraction from the cutoff frequency).	01	
		Frequency pull-in restart.	02	
		Restart is performed from the detection speed by encoder feedback.	03	

■(e.g. 1) Operation example when "Stop method selection [AA115]" = free-run stop (01)

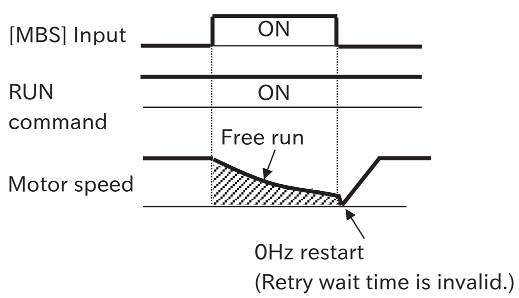


■(e.g. 2) Example of operation when the [MBS] input terminal is turned ON→OFF while stopped

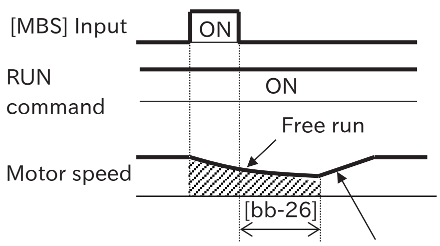


- When the [MBS] input terminal is ON⇒OFF and the run command is ON, the actuator will start up according to the [bb-40] setting.

■(e.g. 3) When the [MBS] inputterminal is turned ON/OFF during operation: Operation example (bb-40≠00)



■(e.g.4) When the [MBS] inputterminal is turned ON/OFF during operation: Operation example (bb-40≠00)



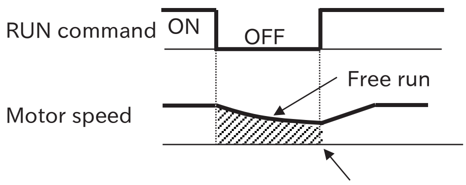
[bb-40]=01: Frequency-adjusted restart
[bb-40]=02: Active frequency matching restart
[bb-41]=03: Restart from search velocity

9.7.7 Select the stop operation

- Select either decelerating stop according to the decelerating time setting when a stop command is input or immediately shut off the output to make the inverter coast to the free run state by using the "Stop method selection [AA115]".
- Assign "Free-run stop [MBS](032)" to one of the input pins when free-run stop is performed using the input of the control pin.
- If "Free-run stop (01)" is selected for [AA115], the drive will be shut off and the motor will be idling at the timing when the operation command is OFF.
- When a coasting stop is performed, the next time an operation command is input, the start will follow the selection of "Restart after coasting release [bb-40]".

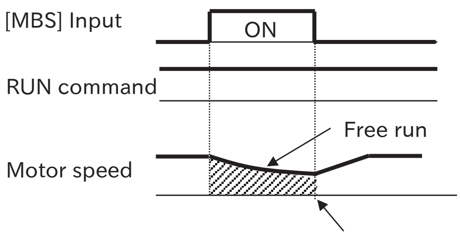
Code	Item	Description	Data	Initial value
AA115	STOP mode selection	When it stops, it performs normal deceleration stop.	00	00
		When stopped, free-run stop will occur due to output shutdown of the inverter.	01	
bb-40	Restart mode after MBS release	0Hz restart is performed.	00	00
		Perform frequency matching restart.	01	
		Frequency pull-in restart.	02	
		Restart is performed from the detection speed by encoder feedback.	03	
CA-01 to CA-08	Input terminal function	Free Run Stop [MBS]: This signal ON shuts off the inverter. The motor idles.	032	-

■Operation when "Stop method selection [AA115]" = free-run stop (01)



Restart according to "Restart after free-run release [bb-

■ [MBS] Typical operation after OFF of terminal



Restart according to "Restart after free-run release [bb-40]"

9.7.8 DC braking

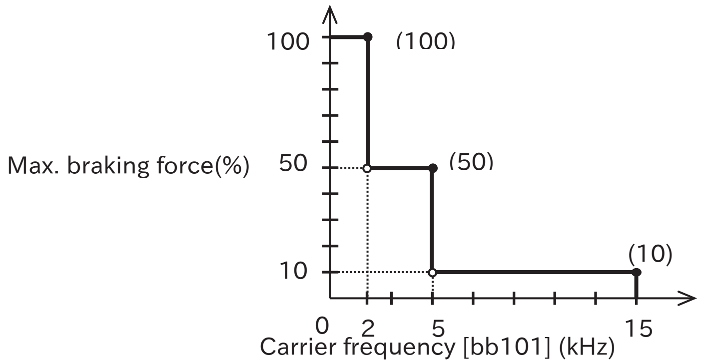
- Rotation of the motor can be stopped by operating the DC braking (DB) when the motor is stopped. There are three DC braking methods.
  - External DC braking : Assign "External DC braking [DB](030)" to the input terminal and control the DC braking with ON/OFF of the [DB] input terminal.
  - DC Braking at Stop: How to start DC braking when "DC Braking Frequency [AF103]" or less at deceleration stop after operation command OFF.
  - Frequency command DC braking: How to initiate DC braking when the frequency command value and the output frequency become less than "DC braking frequency [AF103]".
- DC braking is performed with a braking force equivalent to ND rated output current when [AF105] is set to 100% when standard load (ND) is selected.
- DC braking is performed with a braking force equivalent to 70% of LD rated output current when [AF105] is set to 100% when light load (LD) is selected.
- Set and operate "DC braking force at standstill [AF105]" and "DC braking time at standstill [AF106]" paying attention to heat generation of the motor.
- When DC braking is performed with the "External DC Braking [DB](030)" input terminal, an overcurrent error or overvoltage error may occur if the product is used in a condition where the output frequency is high or the inertial load is large.

Code	Item	Description	Data	Initial value
AF101	DC braking selection [Note]	Internal DC Braking: Disable	00	00
		Internal DC Braking: Enable	01	
		Internal DC Braking: Enable (Operates only with speed command)	02	
AF103	DC braking frequency	When [AF101] is set to "Enabled (01)" or "Enabled (Operation with velocity command only) (02)", DC braking starts when the frequency falls below the frequency of this setting during deceleration stop.	0.00 to 590.00 Hz	0.50
AF104	DC braking delay time	[DB] Delay after ON or [AF103] is reached until DC braking starts. Coasting (output shutoff) takes place during this time.	0.00 to 5.00 s	0.00
AF105	DC braking force	Adjust the direct current braking power. The maximum braking force when set to 100%.	0 to 100 %	50
AF106	DC braking active time at stop	Set the DC braking duration when [AF107] is set to "Edge action (00)".	0.00 to 60.00 s	0.50
AF107	DC braking operation method selection	Edge operation: DC braking is performed for the duration set to [AF106]. (Operation 1-a to 7-a)	00	00
		Level operation: DC braking is performed only when the conditions are satisfied. (Operation 1-b to 7-b)	01	
CA-01 to CA-08	Input terminal function	External DC Braking [DB]: DC braking is applied at ON of this signal. Only enabled when [AF101] is set to "Disabled (00)" and "Enabled (01)".	030	-

Note: Internal DC braking means that DC braking is performed according to the output frequency and operating status by setting parameters, regardless of external signals.

DC braking force and carrier frequency

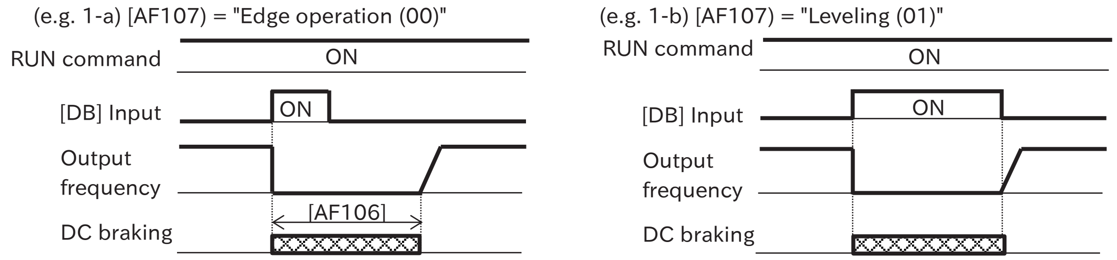
・If the "Carrier frequency [bb101]" exceeds 2kHz, the DC braking force is limited as shown in the figure below.



DC braking with the "External DC braking [DB]" input terminal

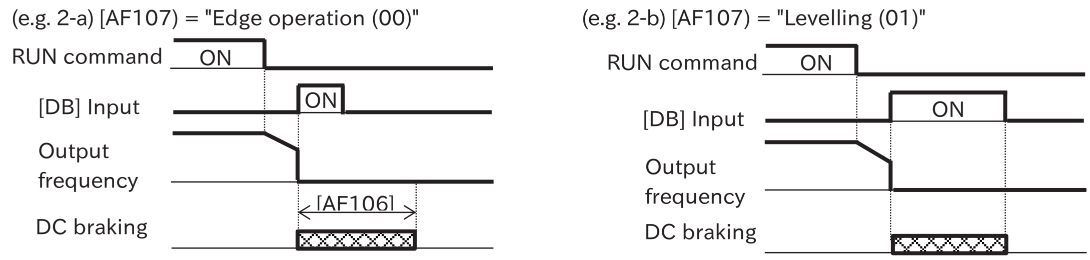
・When DC braking is performed using an input signal to the control circuit terminal block, assign "External DC braking [DB]" to the input terminal and set "DC braking force when stopped [AF105]."
・[DB] DC braking by input terminal is enabled when "DC braking selection [AF101]" = "Disabled (00)" or "Enabled (01)". Regardless of operation commands, DC braking operates when the [DB] input terminal is ON.
・Operation of DC braking varies depending on the setting of edge/level operation of "DC braking trigger selection [AF107]". Set the edge operation or level operation according to the system. If edge operation is selected, set the DC braking time at standstill [AF106].

■(e.g. 1) To ON/OFF [DB] input terminals during operation.



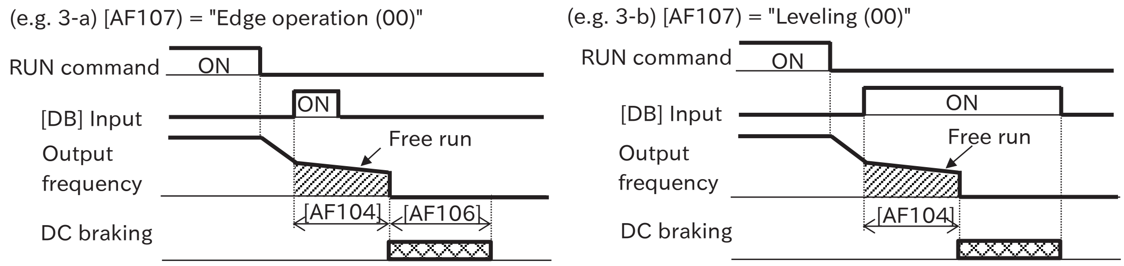
・For edge operation, DC braking will operate for the duration set in [AF106] from ON edge input of the [DB] input terminal.
・For level-operation, DC braking is activated while the [DB] input terminal is ON.

■(e.g. 2) To ON/OFF the [DB] input terminal while the inverter is decelerating by the operation command OFF. [AF104] The setting is 0.0 (s).



・When "DC braking delay time [AF104]" is 0.0s, DC braking starts immediately after the [DB] input terminal is turned ON.

■(e.g. 3) When a value other than 0.0 (s) is set in "DC Braking Delay Time [AF104]" and the operation is the same as (e.g. 2).



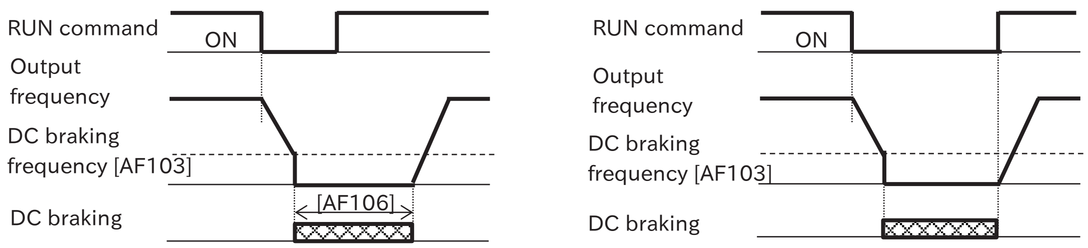
・If a value other than 0.0 s is set to the "DC braking delay time [AF104]", DC braking will be started after a free run (output-off) of the set time. However, if the [DB] input terminal is turned ON when the inverter is stopped, DC braking starts immediately.

DC braking when stopped ([AF101] = "Enable (01)")

- When the inverter is stopped, DC braking can be applied even if the [DB] input terminals are not operated.
- To perform DC braking at stop, set "DC braking selection [AF101]" = "Enable (01)" and set "DC braking frequency [AF103]" and "DC braking force at stop [AF105]."
- When the operation command becomes OFF and the output frequency falls below [AF103], DC braking is applied.
- Operation of DC braking varies depending on the setting of edge/level operation of "DC braking trigger selection [AF107]". In addition, when "DC braking delay time [AF104]" is set to other than 0.00s, free-run (output-shut-off) is performed prior to DC braking. Set the edge operation or level operation according to the system. Set the DC braking duration [AF106] at standstill when edge operation is selected, referring to the operation example in the figure below.

■(e.g. 4) When ON/OFF operation command. [AF104] The setting is 0.00s.

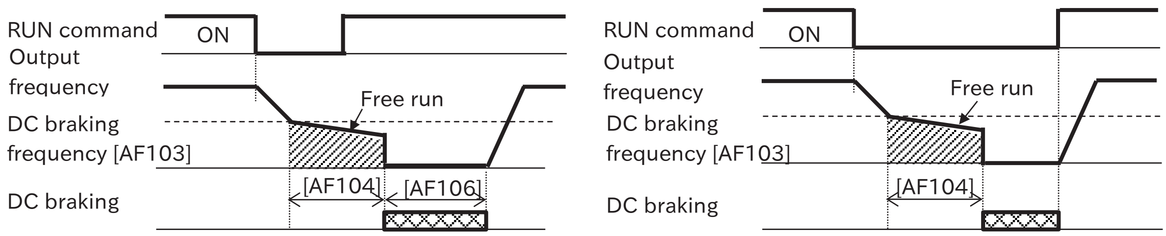
(e.g. 4-a) [AF107] = "Edge operation (00)" (e.g. 4-b) [AF107] = "Leveling (01)"



- For edged operation, DC braking will operate for the [AF106] set period when the output frequency becomes less than or equal to [AF103].
- For level operation, DC braking will operate until the operation command becomes ON when the output frequency becomes [AF103] or less.

■(e.g. 5) When a value other than 0.00 s is set to "DC Braking Delay Time [AF104]" and the operation is the same as (e.g. 4).

(e.g. 5-a) [AF107] = "Edge operation (00)" (e.g. 5-b) [AF107] = "Leveling (00)"



- If a value other than 0.00 s is set to the "DC braking delay time [AF104]", DC braking will be started after a free run (output-off) of the set time.

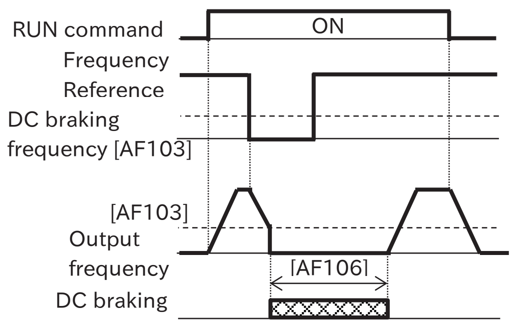
- When "DC Braking Selection [AF101]" is "Enabled (01)", DC braking can be operated at start when the operation command is ON. For details, see section 9.7.2, "Applying DC Braking before Starting."

Frequency reference DC braking ([AF101] = "Enable (Operation at set frequency only) (02)")

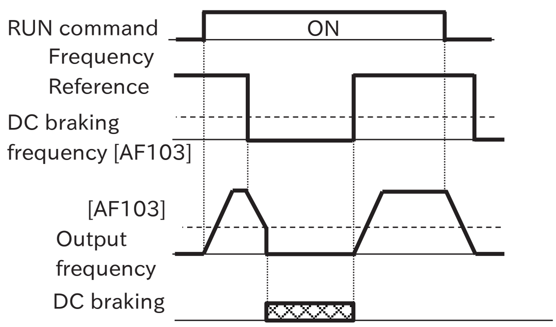
- To perform frequency command DC braking, set "DC braking selection [AF101]" = "Enable (operating only at set frequency) (02)" and set "DC braking frequency [AF103]" and "DC braking force at standstill [AF105]".
- When Frequency-Command DC Braking is enabled, External DC Braking with the [DB] input terminals will not operate.
- DC braking is activated when both the frequency command and the output frequency are below [AF103] in the operating condition.
- If the frequency command becomes [AF103]+2 Hz or more in the operation status, DC braking is released and normal operation starts.
- The DC braking will not operate if [frequency command over AF103]+2Hz is set prior to operation and then operation command is ON. (e.g. 6)
- If the frequency command before operation is "0 Hz" and then the operation command is ON, the operation starts from DC braking because both the frequency command and the output frequency are [AF103] or less. (e.g. 7)
- Operation of DC braking varies depending on the edge/level operation setting of "DC braking trigger selection [AF107]". Set the edge operation or level operation according to the system.
  Set the DC braking duration [AF106] at standstill when edge operation is selected, referring to the operation example in the figure below.

■(e.g. 6) Set a frequency command higher than [AF103] prior to operation. When the frequency command is less than or equal to [AF103] during operation.

(e.g. 6-a) [AF107] = "Edge operation (00)"



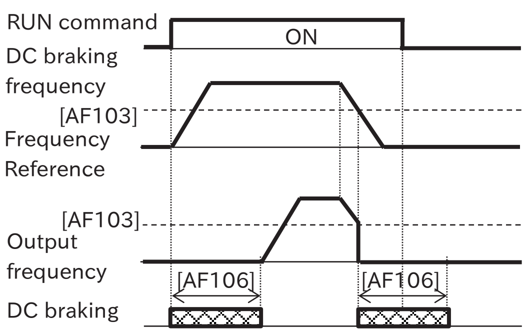
(e.g. 6-b) [AF107] = "Leveling (01)"



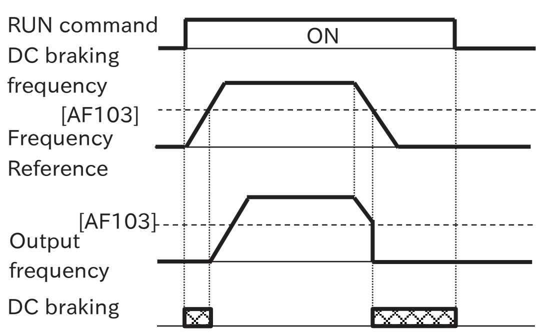
- DC braking starts when the frequency command is [AF103] or less in the operation command ON.
  For edged operation, DC braking operates during [AF106] after the frequency command and the output frequency become less than [AF103].
  For level-operation, from when the frequency command and the output frequency are below [AF103] until the frequency command is above [AF103].

■(e.g. 7) Before operation, set the frequency command below [AF103] for analogue frequency command, etc.
When the frequency command becomes [AF103] or less/or more after the operation.

(e.g. 7-a) [AF107] = "Edge operation (00)"



(e.g. 7-b) [AF107] = "Leveling (01)"



- DC braking starts when the frequency command is [AF103] or less in the operation command ON.
  For edged operation, DC braking operates during [AF106] after the frequency command and the output frequency become less than [AF103].
  For level-operation, DC braking operates until the operation command OFF is reached after the frequency command and the output frequency become [AF103] or less.

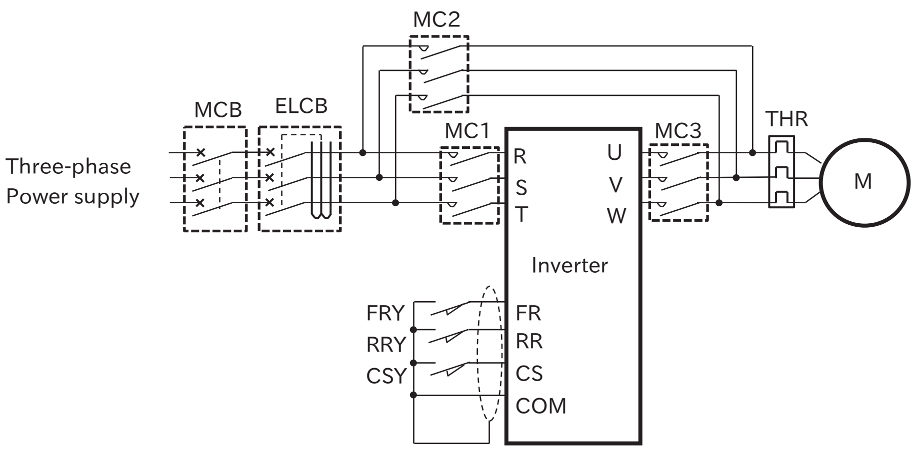
9.7.9 Switch to commercial power supply

- Commercial power supply change, this function can be used for a system with a large load moment of inertia where the acceleration/deceleration is driven by an inverter and the drive is driven by a commercial power supply at a constant speed.
- When the commercial switching [CS] input terminal is turned ON with the operation command ON, the inverter-output is shut off and the motor coasts. [CS] When the input terminal is turned ON to OFF, the inverter restarts by pulling the frequency to the frequency (cutoff frequency) immediately before the [CS] input terminal turns ON after the "momentary power failure/undervoltage retry standby time [bb-26]" (frequency pull-in restart).
- Operation of the "Commercial switching [CS]" input terminal is the same as when the "Free run stop [MBS]" input terminal is ON/OFF with "Frequency retraction restart (02)" for "Restart after free run release" and "Start frequency selection at frequency retraction restart [bb-47]" as "Cutoff frequency (00)". For details, see section 9.7.4, Using the Frequency Pull-in Function to Start.

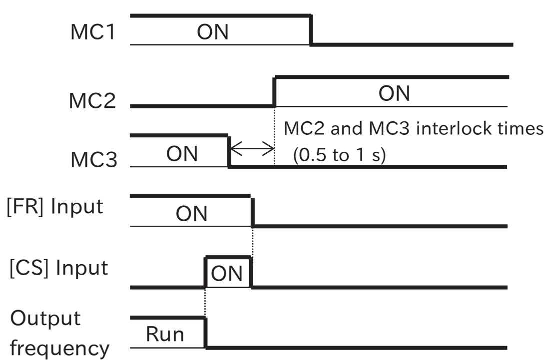
Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	Commercial power supply change [CS]: This function is used during commercial switching. [CS] When the input terminal is turned ON, the inverter shuts off the output.	035

■Example of connection diagram and timing chart in commercial switching operation

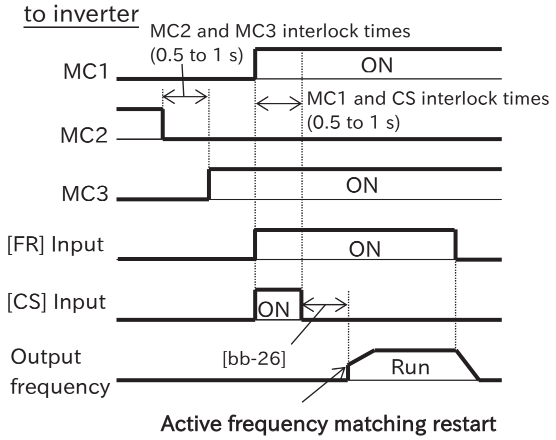
- For FRY, RRY, CSY, use relays for low voltage.
- Take the mechanical interlock of MC3 and MC2. Otherwise, the inverter may be damaged.
- The commercial circuit does not operate when the earth leakage breaker ELCB trips due to a ground fault or the like. Connect a commercial circuit of another system to MC2 when back-up is required.



■Timing of switching from inverter to commercial power supply



■Switching timing from commercial power supply to inverter



9.7.10 Brake control

- With the brake control function, an inverter can control the external brake used for elevating systems, etc. To use this function, set "Brake control selection [AF130]" to "Brake control enable (01)" or "Brake control enable (forward/reverse individual) (02)", and assign "Brake release [BRK]" to the output terminal.
- Setting [AF130] to "Braking Control Enable (Forward/Reverse Individual)" (02) allows you to set a different operation between forward and reverse rotation. This function is effective when the operation differs between hoisting and lowering. When "Braking control enable (01)" is set to [AF130], the forward setting ([AF131] to [AF137]) is enabled for both forward and reverse.
- To operate this function while interlocking by inputting a confinement/release check signal from the external brake to the inverter, assign "Brake check [BOK]" to the input terminal and set "Brake check wait time ([AF134] and [AF141])". Also, assign "Braking error [BER]" to the output terminals as required.
- The brake control function can also be used in combination with position control. For details, refer to "9.14.4 Operation of absolute position control and brake control in conjunction".
- For the control method when the brake control function is used, sensorless vector control ("control method [AA121]" = "sensorless vector control (IM) (08)") that generates high torque at start is recommended.
- If an error occurs in the brake sequence, the inverter trips at the "Brake error [E036]" and turns ON the "Brake error [BER]" signal is. Refer to the operation sequence described below for the detailed conditions to trip.
- In brake control, trip occurs in the following cases.
  - When the output current is less than the "brake release current ([AF136], [AF143])" after the "brake release establishment wait time ([AF131], [AF138])" has elapsed.
  - When using the "Brake check [BOK]" input terminal, if the [BOK] input terminal does not ON within the "Brake check wait time ([AF134], [AF141])" when starting.
  - When using the "Brake check [BOK]" input terminal, if the [BOK] input terminal does not OFF within the "Brake check wait time ([AF134], [AF141])" when stopping.
  - When the "Brake check [BOK]" input terminal is used, the "Brake release [BRK]" signal is output, but the [BOK] input terminal is turned OFF.

■Parameters for brake control

Code	Item	Description	Data	Initial value
AF130	Brake control enable Note:1	Disable	00	00
		Brake control enabled	01	
		Brake control enabled (Forward/Reverse individual setting)	02	
AF131	Brake release wait time (Forward)	Set the time from when the brake release frequency is reached until the output current reaches the brake release current.	0.00 to 5.00 s	0.00
AF138	Brake release wait time (Reverse)			
AF132	Brake wait time for accel.(Forward)	Set the mechanical delay time from the brake confirmation signal (or brake release signal) until the brake is released.	0.00 to 5.00 s	0.00
AF139	Brake wait time for accel. (Reverse)			
AF133	Brake wait time for stopping (Forward)	Set the mechanical delay period from OFF of the brake release signal until the brake is restrained.	0.00 to 5.00 s	0.00
AF140	Brake wait time for stopping (Reverse)			
AF134	Brake confirmation signal wait - motor (Forward)	Set a time longer than the time from when the brake release signal is output until the release completion signal output from the brake is input to the inverter.	0.00 to 5.00 s	0.00
AF141	Brake confirmation signal wait - motor (Reverse)			
AF135	Brake-open frequency (Forward) Note:2	Sets the frequency to ON the brake-release signal.	0.00 to 590.00 Hz	0.00
AF142	Brake-open frequency (Reverse) Note:2			
AF136	Brake-open current (Forward) Note:3	Sets the output current that enables brake release.	(0.00 to 2.00)× Inverter rated output current A	1.00× rated output current
AF143	Brake-open current (Reverse) Note:3			
AF137	Brake-on frequency (Forward) Note:2	Set the frequency at which the brake is closed when stopped.	0.00 to 590.00 Hz	0.00
AF144	Brake-on frequency (Reverse) Note:2			
CA-01 to CA-08	Input terminal function	Braking confirmation [BOK]: Check this input signal as an answerback of the [BRK] output signal to the external brake.	037	-
CC-01 CC-02 CC-07	Output terminal function	Brake release [BRK]: This signal is for restraining/releasing the external brake.	037	002 001 017
		Braking error [BER]: This relay is ON when a sequence error occurs in the brake control function. With ON of this signal, the inverter trips with "Brake error [E036]".	038	

Note: 1. The brake-control-related parameters that are enabled differ depending on the [AF130] setting. Refer to the table below for details.
2. Set a value greater than the minimum frequency [Hb130].
3. Note that the torque may not be sufficient when the brake is released if the setting is low.

■[AF130]= "Brake control enable (01)"

Parameters that is enabled

Item	Valid parameters (forward/reverse common)
Brake release wait time	AF131
Brake wait time for accel.	AF132
Brake wait time for stopping	AF133
Brake confirmation signal wait time	AF134
Brake release frequency	AF135
Brake release current	AF136
Braking frequency	AF137

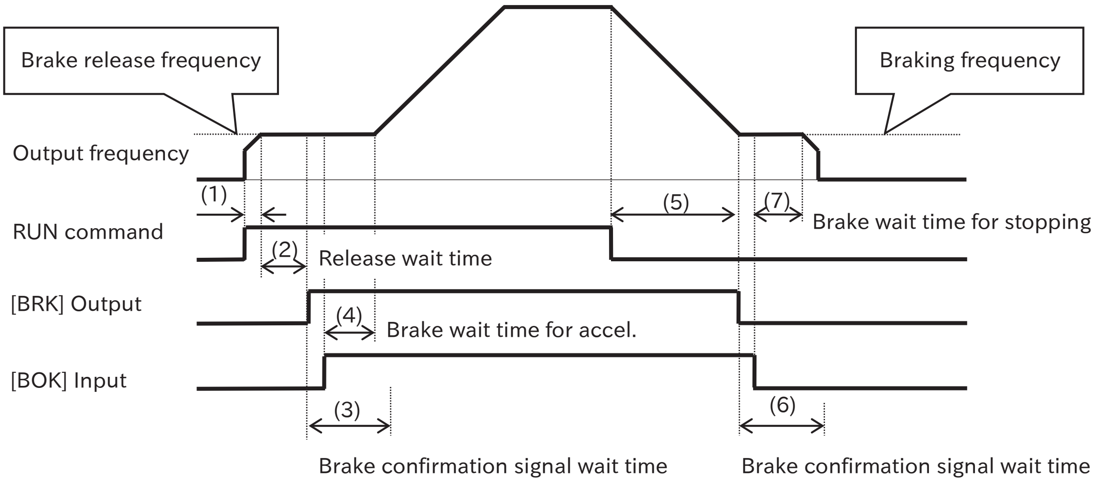
■[AF130]= "Brake control enabled (forward/reverse individual) (02)"

Parameters that is enabled

Item	Valid parameters	
	Forward rotation	Reverse rotation
Brake release wait time	AF131	AF138
Brake wait time for accel.	AF132	AF139
Brake wait time for stopping	AF133	AF140
Brake confirmation signal wait time	AF134	AF141
Brake release frequency	AF135	AF142
Brake release current	AF136	AF143
Braking frequency	AF137	AF144

Operation sequence of the brake control function

・The following figure shows the operation sequence of the brake control function. In the following, the details of the brake control function are explained in this figure. (The figure below shows a case where "Braking check [BOK](037)" is assigned to the input terminal.)



(1) When the RUN command is issued, the inverter accelerates to the "brake release frequency ([AF135], [AF142])".
(2) After the output frequency reaches [AF135] or [AF142] and the time "Brake release establishment wait time ([AF131], [AF138])" has elapsed, the "Brake release [BRK]" signal is turned ON. However, if the output current at this time is less than the "brake release current ([AF136], [AF143])", the [BRK] signal will not be ON, and the "brake error [E036]" trip will occur instead, and the "brake error [BER] signal will be turned ON.
(3) The operation differs depending on whether the "Braking confirmation [BOK]" input terminal is assigned to the input terminal.
- [BOK] With assignment: After the [BRK] signal turns ON, the signal does not accelerate and waits for the [BOK] input terminal to become ON during the "Brake-check wait time ([AF134], [AF141])". If the [BOK] input terminal does not turn ON within the waiting time, a "Braking error [E036]" trip will occur and the [BER] signal will be turned ON.
- [BOK] No assignment: After the [BRK] signal turns ON, go to step (4).
(4) [BOK] After ON of the input terminal (or ON of the [BRK] signal.), when the time of "Acceleration wait time ([AF132], [AF139])" has elapsed, the machine accelerates to the set frequency again.
(5) When the operation command is OFF, the inverter decelerates to the "brake-on frequency ([AF137], [AF144])" and OFF [BRK].
(6) The operation differs depending on whether the [BOK] input connectors are assigned to the input connectors.
- [BOK] With assignment: After the [BRK] signal turns OFF, the inverter does not decelerate and waits for the [AF134] or [AF141] to turn OFF the [BOK] input terminal. If the [BOK] input terminal does not turn OFF within the waiting time, a "Braking error [E036]" trip occurs and the [BER] signal turns ON.
- [BOK] No assignment: After the [BRK] signal turns OFF, proceed to step (7).
(7) The operation differs depending on whether the [BOK] input connectors are assigned to the input connectors.
- [BOK] With assignment: After the [BOK] input terminal is turned OFF, if the time "Stopping wait time ([AF133], [AF140])" has elapsed, the actuator will decelerate to 0 Hz again.
- [BOK] No assignment: After the [BRK] signal turns OFF, when the time "Stop wait time ([AF133], [AF140])" has elapsed, the actuator decelerates to 0Hz.

9.7.11 Control the contactor

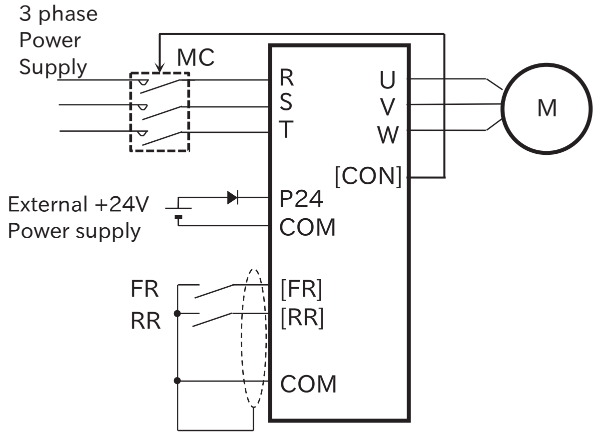
- When performing contactor operation, set "Contactor control selection [AF120]" to "Enabled (primary side) (01)" or "Enabled (secondary side) (02)".
- Input terminal function "Contactor check signal [COK]" and output terminal function "Contactor control [CON]" are available.
- This function must be used for contactor control, since operating the contactor during inverter output may cause surge and inverter damage.
- If an error occurs in the contactor sequence, the drive trips due to a contactor error [E110].
- In contactor control, trip occurs in the following cases when the input terminal function "Contactor check signal [COK]" is used.
  - When the [COK] input terminal does not ON within the Contactor Check Duration [AF123].
  - If the [COK] input terminal does not OFF within the Contactor Check Duration [AF123], when stopped.
  - When the [COK] input terminal turns OFF while the Contactor Control [CON] signals ON.

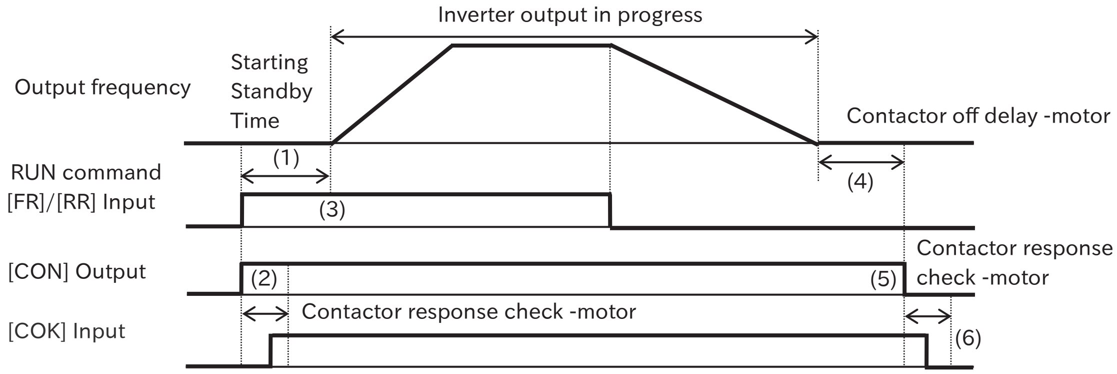
■Required setting items for contactor control function

Code	Item	Description	Data	Initial value
AF120	Contactor -motor	Disable	00	00
		Enable (Primary): A contactor is installed on the primary side of the inverter to reduce standby power.	01	
		Enable (secondary side): A contactor is installed on the secondary side of the inverter to function as a brake sequence.	02	
AF121	Run delay -motor	Sets the standby time from the input of operation command to the start of inverter output.	0.00 to 2.00 s	0.20
AF122	Contactor off delay -motor	Sets the time from inverter output shutoff to contactor control.	0.00 to 2.00 s	0.10
AF123	Contactor response check -motor	Set the time from the input of the operation command to the control of the contactor.	0.00 to 5.00 s	0.10
CA-01 to CA-08	Input terminal function	Contactor check signal [COK]: OFF: Contactor released ON: Contactor is operating	107	-
CC-01 CC-02 CC-07	Output terminal function	Contactor Control [CON]: OFF: Contactor release command ON: Contactor operation command	039	002 001 017

■Example of energy conservation at the primary contactor
(AF120=0: Enabled (primary))

- Reduced standby power when combined with external ＋24V inputs. For the external ＋24V power supply to the control circuit, refer to "5.4.1 Configuration of Control Circuit Terminals".
- By ON/OFF the contactor MC of the main circuit power supply with the output of the setting terminal of the output terminal function "Contactor control [CON]", the power input to the inverter main circuit can be shut off while the inverter output is stopped, thereby realizing an energy saving operation sequence.





(1) After ON of the RUN command, the inverter waits until the start wait time [AF121] elapses.

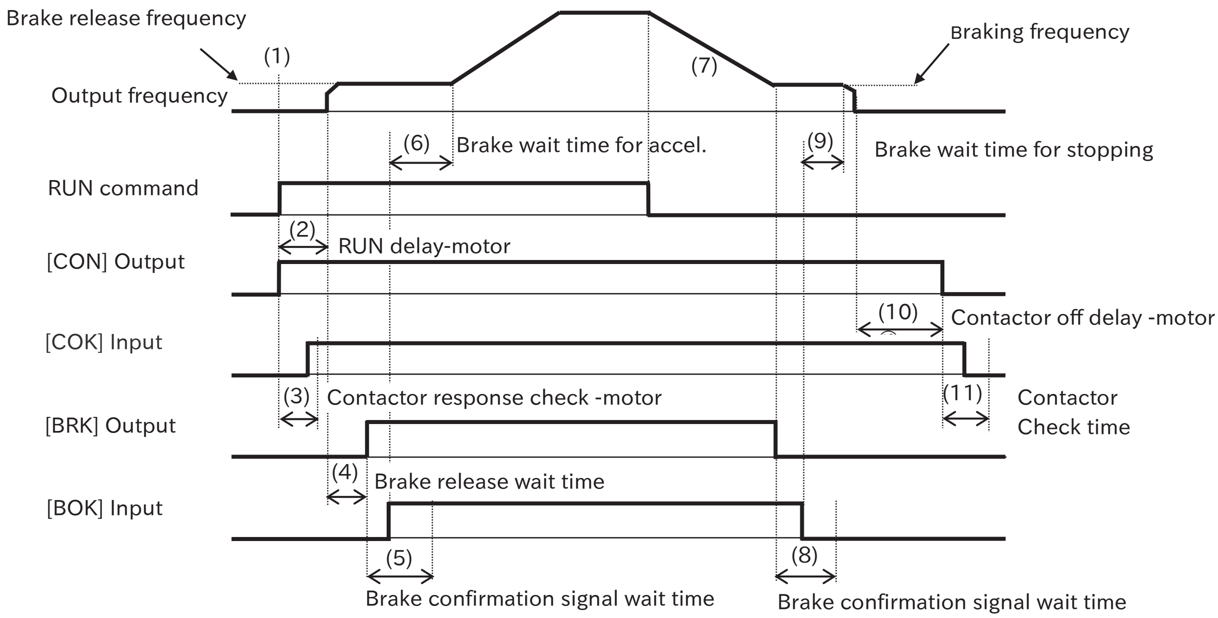
(2) The "Contactor control [CON]" signal turns ON at the same time as the operation command ON. Subsequent operation differs depending on whether "Contactor check signal [COK]" is assigned to the input terminal.
- [COK] Assignment available: If the [COK] input terminal is not ON within the contactor check period [AF123], the inverter trips due to a contactor error [E110].
- [COK] No assignment: Wait for the elapse of "Start standby time [AF121]" after ON the [CON] signal.

(3) Acceleration starts after "Start standby time [AF121]" has elapsed.

(4) Wait until "Contactor release delay time [AF122]" has elapsed after the inverter has stopped outputting.

(5) After the "Contactor release delay time [AF122]" setting time has elapsed, the [CON] signal turns OFF. Subsequent operations differ depending on whether the [COK] input terminal is set for the input terminal function.
- [COK] With assignment: If the [COK] input terminal is not OFF within "Contactor check time [AF123]", it trips with "Contactor error [E110]".
- [COK] No assignment: The inverter does not do anything as it is

■Example of control with secondary contactor
(AF120=02: Enabled (Secondary))
・When enabled (secondary side) is selected, it can be used in combination with brake control.



(1) When the RUN command is issued, the inverter ON the contactor control [CON] signal.

(2) Wait until the "Start standby time [AF121]" has elapsed.

(3) Subsequent operation differs depending on whether "Contactor check signal [COK]" is assigned to the input terminal.
- [COK] With assignment: If the [COK] input terminal is not ON within "Contactor check time [AF123]", it trips with "Contactor error [E110]".
- [COK] No assignment: Move to (4).

(4) The inverter starts outputting and after the time "Brake release establishment wait time ([AF131], [AF138])" has elapsed, the "Brake release [BRK]" signal turns ON. However, if the output current at this time is less than the "brake release current ([AF136], [AF143])", the [BRK] signal will not be ON, and the "brake error [E036]" trip will occur instead, and the "brake error [BER] signal will be turned ON.

(5) Subsequent operations differ depending on whether "Braking confirmation [BOK]" is assigned to the input terminal.
- [BOK] With assignment: After the [BRK] signal turns ON, the signal does not accelerate and waits for the [BOK] input terminal to become ON during the "Brake-check wait time ([AF134], [AF141])". [BOK] When the input terminal is ON, it will go to (6), but if the [BOK] input terminal does not turn ON within the waiting time, it trips due to "Braking error [E036]", and the [BER] signal turns ON.
- [BOK] No assignment: After the [BRK] signal turns ON, go to (6).

(6) When the time of "Acceleration wait time ([AF132], [AF139])" has elapsed, the actuator accelerates to the set frequency again.

(7) When the operation command is OFF, the inverter decelerates to the "brake-on frequency ([AF137], [AF144])" and OFF [BRK].

(8) Subsequent operations differ depending on whether "Braking confirmation [BOK]" is assigned to the input terminal.
  - [BOK] With assignment: After the [BRK] signal turns OFF, the signal does not decelerate and waits for the [BOK] input terminal to become OFF during the "Braking Confirmation Wait Time ([AF134], [AF141])". If the [BOK] input terminal does not turn OFF within the waiting time, it trips due to "Braking error [E036]", and the [BER] signal turns ON.
  - [BOK] No assignment: After the [BRK] signal turns ON, go to (9).

(9) [BOK] After the input terminal is turned OFF (or the [BRK] signal is turned OFF), when the time "Stop wait time ([AF133] and [AF140])" has elapsed, the speed is decelerated and the output is shut off.

(10) After "Contactor release delay time [AF122]" has elapsed, the [CON] signal turns OFF.

(11) Subsequent operation differs depending on whether "Contactor check signal [COK]" is assigned to the input terminal.
  - [COK] With assignment: If the [COK] input terminal is not OFF within "Contactor check time [AF123]", it trips with "Contactor error [E110]".
  - [COK] No assignment: The inverter is still in the stop state.

9.7.12 Perform compulsory operation

- When this function is activated, the output operates in the compulsory operation mode (Em-Force mode) where the inverter runs at a constant rate without shutting down the drive until the power supply is shut off.
- The forced operation mode is entered by setting "Forced operation mode selection [PA-01]" to "Enable (01)" and turning ON "Emergency forced operation [EMF]" assigned to the input terminal function.
- The operation command in the compulsory operation mode is set with "Compulsory operation frequency setting [PA-02]" and "Compulsory operation rotational direction command [PA-03]".
- Whether the present status corresponds to normal, forced operation or bypass mode can be checked in the "Forced operation mode monitor [dC-49]".

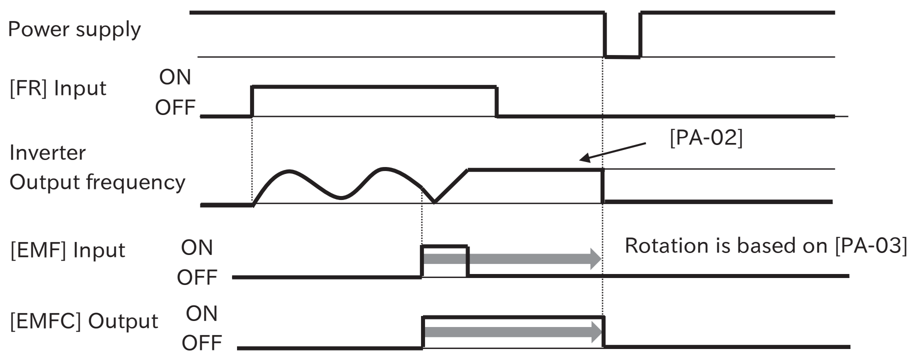
Code	Item	Description	Data	Initial value
dC-49	Emergency-force drive mode monitor	Disabled: Not in forced operation mode and bypass mode.	00	-
		Forced operation: Operation is in progress in forced operation mode.	01	
		Bypass: Operation in Bypass mode.	02	
PA-01	Enable Emergency-force drive mode	Disable: Forced operation mode is invalid. [EMF] The compulsory operation mode is not activated even if the input terminals are turned ON.	00	00
		Enable: Forced operation mode is enabled. [EMF] When the input terminal is set to ON, the unit enters the compulsory operation.	01	
PA-02	Emergency-force drive frequency reference	Set the frequency command in the forced operation mode.	0.00 to 590.00 Hz	0.00
PA-03	Emergency-force drive direction command	Forward rotation is performed during forced operation.	00	00
		Reverse operation is performed during forced operation.	01	
CA-01 to CA-08	Input terminal function	[EMF]: Forced emergency operation OFF: Disable ON: Forced operation mode. ([For PA-01]=01)	105	-
CC-01 CC-02 CC-07	Output terminal function	[EMFC]: Forced operation in progress signal OFF: Disable ON: Forced operation in progress	076	002 001 017
		[EMBP]: Signal during bypass mode OFF: Disable ON: In Bypass Mode	077	

- In forced operation mode, once it is turned ON, it continues operation until the power supply of the inverter is cut off.
- Overcurrent retry, overvoltage retry, and instantaneous power failure/undervoltage retry are automatically activated. To change the operation details, a separate setting is required.
- After the input terminal function "Emergency forced operation [EMF]" is ON, the input terminal function is disabled except "Contactor check signal [COK]".

Operation in compulsory operation

・ON the input terminal function "Emergency forced operation [EMF]" to enter the forced operation mode.

・The drive outputs the frequency set in "Compulsory operation frequency setting [PA-02]" and the rotation direction set in "Compulsory operation rotation direction command [PA-03]" until the power is shut off.



・In the forced operation mode, the following functions operate automatically. In addition, other functions operate according to their settings.

(1) Soft-lock status (equivalent to [UA-16]=01)
Parameters cannot be changed. To return the setting, set the [EMF] input terminal to OFF, turn the power back on, and then change the parameters.

(2) Auto-reset ([Extension bb-10]=02 to Operating Range)
If a trip occurs, it will automatically reset and restart.

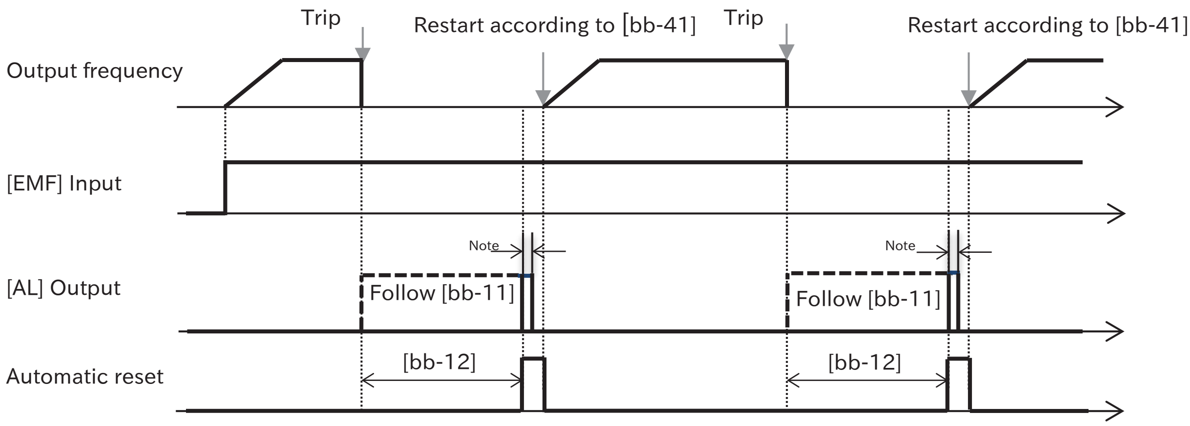
(3) STOP disabled (equivalent to [AA-13]=00)
Disables STOP/RESET button on the control panel.

(4) Operation enabled during optional startup ([oA-13]=01)
Operation is permitted even during option start.

Code	Item	Description	Data	Initial value
PA-01	Enable Emergency-force drive mode	Disable: Forced operation mode is invalid. [EMF] The compulsory operation mode is not activated even if the input terminals are turned ON.	00	00
		Enable: Forced operation mode is enabled. [EMF] When the input terminal is set to ON, the unit enters the compulsory operation.	01	
PA-02	Emergency-force drive frequency reference	Set the frequency command in the forced operation mode.	0.00 to 590.00 Hz	0.00
PA-03	Emergency-force drive direction command	Forward rotation is performed during forced operation.	00	0
		Reverse operation is performed during forced operation.	01	
CA-01 to CA-08	Input terminal function	[EMF]: Forced emergency operation OFF: Disable ON: Forced operation mode. ([For PA-01]=01)	105	-
CC-01 CC-02 CC-07	Output terminal function	[EMFC]: Forced operation in progress signal OFF: Disable ON: Forced operation in progress	076	002 001 017

Automatic reset operation during forced operation

- When an error occurs during forced operation and the inverter trips, resetting is performed automatically equivalent to when the power is turned on.
- Automatic reset operation during compulsory operation differs from that described in 9.15.7, Resetting Alarms Automatically. For details, refer to the table "Automatic Reset Operation during Compulsory Operation" in this section.



Note: In the case of intelligent relay terminal, it operates momentarily even if anything is assigned due to the effect of system reset.

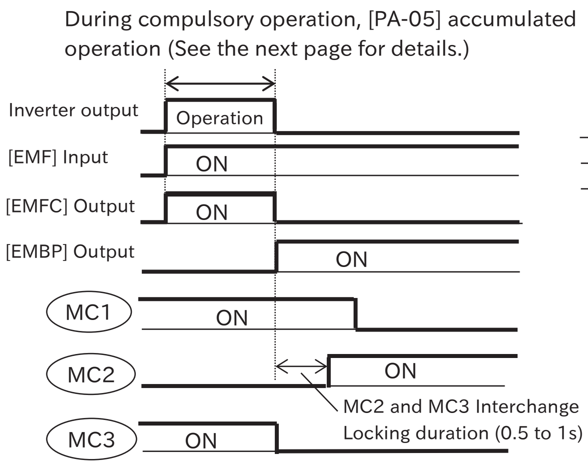
■Automatic reset operation during forced operation

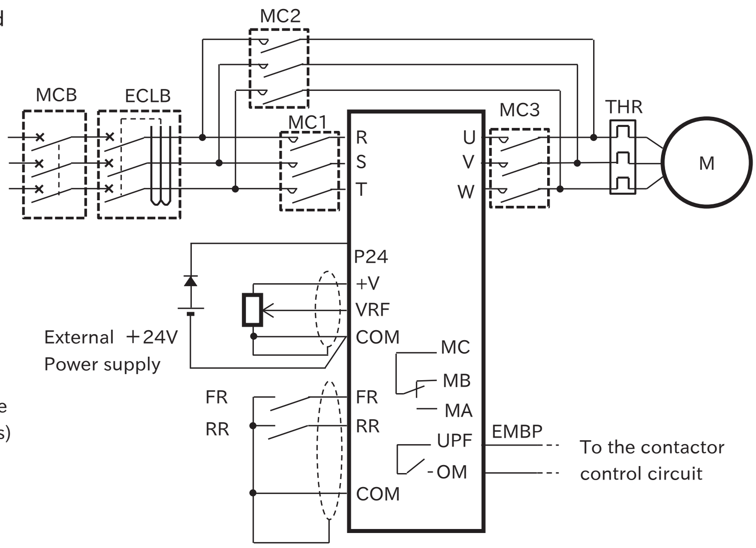
Code	Item	Operation in Compulsory Operation	Initial value
bb-10	Automatic error reset selection	Regardless of the setting, [bb-10] = "Valid (02) after the set period" is forcibly extended to the entire error.	00
bb-11	Alarm signal selection at automatic error reset	The setting in [bb-11] is valid. However, the intelligent relay terminal operates only momentarily at system reset. Therefore, if "Alarm signal [AL]" is assigned to "Output terminal function [ML] selection [CC-07]", the [AL] signal will ON for a moment even if [bb-11] is set to "Not output (01)".	00
bb-12	Automatic error reset wait time	The setting in [bb-12] is valid.	2
bb-13	Automatic error reset number	Performs an infinite number of automatic resets forcibly regardless of the setting.	3
bb-41	Restart mode after RST release	The setting in [bb-41] is valid. The settings for the other retry functions ([bb-20] to [bb-31]) are valid in the same way.	00

Switch to commercial operation (bypass mode)

- When "Bypass function selection [PA-04]" is set to "Enabled (01)", this function can be switched to the commercial operation mode (bypass mode) during forced operation and when the specified operation status is not reached.
- During bypass mode, the output terminal function "Bypass mode in progress signal [EMBP]" is ON and the inverter output is shut off.
- For the bypass mode operation, refer to the connection diagram and timing in the commercial switching operation shown below.
- In the example below, the main power supply of the inverter is also shut off. In such cases, the external ＋24V power supply must be connected to prevent loss of the power supply for internally controlling the inverters.
- [EMBP] Perform contactor control based on the signal.
- When using the bypass mode, an interlock must be provided that considers the operation delay of the contactor when switching to commercial operation. Make sure that system operation is safe before use.
- The output-terminal function "Bypassing mode in progress signal [EMBP]" can be used as a contactor control signal to timing the contactor control. Use interlocks for the commercial power contactor and the inverter output contactor.
- The commercial circuit does not operate when the earth leakage breaker ELCB trips due to a ground fault or the like. Connect a commercial circuit of another system to MC2 when back-up is required.

■ INV-> Commercial Operation Timing

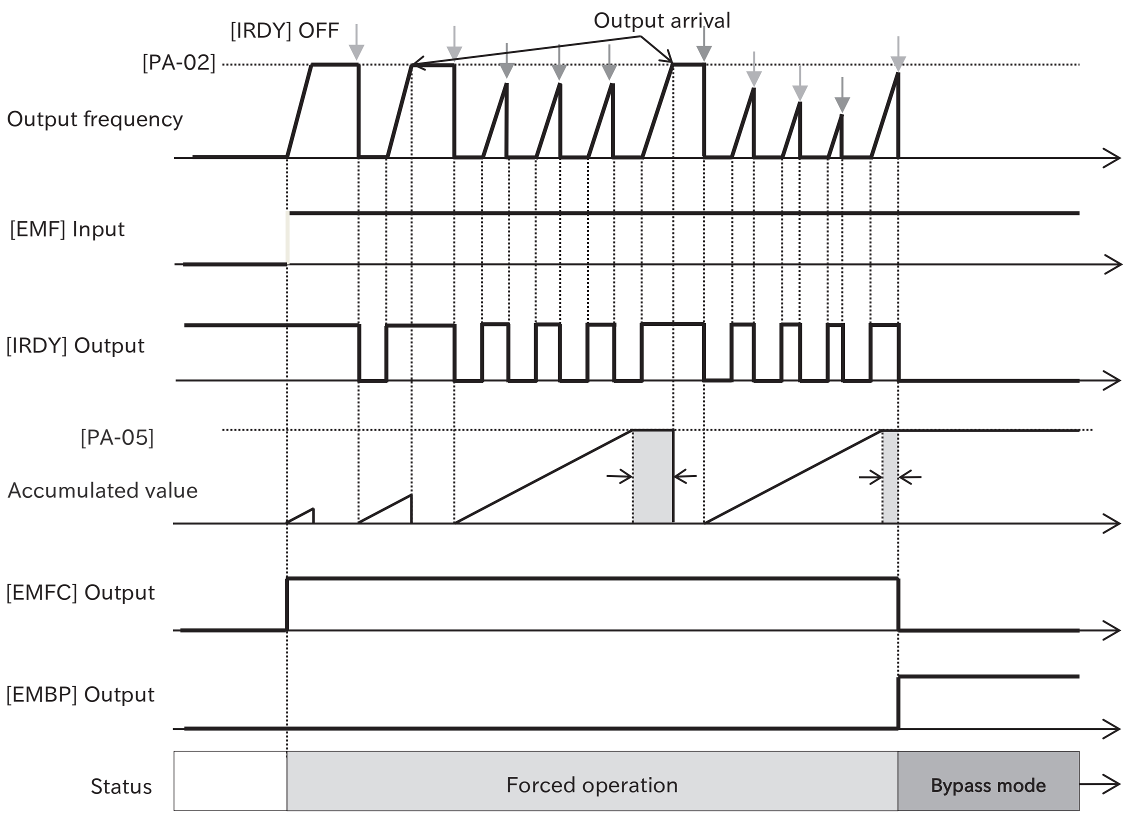




Code	Item	Description	Data	Initial value
PA-04	Commercial power supply Bypass function selection	Disabled: Bypass feature is disabled.	00	00
		Enabled: Bypass feature enabled.	01	
PA-05	Commercial power supply Bypass function delay time	During forced operation, if the output frequency cannot reach the compulsory operation frequency setting [PA-02], and the [PA-05] setting has elapsed, the unit will enter bypass mode.	0.0 to 1000.0 s	5.0
CA-01 to CA-08	Input terminal function	[EMF]: Forced emergency operation OFF: Disable ON: Forced operation mode. ([For PA-01]=01)	105	-
CC-01 CC-02 CC-07	Output terminal function	[EMFC]: Forced operation in progress signal OFF: Disable ON: Forced operation in progress	076	002 001 017
		[EMBP]: Signal during bypass mode OFF: Disable ON: In Bypass Mode	077	

Determination of switching to bypass mode

- When "Commercial power bypass function selection [PA-04]" is set to "Enabled (01)", if the time that "Forced operation frequency setting [PA-02]" cannot be reached during forced operation elapses "Commercial power supply bypass function delay time [PA-05]" and the inverter enters the operation ready status (output terminal function "Operation ready [IRDY]" is OFF), the inverter operation is regarded as impossible and the inverter enters the commercial operation mode (bypass mode).
- Bypass mode continues to be shut down until power to the inverter is shut down once ON.
- While the inverter is starting immediately after resetting, the "Operation ready [IRDY]" signal is OFF for about 1 second, but this section does not change to the bypass mode.
- When the upper limiter function operates and the "compulsory operation frequency setting [PA-02]" cannot be reached, the bypass function delay time accumulated is accumulated.



- In Bypass mode, the following functions operate automatically. In addition, other functions operate according to their settings.
  (1) Soft-lock status (equivalent to [UA-16]=01)
  Parameters cannot be changed. To return the setting, set the [EMF] input terminal to OFF, turn the power back on, and then change the parameters.
  (2) Auto-reset ([Extension bb-10]=02 to Operating Range)
  The automatic reset function is disabled.
  (3) STOP disabled (equivalent to [AA-13]=00)
  Disables STOP/RESET button on the control panel.
  (4) Operation enabled during optional startup ([oA-13]=01)
  Operation is permitted even during option start.

9.7.13 Switch and use two motors

- The target parameters are switched by turning ON the "2nd control [SET](024)" of the input terminal function. Two types of motors with different parameters can be switched and controlled by the second control function.
- [SET] It is linked with ON of the input terminal, and the "2nd control being selected [SETM](012)" of the output terminal function turns ON.
- Parameters whose parameter number is 200 are the 2nd control parameter.
  (e.g.) 2nd control parameter corresponding to "1st main speed command selection [AA101]" is "2nd main speed command selection [AA201]".
- Even if the "2nd control [SET]" input terminal is switched during inverter operation, the parameter will not be switched. In this case, it will be switched after the output is shut off.
- [SET] Even if you want to switch the input terminals for immediate operation, take a switching time of 1 second or longer.

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	2nd control [SET]: Switches to the 2nd control parameter ON this function.	024	-
CC-01 CC-02 CC-07	Output terminal function	While the second control is selected [SETM]: [SET] When switching to the 2nd control parameter after ON the input terminal, this signal is turned ON.	012	002 001 017

■[SET] List of parameters switched by ON/OFF of input terminal

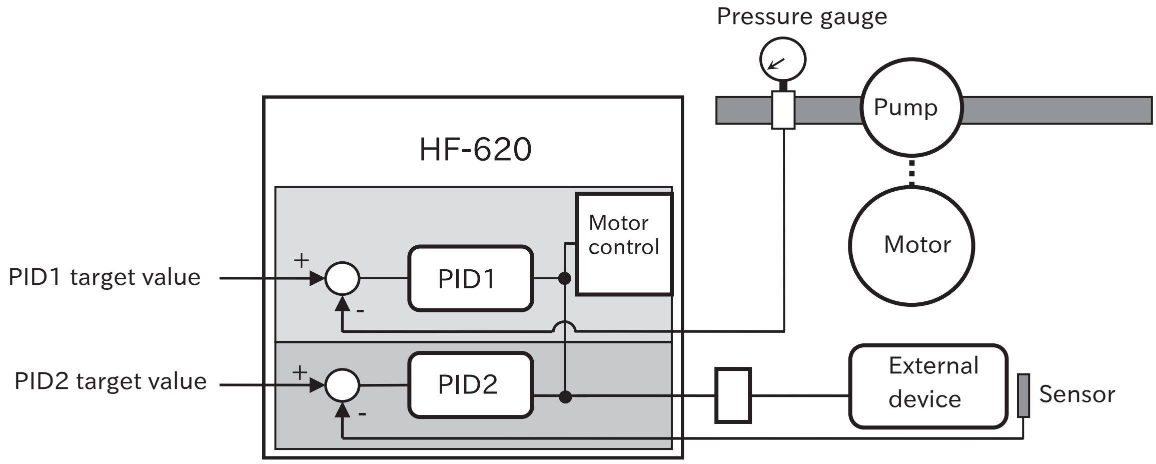
First/second code		Name	First/second code		Setting item
AA101	AA201	Main speed input source selection	AG103	AG203	Jump frequency 2, 1st-motor
AA102	AA202	Sub speed input source selection	AG104	AG204	Jump frequency width 2, 1st-motor
AA104	AA204	Sub speed -motor	AG105	AG205	Jump frequency 3, 1st-motor
AA105	AA205	Speed reference calculation symbol -motor	AG106	AG206	Jump frequency width 3, 1st-motor
AA106	AA206	Add frequency -motor	AG110	AG210	Acceleration stop frequency
AA111	AA211	RUN command input source selection	AG111	AG211	Acceleration stop time
AA114	AA214	RUN direction restriction selection	AG112	AG212	Deceleration stop frequency
AA115	AA215	STOP mode selection	AG113	AG213	Deceleration stop time
AA121	AA221	Control mode selection	bA101	bA201	Upper frequency limit source selection
AA123	AA223	Vector control mode selection	bA102	bA202	Upper frequency limit
AA124	AA224	Speed compensation with encoder selection	bA103	bA203	Lower frequency limit
Ab110	Ab210	Multi-speed 0	bA110	bA210	Torque limit selection
AC115	AC215	2- Accel/Decel change trigger	bA111	bA211	Torque limit parameter mode selection
AC116	AC216	Two-stage acceleration frequency	bA112	bA212	Torque limit 1 (Forward drive)
AC117	AC217	2-speed reduction frequency	bA113	bA213	Torque limit 2 (Reverse regenerative)
AC120	AC220	Acceleration time 1	bA114	bA214	Torque limit 3 (Reverse drive)
AC122	AC222	Deceleration time 1	bA115	bA215	Torque limit 4 (Forward regenerative)
AC124	AC224	Acceleration time 2	bA116	bA216	Torque limit LADSTOP selection
AC126	AC226	Deceleration time 2	bA120	bA220	Overcurrent suppression enable
AF101	AF201	DC braking selection	bA121	bA221	Overcurrent suppression -motor
AF103	AF203	DC braking frequency	bA122	bA222	Overload restriction 1 mode selection
AF104	AF204	DC braking delay time	bA123	bA223	Overload restriction 1 active level
AF105	AF205	DC braking force	bA124	bA224	Overload restriction 1 action time
AF106	AF206	DC braking active time at stop	bA126	bA226	Overload restriction 2 mode selection
AF107	AF207	DC braking operation method selection	bA127	bA227	Overload restriction 2 active level
AF108	AF208	DC braking force at start	bA128	bA228	Overload restriction 2 action time
AF109	AF209	DC braking active time at start	bA140	bA240	Overvoltage suppression enable
AF120	AF220	Contactor -motor	bA141	bA241	Overvoltage suppression active -motor
AF121	AF221	Run delay -motor	bA142	bA242	Overvoltage suppression active time
AF122	AF222	Contactor off delay -motor	bA144	bA244	Constant DC bus voltage control P gain
AF123	AF223	Contactor response check -motor	bA145	bA245	Constant DC bus voltage control I gain
AF130	AF230	Brake control enable	bA146	bA246	Over-magnetization function selection
AF131	AF231	Brake release wait -motor (Forward)	bA147	bA247	Over-magnetization function output filter time constant
AF132	AF232	Brake wait time for accel. (Forward)	bA148	bA248	Over-magnetization function -motor
AF133	AF233	Brake wait time for stopping (Forward)	bA149	bA249	Over-magnetization function -motor
AF134	AF234	Brake confirmation signal wait -motor (Forward)	bb101	bb201	Carrier frequency
AF135	AF235	Brake release frequency -motor (Forward)	bb102	bb202	Sprinkle carrier pattern selection
AF136	AF236	Brake release current -motor (Forward)	bb103	bb203	Automatic carrier reduction selection
AF137	AF237	Braking -motor (Forward)	bb160	bb260	Overcurrent detection -motor
AF138	AF238	Brake release wait -motor (Reverse)	bC110	bC210	Electronic thermal level
AF139	AF239	Brake wait time for accel. (Reverse)	bC111	bC211	Electronic thermal characteristic selection
AF140	AF240	Brake wait time for stopping (Reverse)	bC112	bC212	Electronic thermal decrease function enable
AF141	AF241	Brake confirmation signal wait -motor (Reverse)	bC113	bC213	Electronic thermal decreasing time
AF142	AF242	Brake release frequency -motor (Reverse)	bC115	bC215	Electronic thermal accumulation gain
AF143	AF243	Brake release current -motor (Reverse)	bC120	bC220	Free electronic thermal frequency-1
AF144	AF244	Braking -motor (Reverse)	bC121	bC221	Free electronic thermal current-1
AG101	AG201	Jump frequency 1, 1st-motor	bC122	bC222	Free electronic thermal frequency-2
AG102	AG202	Jump frequency width 1, 1st-motor	bC123	bC223	Free electronic thermal current-2

First/second code		Name	First/second code		Setting item
bC124	bC224	Free electronic thermal frequency-3	Hb142	Hb242	Manual torque boost peak speed
bC125	bC225	Free electronic thermal current-3	Hb145	Hb245	Eco drive enable
CE101	CE201	Low current signal output mode selection	Hb146	Hb246	Eco drive response adjustment
CE102	CE202	Low current detection level 1	Hb150	Hb250	Free-V/f frequency 1
CE103	CE203	Low current detection level 2	Hb151	Hb251	Free-V/f voltage 1
CE105	CE205	Overload signal output mode selection	Hb152	Hb252	Free-V/f frequency 2
CE106	CE206	Overload warning level 1	Hb153	Hb253	Free-V/f voltage 2
CE107	CE207	Overload warning level 2	Hb154	Hb254	Free-V/f frequency 3
CE120	CE220	Over-torque level (Forward drive)	Hb155	Hb255	Free-V/f voltage 3
CE121	CE221	Over-torque level (Reverse regenerative)	Hb156	Hb256	Free-V/f frequency 4
CE122	CE222	Over-torque level (Reverse drive)	Hb157	Hb257	Free-V/f voltage 4
CE123	CE223	Over-torque level (Forward regenerative)	Hb158	Hb258	Free-V/f frequency 5
CE124	CE224	Over/Under-torque output Signal mode selection	Hb159	Hb259	Free-V/f voltage 5
CE125	CE225	Over/Under-torque selection	Hb160	Hb260	Free-V/f frequency 6
HA110	HA210	Stabilization parameter (V/f,A.bst)	Hb161	Hb261	Free-V/f voltage 6
HA112	HA212	Stabilization end ratio (V/f,A.bst)	Hb162	Hb262	Free-V/f frequency 7
HA113	HA213	Stabilized start rate (V/f,A.bst)	Hb163	Hb263	Free-V/f voltage 7
HA115	HA215	Async. Motor speed response	Hb170	Hb270	Slip compensation P-gain with encoder
HA120	HA220	ASR gain switching mode selection	Hb171	Hb271	Slip compensation I-gain with encoder
HA121	HA221	Gain change time	Hb180	Hb280	Output voltage gain
HA122	HA222	ASR gain mapping intermediate speed 1-motor	HC101	HC201	Automatic torque boost voltage compensation gain
HA123	HA223	ASR gain mapping intermediate speed 2-motor	HC102	HC202	Automatic torque boost slip compensation gain
HA124	HA224	ASR gain mapping maximum speed	HC111	HC211	Boost value at -motor (IM-SLV)
HA125	HA225	ASR gain mapping P-gain, 1-motor	HC114	HC214	Direction reversal protection selection
HA126	HA226	ASR gain mapping I-gain, 1-motor	HC115	HC215	Torque conversion -motor
HA127	HA227	Gain mapping P control -gain, 1-	HC120	HC220	Torque current reference filter time constant
HA128	HA228	ASR gain mapping P-gain 2, -motor	HC121	HC221	Speed feedforward compensation -motor
HA129	HA229	ASR gain mapping I-gain 2, -motor	HC137	HC237	Flux settling -motor
HA130	HA230	Gain mapping P control -gain 2,	HC141	HC241	Modulation factor level 1
HA131	HA231	ASR gain mapping P-gain 3, -motor	HC142	HC242	Modulation factor level 2
HA132	HA232	ASR gain mapping I-gain 3, -motor	Hd102	Hd202	SM(PMM) Motor capacity selection
HA133	HA233	ASR gain mapping P-gain 4, -motor	Hd103	Hd203	SM(PMM) Motor pole selection
HA134	HA234	ASR gain mapping I-gain 4, -motor	Hd104	Hd204	SM(PMM) Base frequency
HA181	HA281	Reserved	Hd105	Hd205	SM(PMM) Maximum frequency
Hb101	Hb201	IM Motor type select	Hd106	Hd206	SM(PMM) Motor rated voltage
Hb102	Hb202	IM Motor capacity select	Hd108	Hd208	Sync. Motor rated current
Hb103	Hb203	IM motor pole selection	Hd110	Hd210	Sync. Motor constant R
Hb104	Hb204	IM Base frequency	Hd112	Hd212	Sync. Motor constant Ld
Hb105	Hb205	IM Maximum frequency	Hd114	Hd214	Sync. Motor constant Lq
Hb106	Hb206	IM motor rated voltage	Hd116	Hd216	Sync. Motor constant Ke
Hb108	Hb208	IM Motor Rated Current	Hd118	Hd218	Sync. Motor constant J
Hb110	Hb210	Async. Motor constant R1	Hd130	Hd230	SM(PMM) Minimum frequency (switching)
Hb112	Hb212	Async. Motor constant R2	Hd131	Hd231	Sync. Motor no-Load current
Hb114	Hb214	Async. Motor constant L	Hd132	Hd232	SM(PMM) Starting method selection
Hb116	Hb216	Async. Motor constant I0	Hd133	Hd233	SM(PMM) Initial Position Estimation 0V Wait Count
Hb118	Hb218	Async. Motor constant J	Hd134	Hd234	Sync. Motor IMPE detect wait number
Hb130	Hb230	Lowest frequency	Hd135	Hd235	Sync. Motor IMPE detect number
Hb131	Hb231	Reduced voltage start time	Hd136	Hd236	Sync. Motor IMPE voltage gain
Hb140	Hb240	Manual torque boost operation mode selection	Hd137	Hd237	SM(PMM) Initial position estimation magnetic pole position offset
Hb141	Hb241	Manual torque boost value			

9.8 PID processing control

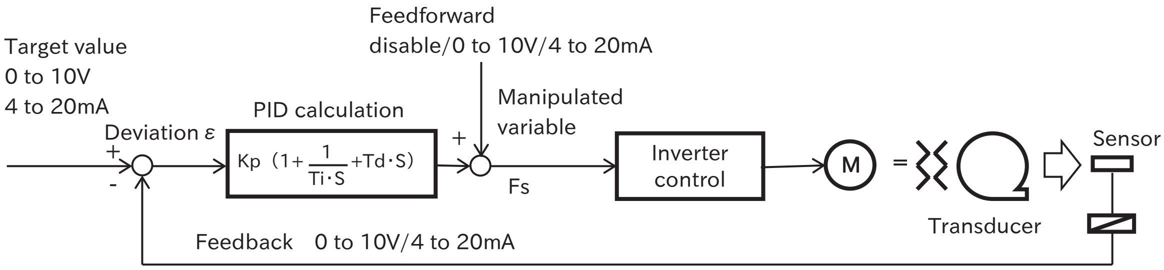
9.8.1 PID control

- PID function enables process control of flow rate, air volume, pressure, etc. In addition, HF-620 has two independent PID functions (PID1/PID2) that can be set individually for PID control.
- When using PID1, set "PID1 selection [AH-01]". When using PID2, set "PID2 selection [AJ-01]" to "Enabled (01)" or "Enabled (with reversing output) (02)", and adjust each related parameter.
- The two PID functions can be switched by the "PID Output Switching 1 [PIO1]" input terminal and used for motor control.
- PID functions that are not used for motor control can be freely used for external PID calculation that is not related to the control of inverters.
- While "PID1 disabled [PID]"/"PID2 disabled [PID2]" of the input terminal function is ON, PID function is disabled and the inverter performs normal frequency-output. The frequency at this time is set to 100 % of the target value setting as the highest frequency.
- PID cascading is also available to connect PID1 operation to PID2 target. This enables more sophisticated PID control such as more stable control and disturbance-suppression.
- The following functions are available in PID1. Please note that it cannot be used in PID2. For details on the functions, see "Using 9.8.2 PID1".
  - Three PID target values/feedback data sets
  - Two types of gain settings
  - PID target value multi-stage switching function
  - PID feed-forward input source function
  - PID soft start function
  - PID sleep function
- When controlling the motor with PID function, "Main speed command selection [AA101]" must be set to "PID calculation (15)".
- "Frequency upper/lower limiter function ([bA101] to [bA103])" operates for the frequency command after PID calculation. Does not operate against PID target.
- If the acceleration/deceleration time setting is longer than PID operation, output-frequency tracking may be delayed and PID control may not work well. In this case, set the acceleration/deceleration time shorter.



Basic configuration and operation of PID control

■PID control block diagram



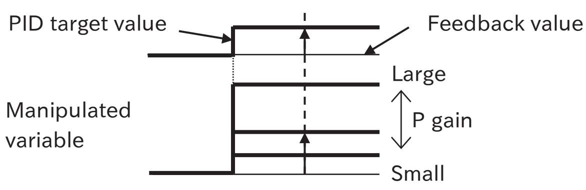
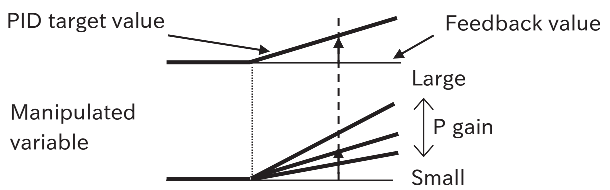
Kp: Proportional gain, Ki: Integral gain (Ki=1/Ti), Kd: Differential gain (Kd=Td)

Ti: Integral time, Td: Derivative time, s: Operator, ε : Deviation

■Operation of PID control

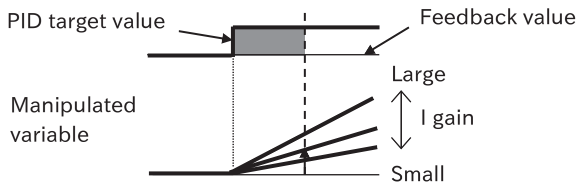
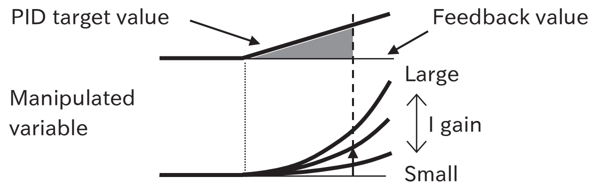
(1) P action: proportinal gain

- Operation in which the manipulated variable of PID command value is proportional to the deviation between PID target value and the present feedback value (FB value).

Target value changes to step	Target value changes to ramp
	

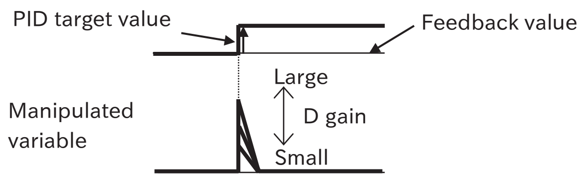
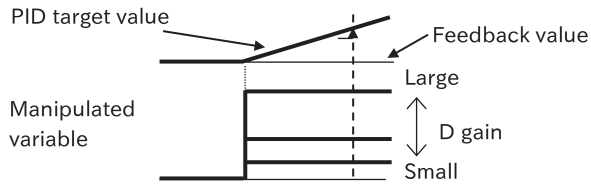
(2) I action: integral gain

- This is an operation in which the manipulated variable of PID command value is proportional to the time-integrated value of the deviation between PID target value and the present feedback value (FB value).
- Integration can be cleared by "PID1 Integration Reset [PIDC]" and "PID2 Integration Reset [PIDC2]" of the input terminal function.
- In P operation, when PID target value and FB value approach each other, the manipulated variable becomes smaller, and it takes time to reach the target value. Therefore, it is supplemented by I operation.

Target value changes to step	Target value changes to ramp
	

(3) D action: differential gain

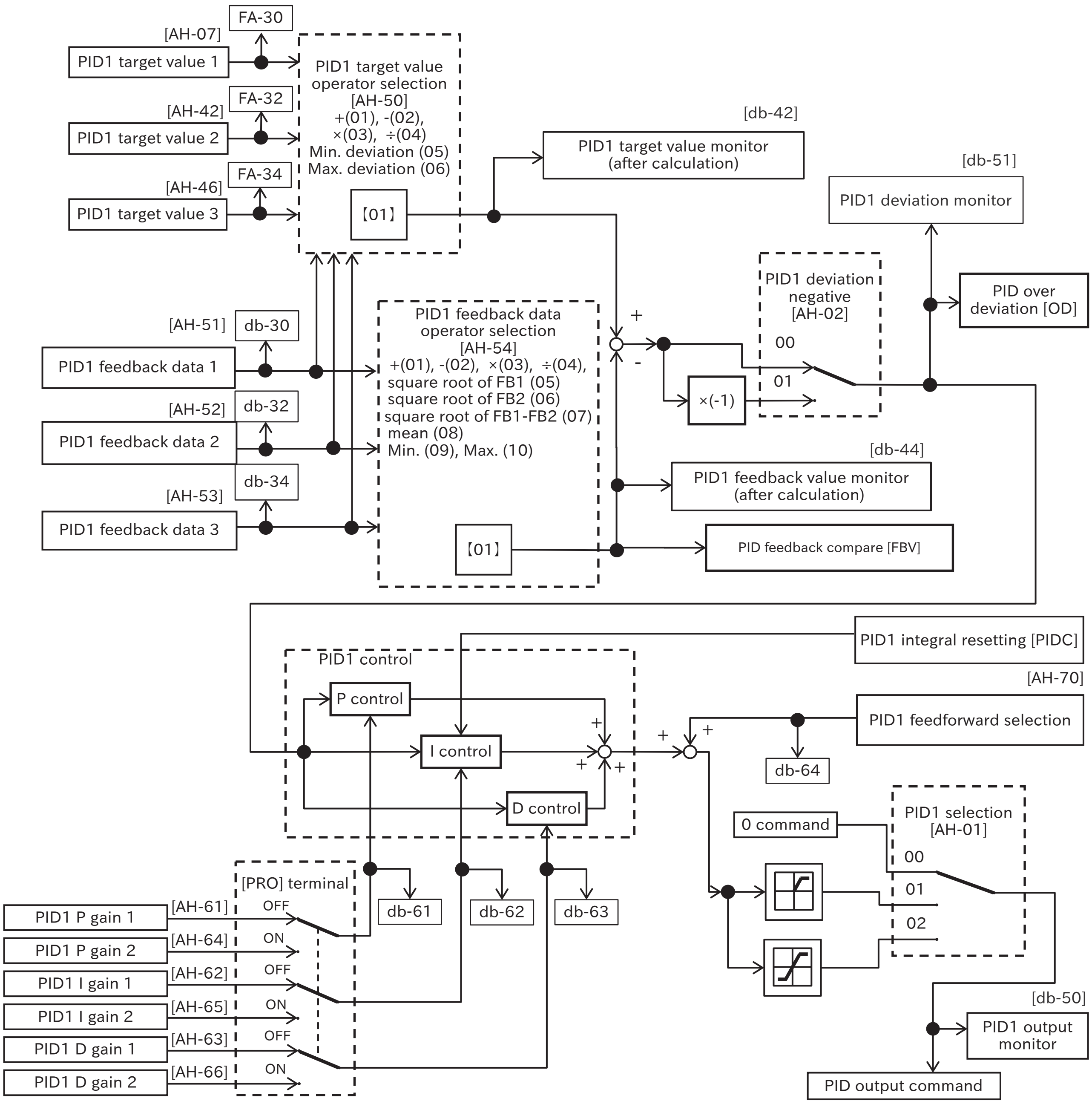
- This is an operation in which the manipulated variable of PID command value is proportional to the change in the deviation between PID target value and the present feedback value (FB value).
- D action has the effect of supplementing the responsiveness of P action and I action, and performs correction when receiving a disturbance, etc.

Target value changes to step	Target value changes to ramp
	

9.8.2 Use PID1

- Three PID1 can be entered for both PID target value /PID feed back value. Refer to the block diagram below for an overview.
- PID gains 1 and 2 can be switched by input terminal function "PID gain switching [PRO]".
- Target value 0 to target value 15 can be set as PID target value, and can be switched by inputterminal function "PID1 multi-stage target value ([SVC1] to [SVC4])".
- Feed-forward control is available to stabilize the disturbance in advance.
- Soft-start function to perform normal speed control for a certain period of time from start of operation can be used.
- With PID sleep function, the output is stopped when PID output drops or a signal is input. After that, restart can be performed automatically when the condition is satisfied.

■PID1 block diagram



Note: In the figure, [ ] and the position of the switch for each parameter indicates the initial value.
Input terminal functions that are not assigned to the input terminal function selection [CA-01] to [CA-08] will be OFF.

・The following shows an example of setting steps when performing PID control.
(e.g.) When simple PID control is performed by entering the target value [VRF] and feedback value [IRF] from the default parameter.

① Set "PID1 selection [AH-01]" to "Enable (01)".
② Set "Main speed command selection [AA101]" to "PID operation (15)".
③ Set the [VRF] jack input (01) to "PID1 target value1 input destination selection [AH-07]."
④ Set the [IRF] connector input (02) to "PID1 feedback data 1 input destination selection [AH-51]."
⑤ Set PID gain to "PID proportional/integral/differential gain 1 ([AH-61] to [AH-63])".
⑥ Enter the command set in "Operation command selection [AA111]" and begin PID control.

List of PID1 related parameters

・The table below lists the parameters related to PID1. For details of each parameter, please refer to the individual function description in this section.

■PID1 related monitor

Code	Item	Description	Data
FA-30	PID1 target setpoint 1 setting (monitor)	Monitor or change the setting of the currently selected PID1 target 1. If [FA-30] is changed or saved when the input destination of target value 1 is parameter setting (=[AH-10]) or PID1 multi-stage target value 1 to 15(=[AH-12] to [AH-40], the set value of the selected target value input destination will also be changed or saved.	-100.00 to 100.00 % [Note]
FA-32	PID1 target setpoint 2 setting (monitor)	Monitors or changes the settings of the currently selected PID1 target value-2. If the target value is set to parameter setting (=[AH-44]), changing/saving [FA-32] will also change/save [AH-44].	
FA-34	PID1 setpoint 3 setting (monitor)	Monitor or change the setting of the currently selected PID1 target value-3. If the target value is set to parameter setting (=[AH-48]), changing/saving [FA-32] will also change/save [AH-48].	
db-30	PID1 feedback value 1 monitor	Displays PID1 feedback-value 1.	
db-32	PID1 feedback value 2 monitor	Displays the feedback-value 2 of PID1.	
db-34	PID1 feedback value 3 monitor	Displays PID1 feedback-value 3.	
db-42	PID1 target value monitor (after calculation)	Displays the target after calculation in [AH-50].	
db-44	PID1 feedback data monitor (after calculation)	Displays the feedback value after calculation in [AH-54].	
db-50	PID1 output monitor	Displays PID1 output.	-100.00 to 100.00 %
db-51	PID1 deviation monitor	Displays PID1 deviation.	-200.00 to 200.00 %
db-52	PID1 deviation 1 monitor	When [AH-50] is "Deviation minimum. (05)" or "Deviation max. (06)", monitor the three deviations of PID1.	
db-53	PID1 deviation 2 monitor		
db-54	PID1 deviation 3 monitor		
db-61	Current PID P-gain monitor	Displays the current P gain.	0.0 to 100.0
db-62	Current PID I-gain monitor	Displays the current I gain.	0.0 to 3600.0 s
db-63	Current PID D-gain monitor	Displays the current D gain.	0.00 to 100.00 s
db-64	PID feedforward input source monitor	Displays the feedforward command value.	0.00 to 100.00 %

Noter: "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Unit Converter Function".

■PID1 related parameters

Code	Item	Description	Data	Initial value
AH-01	PID1 enable	Disabled	00	00
		Enabled: Even if the command by PID operation becomes negative, it will not be outputting in the reverse direction.	01	
		Enabled (with reverse output): When the command by PID calculation becomes negative, it will be outputting in the reverse direction.	02	
AH-02	PID1 deviation minus	Disabled	00	00
		Enabled: Deviation is the difference between the target value and the feedback data multiplied by (-1).	01	
AH-03	PID1 unit selection	Change the units and scale of some monitors/parameters of PID1. For more information, please refer to "9.8.5 PID Units Converter Function".	00 to 58	01
AH-04	Adjust PID1 scale (0%)		-10000 to 10000	0
AH-05	PID1 Scale Adjust (100%)			10000
AH-06	Adjust PID1 scale (decimal point)		0 to 4	2
AH-07	PID1 target value1 input destination selection	None	00	07
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		Parameter setting	07	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
AH-10	PID1 Target1set values	When "Parameter setting (07)" is selected as PID1 target value 1 input destination, set PID1 target value 1.	-100.00 to 100.00 % Note	0.00
AH-12	Multi set-point selection 1	Set the multi-stage target value 1 to 15.		
AH-14	Multi set-point selection 2			
AH-16	Multi set-point selection 3			
AH-18	Multi set-point selection 4			
AH-20	PID1 multi-stage target value 5			
AH-22	PID1 multi-stage target value 6			
AH-24	PID1 multi-stage target value 7			
AH-26	PID1 multi-stage target value 8			
AH-28	PID1 multi-stage target value 9			
AH-30	PID1 multi-stage target value 10			
AH-32	PID1 multi-stage target value 11			
AH-34	PID1 multi-stage target value 12			
AH-36	PID1 multi-stage target value 13			
AH-38	PID1 multi-stage target 14			
AH-40	PID1 multi-stage target value 15			
AH-42	PID1 target value 2 input destination selection	Same as [AH-07]	00 to 12	00
AH-44	PID1 target 2 set values	When "Parameter setting (07)" is selected as PID1 target value 2 input destination, set PID1 target value 2.	-100.00 to 100.00 % Note	0.00
AH-46	PID1 target value 3 input destination selection	Same as [AH-07]	00 to 12	00
AH-48	PID1 target 3 set values	When "Parameter setting (07)" is selected as PID1 target value 3 input destination, set PID1 target value 3.	-100.00 to 100.00 % Note	0.00
AH-50	PID1 Target 1 Operator Selection	Addition	01	01
		Subtraction	02	
		Multiplication	03	
		Division	04	
		Deviation minimum	05	
		Maximum deviation	06	

Note: "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Unit Converter Function".

Code	Item	Description	Data	Initial value
AH-51 AH-52 AH-53	PID1 feedback 1/2/3 input source selection	None	00	02 00 00
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
AH-54	PID1 feedback data operator selection	Addition	01	01
		Subtraction	02	
		Multiplication	03	
		Division	04	
		FB1 square root	05	
		FB2 square root	06	
		FB1-FB2 square root	07	
		Average	08	
		Minimum	09	
		Maximum	10	
AH-60	PID1 gain switching mode selection	Constant gain (only gain 1 is used)	00	00
		[PRO] Switching by input terminal	01	
AH-61	PID1 proportional gain 1	Set PID proportional gain 1.	0.0 to 100.0	1.0
AH-62	PID1 integral gain 1	Sets PID integral gain 1.	0.0 to 3600.0 s	1.0
AH-63	PID1 differential gain 1	Set PID differential gain 1.	0.00 to 100.00 s	0.00
AH-64	PID1 proportional gain 2	Set PID proportional gain 2.	0.0 to 100.0	0.0
AH-65	PID1 integral gain 2	Set PID integral gain 2.	0.0 to 3600.0 s	0.0
AH-66	PID1 differential gain 2	Set PID differential gain 2.	0.00 to 100.00 s	0.00
AH-67	PID1 gain switching time	[PRO] Sets the time from when the input terminal operates until the gain switches.	0 to 10000 ms	100
AH-70	PID1 feedforward selection	None	00	00
		Terminal [VRF]	01	
		Terminal [IRF]	02	
AH-71	PID1 variable range	PID output-variable range is limited by PID target ± this setting. Set the maximum frequency as 100% in % units.	0.00 to 100.00 %	0.00
AH-72	Excessive PID1 deviation	Sets the target value of PID1 and the level at which the deviation of the feedback data is judged to be excessive. For more information, please refer to "Signaling of 9.8.4 PID function".		3.00
AH-73	PID1feedback compare Signal OFF	Sets the tolerance of PID1 feedback data. For more information, please refer to "Signaling of 9.8.4 PID function".		100.00
AH-74	PID1 feedback compare Signal ON			0.00
AH-75	PID soft start function enable	Disabled	00	00
		Enabled	01	
AH-76	PID soft start target level	Sets the target value in % for the soft-start section assuming that the maximum frequency is 100%.	0.00 to 100.00 %	100.00
AH-78	Acceleration time setting for PID soft start function	Set the acceleration time at soft start.	0.00 to 3600.00 s	30.00
AH-80	PID soft start time	Sets the duration of PID soft start function.	0.00 to 600.00 s	0.00
AH-81	PID soft start error detection enable	Disable	00	00
		Enabled (error output): When the start error is judged, the motor trips with "PID start error [E120]".	01	
		Enabled (warning): When the start error is judged, "PID soft start error [SSE]" will be ON.	02	
AH-82	PID soft start error detection level	Sets the start error status when PID soft start function is activated.	0.00 to 100.00 %	0.00
AH-85	PID sleep trigger selection	Disable	00	0
		Output drop: Starts sleep operation when output drops	01	
		[SLEP] Pin: Starts operation on the rising edge of the [SLEP] inputpin	02	

Code	Item	Description	Data	Initial value
AH-86	PID sleep start level	When [AH-85] is set to "Output Drop (01)", Sets the frequency at which the sleep operation starts.	0.00 to 590.00 Hz	0.00
AH-87	PID sleep active time	Sets the waiting time before the machine enters sleep mode.	0.00 to 100.00 s	0.00
AH-88	Enable set-point boost before PID sleep	Disable	00	00
		Enabled: PID target is increased (boosted) prior to starting the sleep operation.	01	
AH-89	Set-point boost time before PID sleep	Sets the time for the boost before the sleep operation starts.	0.00 to 100.00 s	0.00
AH-90	Set-point boost value before PID sleep	Sets the amount of addition (boosting amount) to PID target prior to starting the sleep operation.	0.00 to 100.00 %	0.00
AH-91	Minimum RUN time before PID sleep	Until [AH-91] elapses after starting, the machine will not go into sleep operation even if the conditions are met.	0.00 to 100.00 s	0.00
AH-92	Minimum active time of PID sleep	After the machine enters the sleep state, the machine remains in the sleep state until [AH-92] elapses, even if the conditions are met.		
AH-93	PID wake trigger selection	Deviation amount: If the status where the deviation is [AH-96] or more continues for [AH-95] or longer, the sleep status is canceled.	01	01
		Feedback drop: If the status below [AH-94] for the feedback data continues for [AH-95] or longer, the sleep status is canceled.	02	
		[WAKE] Terminals: [WAKE] Sleep mode is canceled after [AH-95] time elapses after ON of the input terminals is input.	03	
AH-94	PID wake start level	When [AH-93] is set to Feedback Low (02), set the feedback to cancel the sleep operation.	0.00 to 100.00 %	0.00
AH-95	PID wake start time	Sets the standby time for canceling sleep operation.	0.00 to 100.00 s	0.00
AH-96	PID wake start deviation value	When [AH-93] is set to "Deviation amount (01)", set the deviation between the target value and the feed-back value for opening the sleep operation.	0.00 to 100.00 %	0.00

■PID1related I/O terminal functions

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	PID1 disabled [PID]: When this signal is turned ON, PID operation is disabled and the normal frequency operation is performed.	041	-
		PID1 integration resetting [PIDC]: When this signal is turned ON, the integral of PID control is cleared to 0.	042	
		PID1 multi-stage target value 1 to 4 ([SVC1] to [SVC4]): By combining [SVC1] to [SVC4], PID1 target value 1 is switched to multi-stage target value 1 to 15.	051([SVC1]) 052([SVC2]) 053([SVC3]) 054([SVC4])	
		PID gain switching [PRO]: The gain 1 and gain 2 of PID1 can be switched by ON/OFF this signal. The present PID gain can be checked on the monitor below. "PID present P gain monitor [db-61]" "PID present I gain monitor [db-62]" "PID present D gain monitor [db-63]"	055	
		PID output switching 1[PIO1]: This ON/OFF can be used to switch between PID1 and PID2.	056	
		SLEEP condition-satisfied [SLEP]: When "PID Sleep Condition Selection [AH-85]" is set to "[SLEP] Terminal (02)", the sleep function is started by this signal.	058	
		WAKE condition-satisfied [WAKE]: When "PID Wake Condition Selection [AH-93]" is set to "[WAKE] Terminal (03)", the sleep function is canceled by this signal.	059	
CC-01 CC-02 CC-07	Output terminal function	Over deviation for PID control [OD]: This signal is turned ON when PID1 deviation exceeds the set level of "PID1 deviation excess level [AH-72]".	045 Note	002 001 017
		PID Feedback Compare [FBV]: PID1 Feedback Value and "PID1 Feedback Compare Signal ON/OFF Level ([AH-73], [AH-74])" are compared to perform signal ON/OFF.	046 Note	
		PID soft start error [SSE]: When "PID start error determination execution selection [AH-81]" is set to "Enabled (Warning) (02)", if a start error is judged, this signal is turned ON.	093	

Note: For more information, please refer to "Signaling of 9.8.4 PID function".

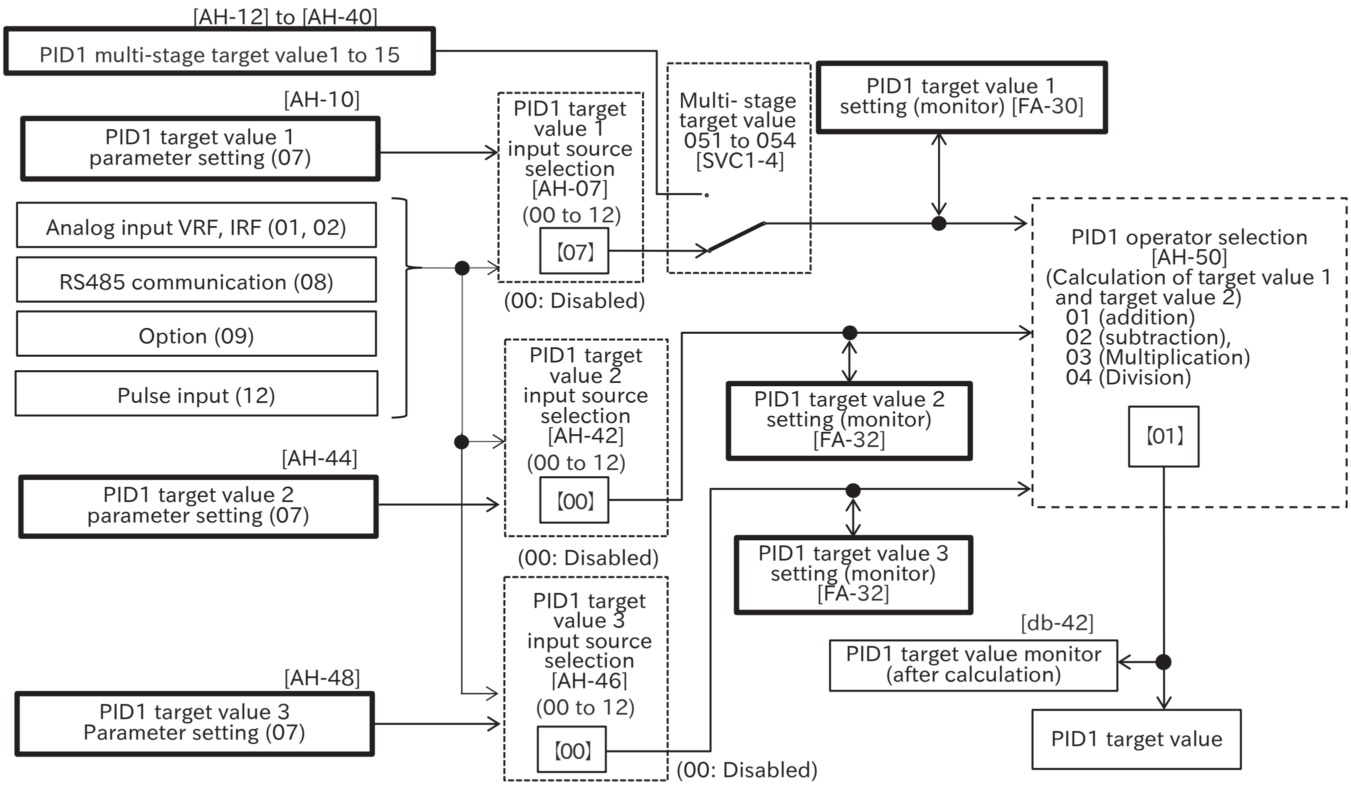
PID1 target selection

- If "PID1 target value 1 input destination selection [AH-07]" is "PID1 target value 1 set value [AH-10]", "PID1 multi-stage target value 1 to 15([AH-12] to [AH-40]", PID1 target value 1 input destination can also be changed/saved by changing/saving "PID1 target value 1 set (monitor) [FA-30]".
- When "PID1 target value 2/3 input destination selection ([AH-42], [AH-46])" is "PID1 target value 2/3 setting value ([AH-44]/[AH-48])," it is also possible to change/save PID1 target value 2/3 input destination by changing/saving "PID1 target value 2 setting (monitor)[FA-32]" and "PID1 target value 3 setting (monitor)[FA-34]".
  e.g. If [AH-07] is referring to [AH-10], the [AH-10] setting will also be applied to [FA-30].
  If [FA-30] is changed in this condition, [AH-10] is changed in the same way.
- If PID target value can be changed with [FA-30]/[FA-32]/[FA-34], the value will be reflected as the entered value just by changing the value with dialing on the control panel. However, if it is not saved, it will return to before the change by turning on the power again. If PID target value cannot be changed, [FA-30]/[FA-32]/[FA-34] is the target value monitor.
- To set the target value input to PID1 target value 1 only, set the target value 2/3 input destination selection [AH-42]/[AH-46] to 00 (none), and set PID1 target value 1 operator selection [AH-50] to 01 (addition).
- Select "None (00)" for the target value and feedback value that are not used.
- Data set to 00 (none) in the input destination selection is excluded from the calculation target.
- "Frequency upper/lower limiter function ([bA101] to [bA103])" operates for the frequency command after PID calculation. Does not operate against PID target.

■Operation of PID1 target operator selection [AH-50]

- [AH-50] The operation changes between (01) to (04) and between (05) and (06).
  (1) When [AH-50] is "addition, subtraction, multiplication, division ((01) to (04))":
  The calculation target is target value 1 and target value 2. Multiplication (03) and division (04) are calculated as follows. The operation result is limited within the range of-100.00 to 100.00%.
  e.g. When target value 1 = 20% and target value 2 = 40%
  Multiplication: 20 × 40% = 20 × 0.4 = 8%, Division: 20/40% = 20/0.4 = 50%

■PID1 target value selection block diagram when [AH-50] is 01 to 04

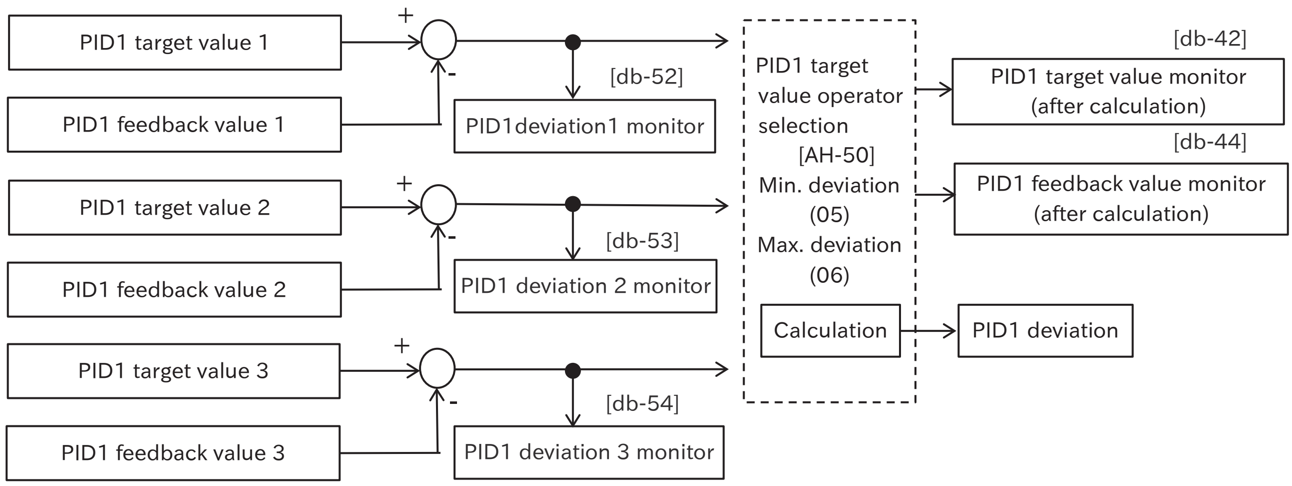


Note: The values in [ ] in the figure are initial values.
Input terminal functions that are not assigned to the input terminal function selection [CA-01] to [CA-08] will be OFF.

(2) When [AH-50] is "Deviation min. (05)" and "Deviation max. (06)":

- When [AH-50] is "Deviation min. (05)" or "Deviation max. (06)", deviation 1 to deviation 3 are calculated as follows, and then PID operation is performed using the minimum or maximum deviation.
  - (deviation 1) = (target value 1)-(feedback value 1)
  - (deviation 2) = (target value 2)-(feedback value 2)
  - (deviation 3) = (target value 3)-(feedback value 3)
- PID1 target and PID1 feedback data used for PID1 related functions are the calculation source data for deviations selected in the operation. Each is displayed in "PID1 Target Monitor (after calculation) [db-42]" and "PID Feedback Data Monitor (after calculation) [db-44]".
- When 05 (minimum deviation) or 06 (maximum deviation) is selected in [AH-50], operator selection [AH-54] is disabled.

■PID1 target/feedback value selection block diagram when [AH-50] is 05 or 06



Code	Item	Description	Data	Initial value
FA-30	PID1 target value 1 setting (monitor)	Monitors the currently selected PID1 target or changes the settings.	-100.00 to 100.00 % Note	-
FA-32	PID1 target value 2 setting (monitor)			
FA-34	PID1 target value 3 setting (monitor)			
db-42	PID1 target value monitor (after calculation)	Displays the target after calculation in [AH-50].		
AH-07 AH-42 AH-46	PID1 desired value 1/2/3 Input source selection	None	00	07 00 00
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		Parameter setting	07	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
AH-10	PID1 Target 1 set value	Set PID1 target value when "Parameter setting (07)" is selected as PID1 target value input destination.	-100.00 to 100.00 % Note	0.00
AH-44	PID1 Target 2 set value			
AH-48	PID1 Target 3 set value			
AH-50	PID1 Target 1 Operator Selection	Addition	01	01
		Subtraction	02	
		Multiplication	03	
		Division	04	
		Deviation minimum	05	
		Maximum deviation	06	

Note: PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

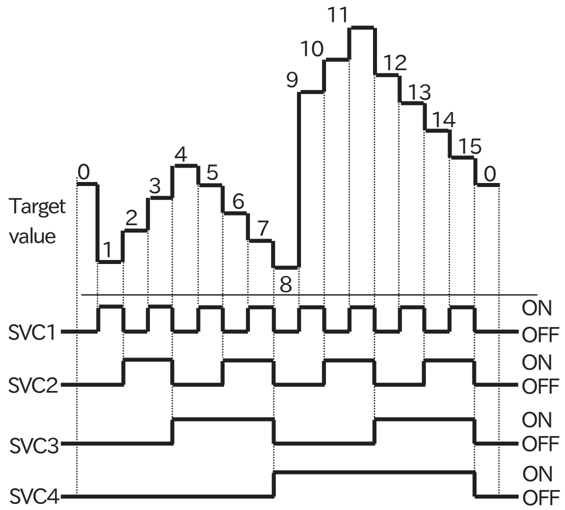
PID target value multi-stage switching function

- PID1 multi-stage target value 1 to 15 can be selected by assigning "PID1 multi-stage target value ([SVC1] to [SVC4]) (051 to 054)" to "Input terminal function selection [CA-01] to [CA-08]".
- The wait time until terminal input is confirmed can be set in "Multi-stage input confirmation time [CA-55]". The transition state during terminal switching operation can be prevented from being adopted.
- If there is no change, the setting of [CA-55] will elapse and the setting will be confirmed. Please note that the input response will be slower if the settling time is increased.

■Operation table

Multi-stage target point	SVC4	SVC3	SVC2	SVC1	Parameter
Selection 0	OFF	OFF	OFF	OFF	AH-10 Note
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

■operation grafh



Note: When "PID1 target value1 input destination selection [AH-07] = "Parameter setting (07)".
When [SVC1] tp [SVC4] is set to all OFF, PID1 target 1 follows the setting of [AH-07].

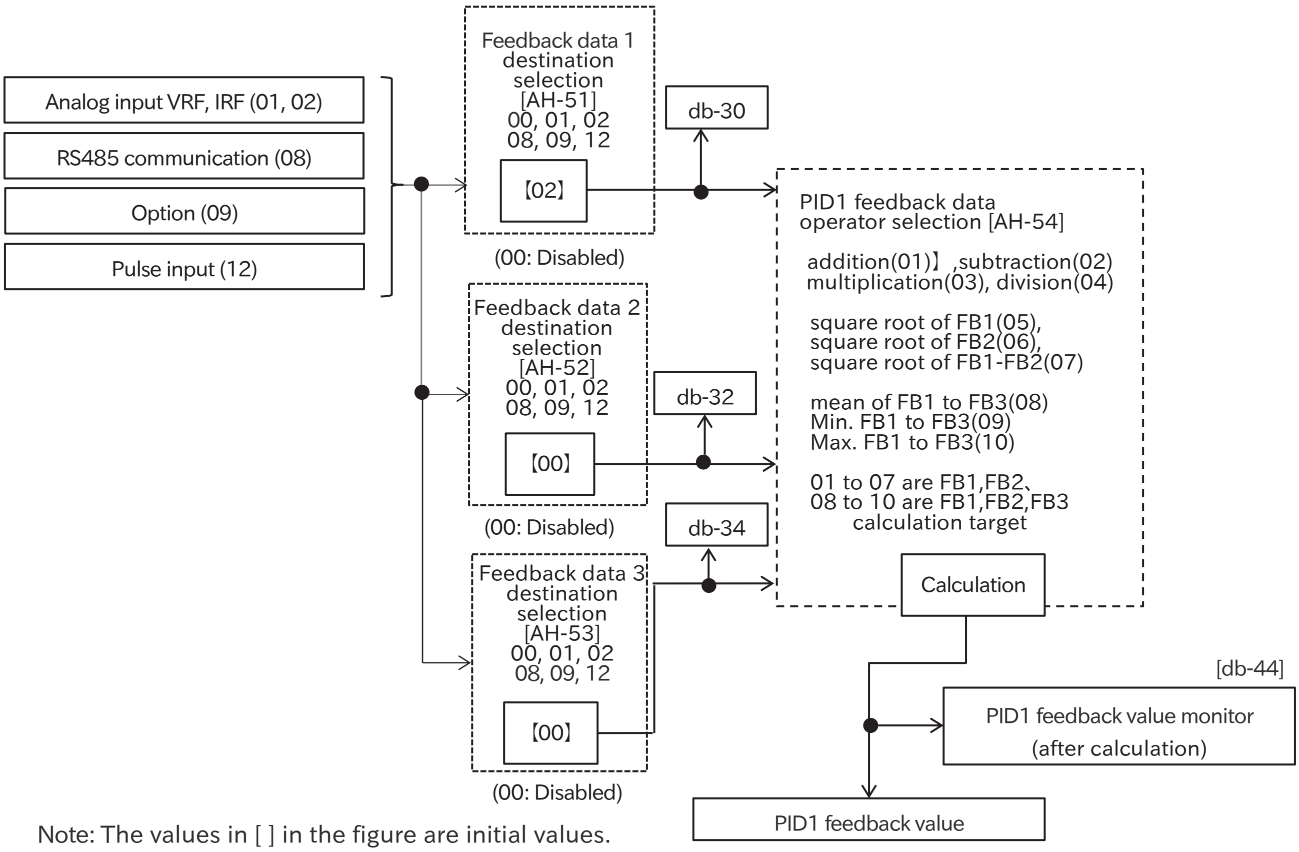
Code	Item	Description	Data	Initial value
FA-30	PID1 target 1 setting (Monitor)	Monitor or change the setting of the currently selected PID1 target 1. If [FA-30] is changed or saved when the input destination of target value 1 is parameter setting (=[AH-10]) or PID1 multi-stage target value 1 to 15(=[AH-12] to [AH-40], the set value of the selected target value input destination will also be changed or saved.	-100.00 to 100.00 % Note	-
AH-10	PID1 Target1set values	When "Parameter setting (07)" is selected as PID1 target value input destination, set PID1 target value 1.		0.00
AH-12 to AH-40	PID1 Multi-stage Target Value 1 to 15	Set the multi-stage target value 1 to 15.		
CA-01 to CA-08	Input terminal function	PID1 multi-stage target value 1 to 4 ([SVC1] to [SVC4]): By combining [SVC1] to [SVC4], PID1 target value 1 is switched to multi-stage target value 1 to 15.	051([SVC1]) 052([SVC2]) 053([SVC3]) 054([SVC4])	-
CA-55	Multistage input determination time	Set the time until the frequency is fixed when the multi-speed, multi-step position command, or multi-step target value is switched.	0 to 2000 ms	0

Note: "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

PID1 feedback data selection

- To set the feedback data input to PID1 feedback data 1 only, set "Feedback data 2/3 input destination selection ([AH-52], [AH-53])" to "None (00)", and set "PID1 feedback data operator selection [AH-54]" to "Addition (01)".
- When (01) to (07) is selected in [AH-54], feedback data 1 and feedback data 2 become calculation targets. When (08) to (10) is selected in [AH-54], feedback data 1 to 3 become calculation targets.
- The [AH-54] operation is limited to a range between-100.00% and 100.00%.
- Select "None (00)" to select the input destination of feedback data that is not used.
- The data set to "None (00)" in the input destination selection is excluded from the calculation target.
- The calculation of "PID1 Feedback Data Operator Selection [AH-54]" is enabled only when (01) to (04) are selected in "PID1 Target Value 1 Operator Selection [AH-50]". When [AH-50] is set to (05) or (06), the calculation of [AH-54] is not executed.

■Feedback data selection block diagram



Note: The values in [ ] in the figure are initial values.

Code	Item	Description	Data	Initial value
db-30	PID1 feedback value 1 monitor	Displays PID1 feedback-value 1.	-100.00 to 100.00 % Note	-
db-32	PID1 feedback value 2 monitor	Displays the feedback-value 2 of PID1.		
db-34	PID1 feedback value 3 monitor	Displays PID1 feedback-value 3.		
db-44	PID1 feedback data monitor (after calculation)	Displays the feedback value after calculation in [AH-54].		
AH-51 AH-52 AH-53	PID1 feedback 1/2/3 input source selection	None	00	02 00 01
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
AH-54	PID1 Feedback Data Operator Selection	Addition	01	01
		Subtraction	02	
		Multiplication	03	
		Division	04	
		FB1 square root	05	
		FB2 square root	06	
		FB1-FB2 square root	07	
		Average	08	
		Minimum	09	
		Maximum	10	

Note: "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

PID1 reverse output

- In normal PID control, if PID operation result is negative, the inverter limits the frequency command by 0Hz without outputting it in negative. When "PID1 selection [AH-01]" is set to "Valid (with reverse rotation output) (02)", the frequency command can be output in the reverse rotation direction if PID operation result is negative.
- If "PID1 selection [AH-01]" is set to "Valid (with reverse output) (02)", the output limit due to "PID1 variable range [AH-71]" is extended to the minus direction.

Code	Item	Description	Data	Initial value
AH-01	PID1 enable	Disabled	00	00
		Enabled: Even if the command by PID operation becomes negative, it will not be outputting in the reverse direction.	01	
		Enabled (with reverse output): When the command by PID calculation becomes negative, it will be outputting in the reverse direction.	02	

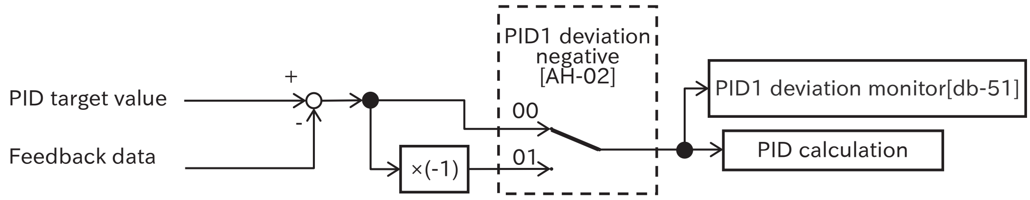
PID1 deviation ± switching output

- PID1 deviation ± can be switched for outputting.
- PID1 deviation is calculated as (PID target value-FB value) when "PID1 deviation minus [AH-02]" is "disabled (00)". When [AH-02] is "Enabled (01)", PID1 error is the same as (FB-PID target value).
- This function is used when PID target and FB deviations do not match the inverter command due to the sensor's properties.

  (e.g.) A compressor for a refrigerator whose temperature sensor specification is-20 to 100℃ is controlled.

  If feedback data is received at analog voltage input 0 to 10V and the target value is 0°C, if the present temperature is 10°C (FB value) > (PID target value), the speed will decrease under normal PID control.

  In such cases, [AH-02] =01 can increase the inverter speed.

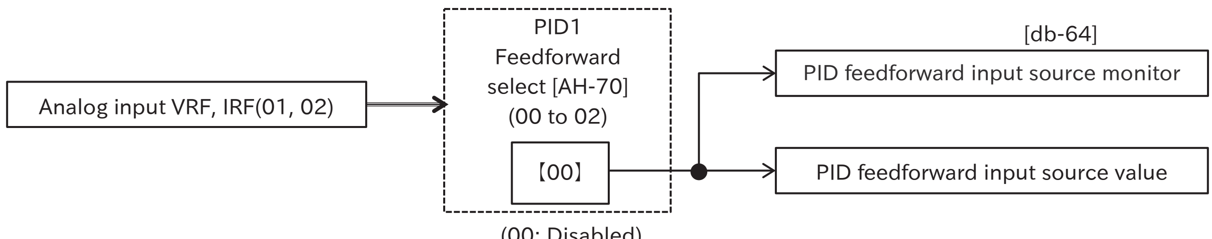


Note: The switches of the parameters in the figure show the initial values.

Code	Item	Description	Data	Initial value
AH-02	PID1 deviation minus	Disabled	00	00
		Enabled: Deviation is the difference between the target value and the feedback data multiplied by (-1).	01	

PID feed-forward input source function

- By setting the setting of "PID1 feedforward selection [AH-70]" to other than "none (00)", the feedforward input can be enabled and the input destination can be selected.
- Feed-forward control is enabled only in PID1.

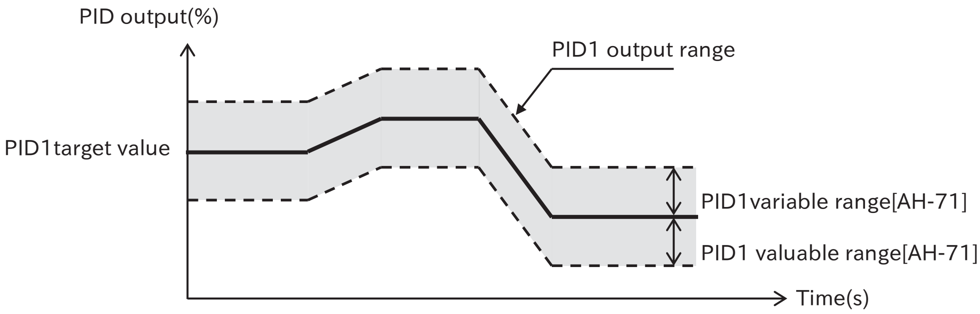


Note: The values in [ ] in the figure are initial values.

Code	Item	Description	Data	Initial value
AH-70	PID1 feedforward selection	None: Feed forward disabled	00	00
		[VRF] Terminal input: Input from the [VRF] connector is used for feedforward.	01	
		[IRF] Terminal input: Input from the [IRF] connector is used for feedforward.	02	

PID1 variable-range restriction

- For PID1 output. Limits the output to a variable range based on PID1 target.
  When [AH-71] PID1 is set to 0.00%, the limiting function is disabled.
- Set "PID1 variable range [AH-71]" with the maximum frequency set to 100%. PID1 output is limited within PID1 target ±[AH-71].



Code	Item	Description	Data	Initial value
AH-71	PID1 variable range	PID output-variable range is limited by PID target ± this setting. Set the maximum frequency in %, where 100%.	0.00 to 100.00 %	0.00

PID1 Integration reset function

- This function clears the integral of PID1 operation. Please do this when PID1 is not operating, when the "PID1 integration reset [PIDC]" inputterminal is turned ON.
- If the "PID1 Integration Reset [PIDC]" input terminal is turned ON during PID1 operation, the accumulated value that has been added to PID1 output command will be cleared, causing PID1 output command value to fluctuate suddenly, leading to an overcurrent error, etc.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	PID1 integration resetting [PIDC]: When this signal is turned ON, the integral of PID control is cleared to 0.	042

PID1 disable function

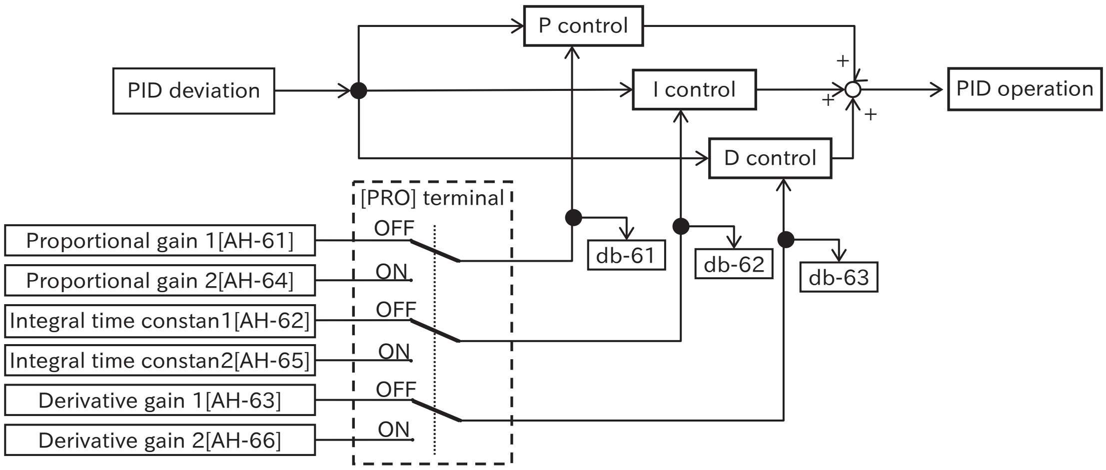
- PID1 disabled [PID] The operation of PID1 is temporarily disabled by turning ON the inputterminal, and it is outputted according to the frequencycommand.
- When PID1 is disabled, the frequency command is set assuming that PID1 target value of 100% is the highest frequency.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	PID1 disabled [PID]: When this signal is turned ON, PID operation is disabled and the normal frequency operation is performed.	041

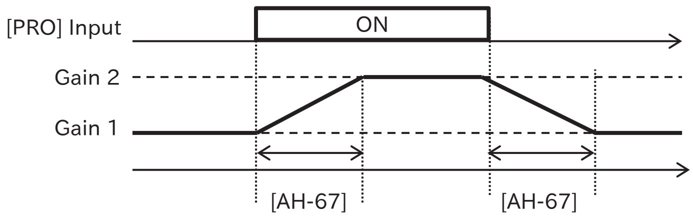
PID1 gain switching/gain adjusting

■ PID1 gain switching

- PID gain can be switched between Gain 1 and Gain 2 by ON/OFF "PID gain switching [PRO]".
- [PRO] When using the inputterminal, set "PID1 Gain Switching Method Selection [AH-60]" to "[PRO] Terminal Switching (01)".



- PID gain is continuously switched at the time of "PID1 gain switching time [AH-67]".
  The gains of PID1 used can be checked in "PID present P/I/D gain monitor ([db-61] to [db-63])".



■ PID1 gain adjusting

- When PID1 function does not respond stably, adjust as described below.
- If the acceleration/deceleration time setting is long, the output frequency tracking may be delayed and control may not work well. In this case, set the acceleration/deceleration time shorter.

Phenomena	Example of remedy
・Even if PID target value is changed, the output responses slowly and the feedback value changes slowly.	To "PID1 proportional gain 1/2([AH-61], [AH-64]) Raise it.
・Feedback value changes quickly and does not stabilize. ・Overshoot and hunting occur	To "PID1 proportional gain 1/2([AH-61], [AH-64]) Decrease it.
・The feedback value vibrates slowly. ・It takes time for the operation to stabilize.	To "PID1 integral gain 1/2([AH-62], [AH-65]) Raise it.
・PID target value and the feed-back value do not agree well.	To "PID1 integral gain 1/2([AH-62], [AH-65]) Decrease it.
・The response is slow even if the proportional gain is increased. ・Fine hunting occurs.	To "PID1 differential gain 1/2([AH-63] and [AH-66]" Raise it.
・The reaction by the disturbance becomes large, it takes time to stabilize.	To "PID1 differential gain 1/2([AH-63] and [AH-66]" Decrease it.

Code	Item	Description	Data	Initial value
AH-60	PID1 gain switching mode selection	Constant gain (only gain 1 is used)	00	00
		[PRO] Switching by input terminal	01	
AH-61	PID1 proportional gain 1	Set PID proportional gain 1.	0.0 to 100.0	1.0
AH-62	PID1 integral gain 1	Sets PID integration gain 1.	0.0 to 3600.0 s	1.0
AH-63	PID1 derivative action gain 1	Sets PID derivative gain 1.	0.00 to 100.00 s	0.00
AH-64	PID1 proportional gain 2	Set PID proportional gain 2.	0.0 to 100.0	0.0
AH-65	PID1 integral gain 2	Sets PID integration gain 2.	0.0 to 3600.0 s	0.0
AH-66	PID1 derivative action gain 2	Sets PID derivative gain 2.	0.00 to 100.00 s	0.00
AH-67	PID1 Gain switching time	[PRO] Sets the time from when the input terminal operates until the gain switches.	0 to 10000 ms	100
CA-01 to CA-08	Input terminal function	PID gain switching [PRO]: The gain 1 and gain 2 of PID1 can be switched by ON/OFF this signal. The present PID gain can be checked on the monitor below. "PID present P gain monitor [db-61]" "PID present I Gain monitor [db-62]" "PID present D Gain monitor [db-63]"	055	-

PID1 target value1 remote control function ([UP]/[DWN]/[UDC] input terminal function)

- The remote control function is used to ON the "Remote control speedup [UP](020)" or "Remote control deceleration [DWN](021)" input terminal to increase or decrease the target 1 of the present PID1.
- This function is enabled when PID1 target setpoint 1 destination is as follows.
  - When "PID1 target value1 input destination selection [AH-07]" is "Parameter setting (07)".
  - When PID1 target value 1 destination is a multi-stage target value command.
  - For "PID1 target value1 input destination selection [AH-07]" of "[VRF] terminal input (01)" or "[IRF] terminal input (02)"
    Analog input, when the "Analog command hold [AHD]" input terminal is ON.
- When [UP]/[DWN] memory selection [CA-61] is "Save (01)", PID1 target value 1 command value after [UP]/[DWN] is stored in the drive when the power is turned off and when the command destination is switched.
- [UP]/[DWN] The acceleration/deceleration time when the inputterminal is ON follows "[UP]/[DWN] Acceleration time for function [CA-64]"/"[UP]/[DWN] Deceleration time for function [CA-66]".
- When the "Remote control data clear [UDC](022)" input terminal is turned ON, PID1 target value 1 command value adjusted by the [UP]/[DWN] input terminal will be the value originally stored prior to adjustment by the [UP]/[DWN] input terminal or 0Hz according to the setting of "UP/DWN [UDC] terminal mode selection [CA-62].
- Do not ON/OFF the [UP]/[DWN] connector or operate dialing on the control panel immediately after turning off the power. The changed PID1 target value1 command may not be stored correctly.
- Refer to "9.2.16 Increasing/Decreasing the Frequency Command by Remote Control" for detailed information on the operations at input terminal functions "Remote Control Acceleration [UP]", "Remote Control Deceleration [DWN]", "Remote Control Data Clearing [UDC]" and "Analog Command Hold [AHD]".

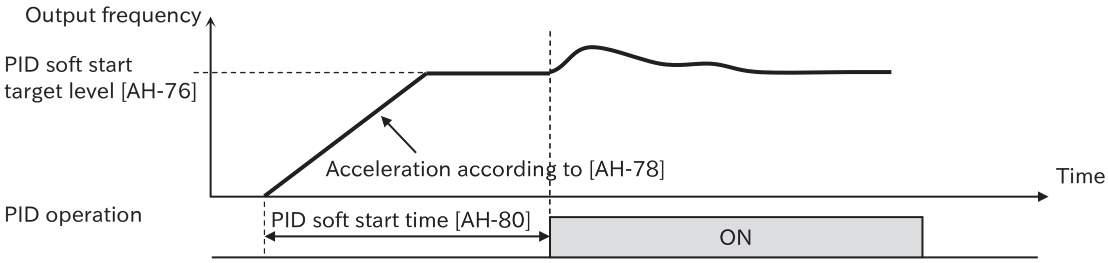
Code	Item	Description	Data	Initial value
CA-60	[UP]/[DWN] UP/DWN overwrite target selection	Overrides the frequency command value.	00 Note	00
		It is overwritten to PID1 target value 1 (PID1 target value 1 ([AH-10] or [FA-30]), multi-stage target value 1 to 15([AH-11] to [AH-40] by parameter setting, and [AHD] hold command value *1 of analogue input.	01	
CA-61	[UP]/[DWN] data save enable	Not saved: PID1 target 1, which was accelerated/decelerated by [UP]/[DWN] is not saved in the internal-memory when the power is turned off and when switching the command destination.	00	00
		Saving: When the power is turned off or when switching the command destination, PID1 target 1 that was accelerated/decelerated by [UP]/[DWN] is saved in the internal-memory.	01	
CA-62	[UP]/[DWN] [UDC] Pin Mode Selection	Cleared to 0Hz:0Hz.	00	00
		Saved data: Use [UP]/[DWN] to change the saved data to the previous saved data.	01	
CA-64	[UP]/[DWN] Acceleration time setting for UP/DWN function	[UP]/[DWN] Set the acceleration time for the function.	0.00 to 3600.00 s	10.00
CA-66	[UP]/[DWN] Deceleration time setting for UP/DWN function	[UP]/[DWN] Set the deceleration time for the function.		
CA-01 to CA-08	Input terminal function	Remote control speedup [UP]: When this terminal is ON, PID1 target value1 command is accelerated.	020	-
		Remote control deceleration [DWN]: When this terminal is ON, PID1 target value1 command is decelerated.	021	
		Remote control data clear [UDC]: When this terminal is turned ON, PID1 target value1 command is cleared. The value at clearing follows the setting of [CA-62].	022	

Note: For details, refer to "9.2.16 Increasing/Decreasing Frequency Command by Remote Control."

PID soft start function

■ PID soft start function

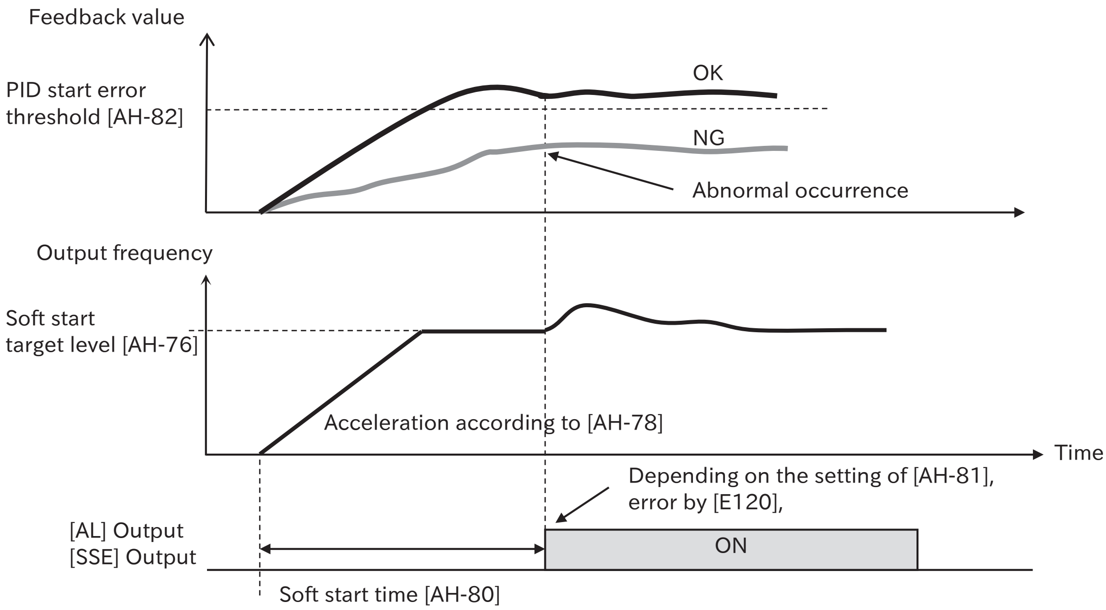
- To use this function, set PID1 Control to Enable ([AH-01]=01,02]) and set "PID soft start function selection [AH-75]" to "Enable (01)".
- When this function is started, the actuator accelerates with PID soft start acceleration period [AH-78] until PID soft start target level [AH-76] is reached.
- After the time set in "PID soft start time [AH-80]" has elapsed, the unit automatically shifts to PID control.
- PID soft start is only available in PID1.



Code	Item	Description	Data	Initial value
AH-75	PID soft start function enable	Disabled	00	00
		Enabled	01	
AH-76	PID soft start target level	Sets the target value for the soft-start interval in % units, assuming the maximum frequency is 100%.	0.00 to 100.00 %	100.00
AH-78	Acceleration time setting for PID soft start function	Set the acceleration time at soft start.	0.00 to 3600.00 s	30.00
AH-80	PID soft start time	Sets the duration of PID soft start function.	0.00 to 600.00 s	0.00

■ PID soft start error detection

- This function is intended to detect damage to the piping such as water leakage.
- If PID soft start time [AH-80] has elapsed and FB value is lower than the "PID start error determination level [AH-82]", it is judged as abnormal.
- If it is judged to be abnormal, the abnormal operation changes according to the setting of "PID start error judgment execution selection [AH-81]".
  - When [AH-81] is set to "Disabled (00)":
    Do nothing.
  - When [AH-81] is set to Enabled (Error Out) (01):
    Trip at "PID start error [E120]" when the set time of [AH-80] has elapsed.
  - When [AH-81] is set to "Enabled (Warning) (02)":
    PID soft start error [SSE] ON the output terminal function when the [AH-80] setting elapses.
    [SSE] The signal remains ON while the drive is running.



Code	Item	Description	Data	Initial value
AH-81	PID soft start error detection enable	Disabled	00	00
		Enabled (error output): In "PID start error error [E120]" at start error judgment The motor trips.	01	
		Enabled (warning): When the start error is judged, "PID soft start error [SSE]" will be ON.	02	
AH-82	PID soft start error detection level	Sets the start error status when PID soft start function is activated.	0.00 to 100.00 %	0.00
CC-01 CC-02 CC-07	Output terminal function	PID soft start error [SSE]: When "PID start error determination execution selection [AH-81]" is set to "Enabled (Warning) (02)", if a start error is judged, this signal is turned ON.	093	002 001 017

PID sleep function

■ PID sleep function

- To use this function, set "PID sleep condition selection [AH-85]" to "Output drop (01)" or "SLEP terminal (02)".
- You can change the start and release times and levels of sleep operations to suit your needs.
- To cancel PID sleep state, you can select "Deviation (01)", "Feedback Reduction (02)" or "WAKE Terminal (03)" of "PID Wake Condition Selection [AH-93]".
- When canceling PID sleep with deviation, even if ± of PID deviation is switched by setting "PID1 deviation minus [AH-02]" to "Enabled (01)," it will be canceled only when PID deviation expands to plus and PID output becomes 0 or more. For example, if the target level is set to 0 during sleep and PID output=0 continues, the sleep mode cannot be canceled.
- PID sleep function is available only in PID1.

■ PID sleep setting

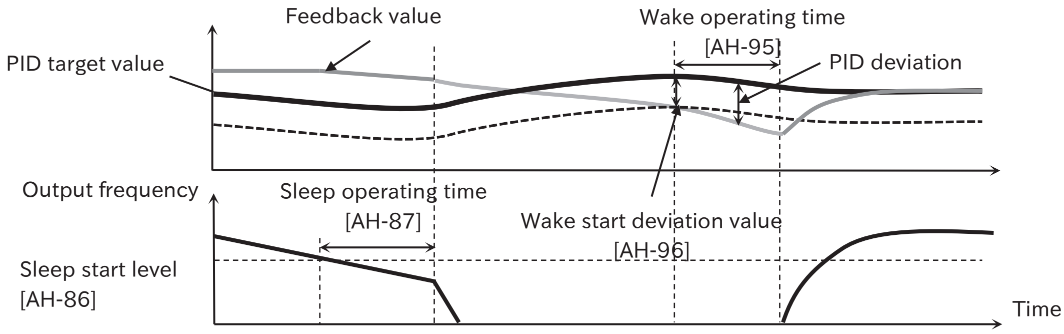
Code	Item	Description	Data	Initial value
AH-85	PID sleep trigger selection	Disabled	00	00
		Output drop: Starts sleep operation when output drops	01	
		[SLEP] Pin: Starts operation on the rising edge of the [SLEP] inputpin	02	
AH-86	PID sleep start level	Set the frequency at which the sleep operation starts when [AH-85] is set to "Low output (01)".	0.00 to 590.00 Hz	0.00
AH-87	PID sleep active time	Sets the waiting time before the machine enters sleep mode.	0.00 to 100.00 s	0.00
CA-01 to CA-08	Input terminal function	SLEEP condition-satisfied [SLEP]: When "PID Sleep Condition Selection [AH-85]" is set to "[SLEP] Terminal (02)", the sleep function is started by this signal.	058	-

■ PID wake setting

Code	Item	Description	Data	Initial value
AH-93	PID wake trigger selection	Deviation amount: If the status where the deviation is [AH-96] or more continues for [AH-95] or longer, the sleep status is canceled.	01	01
		Feedback drop: If the status below [AH-94] for the feedback data continues for [AH-95] or longer, the sleep status is canceled.	02	
		[WAKE] Terminals: [WAKE] Sleep mode is canceled after [AH-95] time elapses after ON of the input terminals is input.	03	
AH-94	PID wake start level	When [AH-93] is set to Feedback Low (02), set the feedback to cancel the sleep operation.	0.00 to 100.00 %	0.00
AH-95	PID wake start time	Sets the standby time for canceling sleep operation.	0.00 to 100.00 s	0.00
AH-96	PID wake start deviation value	When [AH-93] is set to "Deviation amount (01)", set the deviation between the target value and the feed-back value for opening the sleep operation.	0.00 to 100.00 %	0.00
CA-01 to CA-08	Input terminal function	WAKE condition-satisfied [WAKE]: When "PID Wake Condition Selection [AH-93]" is set to "[WAKE] Terminal (03)", the sleep function is canceled by this signal.	059	-

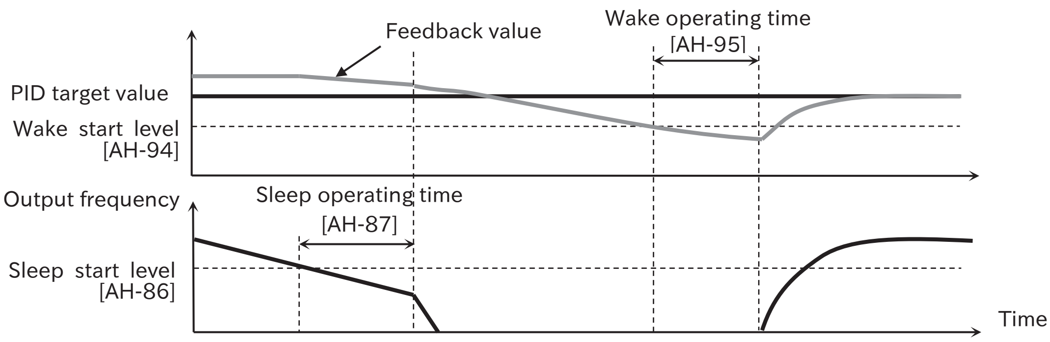
(e.g. 1)

- [AH-85] Sleep start: Output drop (01)
  When the output frequency drops below the "Sleep Start Level [AH-86]" level continuously for the time set to "Sleep Operation Time [AH-87]", the machine enters the sleep operation.
- [AH-93] Sleep release: Deviation (01)
  When PID deviation exceeds the "Wake starting deviation quantity [AH-96]" continuously for the time set in "Wake operation time [AH-95]", the sleep cancel operation will be started. The [AH-02] setting can be set to "Disable (00)" or "Enable (01)." However, be sure that the relation between the target setpoint and the feed-back value expands PID output in the positive direction.



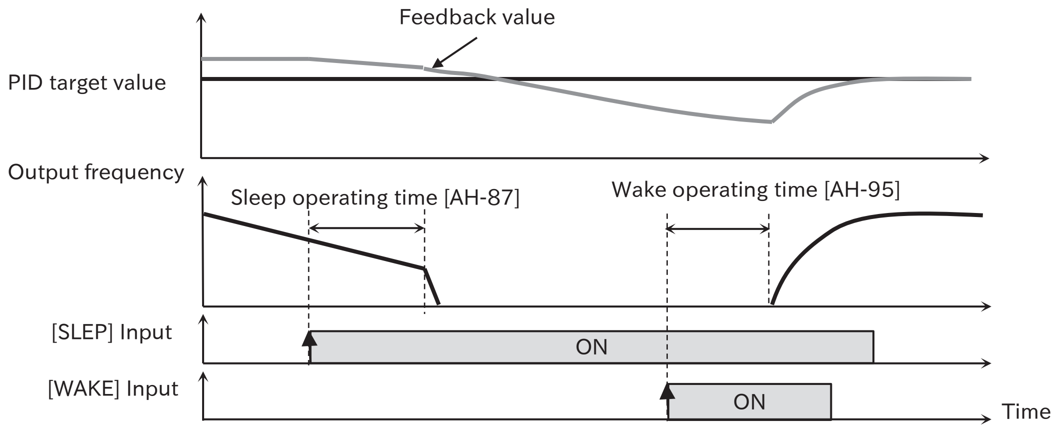
(e.g. 2)

- [AH-85] Sleep start: Output drop (01)
  If the output frequency drops below [AH-86] continuously for the time set to [AH-87], the camera will enter the sleep mode.
- [AH-93] Sleep release: Feedback low (02)
  If the feed-back falls below [AH-94] continuously for the duration set to [AH-95], the camera will enter the sleep cancel operation.



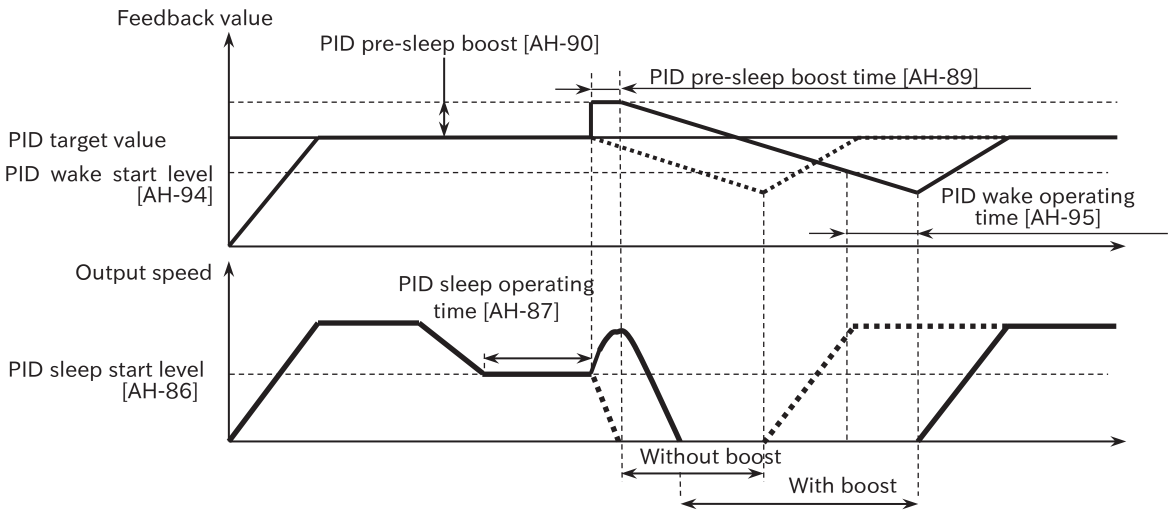
(e.g. 3)

- [AH-85] Starting sleep: 02([SLEP terminal)
  [SLEP] After the [AH-87] setting elapses from ON of the input terminal, the unit enters the sleep mode.
- [AH-93] Sleep cancel: 03([WAKE terminal)
  [WAKE] After [AH-95] has elapsed from ON of the input terminal, the unit enters the sleep cancel operation.



■Boost function before sleep

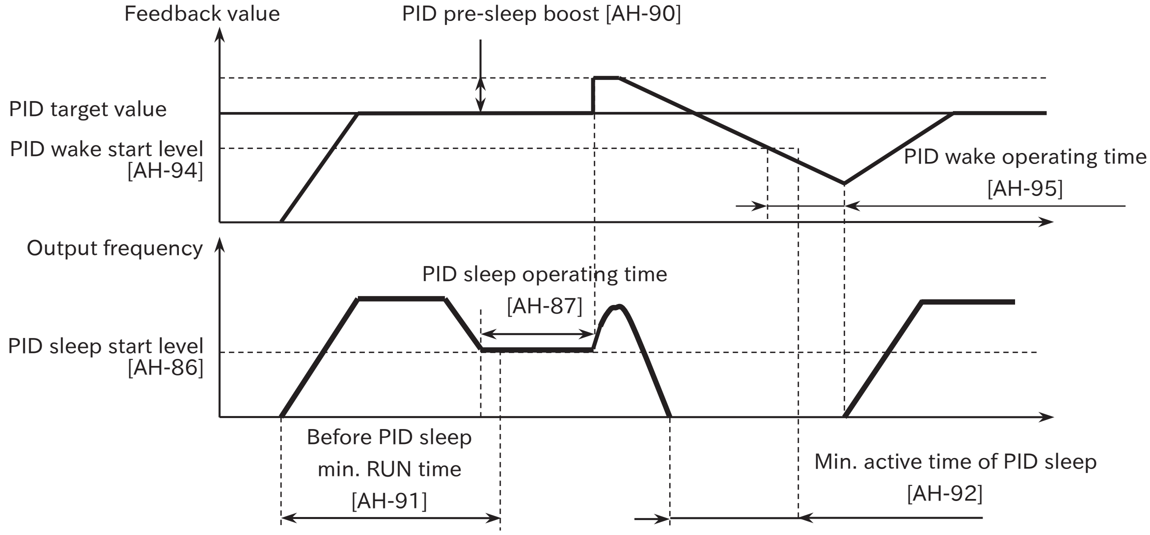
- Increase PID target prior to sleep to increase the feed-back volume. This function allows you to maintain sleep state for a longer period of time.
- The following diagram shows the condition when "PID sleep condition selection [AH-85]" is set to "Output drop (01)" and "PID wake condition selection [AH-93]" is set to "Feedback drop (02)".
- When "PID pre-sleep boost selection [AH-88]" is "enabled (01)," if the output frequency continuously falls below the "PID sleep start level [AH-86]" set to "PID sleep operation time [AH-87]", the "PID pre-sleep boost amount [AH-90]" will be added to PID target value during "PID pre-sleep boost time [AH-89]".



Code	Item	Description	Data	Initial value
AH-88	Enable set-point boost before PID sleep	Disabled	00	00
		Enabled: PID target is increased (boosted) prior to starting the sleep operation.	01	
AH-89	Set-point boost time before PID sleep	Sets the time for the boost before the sleep operation starts.	0.00 to 100.00 s	0.00
AH-90	Set-point boost value before PID sleep	Sets the amount of addition (boosting amount) to PID target prior to starting the sleep operation.	0.00 to 100.00 %	0.00

■ PID sleep function disable time

・You can prevent frequent switching between PID sleep state and PID wake state by specifying the "PID pre-sleep minimum operating time [AH-91]" and the "PID sleep state minimum holding time [AH-92]."

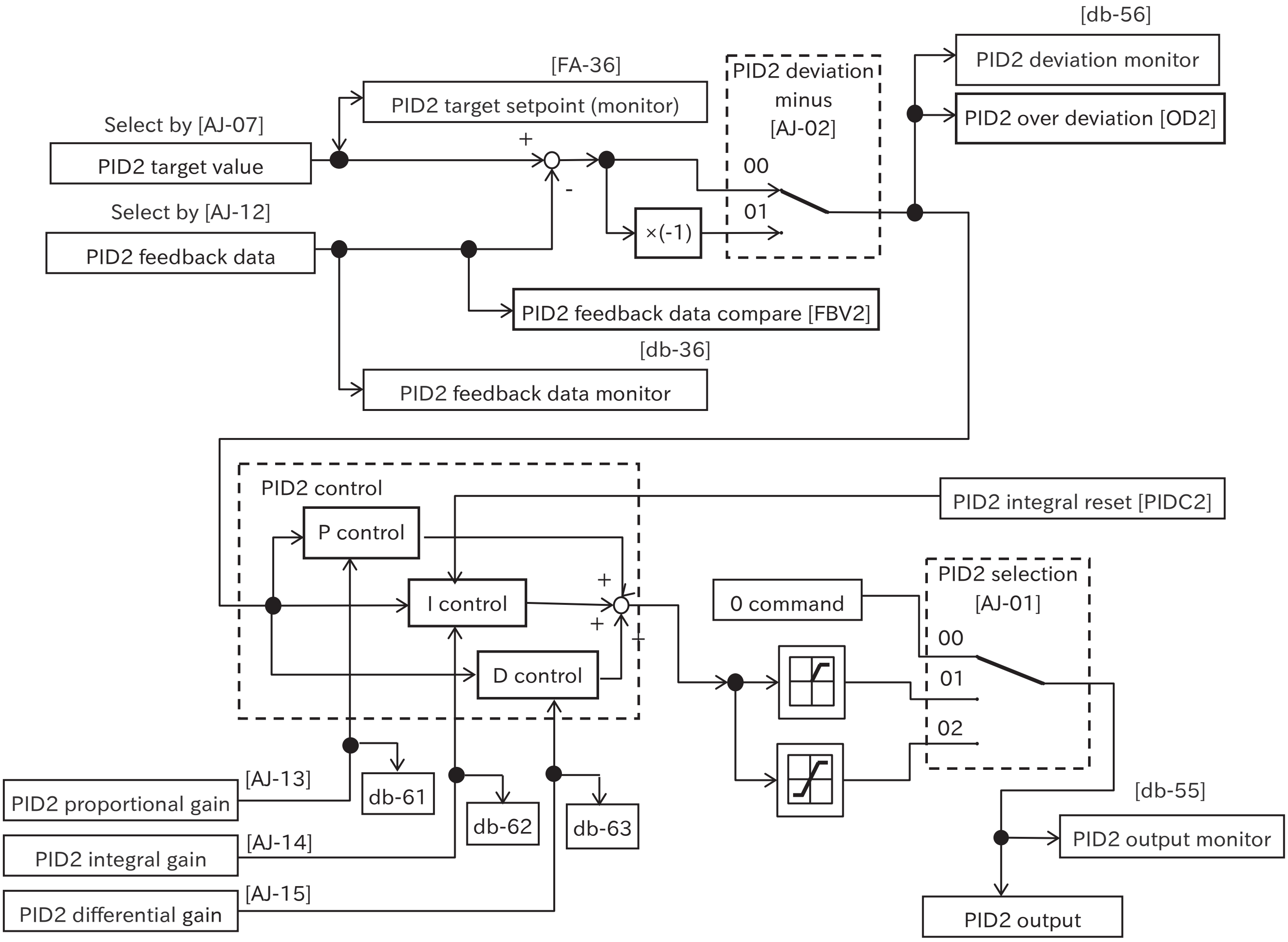


Code	Item	Description	Data	Initial value
AH-91	Minimum RUN time before PID sleep	Until [AH-91] elapses after starting, the machine will not go into sleep operation even if the conditions are met.	0.00 to 100.00 s	0.00
AH-92	Minimum active time of PID sleep	After the machine enters the sleep state, the machine remains in the sleep state until [AH-92] elapses, even if the conditions are met.		

9.8.3 Use PID2

- PID1 and PID2 operate independently.
- Switching PID1, PID2 by inputterminal can be used for batch-control switching, etc.
- PID2 is capable of selecting PID1 output as the target. This allows cascade control considering the effects from the two systems.

■PID2 block diagram

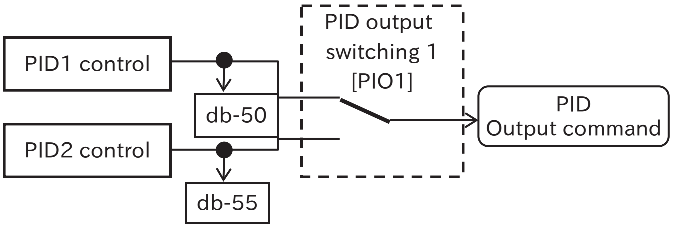


Note: The switches of the parameters in the figure show the initial values.

■Switching between PID1 and 2

・PID1, PID2 can be switched by ON/OFF the input terminal function "PID output switching 1 [PIO1]".

PID function	PIO1
PID1 enabled	OFF
PID2 ebabled	ON

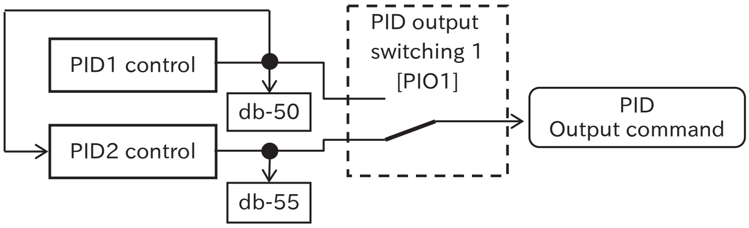


■Cascade-connection for PID1 and PID2

・PID2 can be cascaded with PID1 by setting PID2 target to PID1 output. ([AJ-07]=15)

・To perform cascade-connection, set "PID2 target valueinput selection [AJ-07]" to "PID1 output (15)" and enable the output command of PID2 as shown below at the "PID output switching 1 [PIO]" input terminal.

PID function	PIO1
PID2 enabled	ON



■PID2 rerated monitor

Code	Item	Description	Data
FA-36	PID2 target setpoint (monitor)	Monitors or changes the settings of the currently selected PID2 target. If the target value is set to parameter setting (=[AJ-10]), changing/saving [FA-36] will also change/save [AJ-10].	-100.00 to 100.00 % Note
db-36	PID2 feedback value monitor	Displays PID2 feedback.	
db-55	PID2 output monitor	Displays PID2 output.	-100.00 to 100.00 %
db-56	PID2 deviation monitor	Displays PID2 deviation.	-200.00 to 200.00 %
db-61	Current PID P-Gain monitor	Displays the current P gain.	0.0 to 100.0
db-62	Current PID I-Gain monitor	Displays the current I gain.	0.0 to 3600.0 s
db-63	Current PID D-Gain monitor	Displays the current D gain.	0.00 to 100.00 s

Note: "PID2 Scale Adjust ([AJ-04] to [AJ-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

■PID2 rerated parameters

Code	Item	Description	Data	Initial value
AJ-01	PID2 enable	Disabled	00	00
		Enabled: Even if the command by PID operation becomes negative, it will not be outputting in the reverse direction.	01	
		Enabled (with reverse output): When the command by PID calculation becomes negative, it will be outputting in the reverse direction.	02	
AJ-02	PID2 deviation minus	Disabled	00	00
		Enabled: Deviation is the difference between the target value and the feedback data multiplied by (-1).	01	
AJ-03	PID2 unit selection	Change the units and scale of some monitors/parameters of PID2. For more information, please refer to "9.8.5 PID Units Converter Function".	00 to 58	01
AJ-04	PID2 Scale Adjust (0%)		-10000 to 10000	0
AJ-05	PID2 Scale Adjust (100%)			100000
AJ-06	Adjust PID2 scale (decimal point)		0 to 4	2
AJ-07	PID2 target destination selection	None	00	07
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		Parameter setting	07	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
		PID1 output	15	
AJ-10	PID2 target setpoint	Set PID2 target value when "Parameter setting (07)" is selected as PID2 target value input destination.	-100.00 to 100.00 % Note	0.00
AJ-12	PID2 feedback Input source selection	None	00	12
		Terminal [VRF]	01	
		Terminal [IRF]	02	
		RS485 Setting	08	
		Option	09	
		Pulse input	12	
AJ-13	PID2 proportional gain	Sets PID proportional gain.	0.0 to 100.0	1.0
AJ-14	PID2 integral gain	Sets PID integration gain.	0.0 to 3600.0 s	1.0
AJ-15	PID2 derivative action gain	Sets PID proportional gain.	0.00 to 100.00 s	0.00
AJ-16	PID2 variable range	PID2 output-variable range is limited by PID2 target ± this setting. Set the maximum frequency as 100% in % units.	0.00 to 100.00 %	0.00
AJ-17	Excessive PID2 deviation	Sets the target value of PID2 and the level at which the deviation of the feedback data is judged to be excessive. For more information, please refer to "Signaling of 9.8.4 PID function".		3.00
AJ-18	PID2 feedback compare signal OFF	Sets the tolerance of PID2 feedback data. For more information, please refer to "Signaling of 9.8.4 PID function".		100.00
AJ-19	PID2 feedback compare signal ON			0.00

Note: "PID2 Scale Adjust ([AJ-04] to [AJ-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

■PID2 related I/O terminal functions

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Disable PID2 [PID2]: When this signal is turned ON, PID operation is disabled and the normal frequency operation is performed.	043	-
		PID2 integration reset [PIDC2]: When this signal is turned ON, the integral of PID control is cleared to zero.	044	
		PID output switching 1[PIO1]: This ON/OFF can be used to switch between PID1 and PID2.	056	
CC-01 CC-02 CC-07	Output terminal function	Over deviation for PID2 control [OD2]: When PID2 deviation exceeds the level set in "PID2 Error Excessive Level [AJ-17]", this signal turns ON.	047 Note	002 001 017
		PID2 feedback comparison [FBV2]: PID2 feedback value is compared with the "PID2 Feedback Compare Signal ON/OFF Level ([AJ-18]/[A J-19])", and the signal is ON/OFF.	048 Note	

Note: For more information, please refer to "Signaling of 9.8.4 PID function".

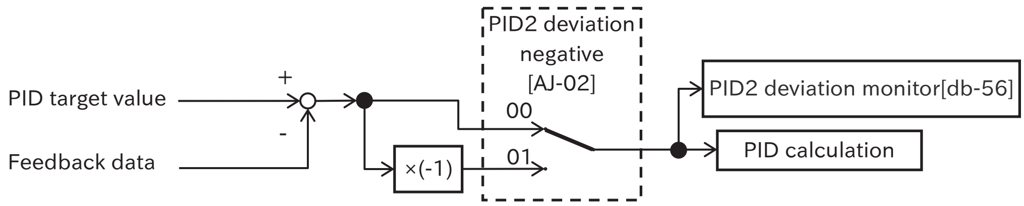
PID2 reverse output

- In normal PID control, if PID operation result is negative, the inverter limits the frequency command by 0Hz without outputting it in negative. When "PID2 selection [AJ-01]" is set to "Valid (with reverse rotation output) (02)", the frequency command can be output in the reverse rotation direction if PID operation result is negative.
- If "PID2 selection [AJ-01]" is set to "Valid (with reverse output) (02)", the output limit due to "PID2 variable range [AJ-16]" is extended to the minus direction.

Code	Item	Description	Data	Initial value
AJ-01	PID2 enable	Disabled	00	00
		Enabled: Even if the command by PID operation becomes negative, it will not be outputting in the reverse direction.	01	
		Enabled (with reverse rotation output): When the command by PID operation becomes minus, output is performed in the reverse direction.	02	

PID2 deviation ± switching output

- PID2 deviation ± can be switched for outputting.
- PID2 deviation is calculated (PID target value-FB value) when "PID2 deviation minus [AJ-02]" is "disabled (00)". When [AJ-02] is "Enabled (01)", PID2 deviation is the same as (FB-PID target value).
- This function is used when PID target and FB deviations do not match the inverter command due to the sensor's properties.

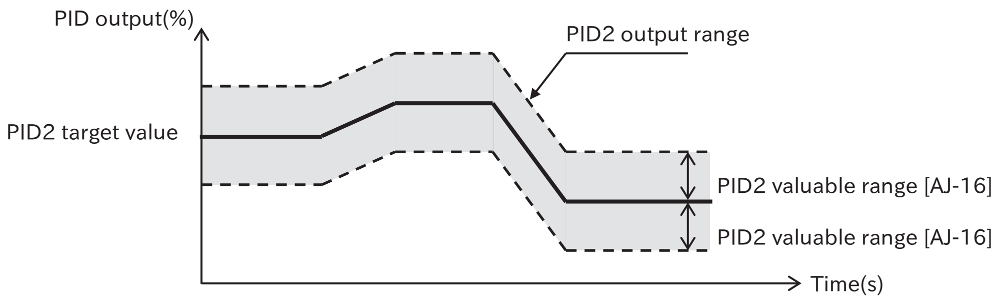


Note: The switches of the parameters in the figure show the initial values.

Code	Item	Description	Data	Initial value
AJ-02	PID1 deviation minus	Disabled	00	00
		Enabled: Deviation is the difference between the target value and the feedback data multiplied by (-1).	01	

PID2 variable-range restriction

・For PID2 output. Limits the output to a variable range based on PID1 target.
When [AJ-16] PID2 is set to 0.00%, the limiting function is disabled.
・Set "PID2 variable range [AJ-16]" with the maximum frequency set to 100%. PID2 output is limited within PID2 target ±[AJ-16].



Code	Item	Description	Data	Initial value
AJ-16	PID2 variable range	PID2 output-variable range is limited by PID2 target ± this setting. Set the maximum frequency as 100% in % units.	0.00 to 100.00 %	0.00

PID2 integration resetting function

・This function clears the integral of PID2 operation. Please do this when PID2 is not operating, when the "PID2 integration reset [PIDC]" inputterminal is turned ON.
・If the "PID2 Integration Reset [PIDC]" input terminal is turned ON during PID2 operation, the accumulated value that has been added to PID2 output command will be cleared, causing PID2 output command value to fluctuate suddenly, leading to an overcurrent error, etc.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	PID2 integration reset [PIDC2]: When this signal is turned ON, the integral of PID control is cleared to 0.	044

PID2 disable function

・PID2 disable [PID2] The operation of PID2 is temporarily disabled by turning ON the inputterminals, and it is outputted according to the frequencycommand.
・When PID2 is disabled, the frequency command is set assuming that PID2 target value of 100 % is the highest frequency.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	PID2 disabled [PID]: When this signal is turned ON, PID operation is disabled and the normal frequency operation is performed.	043

PID2 adjusting the gain

■ PID2 tune the operation

・When PID2 function does not respond stably, adjust as described below.
・If the acceleration/deceleration time setting is long, the output frequency tracking may be delayed and control may not work well. In this case, set the acceleration/deceleration time shorter.

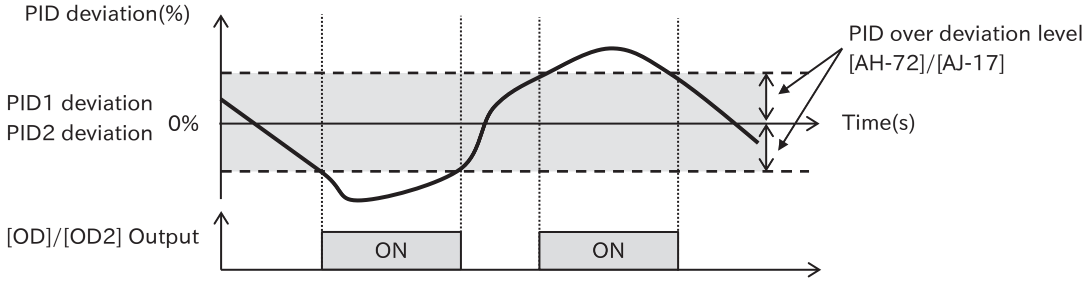
Phenomena	Example of remedy
・Even if PID target value is changed, the output responses slowly and the feedback value changes slowly.	Increase "PID2 proportional gain [AJ-13]".
・Feedback value changes quickly and does not stabilize. ・Overshoot and hunting occur	Decrease "PID2 proportional gain [AJ-13]".
・The feedback value vibrates slowly. ・It takes time for the operation to stabilize.	Increase "PID2 integration gain [AJ-14]".
・PID target value and the feed-back value do not agree well.	Decrease "PID2 integral gain [AJ-14]".
・The response is slow even if the proportional gain is increased. ・Fine hunting occurs.	Increase "PID2 differential gain [AJ-15]".
・The reaction by the disturbance becomes large, it takes time to stabilize.	Decrease "PID2 differential gain [AJ-15]".

Code	Item	Description	Data	Initial value
AJ-13	PID2 proportional gain	Sets PID2 proportional gain.	0.0 to 100.0	1.0
AJ-14	PID2 integral gain	Sets PID2 integration gain.	0.0 to 3600.0 s	1.0
AJ-15	PID2 derivative action gain	Sets PID2 derivative gain.	0.00 to 100.00 s	0.00

9.8.4 Signal output of PID function

PID deviation excessive signal

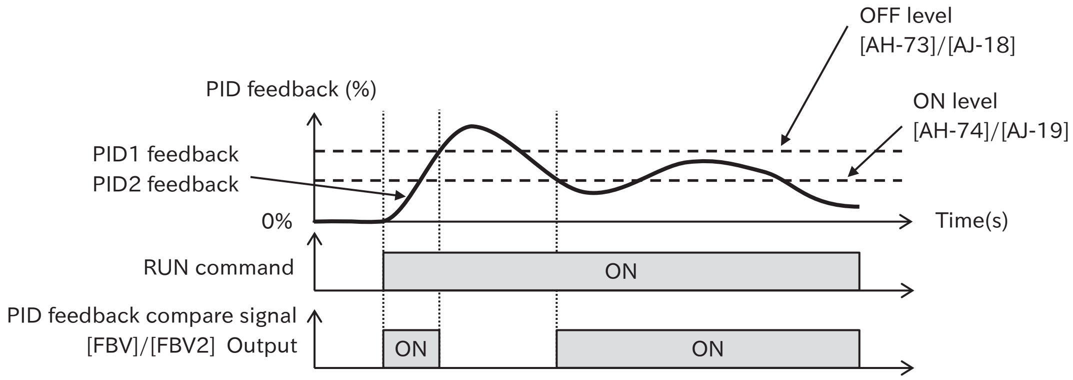
・If PID deviation (difference between the target value and the feedback value) exceeds the range set in "PID deviation excess level ([AH-72], [AJ-17])", the "PID deviation excess ([OD], [OD2])" signal will be outputted.



Code	Item	Description	Data	Initial value
db-51	PID1 deviation monitor	Displays PID1 deviation.	-200.00 to 200.00 %	-
db-56	PID2 deviation monitor	Displays PID2 deviation.		
AH-72	Excessive PID1 deviation	[OD] Sets the output judgment level of the signal.	0.00 to 100.00 %	3.00
AJ-17	Excessive PID2 deviation	[OD2] Sets the output judgment level of the signal.		
CC-01 CC-02 CC-07	Output terminal function	Over deviation for PID control [OD]: This signal is turned ON when PID1 deviation exceeds the set level of "PID1 deviation excess level [AH-72]".	045	002 001 017
		Over deviation for PID2 control [OD2]: When PID2 deviation exceeds the level set in "PID2 Error Excessive Level [AJ-17]", this signal turns ON.	047	

PID feedback compare signal

- If PID1 or PID2's PID feedback data exceeds the respective "PID feedback signal OFF level ([AH-73], [AJ-18])", the "PID feedback compare ([FBV], [FBV2])" signal will be OFF.
- If the signal is turned OFF, the signal will ON again when PID feedback data falls below the "PID feedback signal ON level ([AH-74], [AJ-19])".
- Set PID feedback compare signal ON/OFF level so that OFF level ≧ ON level. When OFF level < ON level is set, OFF operation takes precedence.
- By setting ON level /OFF level to a value other than 0.00, the feedback compare signal starts outputting. In such cases, the "PID Feedback Compare ([FBV], [FBV2])" signal remains ON until the "PID Feedback Signal OFF Level ([AH-73], [AJ-18])" is exceeded from the start of operation.



Code	Item	Description	Data	Initial value
db-36	PID2 feedback Data Monitor	Displays PID2 feedback.	-100.00 to 100.00 % Note:1	-
db-44	PID1 feedback data monitor (after calculation)	Displays the feedback-value after PID1 calculation.	-100.00 to 100.00 % Note:2	
AH-73	PID1 Feedback Compare Signal OFF	[FBV] Sets PID1 feedback value at which the signal is turned OFF.	0.00 to 100.00 %	100.00
AH-74	PID1 Feedback Compare Signal ON	[FBV] Sets PID1 feedback value at which the signal is turned ON.		0.00
AJ-18	PID2 Feedback Compare Signal OFF	[FBV2] Sets PID2 feedback value at which the signal is turned OFF.		100.00
AJ-19	PID2 Feedback Compare Signal ON	[FBV2] Sets PID2 feedback value at which the signal is turned ON.		0.00
CC-01 CC-02 CC-07	Output terminal function	PID Feedback Compare [FBV]: PID1 feedbacks and [AH-73]/[AH-74]) are compared and ON/OFF is performed. OFF: OFF level[AH-73] has been exceeded. ON: ON level[AH-74] was lowered.	046	002 001 017
		PID2 feedback comparison [FBV2]: PID2 feedbacks and [AJ-18]/[AJ-19] are compared for ON/OFF. OFF: OFF level[AJ-18] has been exceeded. ON: ON level[AJ-19] was lowered.	048	

Note: 1. "PID2 Scale Adjust ([AJ-04] to [AJ-06]) will change the setting.
2. "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

9.8.5 PID unit converter function

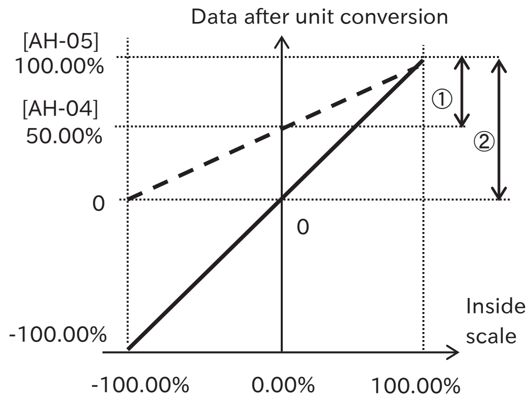
・The unit and scale of the following parameters can be changed using this function.

■PID unit conversion function target parameters

PID function	Code	Item
PID1	FA-30	PID1 target value 1 setting (monitor)
	FA-32	PID1 target value 2 setting (monitor)
	FA-34	PID1 target value 3 setting (monitor)
	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 (after calculation)
	db-44	PID1 feedback data monitor (after calculation)
	AH-10	PID1 Target1set values
	AH-12 to AH-40	PID1 Multi-stage Target Value 1 to 15
	AH-44	PID1 Target2set values
	AH-48	PID1 Target3set values
PID2	FA-36	PID2 target setpoint (monitor)
	db-36	PID2 feedback value monitor
	AJ-10	PID2 target setpoint

・For PID target value setting and PID feedback monitor value, the internalscale-100.00% to 100.00% can be converted to the desired setting range/unit by the unit conversion parameter. The default factory settings for "PID1 Target 1 Setting (Monitor)[FA-30]" are "PID1 Unit Selection [AH-03]"="% (01)", "PID1 Scale Adjustment (0%)[AH-04]" = 0, and PID1 Target 1 Setting Range is-100.00% to 100.00% from "PID1 Scale Adjustment (100%)[AH-05]"= 10000, "PID1 Scale Adjustment (Decimal Point) [AH-06]" = 2 (Decimal Point 2-digit). (solid line part in the figure below)

(e.g.) If [AH-04]=5000, [AH-05]=10000, [AH-06] = 2 (2decimal places) is set, the converted area will be 0.00 to 100.00 as shown by the broken line in the figure on the right.
In this case, when the input destination is analog input or pulse input, the range after conversion is 50.00 to 100.00 on the + side (range ①) only as shown in the figure on the right. When the input destination is the operation panel setting, the range ② is 0.00 to 100.00.

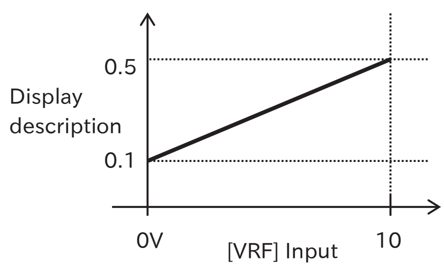


・When performing the unit and scale conversion, note that [AH-04] is set to the conversion value of 0% (the center point between-100.00% and 100.00% of the inner scale)

(Adustment exsample)

When 0 to 10V (0 to 100%) are displayed as 0.10 to 0.50 kPa in [db-30] while analogue input1 [VRF] is feeding back voltage.

- Units selection [AH-03]=kPa(56)
- Scale adjustment (0%) [AH-04]=10
- Scale Adjust (100%)[AH-05]=50)
- Decimal point position [AH-06]=02



■Parameter

Code	Item	Description	Data	Initial value
AH-03	PID1 unit selection	Sets the unit of PID1 display/conversion target parameters. Refer to the table below for details.	00 to 58	01
AH-04	Adjust PID1 scale (0%)	Sets the input-0% reference for PID1 display/conversion target parameter.	-10000 to 10000	0
AH-05	PID1 Scale Adjust (100%)	Sets the reference for 100% of PID1 display/conversion target parameter.		10000
AH-06	Adjust PID1 scale (decimal point)	0:00000. / 1:0000.0 / 2:000.00 3:00.000 / 4:0.0000	0 to 4	2
AJ-03	PID2 unit selection	Sets the unit of PID2 display/conversion target parameters. Refer to the table below for details.	00 to 58	01
AJ-04	Adjust PID2 scale (0%)	Sets the input-0% reference for PID2 display/conversion target parameter.	-10000 to 10000	0
AJ-05	PID2 Scale Adjust (100%)	Sets the reference for 100 % of PID2 display/conversion target parameter.		10000
AJ-06	Adjust PID2 scale (decimal point)	0:00000. / 1:0000.0 / 2:000.00 3:00.000 / 4:0.0000	0 to 4	2

■[AH-03], List of units that can be set with [AJ-03]

Data	Item
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

Data	Item
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
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

Data	Item
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

9.9 Trip-less function

9.9.1 Overload limit function

・The overload limit function monitors the motor current at acceleration or at constant speed, and when it reaches "Overload limit 1 level [bA123]", it automatically lowers the outputfrequency according to "Overload limit 1 operation time [bA124]". Operation is as follows according to "Overload limit 1 selection [bA122]".

・[bA124] is the duration to decelerate from "IM max. frequency [Hb105]" to 0Hz or to accelerate from 0Hz to [Hb105].

・Two independent overload limit operations can be set. The overload limit 1/2 can be switched by assigning "Overload limit switching [OLR](038)" to the inputterminal and ON/OFF the terminal. See "Switching Two Types of Overload Limit Settings" in this section for details.

Stall prevention mode selection [bA122]	Operation
Enable during accel. and constant speed (01)	Monitors the output current at acceleration or constant speed. Suppresses current by decelerating against excessive load during acceleration and rapid load fluctuation at constant speed.
Valid at constant speed (02)	Monitors the output current only at constant speed. Current suppression by deceleration is performed only for sudden load fluctuation at constant speed.
Enable during accel. And constant speed (Speed increase during regeneration) (03)	Monitors the output current at acceleration or constant speed. In addition to the operation of "Effective at Acceleration and Constant Speed (01)", when a regenerative load is applied at constant speed, it is accelerated to prevent overload.

・If this function is activated during acceleration, the acceleration time until the frequency command is reached becomes longer than the setting.

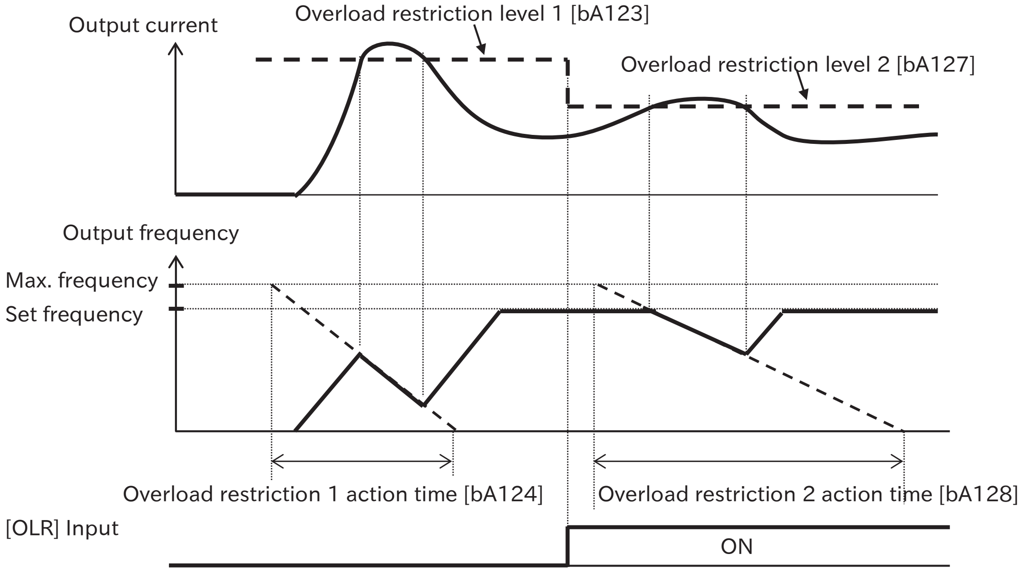
・If the overload limit operation time is shortened too much, an overvoltage trip may occur due to regenerative energy from the motor due to the automatic deceleration of this function.

・If this function is activated during acceleration and the output frequency does not reach the target frequency, the following adjustments may be made.
- Increase the acceleration time
- Adjust the torque boost
- Increase the overload limit level

Code	Item	Description	Data	Initial value
bA122	Overload restriction 1 mode selection	Disabled	00	01
		Enable during accel. and constant speed	01	
		Enable during . and constant speed	02	
		Enable during accel. and constant speed (accel. during regeneration)	03	
bA123	Overload restriction 1 active level	Sets the current value at which the overload limit operates.	(0.20 to 2.00)×Inverter rated output current A	1.50×Rated output current
bA124	Overload restriction 1 action time	Set the deceleration time when the overload limit operates, in the deceleration time from the highest frequency to 0 Hz.	0.10 to 3600.00 s	1.00

■Switching two types of over load limit setting

- Two independent settings of "Overload limit 1 ([bA122] to [bA124])" and "Overload limit 2 ([bA126] to [bA128])" can be set for the overload limit.
- Switching between Overload Limit 1 and Overload Limit 2 is performed by ON/OFF of the "Overload Limit Switching [OLR]" inputterminal. [OLR] Overload limit 2 is enabled by ON the inputterminal.



Code	Item	Description	Data	Initial value
bA126	Overload restriction 2 mode selection	[OLR] Sets operation of overload limit 2, which operates when the input terminal is ON. The setting is the same as that of [bA122]/[bA123]/[bA124].	00 to 03	01
bA127	Overload restriction 2 active level		(0.20 to 2.00)×Inverter rated output current A	1.50×Rated output current
bA128	Overload restriction 2 action time		0.10 to 3600.00 s	1.00
CA-01 to CA-08	Input terminal function	Overload limit switching [OLR]: The overload limit 1/2 is switched by ON/OFF of this signal. OFF: Overload limit 1 enabled ON: Overload limit 2 enabled	038	-

9.9.2 Limit the output frequency during acceleration to prevent overcurrent

- The overcurrent suppression function suppresses overcurrent caused by steep current growth during rapid acceleration, etc.
- When "Overcurrent suppression selection [bA120]" is set to "Enabled (01)" or "Enabled (voltage reduction status enabled) (02)", the overcurrent suppression function operates when the output current exceeds the setting of "Overcurrent suppression level [bA121]".
- Setting [bA120] to "Enable (with voltage reduction) (02)" reduces the outputvoltage during the overcurrent suppression function operation, increasing the current suppression effectiveness. Use this function when "overload error ([E005], [E038], [E039])" or the like occurs when this function is operated with "Enabled (01)". However, torque shortage is likely to occur because the output voltage is reduced.
- Disable this function when using this product for an elevator. Suppressing the current may cause insufficient torque, resulting in slippage of the load cage or lifted objects.
- Even if this function is enabled, an overcurrent trip may occur if the current grows steeply due to an impact load, etc.
- The output current at which overcurrent occurs can be set using the overcurrent detection-level [bb160]. When using the overcurrent suppression function, be sure to set the overcurrent suppression level [bA120] to a value lower than [bb160].
- This function is automatically enabled during DC braking or frequency retraction restart. However, the overcurrent suppression level at frequency retraction restart is set by "Overcurrent suppression level at frequency retraction restart [bb-46]". For details, see section 9.7.4, Using the Frequency Pull-in Function to Start.
- This function is automatically disabled during auto-tuning.

Code	Item	Description	Data	Initial value
bA120	Overcurrent suppression enable	Disabled	00	00
		Enabled	01	
		Enabled (with voltage reduction)	02	
bA121	Overcurrent suppression -motor	Sets the operation level of the overcurrent suppression function.	(0.30 to 1.80)×Inverter rated output current A	1.80×Rated output current
bb-46	OC-suppress level at active frequency matching	Sets the operation level of the overcurrent suppression function at the time of frequency retraction restart.		
bb160	Overcurrent detection -motor	Sets the level at which overcurrent is detected.	(0.30 to 2.20) ×Inverter rated output current A	2.20×Rated output current

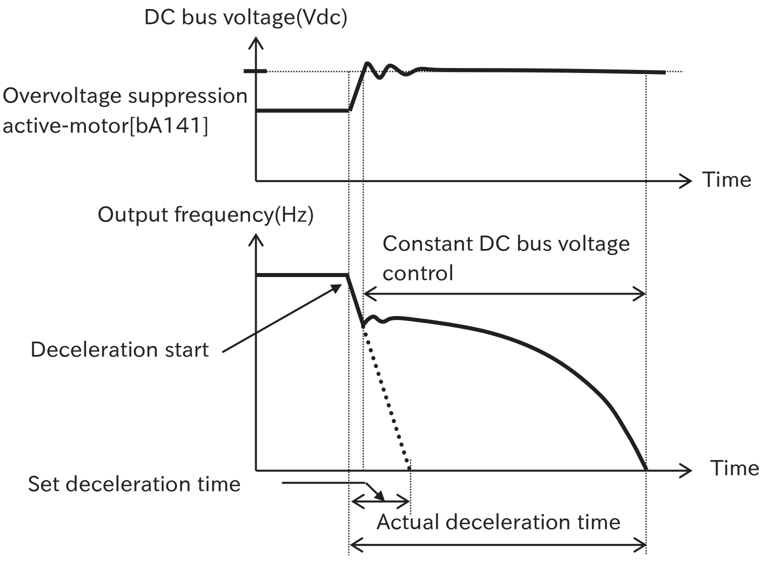
9.9.3 Control the output frequency during deceleration to prevent an overvoltage

- The overvoltage suppression function can suppress the occurrence of an overvoltage trip during deceleration.
- Set "Overvoltage suppression function selection [bA140]" to other than "Disable (00)", and when DC voltage between P-N of the inverter exceeds "Overvoltage suppression level setting [bA141]", this function will operate.
- Actual deceleration time is longer than the set value due to operation of this function.
- Depending on the moment of inertia of the load, it may take a long time to stop.
- Even if this function is enabled, overvoltage trip may occur depending on the deceleration rate and load conditions.
- Set "Overvoltage suppression level setting [bA141]" so that the received power voltage × √2 × 1.1 or more. If a value lower than the DC voltage between P-N during operation is set, the motor may not be able to be stopped.

Code	Item	Description	Data	Initial value
bA140	Overvoltage suppression enable	Disabled	00	00
		DC voltage constant control (deceleration stop)	01	
		With acceleration (at deceleration)	02	
		With acceleration (at constant speed and deceleration)	03	
bA141	Overvoltage suppression active - motor	Sets the operation level of the overvoltage suppression function.	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	200V class: 380.0 400V class: 760.0
bA142	Overvoltage suppression active time	Acceleration time when overvoltage suppression function is activated.	0.00 to 3600.00 s	1.00
bA144	Constant DC bus voltage control P gain	Proportional gain for PI control of DC voltage-constant control.	0.00 to 5.00	0.20
bA145	Constant DC bus voltage control I gain	Integral gain for PI control of DC voltage-constant control.	0.00 to 150.00 s	1..00

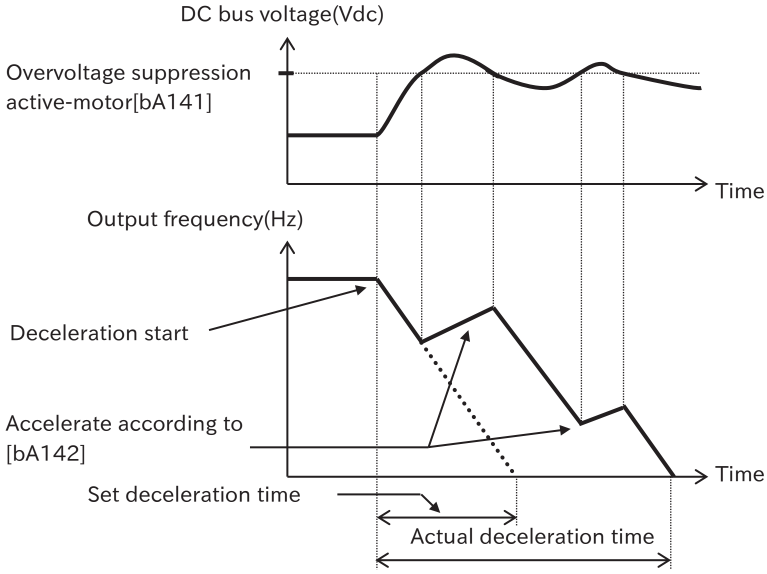
■When "Over-voltage suppression selection [bA140]" = "DC voltage constant control (deceleration-stop) (01)"

- When "DC voltage constant control (deceleration stop) (01)" is selected for [bA140], the motor decelerates automatically while performing PI control so that the DC voltage across P-N does not exceed the "overvoltage suppression-level setting [bA141]" at deceleration.
- If "DC voltage constant control P gain [bA144]" is set larger or "DC voltage constant control I gain [bA145]" is set shorter, the response will be faster, but it will be easier to trip.



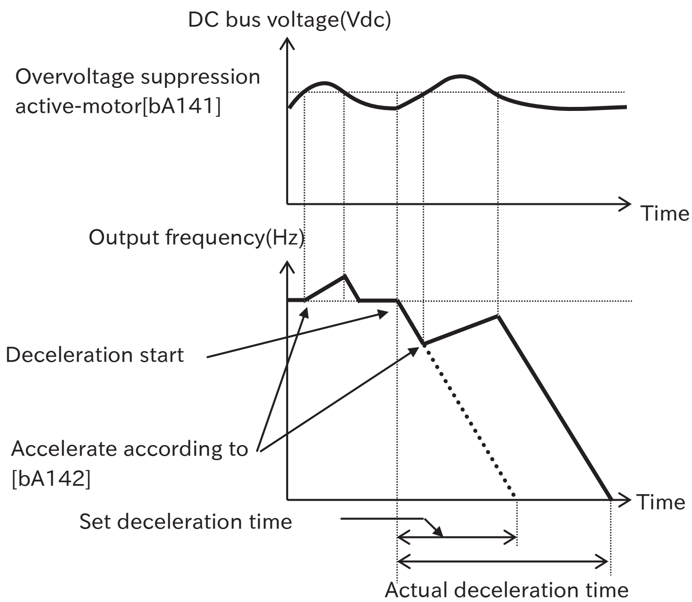
■When "Over-voltage suppression selection [bA140]" = "Acceleration present (at deceleration) (02)"

・When "Acceleration present (at deceleration) (02)" is selected for [bA140], if the DC voltage across P-N exceeds the "overvoltage suppression level setting [bA141]" at deceleration, the acceleration operation is performed according to the "overvoltage suppression operation duration [bA142]". After that, when DC-voltage between P-N becomes less than [bA141], normal deceleration resumes.



■When "Over-voltage suppression selection [bA140]" = "Acceleration present (at constant speed and deceleration) (03)"

・When "Acceleration present (at constant speed and deceleration) (03)" is selected for [bA140], if the DC voltage across P-N exceeds the "overvoltage suppression level setting [bA141]" at constant speed and deceleration, acceleration operation is performed according to the "overvoltage suppression operation time [bA142]". After that, when the DC voltage between P-N falls below the overvoltage suppression level, normal deceleration resumes.



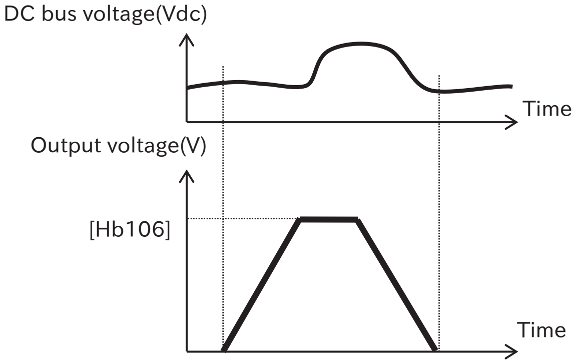
・When "Over-voltage suppression selection [bA140]" is set to "Acceleration present (at deceleration) (02)" or "Acceleration present (at constant speed and deceleration) (03)", acceleration is controlled to the maximum frequency setting.
・If "Overvoltage suppression operation time [bA142]" is shortened, the increase in the outputfrequency due to acceleration may exceed the decrease in the frequency due to deceleration, making it impossible to stop. In such cases, increase the setting of "Over-voltage suppression level setting [bA141]".

9.9.4 Overexcitation function

- The overexcitation function increases the outputvoltage in response to an increase in the DC voltage between P-N to increase the loss of the motor and reduce the energy to be regenerated, thereby preventing the occurrence of overvoltage errors.
- Setting "Overexcitation function selection (V/f)[bA146]" to other than "Disable (00)" enables this function.
- Even if "Disable (00)" is set, a voltage exceeding the received power voltage cannot be output.
- When the overexcitation function is enabled, the motor heat generation may increase due to an increase in the output current caused by an increase in the output voltage or due to overexcitation of the motor.
- Even if the overexcitation function is enabled, the overvoltage may trip depending on the deceleration rate and load conditions.
- Overexcitation function is enabled when "V/f control (00) to (03)" is set to "Control method [AA121]".
- When using AVR function OFF operation of the conventional model, set "Overexcitation function selection (V/f)[bA146]" as follows. Always AVR OFF: [bA146]=01, During decelerationAVR OFF: [bA146]=02

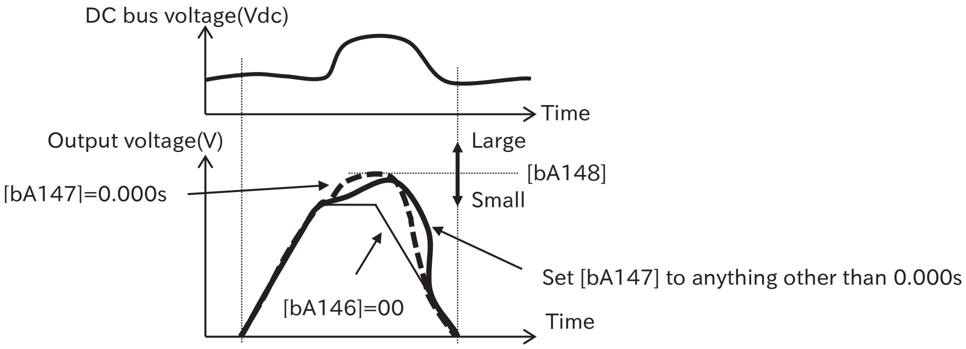
Code	Item	Description	Data	Initial value
bA146	Overexcitation function selection (V/f)	Disable	00	00
		Always active	01	
		Operation only at deceleration	02	
		Level operation	03	
		Level action only at deceleration	04	
bA147	Overexcitation function output filter time constant (V/f)	Filter time constant for the output voltage in the overexcitation status.	0.000 to 10.000 s	0.300
bA148	Overexcitation function voltage gain (V/f)	Gain with respect to the output voltage in the overexcitation status.	50 to 400 %	100
bA149	Overexcitation function operation level (V/f)	Sets the operation level of the overvoltage suppression function.	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	200V class: 380.0 400V class: 760.0
Hb106	IM motor rated voltage	Set the rated voltage of the motor.	1 to 1000 V	200V class:200 400V class:400

■When "Overexcitation function selection (V/f) [bA146]" = "Disabled (00)"

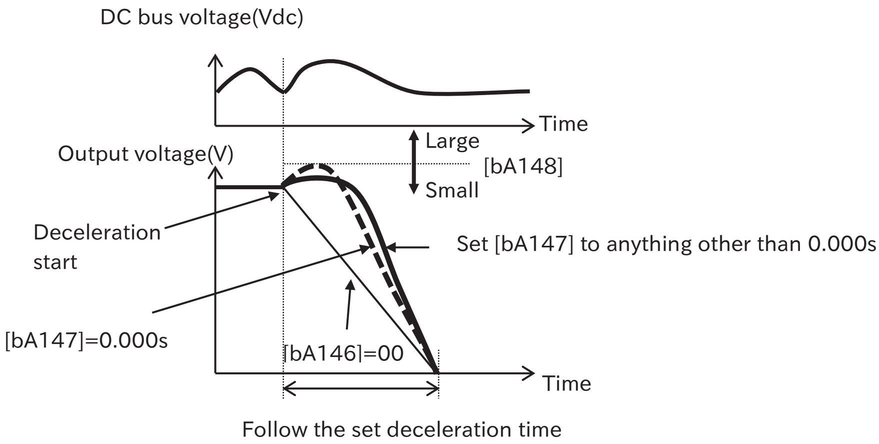


Even if the DC voltage (incoming voltage) fluctuates between P-N, the voltage output to the motor is kept at the [Hb106] setting.
Note: Voltage exceeding the receiving voltage cannot be output.

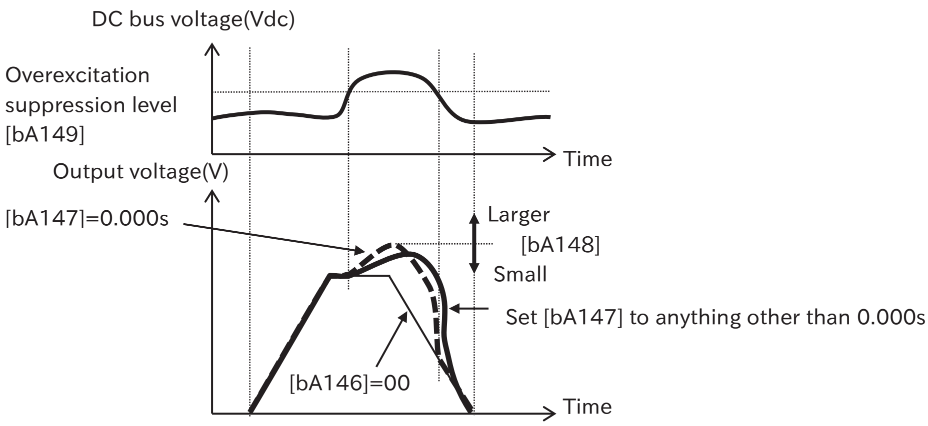
■When "Overexcitation function selection (V/f)[bA146]" = "Always operation (01)"



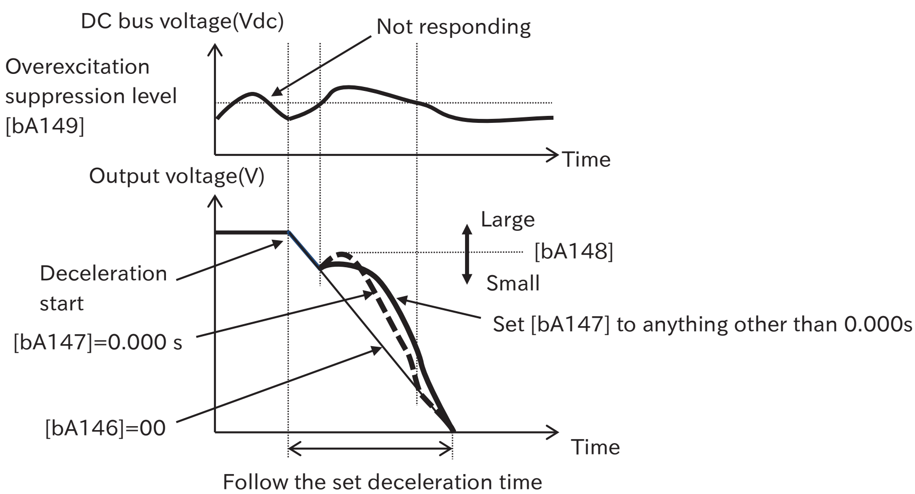
■When "Overexcitation function selection (V/f)[bA146]" = "Operation only at deceleration (02)"



■When "Overexcitation function selection (V/f)[bA146]" = "Level operation (03)"

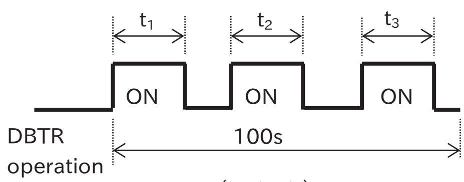


■When "Overexcitation function selection (V/f)[bA146]" = "Level-operated only at deceleration (04)"



9.9.5 Braking resistor operating circuit (DBTR)

- During deceleration, the motor acts as a generator and energy is regenerated to the inverter. As a consequence, the DC voltage rises between P-N of the inverter and trips when the over-voltage is exceeded. To prevent this, DBTR function uses an external resistor to dissipate regenerative power from the motor.
- When using this function, connect an external braking resistor referring to "5.3.5 Wiring Braking Resistor and Regenerative Braking Unit" and set each parameter in the table below.
- It is also possible to obtain a larger regenerative torque by using the optional regenerative braking unit without using the built-in braking resistor operating circuit (DBTR). If this happens, set "Braking Resistor Operation Circuit (DBTR) Select [bA-61]" to "Disable (00)".
- The "Braking Resistor Operating Circuit (DBTR) On Level [bA-62]" is the level setting of the main circuit DC smoothing capacitor in the inverter. Be sure to set a value exceeding √2 times the received voltage. It may lead to burnout of the braking resistor.
- The minimum resistance value that can be connected varies depending on the model.
  For details, refer to "Chapter 17 Specifications".

<table>
<tr><th>Code</th><th>Item</th><th>Description</th><th>Data</th><th>Initial value</th></tr>
<tr><td>dA-41</td><td>DBTR load ratio monitor</td><td>Displays according to DBTR use.</td><td>0.00 to 100.00 %</td><td>-</td></tr>
<tr><td>bA-60</td><td>Dynamic brake use ratio</td><td>When this setting is 0.0, DBTR function does not operate.
The upper limit of [bA-60] changes depending on the "Braking Resistor Operating Circuit (DBTR) Resistance Value [bA-63]" setting. Be sure to set [bA-63] first. Then, set DBTR duty cycle to the allowable %ED or less of the braking resistor to be connected, referring to the figure below.


$\text{DBTR \%ED} = \frac{(t_1+t_2+t_3)}{100s} \times 100$
If the set usage rate is exceeded, the motor trips due to "Braking resistor overload error [E006]".</td><td>0.0 to 10.0 × ([bA-63]/ Min. resistance)^2 %</td><td>10.0</td></tr>
<tr><td rowspan="3">bA-61</td><td rowspan="3">Dynamic brake activation selection</td><td>Disabled</td><td>00</td><td rowspan="3">00</td></tr>
<tr><td>Enabled (disabled during stop)</td><td>01</td></tr>
<tr><td>Enabled (enabled during stop)</td><td>02</td></tr>
<tr><td>bA-62</td><td>Dynamic brake activation level</td><td>ON at which DBTR operates. This function is used to adjust the operation of DBTR function according to the power input of the inverter.
Be sure to set a value exceeding √2 times the received voltage.</td><td>200V class
DC330.0 to 400.0 V
400V class:
DC660.0 to 800.0 V</td><td>200V class:
380.0
400V class:
760.0</td></tr>
<tr><td>bA-63</td><td>Dynamic brake resistor value</td><td>Set the actually connected braking resistance value. The upper limit of DBTR utilization of the inverter is calculated automatically. This makes it better to set [bA-60] considering only the allowable %ED of the braking resistor.</td><td>Min resistance to 600.0 Ω</td><td>Min. resistance</td></tr>
</table>

9.9.6 Restart after instantaneous power failure or undervoltage

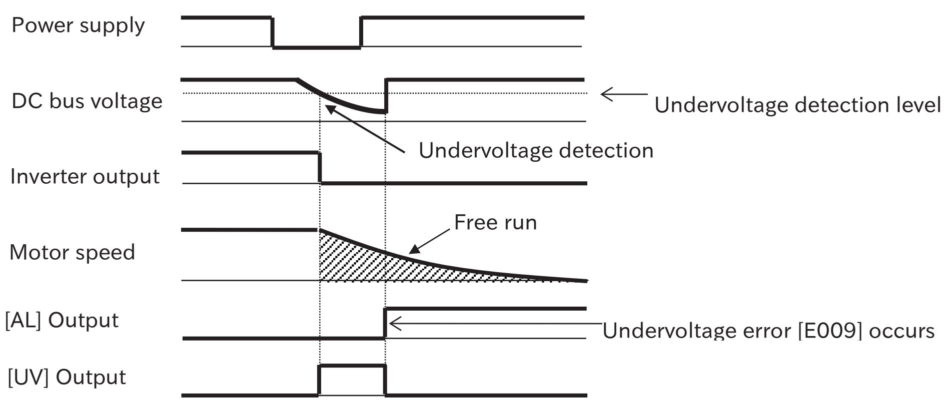
- When DC voltage between P-N falls below the undervoltage level and power is restored afterwards, the inverter can be set to trip or restart without tripping by "undervoltage retry count selection [bb-21]".
- If [bb-21] is set to 0 times, "Undervoltage Error [E009]" will occur when undervoltage occurs, and restart will not be performed. When [bb-21] is set to 1 to 16 times, restarting is performed for the set number of times when power is restored from undervoltage, and then tripped. If [bb-21] is set to 255, the number of restarts is unlimited.
- The restart method can be selected by "Instantaneous power failure/undervoltage retry selection [bb-24]".
- If Frequency Adjustment Restart is selected ([bb-24]=01, 04), the actual operation will be the frequency retraction restart from the frequency at cutoff. For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.
- When frequency pull-in restart is selected ([bb-24]=02), refer to "9.7.4 Using Frequency Pull-in Function to Start" for more information.
- When the power is turned off while the inverter is stopped for energy saving, etc., the undervoltage trip during stop can be avoided by setting "Momentary power failure/undervoltage trip selection during stop [bb-27]" to "Disabled (00)" or "Disabled during stop and deceleration stop (02)".
- If the power failure time is long and the control microcomputer power is completely turned off, the operation at power on is performed at power restoration. In such cases, restart can be performed by setting "Restart [bb-41] after releasing reset". For details, refer to "9.7.5 Start after Trip Reset or Power On".
- When the DC voltage across P-N drops below the undervoltage level (approx. DC173V for 200 V class, approx. DC345V, 400V class), the inverter shuts off the output. The motor coasts. If the time until power restoration is "Under-voltage Time", "Undervoltage Error [E009]" will occur in the following cases.
  - [bb-21] = "0 times" and "Undervoltage time" ≦ "Allowable instantaneous power failure/undervoltage time [bb-25]"
  - [bb-21] When "≠ 0 times" and "Undervoltage time" > "Momentary power failure/undervoltage allowable time [bb-25]"
  - When "Under-voltage time" is about 40 seconds or more, "Undervoltage error [E009]" occurs without waiting for power restoration.
- If "Trip after deceleration stop (04)" is set for "Momentary power failure/undervoltage retry selection [bb-24]", if a trip such as overvoltage or overcurrent occurs during deceleration after restart, "Undervoltage error [E009]" will be displayed and the motor will free-run. In this case, increase the deceleration time.
- The undervoltage signal [UV] signalwill be outputted in an undervoltage condition as well as with or without a trip. It also continues outputting while the inverter-controlled power supply remains (including external +24V power supply).

Code	Item	Description	Data	Initial value
bb-21	Number of retries after under voltage	Sets the number of restarts when power is restored from undervoltage. 0 times: Tripped when undervoltage occurs. 1 to 16 times: Restart is performed by the set number of times, and then trips. 255: The number of restarts is unlimited.	0 to 16 times /255	0
bb-24	Restart mode selection after instantaneous power failure/undervoltage error	0 Restart Hz.	00	01
		Restart the frequency adjustment (restart the frequency retraction from the cutoff frequency).	01	
		Frequency pull-in restart.	02	
		Restart at feedback detection speed (frequency).	03	
		After the frequency adjustment restart (frequency retraction restart from the cutoff frequency) is completed, the motor decelerates to a stop and trips.	04	
bb-25	Instantaneous power failure allowed time	If the power is restored within this set time, the unit will restart. If the instantaneous power failure/undervoltage time is longer than this setting time, the motor trips regardless of the setting of [bb-21].	0.3 to 25.0 s	1.0
bb-26	Instantaneous power failure/undervoltage Retry wait time after an error	Sets the waiting time from power restoration to restart.	0.3 to 100.0 s	1.0
bb-27	Enable instantaneous power failure/ undervoltage trip while in stop status	Invalid: Does not trip during stop.	00	00
		Enabled: Trip also occurs during stop.	01	
		Disabled during stop and deceleration stop: Does not trip during stop or decelerating stop at operation command OFF.	02	
CC-01 CC-02 CC-07	Output terminal function	Undervoltage [UV]: This signal is turned ON when the DC voltage between P-N is below the undervoltage level.	021	002 001 017

Operation when power is restored from instantaneous power failure or undervoltage

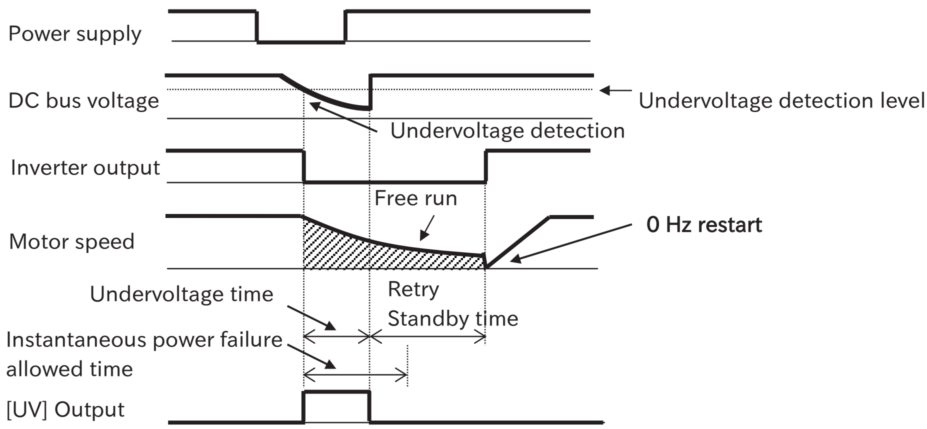
■Trip ([bb-21]=0)

・When an instantaneous power failure or undervoltage is detected, the inverter output is shut off and the motor coasts. Then, if power is restored to [bb-25], "Undervoltage error [E009]" is generated and "Alarm signal [AL]" is outputted.



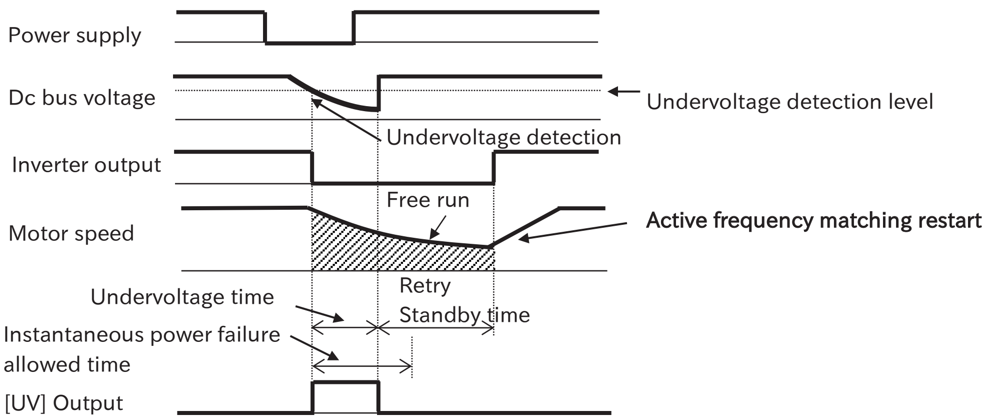
■0Hz start ([bb-21]≠0, [bb-24]=00)

・When instantaneous power failure or undervoltage is detected, the inverter output is shut off and the motor coasts. After the power is restored, the inverter starts restarting 0Hz after the retry wait time of the [bb-26] setting. At this time, "Alarm signal [AL]" is not outputted.



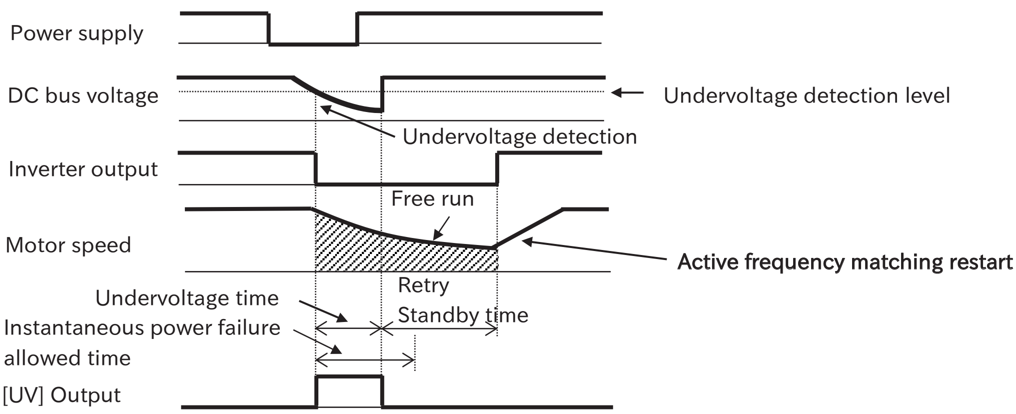
■Frequency alignment restart ([bb-21]≠0, [bb-24]=01)

・When instantaneous power failure or undervoltage is detected, the inverter output is shut off and the motor coasts. After the power is restored, after the retry wait time of the [bb-26] setting, the inverter starts frequency retraction restart from the frequency at the time of shutdown. At this time, "Alarm signal [AL]" is not outputted.
・For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.



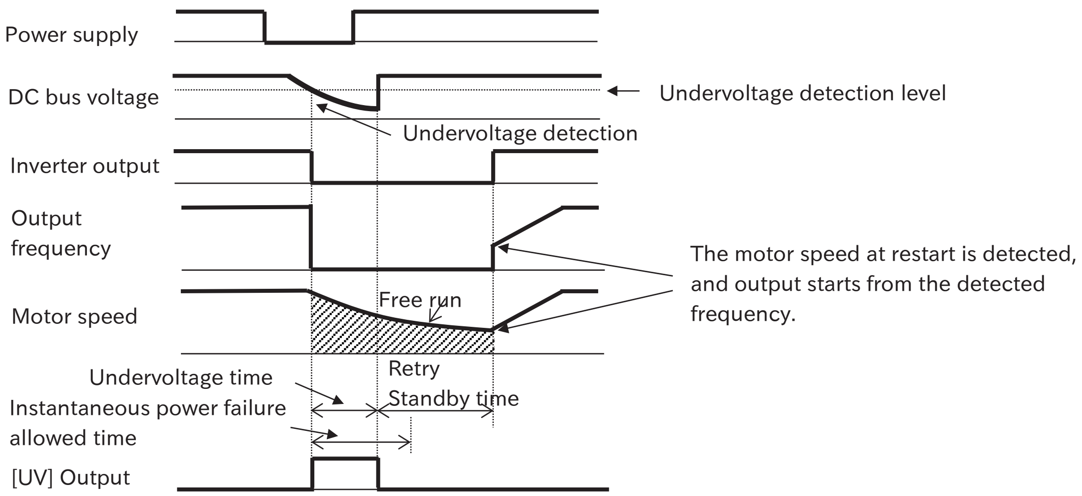
■Frequency retract restart ([bb-21]≠0, [bb-24]=02)

・When instantaneous power failure or undervoltage is detected, the inverter output is shut off and the motor coasts. After the power is restored, after the retry wait time of the [bb-26] setting, the inverter starts frequency retraction restart from the frequency at the time of shutdown. At this time, "Alarm signal [AL]" is not outputted.
・For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.



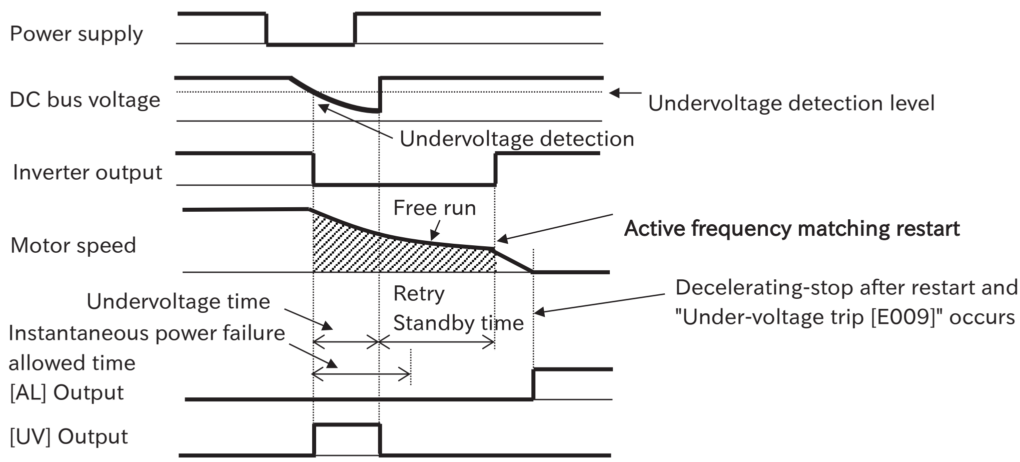
■Detect velocity ([bb-21]≠0, [bb-24]＝03)

- When instantaneous power failure or undervoltage is detected, the inverter output is shut off and the motor coasts. After the power is restored, the inverter starts outputting from the rotational velocity detected by the encoder feedback after the retry standby time of the [bb-26] setting. At this time, "Alarm signal [AL]" is not outputted.
- When this setting is used, a setting related to encoder feedback is separately required. For details, refer to "9.5.11 Using Encoder Feedback".



■Trip after decelerating stop ([bb-21]≠0, [bb-24]＝04)

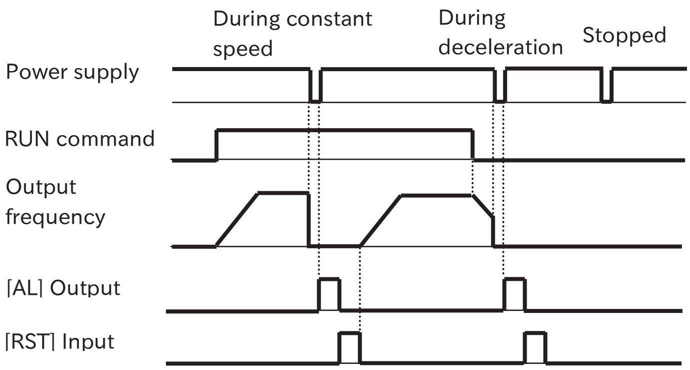
- Instanteneous power failure and undervoltage detection shut off the inverter output and coasts the motor. After the power is restored, after the retry wait time of the [bb-26] setting, the inverter performs frequency retraction restart from the frequency at the time of shutdown. Then, decelerating stop is performed, and "Alarm signal [AL]" is outputted after stop.
- For details, see section 9.7.3, Using the Frequency Adjustment Function to Start.



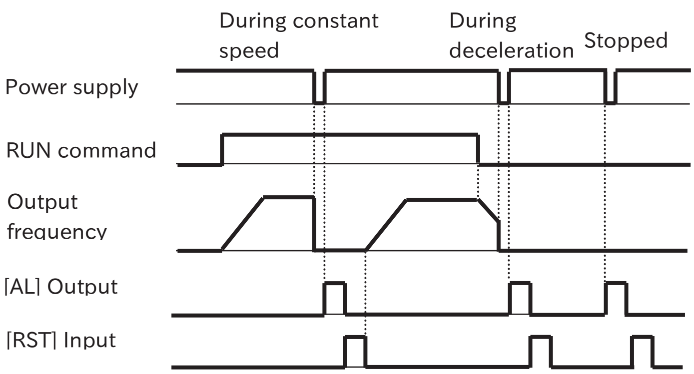
Operation of Momentary Power Loss/Undervoltage Trip Selection [bb-27] during Stop

- Use [bb-27] to select whether or not a trip signal is output when an instantaneous power failure or undervoltage occurs during standstill.
- The trip signal is output while the inverter's control power remains.

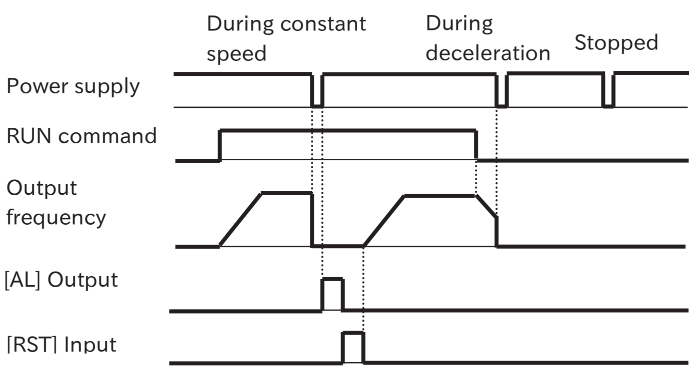
■[bb-27] ="Invalid (00)"



■[bb-27] ="Valid (01)"



■[bb-27] ="Disabled during stop and deceleration stop (02)"



9.9.7 Restart after overcurrent

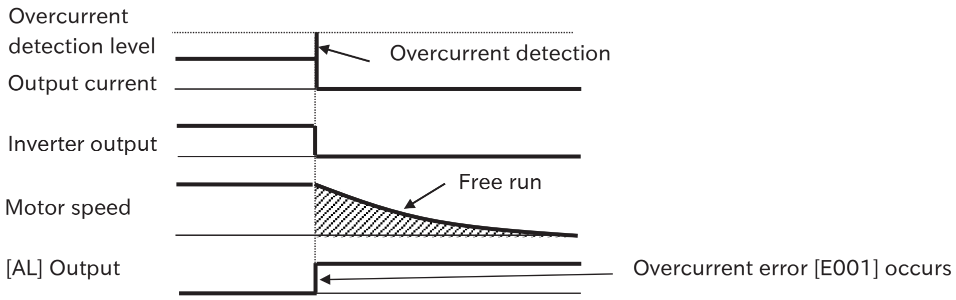
- When overcurrent is detected, it can be set by "Overcurrent retry count selection [bb-22]" whether the inverter trips or restarts without tripping. If [bb-22] is set to 0 times, "overcurrent error [E001]" will occur immediately when overcurrent is detected. When [bb-22] is set to 1 to 5 times, restart is performed according to the setting of "Overcurrent trip retry selection [bb-28]" for the number of times set to [bb-22] at overcurrent detection, and when the overcurrent detection count exceeds [bb-22], trip is performed at [E001].
- The output current value that is judged as overcurrent can be set in "Overcurrent detection level [bb160]".
- When Frequency Adjustment Restart is selected ([bb-28]=01, 04), refer to "9.7.3 Using the Frequency Adjustment Function to Start" for more information.
- When restarting the frequency pull-in function ([bb-28]=02), refer to "9.7.4 Using the Frequency Pull Function to Start" for more information.
- If an overcurrent error occurs continuously, it may be due to too short acceleration time, heavy load, or locked motor.

Code	Item	Description	Data	Initial value
bb-22	Number of retries after overcurrent	Sets the number of restarts in the event of an overcurrent. In case of 0 times, it trips immediately due to overcurrent error without restarting.	0 to 5 times	0
bb-28	Restart mode selection after an overcurrent error	0 Restart Hz.	00	01
		Restart the frequency adjustment (restart the frequency retraction from the cutoff frequency).	01	
		Frequency pull-in restart.	02	
		Restart at feedback detection speed (frequency).	03	
		After the frequency adjustment restart (frequency retraction restart from the cutoff frequency) is completed, the motor decelerates to a stop and trips.	04	
bb-29	Retry wait time after an overcurrent error	Sets the waiting time from overcurrent detection to restart start.	0.3 to 100.0 s	0.3
bb160	Overcurrent detection -motor	Sets the level at which overcurrent is detected.	(0.30 to 2.20)×Inverter rated output current A	2.20×Rated output current

Operation when overcurrent is detected

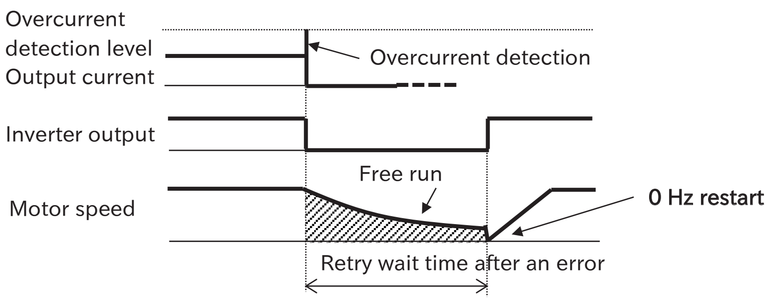
■Trip ([bb-22]=0)

・When overcurrent is detected, the inverter output is shut off and the motor coasts. "Over current error [E001]" occurs and "Alarm signal [AL]" is outputted.



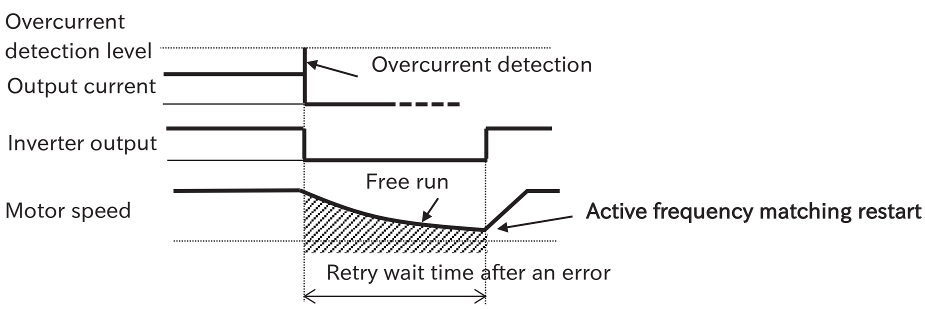
■0Hz start ([bb-22]≠0、[bb-28]=00)

・When overcurrent is detected, the inverter output is shut off and the motor coasts. After that, the inverter starts restarting 0Hz after the retry wait time of the [bb-29] setting. At this time, "Alarm signal [AL]" is not outputted.



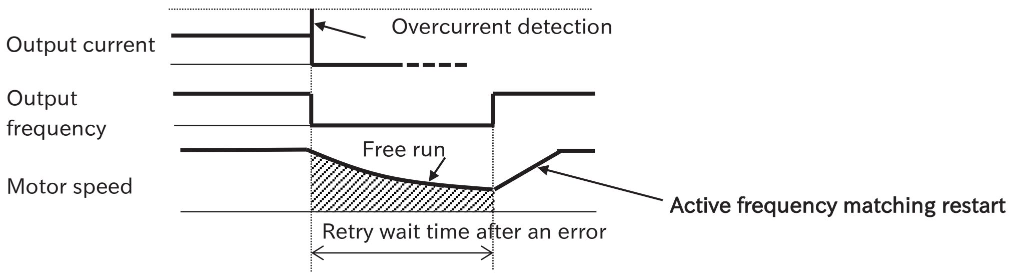
■Frequency alignment restart ([bb-22]≠0, [bb-28]=01)

・When overcurrent is detected, the inverter output is shut off and the motor coasts. After that, after the retry standby time of the [bb-29] setting, the inverter starts frequency retraction restart from the frequency at the time of shutdown. At this time, "Alarm signal [AL]" is not outputted.
・Refer to "9.7.3 Using the Frequency Adjustment Function to Start" for details on frequency adjustment restart.



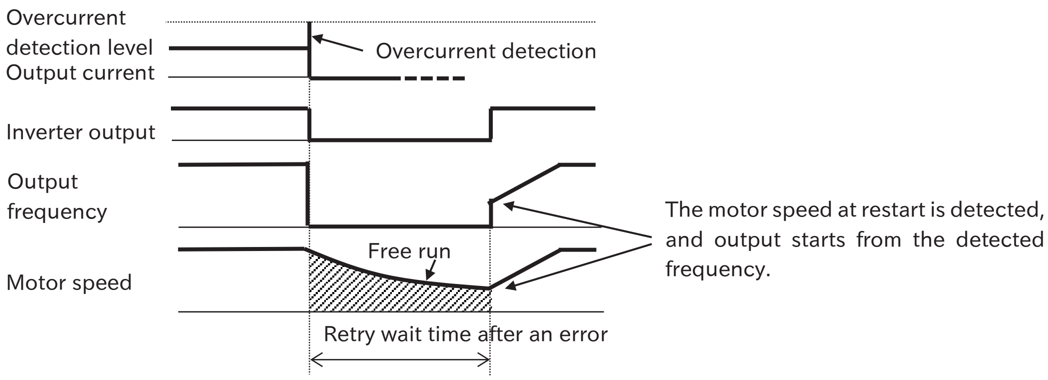
■**Frequency retract restart ([bb-22]≠0, [bb-28]=02)**

- When overcurrent or overvoltage is detected, the inverter output is shut off and the motor coasts. After that, after the retry wait time of the [bb-31] setting, the inverter starts active frequency matching restart. At this time, "Alarm signal [AL]" is not outputted.
- Refer to "9.7.4 Using the Frequency Pull Function to Start" for details on restarting the frequency pull-in.



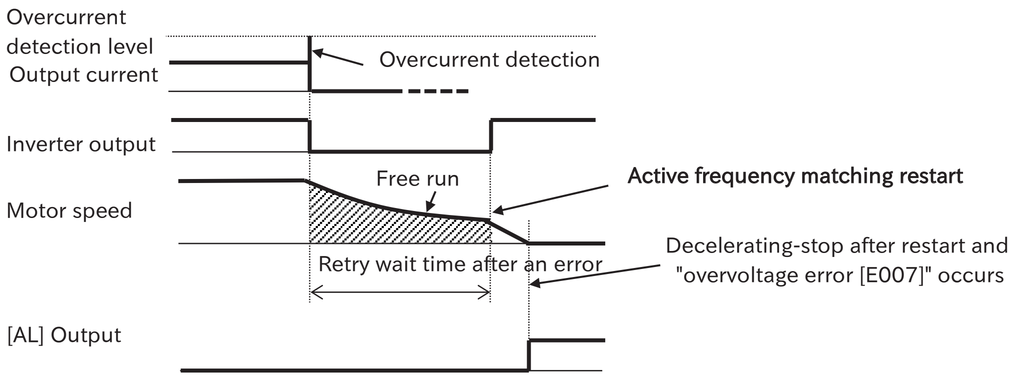
■**Detect velocity ([bb-22]≠0, [bb-28]=03)**

- When overcurrent or overvoltage is detected, the inverter output is shut off and the motor coasts. Then, after the retry wait time of the [bb-31] setting, the inverter starts outputting from the rotational velocity detected by the encoder feedback. At this time, "Alarm signal [AL]" is not outputted.
- When this setting is used, a setting related to encoder feedback is separately required. For details, refer to "9.5.11 Using Encoder Feedback".



■**Trip after decelerating stop ([bb-22]≠0, [bb-28]=04)**

- The overvoltage detection shuts off the inverter output and coasts the motor. After that, after the retry wait time of the [bb-31] setting, the inverter performs the frequency retraction restart from the frequency at the time of shutdown. Then, decelerating stop is performed, and "Alarm signal [AL]" is outputted after stop.
- Refer to "9.7.4 Using the Frequency Pull Function to Start" for details on restarting the frequency pull-in.



9.9.8 Restart after overvoltage

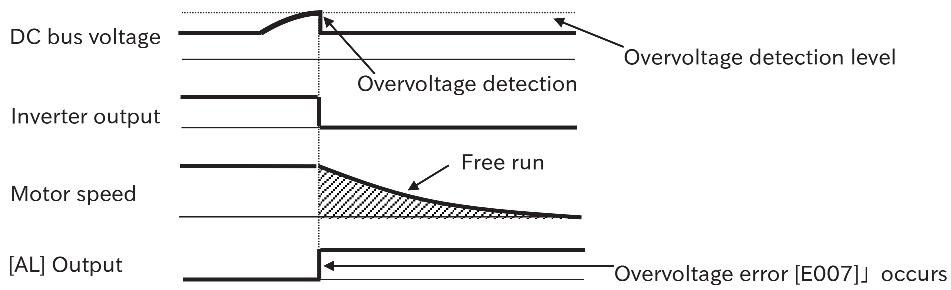
- When overvoltage is detected, it can be set by "Overvoltage retry selection [bb-23]" whether the inverter trips or restarts without tripping. If [bb-23] is set to 0 times, an "overvoltage error [E007]" will immediately occur when overvoltage is detected. When [bb-23] is set to 1 to 5 times, at overvoltage detection, restart is performed according to the setting of "Overvoltage trip retry selection [bb-30]" by the number of times set to [bb-23]. If the overvoltage detection count exceeds [bb-23], it trips at [E007].
- When Frequency Adjustment Restart is selected ([bb-30]=01, 04), refer to "9.7.3 Using the Frequency Adjustment Function to Start" for more information.
- When restarting the frequency pull-in function ([bb-30]=02), refer to "9.7.4 Using the Frequency Pull Function to Start" for more information.
- If overvoltage is applied continuously, the deceleration time may be too short, the load may be heavy, or the motor may be turned by an external force.
- Even if Restart is selected, the inverter will detect a trip again if the trip factor has not been cleared after the "overvoltage retry wait time [bb-31]". In this case, increase the retry wait time.

Code	Item	Description	Data	Initial value
bb-23	Number of retries after over voltage	Sets the number of restarts if an overvoltage occurs. In case of 0 times, it trips immediately due to overvoltage error without restarting.	0 to 5 times	0
bb-30	Restart mode selection after an overvoltage error	0 Restart Hz.	00	01
		Restart the frequency adjustment (restart the frequency retraction from the cutoff frequency).	01	
		Frequency pull-in restart.	02	
		Restart at feedback detection speed (frequency).	03	
		After the frequency adjustment restart (frequency retraction restart from the cutoff frequency) is completed, the motor decelerates to a stop and trips.	04	
bb-31	Retry wait time after an overvoltage error	Sets the waiting time from overvoltage detection to restart start.	0.3 to 100.0 s	0.3

Overvoltage detection mode selection

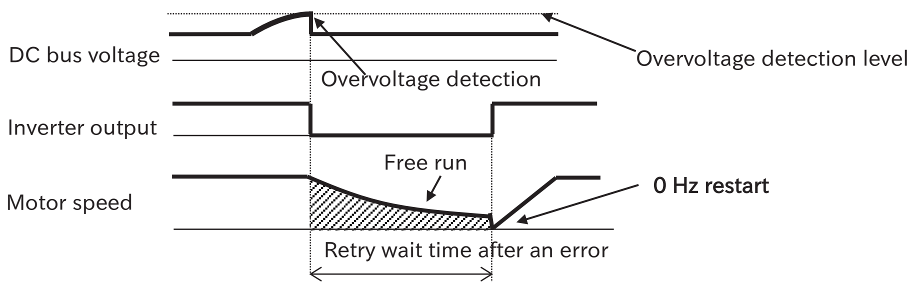
■Trip ([bb-23]=0)

・The overvoltage detection shuts off the inverter output and coasts the motor. "Over voltage error [E007]" will occur and "Alarm signal [AL]" will be outputted respectively.



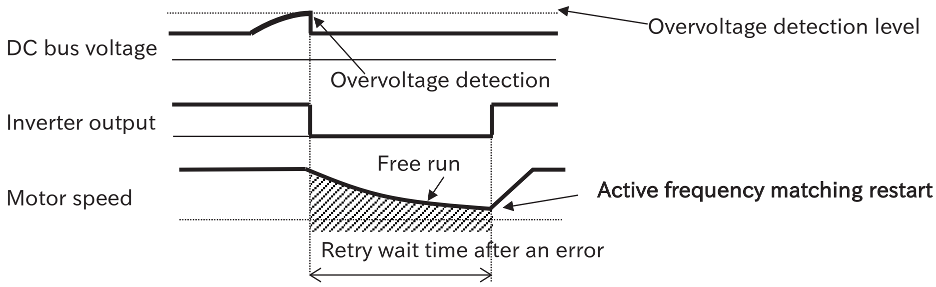
■0Hz start ([bb-23]≠0, [bb-30]=00)

・The overvoltage detection shuts off the inverter output and coasts the motor. After that, after the retry wait time of the [bb-31] setting, the inverter starts 0Hz restart. At this time, "Alarm signal [AL]" is not outputted.



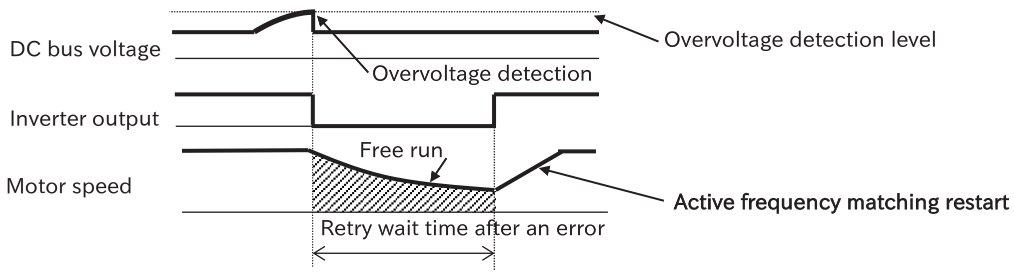
■Frequency Alignment Restart ([bb-23]≠0, [bb-30]=01)

・The overvoltage detection shuts off the inverter output and coasts the motor. After that, after the retry standby time of the [bb-31] setting, the inverter starts frequency retraction restart from the frequency at the time of shutdown. At this time, "Alarm signal [AL]" is not outputted.
・Refer to "9.7.3 Using the Frequency Adjustment Function to Start" for details on frequency adjustment restart.



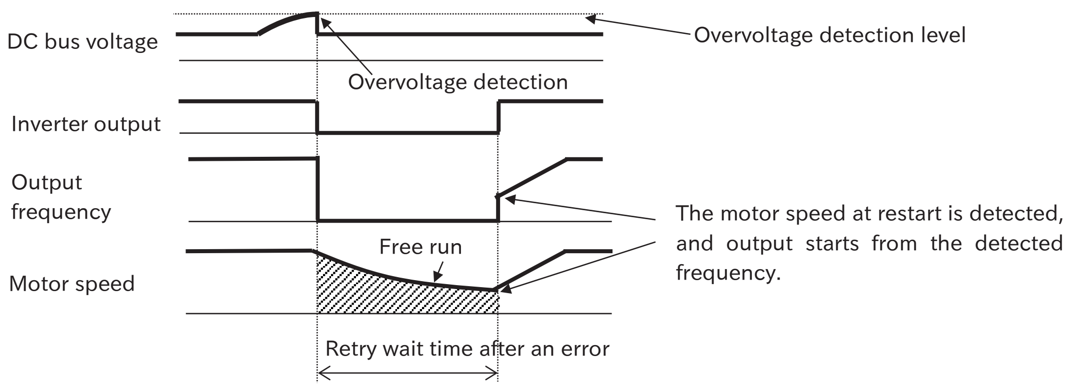
■Frequency retract restart ([bb-23]≠0, [bb-30]=02)

- When overcurrent or overvoltage is detected, the inverter output is shut off and the motor coasts. After that, after the retry wait time of the [bb-31] setting, the inverter starts active frequency matching restart. At this time, "Alarm signal [AL]" is not outputted.
- Refer to "9.7.4 Using the Frequency Pull Function to Start" for details on restarting the frequency pull-in.



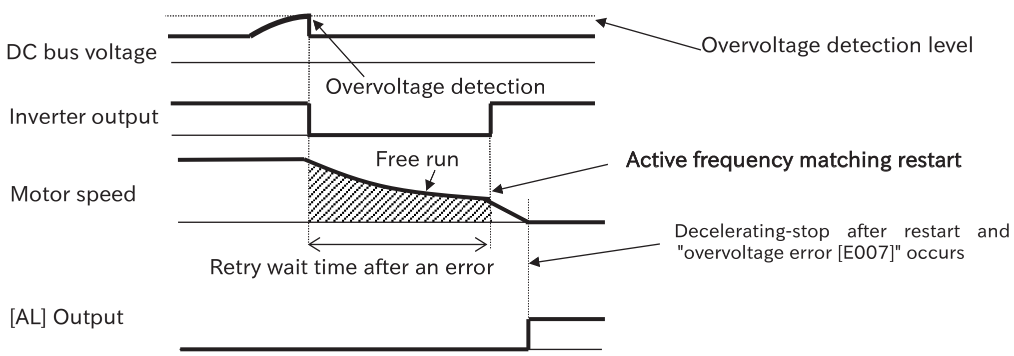
■Detect velocity ([bb-23]≠0, [bb-30]=03)

- When overcurrent or overvoltage is detected, the inverter output is shut off and the motor coasts. Then, after the retry wait time of the [bb-31] setting, the inverter starts outputting from the rotational velocity detected by the encoder feedback. At this time, "Alarm signal [AL]" is not outputted.
- When this setting is used, a setting related to encoder feedback is separately required. For details, refer to "9.5.11 Using Encoder Feedback".



■Trip after decelerating stop ([bb-23]≠0, [bb-30]=04)

- The overvoltage detection shuts off the inverter output and coasts the motor. After that, after the retry wait time of the [bb-31] setting, the inverter performs the frequency retraction restart from the frequency at the time of shutdown. Then, decelerating stop is performed, and "Alarm signal [AL]" is outputted after stop.
- Refer to "9.7.4 Using the Frequency Pull Function to Start" for details on restarting the frequency pull-in.



9.9.9 Instantaneous power failure non-stop function

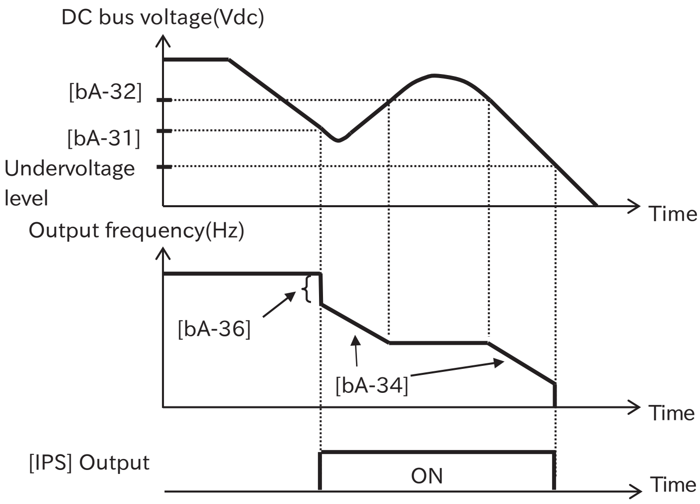
- The instantaneous power failure non-stop function decelerates and stops the inverter without shutting off the output, while keeping the overvoltage level from being exceeded, even if a power shutdown occurs during operation. If the power is restored during this function, it is possible to return to the normal operation state in addition to decelerating stop.
- Three decelerating stop operation modes can be selected according to the setting of "Instantaneous power failure non-stop selection [bA-30]".
  Refer to the next page for details on the operation of each setting.
- When the instantaneous power failure non-stop function is operating, "Power failure deceleration [IPS]" is outputted.
- Instantaneous power failure non-stop function, DC voltage between P-N is "Instantaneous power failure non-stop starting voltage [bA-31]"It operates when it falls below.
- Keep [bA-31] and "Momentary power failure non-stop target level [bA-32]" at least the undervoltage level (200V class: approx. DC172.5V, 400V class: approx. DC345V). This function does not operate when undervoltage occurs.
- If "Instantaneous power failure non-stop selection [bA-30]" is set to "enable (deceleration stop) (01)" or "enable (no return) (02)", after this function operation, it will not be released until deceleration stop is completed. To restart operation, check that the power reception is restored after deceleration-stop by this function is completed, and turn OFF the operation command once to ON again.
- When [bA-30] is set to "Valid (with return) (03)", if DC voltage between P-N recovers during deceleration, it starts to accelerate to the original frequency again. However, if decelerating stop occurs prior to recovery, the operation command must be turned OFF once and then ON again to restart operation.

Code	Item	Description	Data	Initial value
bA-30	Instantaneous power failure non-stop function, mode selection	Disabled	00	00
		Enabled (decelerating stop): Decelerates to a stop.	01	
		Enabled (no recovery): Decelerates and stops at a constant DC voltage control. Even if the power is restored during this function, the decelerating stop will continue.	02	
		Stop (with recovery) Decelerates and stops at a constant DC voltage control. If the power is restored during this function operation, the unit will return to the operating state.	03	
bA-31	Instantaneous power failure non-stop function, start voltage level	When DC between P-N becomes less than or equal to this setting, deceleration starts.	200V class: DC0.0 to 400.0 V 400V class: DC0.0 to 800.0 V	200class: 220.0 400 class: 440.0
bA-32	Instantaneous power failure non-stop function, target voltage level	After deceleration starts, if DC between P-N exceeds this setting by regeneration, deceleration stops once.		200 class: 360.0 400 class: 720.0
bA-34	Instantaneous power failure non-stop function, deceleration time	Set the deceleration time when this function is activated.	0.01 to 3600.00 s	1.00
bA-36	Instantaneous power failure non-stop function, start frequency decrement	Set the frequency to start deceleration by the difference from the output frequency.	0.00 to 10.00 Hz	0.00
bA-37	Instantaneous power failure non-stop function, DC bus voltage control P gain	Proportional gain for PI control of DC voltage-constant control.	0.00 to 5.00	0.20
bA-38	Instantaneous power failure non-stop function, DC bus voltage control I gain	Integral gain for PI control of DC voltage-constant control.	0.00 to 150.00 s	1.00
CC-01 CC-02 CC-07	Output terminal function	During power failure deceleration [IPS]: Outputs a signal during instantaneous power failure non-stop deceleration. OFF: The function is not working. ON: Momentary power failure non-stop deceleration.	023	002 001 017

Instantaneous power failure non-stop operation

■Instantaneous power failure non-stop decelerating stop ([bA-30]=01)

- If the power is cut off during operation, once the DC voltage falls below the "instantaneous power failure non-stop start voltage [bA-31]" between P-N, the output frequency will be lowered to the "instantaneous power failure non-stop deceleration start width [bA-36]" and then the deceleration will start with the "instantaneous power failure non-stop deceleration time [bA-34]." At that time, decelerating stop is performed while the DC between P-N does not exceed the "instantaneous power failure non-stop target level [bA-32]".
- During deceleration, when DC voltage between P-N exceeds [bA-32] due to regenerative energy, deceleration is stopped and constant speed operation is performed until DC voltage between P-N becomes less than [bA-32].



- Set "Instantaneous power failure non-stop starting voltage [bA-31]" so that it is smaller than " Instantaneous Momentary power failure non-stop target level [bA-32]". If the [bA-31] setting is greater than [bA-32], the instantaneous power failure non-stop target level will internally operate as the same value as [bA-31]. However, the [bA-32] setting itself does not change.
- Be sure to set [bA-32] to a value greater than √2 times of the receiving voltage. If [bA-32] is less than √2 times of the incoming voltage, if power is duplicated during this function operation, the constant speed operation status is retained and deceleration cannot be performed. In this state, the change of stop command and frequency command is also not accepted. The power must be turned off and on again, or [bA-32] must be set again during operation.
- If " Instantaneous power failure non-stop deceleration starting range [bA-36]" is too large, sudden deceleration may occur during this function operation, causing an overcurrent error. In addition, if " Instantaneous power failure non-stop deceleration starting range [bA-36]" is too small or " Instantaneous power failure non-stop deceleration time [bA-34]" is too long, "Undervoltage error [E009]" may occur due to insufficient regenerative force.

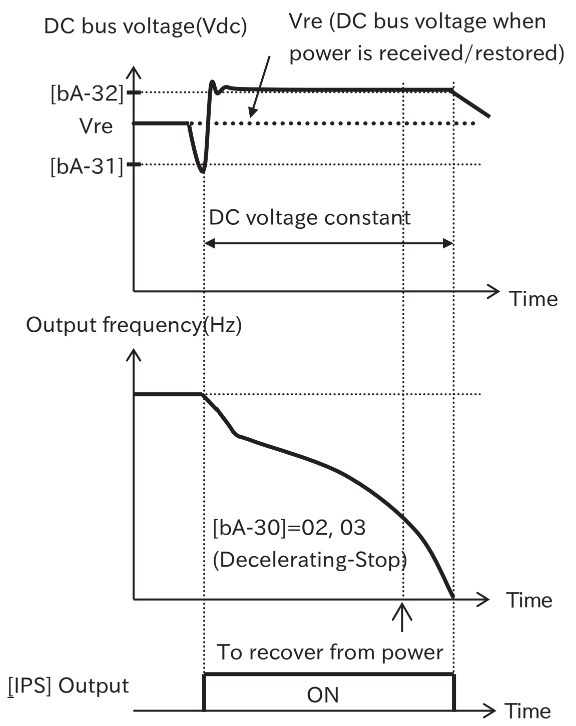
■Instantaneous power failure non-stop DC voltage-constant control ([bA-30]=02, 03)

- When the DC voltage drops during an instantaneous power failure or P-N, and the DC voltage falls below the "instantaneous power failure non-stop starting voltage [bA-31]", the motor decelerates automatically while holding the DC voltage between P-N at the "instantaneous power failure non-stop target level [bA-32]".
- If the instantaneous power failure time is short, operation can be continued without output shutdown by this function. However, if an undervoltage occurs due to a momentary power failure, the output is immediately shut off and this function terminates operation. After that, the operation at recovery from an instantaneous power failure follows "Instantaneous power failure/undervoltage retry selection [bb-24]". For details, refer to "9.9.6 Restarting after instantaneous power failure or undervoltage."
- If "Instantaneous power failure non-stop selection [bA-30]" is "Enabled: Restore (03)", if power is restored prior to power shutdown, normal operation can be resumed. However, depending on the setting of [bA-32], it will decelerate and stop. Details are as follows.

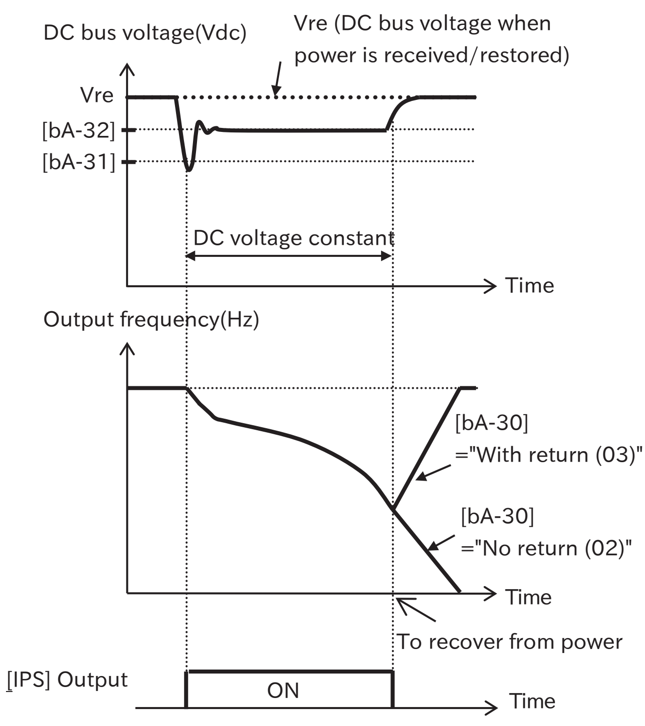
Instantaneous power failure non-stop function, mode selection [bA-30]	Instantaneous power failure non-stop function, target voltage level [bA-32]	Operation
Valid (no return) (02)	[bA-32] > Vre [Note]	Deceleration stop (DC voltage constant control) (e.g.1)
	[bA-32] < Vre [Note]	Deceleration stop (Normal operation) (e.g. 2)
Valid (with return) (03)	[bA-32] > Vre [Note]	Deceleration stop (DC voltage constant control) (e.g. 1)
	[bA-32] < Vre [Note]	Operation (normal operation) (e.g. 2)

Note: [Vre] DC-voltage between P-N when receiving power and restoring power

■With the instantaneous power failure non-stop target level [bA-32]



■With the instantaneous power failure non-stop target level [bA-32]



Note: Depending on the proportional (P) gain/integral (I) gain ([bA-37], [bA-38]) setting of DC voltage constant control for the instantaneous power failure non-stop function, the DC voltage between P-N may be lower than [bA-32].

- If the difference between the "instantaneous power failure non-stop starting voltage [bA-31]" and the "instantaneous power failure non-stop target level [bA-32]" is large, if the "DC voltage constant control P gain [bA144]" is made too large, rapid acceleration may occur immediately after this function starts operation, causing an overcurrent error.
- Adjust this function using "Instantaneous power failure non-stop DC voltage constant control P gain [bA-37]" and "Instantaneous power failure non-stop DC voltage constant control I gain [bA-38]". Setting a larger proportional (P) gain [bA-37] or a shorter integral (I) gain [bA-38] will make the answer faster but will make it easier to trip. If the proportional (P) gain [bA-37] is too low, an undervoltage error [E009] may occur due to a drop in voltage immediately after this function starts operation.

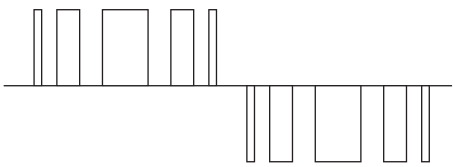
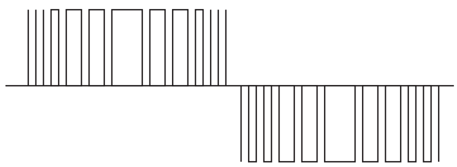
9.10 Protective function

9.10.1 Adjust the carrier frequency

- The carrier frequency is the frequency of PWM wave outputting from the inverter.
- Metallic noise from the motor can be reduced by setting "Carrier frequency [bb101]" to a large value. However, electromagnetic noise and leakage current generated by the inverter may increase. Changing the carrier frequency may also be effective to avoid resonance in the mechanical system and the motor.
- The setting of "Load-specification selection [Ub-03]" automatically limits the carrier frequency setting.
- Carrier frequency may be automatically reduced by the setting of "Auto Carrier Reduction Select [bb103]" or the DC braking function, etc.
- The higher the carrier frequency, the greater the heat generated by the inverter. Therefore, derating may be required for the rated output current. The relationship between the carrier frequency and the output current derating varies depending on the model. For details, refer to "17.3 Current derating".
- When the "control method [AA121]" is set to "sensorless vector control (IM) (08)", in order to secure the torque during operation in the low-speed range, even if the "carrier frequency [bb101]" is set to a value exceeding 2.0kHz, operation is performed by automatically lowering it to 2.0kHz. In addition, since the carrier frequency increases with acceleration, electromagnetic noise, etc. from the motor may change depending on the output frequency.
- Set the carrier frequency to be 10 times or more of the "IM max. frequency [Hb105]" or more.
  (e.g.) [bb101]=5.9kHz or more for Hb105]=590.00Hz

Code	Item	Description	Data	Initial value
bb101	Carrier frequency	Set the carrier frequency of PWM wave outputting from the inverter to the motor.	2.0 to 15.0 kHz (ND: Normal load) 2.0 to 10.0 kHz (LD: Light load)	2.0

■Carrier frequency and its influence range

Carrier frequency	Low	High
Electromagnetic noise of the motor	Large	Small
Electromagnetic noise and leakage current	Small	Large
Heat generated by the inverter		
Sample Output Voltage-Waveform of Inverter (PWM Output)	Callier frequency: Low 	Callier frequency: High 

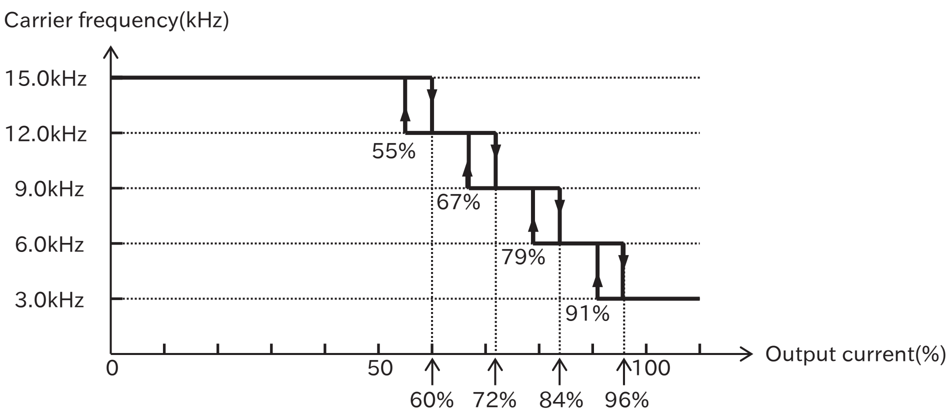
9.10.2 Automatically reduce the carrier frequency

- The higher the carrier frequency, the higher the internal temperature of the inverter will rise, which may result in shorter life or failure. The automatic carrier reduction function reduces the life of the inverter by automatically reducing the carrier frequency according to the output current or the cooling fin temperature.
- Depending on the current derating specification, it may be necessary to reduce the carrier frequency further than this function. If this happens, reduce the "Carrier frequency [bb101]" or review the operation pattern/system so that the max. output current may be reduced to meet the current derating specifi cations for each model. For details, refer to "17.3 Current derating".
- The variation of carrier frequency is within the upper limit "carrier frequency [bb101]" to lower limit 3kHz. This function is disabled when [bb101] is less than or equal to 3kHz.
- This function is disabled regardless of the setting of "Auto Carrier Reduction Select [bb103]" when "Sprinkle Carrier Pattern Select [bb102]" is set to other than "Disabled (00)".
- When the carrier frequency is changed, the operation rate is 2kHz per second.

Code	Item	Description	Data	Initial value
bb103	Automatic carrier reduction selection	The automatic carrier reduction function does not work.	00	00
		Reduces the carrier according to the output current.	01	
		Reduce the carrier according to the cooling fin temperature.	02	

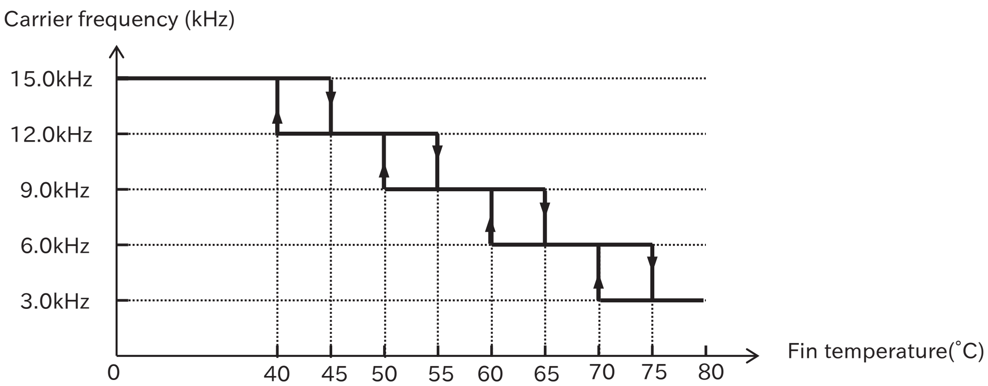
■Reduction Curve for Output-Current-Dependent ([bb103]=01)

- If the output current exceeds a certain percentage of the rated output current, the carrier frequency is reduced.
- The carrier frequency automatically recovers when the output current drops.



■Reduction Curve for Cooling-Fin Temperature Dependence ([bb103]=02)

- When the cooling fin temperature exceeds a certain value, the carrier frequency is reduced.
- The carrier frequency automatically recovers when the temperature drops.



9.10.3 Reduce motor electromagnetic noise

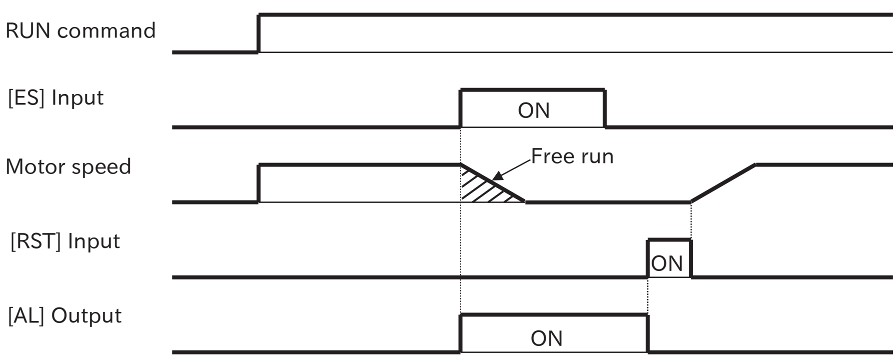
- Enabling "Sprinkle Carrier Pattern Selection [bb102]" may reduce the electromagnetic noise of the motor due to low carrier frequency.
- When [bb102] is set to "Pattern 1 valid (01)", it is possible to cut electromagnetic sound in a certain area and change the electromagnetic sound from the motor.
- When "Sprinkle carrier pattern selection [bb102]" is set to "Pattern 1 valid (01)",The carrier frequency of the inverter is about the same as when "Carrier frequency [bb101]" is set to 2.5kHz.
- The electromagnetic noise reduction effect of the motor varies depending on the motor used. Depending on the motor characteristics, there may be no effect.

Code	Item	Description	Data	Initial value
bb102	Sprinkle carrier pattern selection	Disabled: Carrier frequency set in "Carrier frequency [bb101]" is used for operation.	00	00
		Pattern 1 valid: Changing the carrier frequency at a fixed cycle may reduce electromagnetic noise from the motor.	01	

9.10.4 Trip the inverter externally

- The external trip function generates an "external trip error [E012]" by assigning an "external error [ES](033)" input terminal to the "input terminal function ([CA-01] to [CA-08])" and ON the terminal.
- Use this function when the inverter is to be tripped by an error (trip) signal generated by a peripheral system, etc.
- If "External trip error [E012]" occurs, trip is not canceled even if the "External error [ES]" inputterminal is turned OFF. Reset the trip by resetting or turning the power off and then on again.
- [ES] If the trip release is performed while the inputterminals remain ON, the [E012] occurs again. Before releasing the trip, make sure that the [ES] inputterminal is OFF.
- Restart after reset follows the setting of "Restart after reset release [bb-41]". For details, refer to "9.7.5 Start after Trip Reset or Power On".
- [E012] occurs when the [ES] inputterminal is ON even when the inverter is stopped outputting.

Code	Item	Description	Data	Initial value
CA-06	Input terminal function	External error [EXT]: When this signal is turned ON, "External trip error [E012]" will occur.	033	033

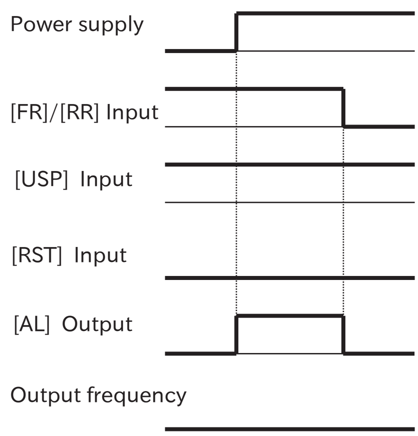


9.10.5 Prevent starting immediately after power-on

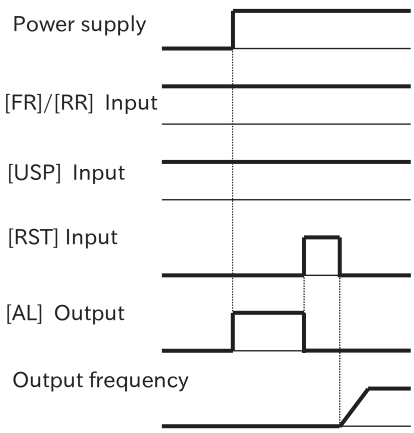
- The power restoration restart prevention function generates "USP error [E013]" when the power is turned on while the operation command to the inverter remains ON to prevent a sudden start. To use this function, assign "Prevent restart after power restoration [USP](034)" to the input terminal or set "[USP] setting selection [CA-73]" to "Enabled (01)". When "Disable (00)" is selected, this function operates when the [USP] pin input is ON, and when "Enable (01)", this function operates at all times regardless of the input pin status.
- The "USP error [E013]" trip can also be released by turning OFF the operation command in addition to the resetting operation. (e.g. 1)
- If the trip is released while the operation command is ON, the inverter starts operation at the same time as the release. (e.g. 2)
- If the operation command is ON after the power is turned on, normal operation will occur. (e.g. 3)
- Unlike other trips, "USP error [E013]" is automatically cancelled when the operation command is turned OFF.
- This function performs judgment for up to 2 seconds after the control power supply is established.

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Preventing power restoration restart [USP]: If the power is turned on while this signal and the operation command are ON, a "USP error [E013]" will occur.	034	-
CA-73	[USP] active selection	Disabled: [USP] input-pin enabled	00	00
		Enabled: Always enable the power restart prevention function	01	

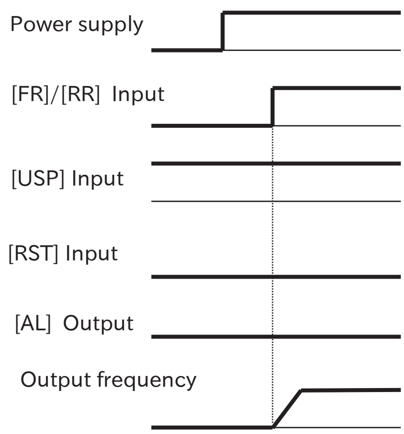
(e.g. 1) Turning the power ON with the operation command ON
(Cancel by operation command OFF)



(e.g. 2) Turning the power ON with the operation command ON
(Cancel by [RST] connector)



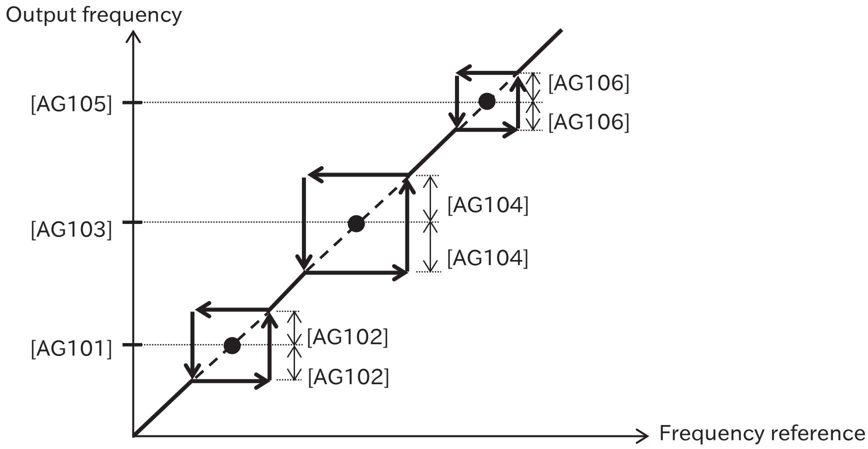
(e.g. 3) Operation command after power ON
(normal operation)



9.10.6 Jump frequency

- The frequency jump function is used when the actuator is operated avoiding the resonance point of the load machine system.
- Three jump frequencies can be set.
- The output frequency outside the range of the jump command changes continuously according to the normal acceleration/deceleration time.
- When this function is set, acceleration or deceleration stops at a frequency outside the jump frequency range when the output frequency is set within the jump frequency range to avoid constant speed operation within the jump frequency range. In addition, "Icon 2 LIM detailed monitor [dC-37]" displays "Upper/lower limit, jump frequency setting limit in progress (05)". For details on [dC-37], refer to "10.3.7 Checking the details of the warning status of the inverter".

Code	Item	Description	Data	Initial value
AG101	Jump frequency 1, 1st-motor	Sets the center of the frequency range that you want to jump. 0.00 For Hz, the frequency-jump function is disabled.	0.00 to 590.00 Hz	0.00
AG103	Jump frequency 2, 1st-motor			
AG105	Jump frequency 3, 1st-motor			
AG102	Jump frequency width 1, 1st-motor	Set 1/2 of the frequency width to be jumped. Jumps the range of ± jump frequency width from the jump frequency.	0.00 to 10.00 Hz	0.50
AG104	Jump frequency width 2, 1st-motor			
AG106	Jump frequency width 3, 1st-motor			



9.10.7 Select cooling fan operation

- The following cooling fan operations can be selected by the setting of cooling fan operation selection [bA-70].
  - Always run the cooling fan.
  - Operate the cooling fan under any conditions when the cooling fin temperature reaches 60°C or higher for 3 minutes during inverter operation and after shutdown.
  - Operate the cooling fan when the cooling fin temperature reaches approximately 40°C or higher.
- If an undervoltage status occurs due to a momentary power failure or power shutdown while the cooling fan is running, the cooling fan will pause and automatically recover after power is restored.
- Refer to "9.11.10 Outputting Cooling Fan Life Warning" and "10.3.3 Monitoring Life Warning" and "16.2.6 Life Warning Output" for more information on the cooling fan life diagnosis, "Fan Life Indication [WAF]" and "Cooling Fan Cumulative Operating Time Monitor [dC-26]".
- The cooling fin temperature can be checked in "Cooling fin temperature monitor [dC-15]". For details, refer to "10.3.2 Monitoring Cooling Fin Temperature".

Code	Item	Description	Data	Initial value
bA-70	Cooling fan control method selection	Continuous operation: The cooling fan operates at all times.	00	01
		ON during operation: When the inverter enters the operating state, the cooling fan operates automatically. It also operates for 3 minutes after the inverter operation is stopped. However, if the cooling fin temperature still exceeds 50˚C after three minutes, the cooling fan will continue to operate until the temperature drops below 50˚C and then stop after a further three minutes. Note: Even when operation is stopped, if the cooling fin temperature exceeds 60˚C, the cooling fan will start operating.	01	
		Depends on temperature If the temperature of the cooling fins in the inverter exceeds approximately 40˚C, the cooling fan will operate. When the cooling fin temperature is 40˚C or less for 3 minutes, it stops.	02	

9.10.8 Monitor the temperature of the motor

- Thermistors installed in external devices such as motors can be wired to the inverter and set functions to protect the temperature of the external devices.
- When using an external thermistor, wire between the [AUT]-[COM] terminals of the control terminal block after setting "Thermistor selection [Cb-40]" to "PTC (resistor) enable (01)". In this case, the common is the [COM] terminal regardless of the sink/source logic.
- If the resistance of PTC thermistor is greater than or equal to the thermistor error level [bb-70], "thermistor error [E035]" will occur. Adjust [bb-70] or "Thermistor Adjust [Cb-41]" according to the characteristics of the thermistor to be used.
- When "Thermistor selection [Cb-40]" is set to "PTC (resistance) enable (01)", the setting of "Input terminal function [AUT] selection [CA-05]" is disabled.
- Separate the wiring of the external thermistor from other common wires as twisted wires. Keep the wire length within 20 m. For wiring, refer to "5.4 Control Circuit Terminal Block".
- Since the current flowing through the thermistor is a weak current, consider wiring separation, etc. so that the thermistor will not be affected by noise caused by motor current, etc.

Code	Item	Description	Data	Initial value
bb-70	Thermistor error level	Set the thermal resistance to generate a thermistor error [E035] according to the thermistor specifications. Valid when "Thermistor selection [Cb-40]" is "PTC (resistor) valid (01)".	0 to 10000 Ω	3000
Cb-40	Thermistor type selection	Disabled	00	00
		PTC (resistor) enabled	01	
Cb-41	Thermistor gain adjustment	Use this for gain adjustment.	0.0 to 1000.0	100.0

9.10.9 Detect a ground fault

- Set the ground fault detection protective function in the ground fault detection selection [bb-64].
- When the ground fault detection protective function is enabled, the ground fault detection is performed when the power is turned on. If the output of the inverter (between the inverter output terminal and motor) is grounded, "Ground fault error [E014]" will occur.
- If the ground fault is detected when the motor has the induced voltage (which is running in coasting mode), the ground fault error [E014] may be detected incorrectly. In this case, disable the ground fault detection selection or turn on the power with the induced voltage dropped sufficiently.
- If a trip has occurred, it will not operate even if the ground fault detection protection function is enabled. [E014] is a serious failure error. It cannot be cleared by resetting operation. Shut off the power supply, check the insulation and wiring of the motor, and check that there is no problem before turning the power on again.
- This function detects a ground fault between the inverter output and the motor. It cannot detect a ground fault on the input side.

Code	Item	Description	Data	Initial value
bb-64	Detect ground fault selection	Disabled: Earth fault detection function is disabled.	00	00
		Enabled: Earth fault detection function is enabled.	01	

9.10.10 Detect an input phase loss

- Set the input open-phase protective function with the input open-phase selection [bb-65].
- If [bb-65] is set to "Enabled (01)", "Input Phase Loss Error [E024]" will occur if the input power line is disconnected or disconnected and the phase loss status continues.
- 「If an input open-phase error [E024] occurs, the power supply to the inverter must be disconnected and the status of the wires and breakers must be checked. ([E024] may also occur when the voltage imbalance of the three-phase input power supply is significant.)
- If the "Input-Phase Loss Judgment Level [bb-77]" is set to a small value, false detection is likely to occur during normal operation. If it is set to a large value, false detection may not be possible during phase loss. In addition, the detection accuracy will deteriorate when the motor is in the regenerative state or when the output current is very small with respect to the inverter rated current. Adjust [bb-77] according to your system. Be sure to check that there is no problem. If it does not improve by adjusting [bb-77], set "Input Phase Loss Selection [bb-65]" to "Disabled (00)".

Code	Item	Description	Data	Initial value
bb-65	Input phase loss detection enable	Disabled: Input phase loss function disabled.	00	00
		Enabled: Input phase loss function is enabled.	01	
bb-77	Input phase loss detection level	Adjust the judgment level of the input phase loss.	0 to 200	50

9.10.11 Output phase loss detection sensitivity

- Set the output phase loss protective function with the output phase loss selection [bb-66].
- If [bb-66] is set to "Enabled (01)", "Output Phase Loss Error [E034]" will occur if the status of phase loss continues due to disconnection or disconnection of the motor wire, etc.
- This function operates when the outputfrequency is equal to or greater than 5 Hz and equal to or less than 100Hz.
- Set "Output-phase failure detection sensitivity [bb-67]" to a value less than or equal to the current that flows constantly, assuming that the rated current is 100%.
- If the drive motor capacity is smaller than the inverter capacity or the "Carrier frequency [bb101]" is lower, an out-of-phase may be incorrectly detected. Detection accuracy may also deteriorate depending on the environment of your system. Adjust [bb-67] and [bb101] according to your system. Be sure to check that there is no problem. If it does not improve by adjusting [bb-67] or [bb101], set "Output Phase Loss Selection [bb-66]" to "Disable (00)".

Code	Item	Description	Data	Initial value
bb-66	Output phase loss detection enable	Disabled: Output phase loss function disabled.	00	00
		Enabled: Output phase loss function is enabled.	01	
bb-67	Output phase loss detection sensitivity	Adjusts the sensitivity of the output phase loss.	1 to 100 %	10
bb101	Carrier frequency	Set the carrier frequency of PWM wave outputting from the inverter to the motor.	2.0 to 15.0 kHz (ND: Normal load) 2.0 to 10.0 kHz (LD: Light load)	2.0

9.11 Warning signal

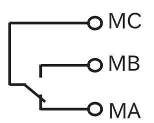
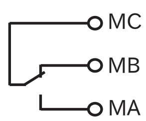
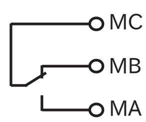
9.11.1 Alarm signal

- By assigning "Alarm signal [AL](017)" to any of the output terminal function selections ([CC-01]/[CC-02]/[CC-07]), a signal is output when the inverter trips.
- In the "Output terminal a/b(NO/NC" selections ([CC-11], [CC-12], and [CC-17]), the output specifi cations of the a-contact (NO: normally open) or b-contact (NC: normally closed) can be set individually for the output terminals [UPF]/[DRV] and the relay output terminals.
  - A contact (the contact closes in NO):ON and the contact opens in OFF)
  - Contact b (Contact closes at NC):OFF and contact opens at ON)
- In the default status, the [AL] signal is assigned to the c-contact relay of [MB]-[MC]/[MA]-[MC].
  - "Output terminal function [AL] selection [CC-07]" = "Alarm signal [AL](017)"
  - "Output terminal [ML]a/b(NO/NC) selection [CC-17]" = "Normally closed (01)"
- If the system recognizes an error when the inverter power is cut off, this may be improved by changing the wiring and contact selection.
- In the default setting, [MA]-[MC] closes when the power is turned OFF and opens when there is no problem with the inverter at the power ON, as shown in the table below. To avoid this condition, set "Output terminal [ML]a/b (NO/NC)[CC-17]" to "a contact (NO) (00)", or change the error detecting wire.
- Refer to Section 5.4 "Control Terminal Block" for the electric specifi cations of the relay contacts ([MB]-[MC] and [MA]-[MC]).

Output terminal [ML] active state [CC-17]	Power supply	Inverter status	Status output terminal	
			MA - MC	MB - MC
00 (Initial setting)	ON	Abnormal condition	Close	Open
		Normal condition	Open	Close
	OFF	-	Open	Close
01	ON	Abnormal condition	Open	Close
		Normal condition	Close	Open
	OFF	-	Open	Close

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Alarm signal[AL]: This signal turns ON when a trip occurs.	017	002 001 017
CC-11 CC-12 CC-17	Output terminal active state	Operates as a-contact (NO: normally open).	00	00
		Operates as a b-contact (NC: normally closed).	01	

■Logic for relay output operation

<table>
<tr><th></th><th colspan="2">Power ON</th><th>Power OFF</th></tr>
<tr><td>CC-17</td><td>01 (Normal close)</td><td>00 (Normal open)
(Initial setting)</td><td>-</td></tr>
<tr><td>Normal condition</td><td>
</td><td>
</td><td rowspan="2">
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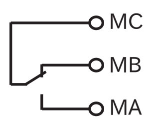
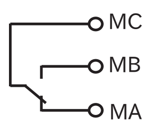
<tr><td>Abnormal condition</td><td>
</td><td>
</td></tr>
</table>

9.11.2 Output a serious failure signal

- By assigning "major failure signal [MJA](018)" to one of the output terminal function selections ([CC-01]/[CC-02]/[CC-07]), the output of a major failure signal is enabled.
- The trips judged as serious failures are as shown in the table below. If these conditions occur, the trip release by resetting cannot be performed.
- When this signal is output, the hardware of the inverter may have failed. Check the trip history and take appropriate action.

Error Code	Name	Contents
E008	Memory error	There is an error in the storage element of the inverter.
E011	CPU failure	There is an error in the inverter CPU of the drive.
E014	Earth fault error	The inverter has a ground fault.
E030	IGBT(Driver) error	There is an error in the main elements of the inverter.

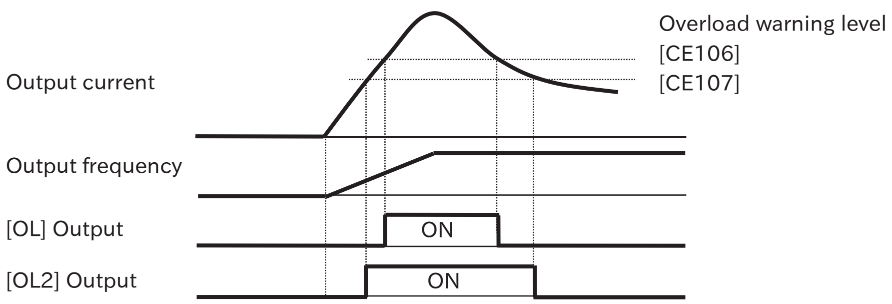
Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Heavy Fault Signaling [MJA]: This signal turns ON when an error (trip in the table above) that is judged to be a serious failure occurs.	018	002 001 017

9.11.3 Outputs warning in case of overload

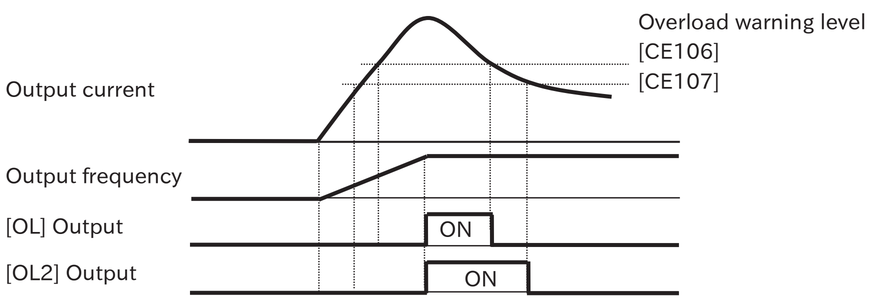
- The overload notice can be output by assigning "Overload notice [OL](035)"/"Overload notice 2 [OL2](036)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]).
- [OL]/[OL2] The signal is output when the output current exceeds the respective overload forewarning level.
- Signal can be output according to the operation status by changing "Overload notice signal output mode selection [CE105]".
- If the overload notice level is set too high, an overcurrent error may occur before the overload notice signal is output. In this case, lower the overload forewarning level.
- When "Overload notice signal output mode selection [CE105]" is set to "Constant speed medium only (01)" and the output frequency command destination is the analogue input, if the frequency command input fluctuates finely, it may not be judged as constant speed operation. In such cases, change [CE105] to "Acceleration/Deceleration, Constant Speed (00)" or increase "Output Current-related Output Terminal Function Filter Time Constant (LOC/LOC2/OL/OL2)[CE-61)".

Code	Item	Description	Data	Initial value
CE105	Overload signal output Mode selection	Valid during acceleration/deceleration and constant speed	00	00
		Valid only during constant speed	01	
CE106	Overload warning level 1	Sets the current level at which the overload notice signal is output.	(0.00 to 2.00)×Inverter rated output current A	1.15×Rated output current
CE107	Overload warning level 2			
CE-61	Output current related filter for terminal function	[LOC]/[LOC2]/[OL]/[OL2] Sets the filter for the detection level.	0 to 2000 ms	300
CC-01 CC-02 CC-07	Output terminal function	Overload warning notice [OL]: This signal is turned ON when the output current exceeds the overload forewarning level 1.	035	002 001 017
		Overload warning notice 2[OL2]: This signal is turned ON when the output current exceeds the overload forewarning level 2.	036	

■When overload warning signal output mode is in acceleration/deceleration or enabled during constant speed operation ([CE105] = 00))



■When overload warning signal output mode is enabled only during constant speed operation ([CE105] = 01])

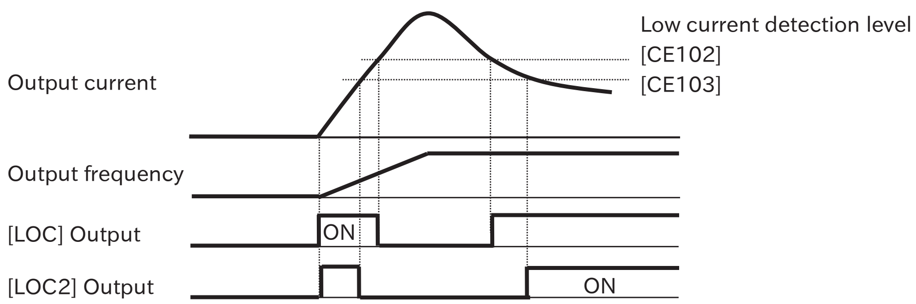


9.11.4 Warning signal in case of low current

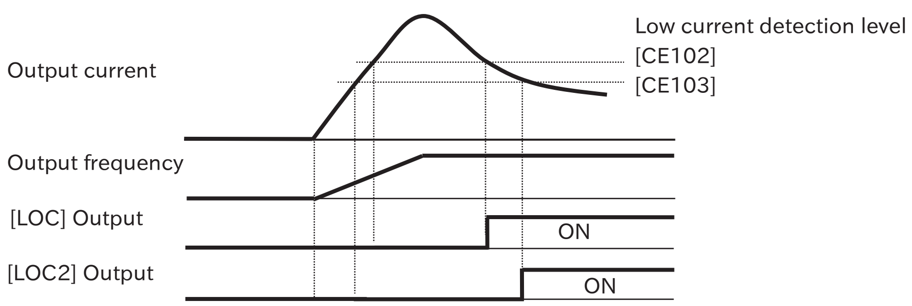
- Low-current signals can be output by assigning "Low-current signals [LOC](033)"/ "Low-current signals 2 [LOC2](034)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]).
- [LOC]/[LOC2] The signal is output when the load becomes lighter and the output current falls below "Low current detection level 1 [CE102]"/"Low current detection level 2 [CE103]."
- Signal can be output according to the operation status by changing "Low current signal output mode selection [CE101]".
- If "Low current signal output mode selection [CE101]" is set to "Constant speed medium only (01)" and the output frequency command destination is an analog input, the operation may not be judged as constant speed operation if the frequency command input fluctuates finely. In such cases, change [CE101] to "Acceleration/Deceleration, Constant Speed (00)" or increase "Output Current-related Output Terminal Function Filter Time Constant (LOC/LOC2/OL/OL2)[CE-61)".

Code	Item	Description	Data	Initial value
CE101	Low current signal output mode selection	Valid during acceleration/deceleration and constant speed	00	01
		Valid only during constant speed	01	
CE102	Low current detection level 1	Sets the output current level at which the overload warning signal is output.	(0.00 to 2.00)×Inverter rated output current A	1.00×Rated output current
CE103	Low current detection level 2			
CE-61	Output current related filter for terminal function	[LOC]/[LOC2]/[OL]/[OL2] Sets the filter for the detection level.	0 to 2000 ms	300
CC-01 CC-02 CC-07	Output terminal function	Low Current Signaling [LOC]: This signal turns ON when the output current falls below the low-current detection level.	033	002 001 017
		Low-current indication 2[LOC2]: This signal turns ON when the output current falls below the low-current detection level 2.	034	

■When the low-current signal mode is enabled during acceleration/deceleration or constant speed operation ([CE101] = 00))



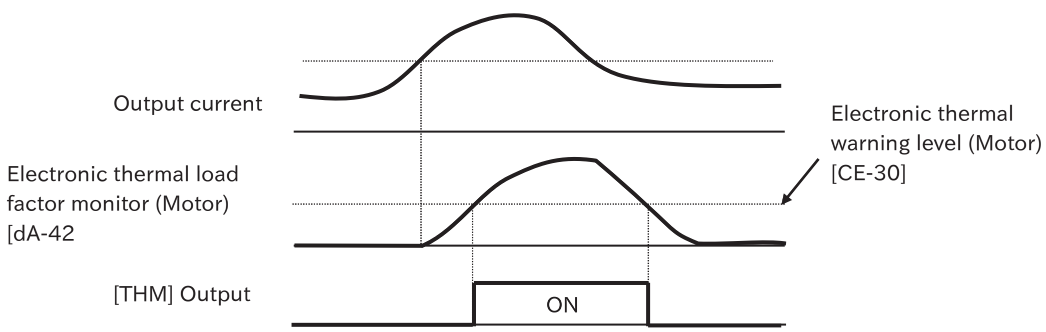
■Low-current signal mode is enabled only during constant speed operation ([CE101] = 01).



9.11.5 Warning signal before electronic thermal protection of motor

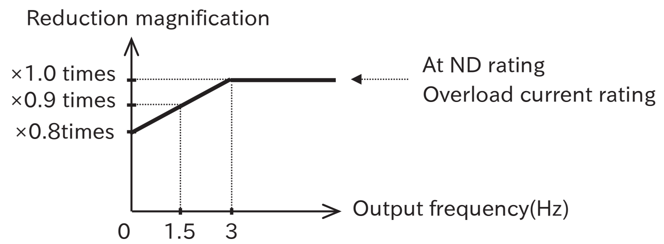
- Electronic thermal warning signal can be output by assigning "Electronic thermal warning (motor) [THM](026)" to one of the output terminal function selections ([CC-01], [CC-02], and [CC-07]).
- Before "Motor overload error [E005]" occurs in the electronic thermal function, the status can be known by outputting a warning signal.
- An "Motor overload error [E005]" occurs when the accumulated flow of electronic thermal load ratio monitor (motor) [dA-42]" reaches 100.00%.
- Refer to "8.1.4 Electronic Thermal Setting" for details of the electronic thermal setting for the motor.

Code	Item	Description	Data	Initial value
dA-42	Electronic thermal load factor monitor (Motor)	Electronic thermal load factor monitor (Motor) If this monitor reaches 100.00%, "Motor overload error [E005]" occurs.	0.00 to 100.00 %	-
CE-30	Electronic thermal warning level (Motor)	Set the level to turn ON the electronic thermal warning (motor) [THM]. When [dA-42] exceeds this setting, the [THM] signal turns ON. It does not work when set to 0.00%.		85.00
CC-01 CC-02 CC-07	Output terminal function	Electronic thermal warning (motor) [THM]: When [dA-42] exceeds the [CE-30] setting, this signal turns ON.	026	002 001 017



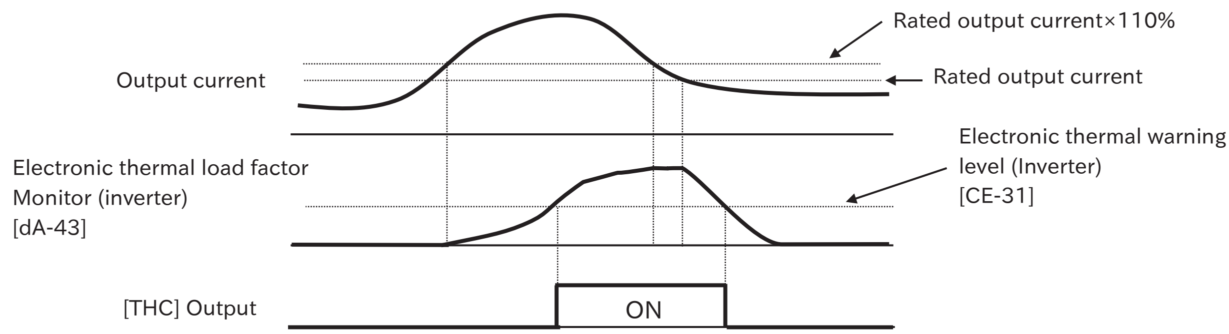
9.11.6 Warning signal before electronic thermal protection of the inverter

- Electronic thermal warning signal can be output by assigning "Electronic thermal warning (inverter) [THC](027)" to one of the output terminal function selections ([CC-01], [CC-02], and [CC-07]).
- Before "Controller overload error [E039]" occurs in the electronic thermal function, the status can be known by outputting a warning signal.
- 「The controller overload error [E039] occurs when the totalized value of the electronic thermal load factor monitor (inverter) [dA-43] reaches 100.00%.
- The characteristics of the inverter electronic thermal are fixed for each type to protect the inverter. Adjustment by parameters is not possible.
- Regardless of the "Load spec. selection [Ub-03]" setting, the overload current rating at ND rating applies to the electronic thermal of the inverter. To protect the inverter, if it is less than 3.0Hz, the reduction ratio is applied as shown in the figure below. Therefore, due to operation in the low-speed range, the electronic thermal warning (inverter) [THC] may be outputted faster.



- When the output current is less than the rated output current of the inverter, the integrated electronic thermal load factor of the inverter subtracts 0% from 100% at a rate that changes linearly in 10 seconds.

Code	Item	Description	Data	Initial value
dA-43	Electronic thermal load factor monitor (Inverter)	Electronic thermal load factor monitor (Motor) If this monitor reaches 100.00%, "Controller overload error [E039]" occurs.	0.00 to 100.00 %	-
CE-31	Electronic thermal warning level (Inverter)	Set the level to turn ON the electronic thermal warning (inverter) [THC]. When [dA-43] exceeds this setting, the [THC] signal turns ON. It does not work when set to 0.00%.	0.00 to 100.00 %	85.00
CC-01 CC-02 CC-07	Output terminal function	Electronic Thermal Warning (Inverter) [THC]: When [dA-43] exceeds the [CE-31] setting, this signal turns ON.	027	002 001 017



Note: Example of operation during constant speed operation at the highest frequency

9.11.7 Warning signal when the received power voltage is high

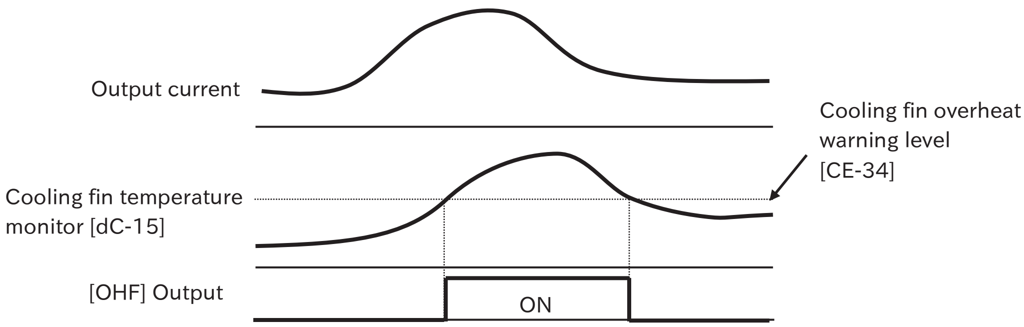
- By assigning "Receiving overvoltage [OVS](081)" to one of the output terminal function selections ([CC-01], [CC-02], and [CC-07]), a signal is output when the power of the inverter is high.
- The power receiving overvoltage signal is turned ON when the DC voltage across P-N continuously exceeds the voltage level set in "Power receiving voltage level selection [bb-62]" for 100 seconds.
- When "Power receiving overvoltage selection [bb-61]" is "warning (00)", the [OVS] signal is outputted.
- When [bb-61] is "Error (01)", the [OVS] signal is outputted, and tripped at "Receiving overvoltage error [E015]".
- This function does not operate during operation and is detected only when the inverter is stopped.
- Even if the power receiving overvoltage state continues, the trip can be cancelled. However, if the power-receiving overvoltage status continues for 100 seconds after releasing the trip, it trips again with "Power-receiving overvoltage error [E015]".

Code	Item	Description	Data	Initial value
bb-61	Power supply overvoltage selection	[OVS] Outputs the signal.	00	00
		[OVS] Outputs a signal. Trip at "Receiving overvoltage error [E015]".	01	
bb-62	Power supply overvoltage level setting	Sets the incoming overvoltage level.	200V class: DC300.0 to 400.0 V 400V class: DC600.0 to 800.0 V	200V class 390.0 400V class 780.0
CC-01 CC-02 CC-07	Output terminal function	Receiving overvoltage [OVS]: When [bb-62] setting or higher is maintained for 100 seconds while the inverter is stopped, a signal is output. OFF: Level than incoming overvoltage ON: Incoming overvoltage or higher	081	002 001 017

9.11.8 Warning signal when the temperature of the cooling fin rises

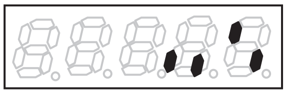
- Allocation of "Cooling fin overheat warning [OHF](032)" to any of the "Output terminal function selections ([CC-01], [CC-02], and [CC-07])" enables output of a warning signal when the cooling fin overheats.
- Monitor the temperature of the cooling fins inside the inverter. Before "Temperature error [E021]" occurs, the status can be known by signal ling.
- If the cooling fin temperature exceeds 105˚C max, "Temperature error [E021]" will occur.

Code	Item	Description	Data	Initial value
dC-15	Cooling fin temperature monitor	Monitors the temperature of the cooling fins.	-20.0 to 200.0 ℃	-
CE-34	Cooling fin overheat warning level	Set the cooling fin temp. to turn ON the cooling fin overheat warning [OHF].	0 to 200 ℃	100
CC-01 CC-02 CC-07	Output terminal function	Cooling fin overheat warning [OHF]: When the [dC-15] value exceeds the [CE-34] setting, this signal is turned ON.	032	002 001 017



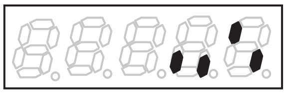
9.11.9 Warning signal of electrolytic capacitor life on the board

- By assigning "Capacitor life notice [WAC](029)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]), a warning signal for the electrolytic capacitor life on the PCB can be output.
- The life of the capacitor on the board is diagnosed from the temperature inside the inverter and the ambient temperature set to "Average ambient temperature of cooling fan [bA-72]".
- The status of this signal can also be monitored in the Life Diagnostic Monitor [dC-16].
- When the warning of the electrolytic capacitor life occurs, it is recommended to replace the inverter body.

Code	Item	Description	Data	Initial value
dC-16	Life assessment monitor	Displays the life judgment of the electrolytic capacitor on the board, the cooling fan, the power module that is the main element of the inverter, and the internal circuit (inrush current prevention circuit) that suppresses inrush current to the inverter.	 ON OFF 4 3 2 1 ON: Life span 1: Capacitor on board OFF: Normal 2: Cooling fans 3: Power modules 4: Inrush current prevention circuit	-
bA-72	Ambient temperature	Set the ambient temperature of the operating environment.	-10 to 50 ℃	40
CC-01 CC-02 CC-07	Output terminal function	Capacitor life indicator [WAC]: Outputs a warning of the life of the electrolytic capacitor on the board. OFF: No warning ON: Circuit board replacement due to the life of the capacitor	029	002 001 017

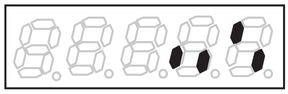
9.11.10 Warning signal of cooling fan life

- By assigning "Fan life notice [WAF](030)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]), a warning signal for the cooling fan life can be output.
- The life of the cooling fan is estimated from the cumulative operating hours of the cooling fan and the ambient temperature set to "ambient temperature [bA-72]", and when it is time to replace the cooling fan, a signal is outputted.
- After replacing the cooling fan, the accumulated operating time is cleared by Clear Cooling Fan Cumulative Time [bA-71]. This enables the life assessment of the cooling fan after replacement.
- The status of this signal can also be monitored in the Life Diagnostic Monitor [dC-16].
- Check for clogging of the cooling fan when the "Fan life indicator [WAF]" signal is output.
- Do not clear the cumulative operation time except when replacing the cooling fan, as the life diagnosis of the cooling fan will not work properly.
- When the fan is stopped in the "Cooling fan operation selection [bA-70]", the accumulated operation time of the cooling fan is not performed.

Code	Item	Description	Data	Initial value
dC-16	Life assessment monitor	Displays the life judgment of the electrolytic capacitor on the board, the cooling fan, the power module that is the main element of the inverter, and the internal circuit (inrush current prevention circuit) that suppresses inrush current to the inverter.	 ON OFF 4 3 2 1 ON: Life span 1: Capacitor on board OFF: Normal 2: Cooling fans 3: Power modules 4: Inrush current prevention circuit	-
bA-71	Cooled fan accumulated time clearing select	Disable	00	00
		Clears the accumulated operating time of the cooling fan.	01	
bA-72	Ambient temperature	Set the ambient temperature of the operating environment.	-10 to 50 ℃	40
CC-01 CC-02 CC-07	Output terminal function	Fan life indicator [WAF]: Outputs the life indicator of the cooling fan. OFF: No warning ON: Time to replace cooling fan due to lifetime	030	002 001 017

9.11.11 Warning signal of inverter main element life

- By assigning "Power Module Life Indication [WAP](097)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]), a signal can be output to warn that the life of the power module, which is the main element of the inverter, is approaching.
- By assigning "Inrush-proof circuit life notice [WAIC](098)" to any of the "output terminal function selections ([CC-01], [CC-02], and [CC-07])", a signal can be output to alert the user that the life of the internal circuit (inrush current prevention circuit) that suppresses inrush current flowing through the inverter is approaching.
- The status of this signal can also be monitored in the Life Diagnostic Monitor [dC-16].
- When the warning of the power module life or the inrush current prevention circuit life occurs, it indicates that the replacement time of the inverter main unit is near. Consider early replacement.

Code	Item	Description	Data	Initial value
dC-16	Life assessment monitor	Displays the life judgment of the electrolytic capacitor on the board, the cooling fan, the power module that is the main element of the inverter, and the internal circuit (inrush current prevention circuit) that suppresses inrush current to the inverter.	 ON: Life span 1: Capacitor on board OFF: Normal 2: Cooling fans 3: Power modules 4: Inrush current prevention circuit	-
CC-01 CC-02 CC-07	Output terminal function	Power Module life indicator [WAP]: Outputs the power module life indicator. OFF: No warning ON: The power module is near the end of its life. Consider updating the inverter.	097	002 001 017
		Emergency protection circuit life indicator [WAIC]: Outputs a warning of the life of the inrush current prevention circuit. OFF: No warning ON: The inrush current circuit is nearing the end of its service life. Consider updating the inverter.	098	

9.11.12 Warning signal when the operating time has elapsed/power ON time has elapsed

- By assigning "RUN time over [RNT](024)" or "Power ON time over [ONT](025)" to any of the output terminal function selections ([CC-01], [CC-02], and [CC-07]), a signal can be output when the operation time or power ON time exceeds the set time.
- When the cumulative operation time of the inverter exceeds the setting time of "RUN time/power ON time level[CE-36]", the [RNT] signal is outputted. Cumulative operation time can be checked in "Cumulative time during RUN monitor [dC-22]".
- When the cumulative power ON time exceeds the set time of "RUN time/power ON time level[CE-36]", the [ONT] signal is issued. Cumulative power ON time can be checked in "Cumulative power ON time monitor [dC-24]".
- When setting the value as a guide for replacing the inverter, set it with a margin.
- The power ON times include not only the main-circuit power supply but also the power supply status of only the external ＋24V power supply.

Code	Item	Description	Data	Initial value
dC-22	Accumulated RUN time monitor	The inverter operation time is accumulated and stored for monitoring.	0 to 1,000,000 hr	-
dC-24	Accumulated power-on time monitor	The power ON hours of the inverter are accumulated and stored for monitoring.		
CE-36	Accumulated RUN time (RNT) Accumulated Power-on time (ONT) setting	[RNT], [ONT] Sets the elapsed time when the signal is output.	0 to 100,000 hr	0
CC-01 CC-02 CC-07	Output terminal function	RUN time-over [RNT]: RUN time-over signal is outputted. OFF: Less than set duration ON: Set duration or longer	024	002 001 017
		Power ON time-over [ONT]: Power ON time-over signal is outputted. OFF: Less than set duration ON: Set duration or longer	025	

■Setting of RUN time over [RNT]/Power ON time over [ONT]

RUN time-over [RNT]/Power ON time-over [ONT]		RUN time/power ON time level [CE-36] setting
e.g. 1	When the inverter is operated for 250 days/year × 8 hours × 5 years = 10000 hours for the first time after shipping from the factory, a warning is issued.	10000
e.g. 2	After (Example 1), when the inverter is operated for 250 days/year x 8 hours x 3 years = 6000 hours, a warning is issued.	16000 (10000+6000)
e.g. 3	When the inverter is turned ON for 300 days/year × 24 hours × 3 years = 21600 hours for the first time from the factory-shipped condition, an alarm is issued.	21600
e.g. 4	After (Ex. 3), 250 days/year × 8 hours × 5 years = 10000 hours, a warning is issued when the inverter is turned ON.	31600 (21600+10000)

9.11.13 Detection for disconnection and out of range of analog input

- By assigning "Analog burnout VRF[VRFDc](050)" or "Analog burnout IRF[IRFDc](051)" to any of the output terminal function selections ([CC-01]/[CC-02]/[CC-07]), analog burnout can be output. However, when "[VRF] Operating level selection at disconnection [CE-51]"/"[IRF] Operating level selection at disconnection ([CE-53])" is "Disabled (00)", this signal is not output. When used, it must be set to "Valid (in range) (01)" or "Valid (out of range) (02)".
- Window comparator signal can be output by assigning "Window comparator VRF [WCVRF](056)" and "Window comparator IRF[WCIRF](057" to any of "Output terminal function selection ([CC-01]/[CC-02]/[CC-07])".
- The [VRF]/[IRF] signal is output when the input value of the analog input [WCIRF]/[WCIRF] is within the range of "Window comparator [VRF] upper limit level [CE-40]" to "Window comparator [VRF] lower limit level [CE-43]" or "Window comparator [IRF] upper limit level [CE-40]" to "Window comparator [IRF] lower limit level [CE-44]". In addition, a hysteresis width can be provided at the upper/lower limit level.
- The window comparator signal output range is also applied to the analog disconnection signal. The signal ON/OFF status can be changed by setting [CE-51]/[CE-53]. Refer to the table below for details.
- The inverter can be operated with a specific frequency command even when the analog input becomes maximum due to a short-circuit failure or when the analog input becomes 0% due to disconnection. If this happens, set [CE-51]/[CE-53] to "Valid (Within Range) (01)" or "Valid (Out of Range) (02)", and set the analogue input value (%) equivalent to the frequency command that you want to output to "[VRF] Operating level at burnout [CE-50]" or "[IRF] Operating level at burnout [CE-52]". Refer to the table below for the analogue input type according to the setting of [CE-51]/[CE-53].

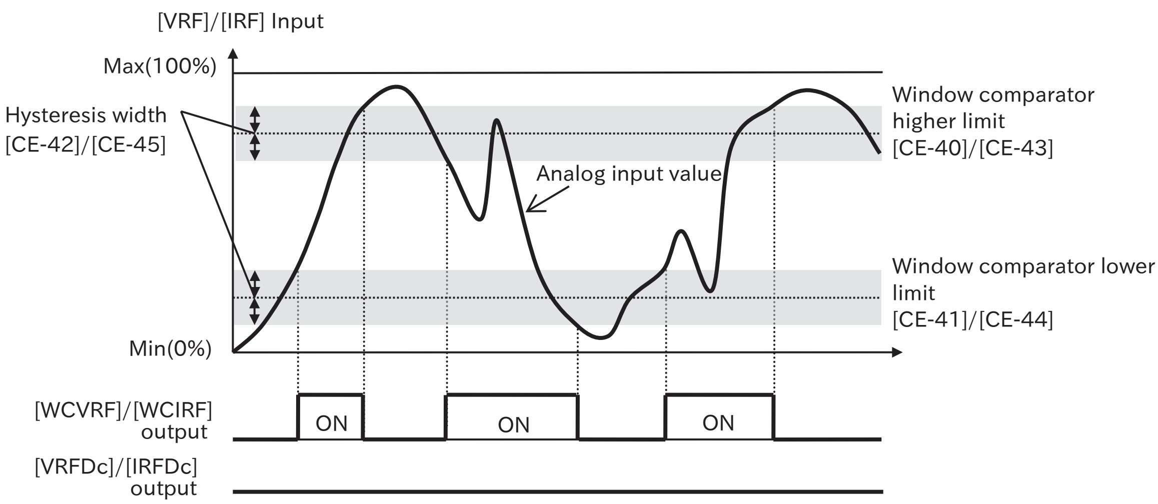
Operation set level implement timing [CE-51]/[CE-53]	Window comparator [WCVRF]/ [WCIRF]	Analog disconnection [VRFDc]/[IRFDc]	Analog input use value
Disable (00)	ON	OFF	The analog input value is used without change.
	OFF	OFF	The analog input value is used without change.
Valid (within range) (01)	ON	ON	[CE-50]/[CE-52] Use set value
	OFF	OFF	The analog input value is used without change.
Valid (out of range) (02)	ON	OFF	The analog input value is used without change.
	OFF	ON	[CE-50]/[CE-52] Use set value

- [VRFDc]/[IRFDc] When outputting a signal, "Operating level at disconnection ([CE-50], [CE-52])" can be used as the analog input instead of the actual analog input. However, if "Analogue command hold [AHD]" of the inputterminal function is ON, the held frequency command takes precedence.
- To use the analog disconnection signal as disconnection detection (analog input value: min.), set the analog input value to be judged as disconnection to the window comparator upper limit level ([CE-40] and [CE-43]).
- To use the analogue disconnection signal as short circuit detection (analogue input value: max.), set the analogue input value to be judged as short circuit to the window comparator lower limit level ([CE-41], [CE-44]).

Code	Item	Description	Data	Initial value
CE-40	[VRF] Window comparator higher limit	Sets the upper limit level of the window comparator. (For each of the lower limits of VRF/IRF upper limit, [CE-40]+([CE-42]×2), [CE-44]+([CE-45]×2) It becomes)	0 to 100 %	100
CE-43	[IRF] Window comparator upper limit			
CE-41	[VRF] Window comparator lower limit	Sets the lower limit level of the window comparator. (The upper limit of VRF/IRF lower limit is: [CE-40]-([CE-42]×2), [CE-43]-([CE-45]×2) It becomes.)	0 to 100 %	0
CE-44	[IRF] Window comparator lower limit			
CE-42	[VRF] Window comparator hysteresis width	Sets the hysteresis width for the upper/lower limit level. (The upper limit of VRF/IRF hysteresis-range setting is: ([CE-40]-[CE-41])/2, ([CE-43]-[CE-44])/2 It becomes.)	0 to 10 %	0
CE-45	[IRF] Window comparator hysteresis width			
CE-50	[VRF] Operation set level at disconnection or compare event	[WCVRF]/[WCIRF]/[VRFDc]/[IRFDc] For output, set the analogue input adoption value.	0 to 100 %	0
CE-52	[IRF] Operation set level at disconnection or compare event			
CE-51	[VRF] Operating Level Selection at Disconnection	Disabled	00	00
		Enabled (within range)	01	
		Enabled (out of range)	02	
CE-53	[IRF] Operating Level Selection at Disconnection	Disabled	00	00
		Enabled (within range)	01	
		Enabled (out of range)	02	
CC-01 CC-02 CC-07	Output terminal function	Analog burnout VRF[VRFDc]/Analog burnout IRF [IRFDc]: Outputs analog disconnection signal	050/051	002 001 017
		Window comparator VRF[WCVRF]: Window comparator IRF[WCIRF]: Outputs the window comparator signal.	056/057	

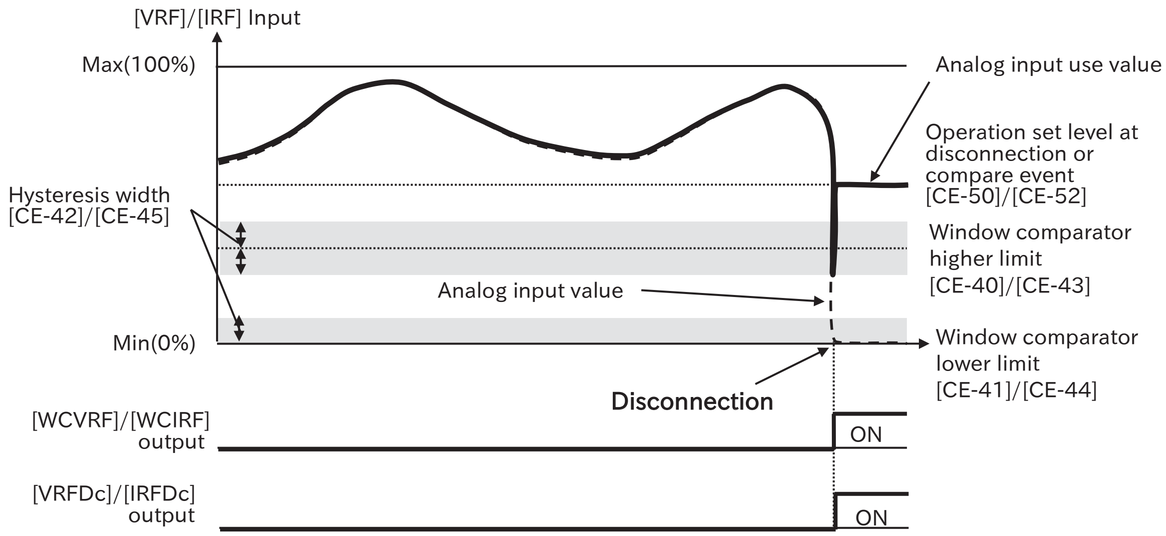
■Window comparator operation e.g. 1
[CE-51]/[CE-53] = Operation when "Disabled (00)" is set

・ When [CE-51]/ [CE-53] is "Disabled (00)", the [WCVRF]/[WCIRF] signal is outputted when the analogue input is within the window comparator upper/lower limit level range. However, the [VRFDc]/[IRFDc] signal does not operate.



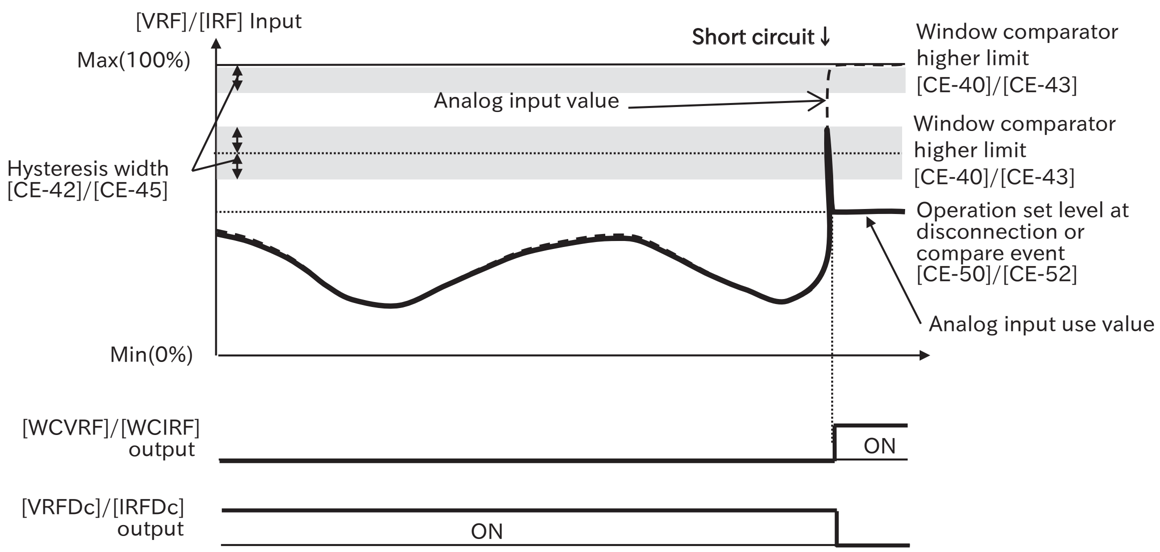
■Window comparator operation e.g. 2
[CE-51]/[CE-53] = Disconnection detection when "valid (within range) (01)" is set

・If the lower limit level, upper limit level, or operating level at disconnection is set as shown in the figure below, if the analog input becomes the smallest value due to disconnection, the analog disconnection signal will be turned ON, and the operating level set value at disconnection will be adopted as the analog input value instead of the actual analog input value.
・When [CE-51]/ [CE-53] is "valid (within range) (01)", the [VRFDc]/[IRFDc] signal has the same operation as the [WCVRF]/[WCIRF] signal.



■Window comparator operation e.g. 3
[CE-51]/[CE-53] = Short-circuit detection when "valid (out of range) (02)"

・If the lower limit level, upper limit level, or open circuit operating level is set as shown in the figure below, if the analog input reaches its max. value due to a short circuit, the analog disconnection signalbecomes ON, and the operating level setting value at the break is adopted as the analog input value instead of the actual analog input value.
・When [CE-51]/ [CE-53] is set to "Valid (Out of Range) (02), [VRFDc]/[IRFDc] signal has the opposite action to the [WCVRF]/[WCIRF] signal.

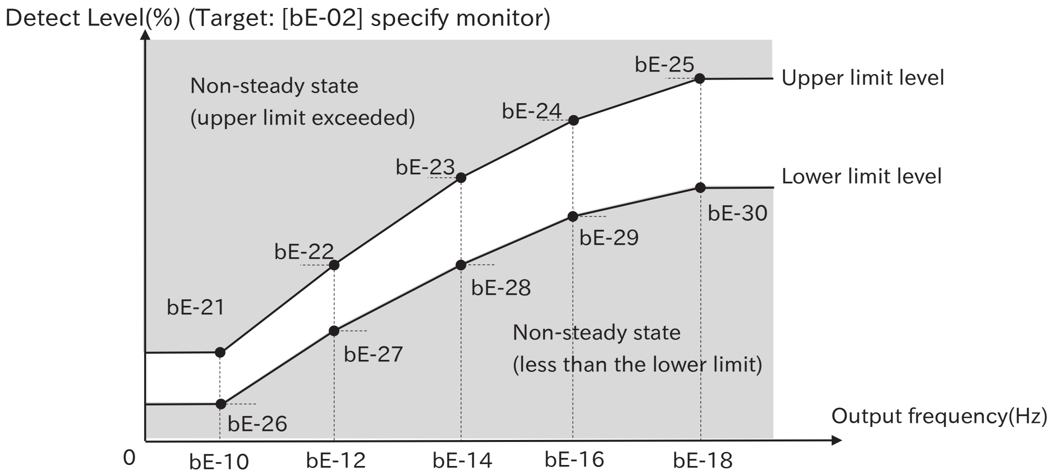


9.11.14 Unsteady detection function

- The unsteady detection function outputs and protects a signal when a specified monitor value such as output current or output torque deviates from the specified range (steady state) according to a specific operation pattern in advance.
- This function is enabled when "Non-stationary detection selection (bE-01)" is "Enabled (Frequency mode) (01)" or "Enabled (Time mode) (02)". In "Enable (Frequency mode) (01)", the steady state of the monitor value is set according to the output frequency. On the other hand, in "Enable (time mode) (02)", it is set according to the elapsed time starting from the operation start point. In both modes, the upper and lower limit levels that define the steady range of the monitored object are set, and the upper limit is exceeded and less than the lower limit are detected, and it is judged as non-steady. (Refer to the next section for the setting of each mode and level.)
- Set the parameters of the monitor that you want to monitor for the "Non-stationary object (bE-02)". For the parameters that can be set, see "9.16.3 Selecting the monitor to be output".
- By assigning "non-steady upper limit exceeded state [ABU](082)" and "non-steady lower limit less state [ABL](083)" to any of the output terminal function selection ([CC-01]/[CC-02]/[CC-07]), the state of exceeding the upper limit and the state of less than the lower limit can be output individually. However, these signals are not output if the "Non-Constant Detection Selection (bE-01)" is "Disabled (00)".
- For the [ABU] non-steady upper limit exceeding state and [ABL] non-steady lower limit exceeding state, delay can be set separately by "Non-steady upper limit detecting time [bE-06]" and "Non-steady lower limit detecting time [bE-08]".
- The motor can be tripped when [ABU] or [ABL] is outputted in the "Operation at non-stationary upper limit detection [bE-05]" or "Operation at non-stationary lower limit detection [bE-07]" sets. If [bE-05]/[bE-07] is set to "Trip (02)", it trips at "Non-stationary upper limit detection error [E121]"/"Non-stationary lower limit detection error [E122]" at the same time as the outputting of [ABU]/[ABL]. In addition, if "Trip after deceleration stop (03)" is set, it forcibly shifts to stop operation at the same time as outputting [ABU]/[ABL], and when it stops, it trips at [E121]/[E122].
- The upper and lower limits of non-stationary detection can also be automatically obtained during operation by setting "Non-stationary detection auto-tuning selection [bE-03]" to "Enabled (01)". Refer to the next section for details.

■Unsteady Detection Frequency Mode (bE-01=01)

- This function specifies the unsteady detection frequency ([bE-10] to [bE-18]) and the upper and lower limit levels at the frequencies, and monitors the unsteady state according to the output frequency.



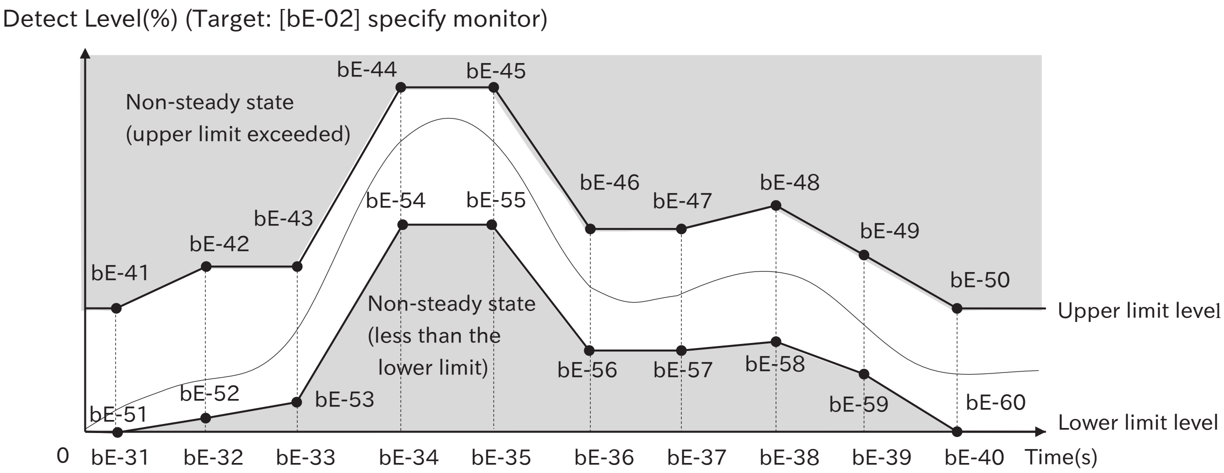
■Correspondence table between set point (frequency) and upper and lower limit levels

Set point		Upper limit at object code	Lower limit at target code
Abnormal detection minimum frequency	bE-10	bE-21	bE-26
Abnormal detection intermediate frequency 1	bE-12	bE-22	bE-27
Abnormal detection intermediate frequency 2	bE-14	bE-23	bE-28
Abnormal detection intermediate frequency 3	bE-16	bE-24	bE-29
Abnormal detection maximum frequency	bE-18	bE-25	bE-30

・Regarding the upper and lower limit levels from 0Hz to "Lowest frequency of non-stationary detection [bE-10]", the "Lowest frequency of upper limit level [bE-21]" and the "Lowest frequency of lower limit level [bE-26]" are applied, and from "Highest frequency of non-stationary detection [bE-18]", the "Highest frequency of upper limit level [bE-25]" and the "Highest frequency of lower limit level [bE-30]" are applied.
・The % criteria for the upper and lower limits are based on the full scale of 100 % of the target selected in [bE-02] for non-stationary detection.

■ Non-stationary detect time-mode (bE-01=02)

・This function specifies the "unsteady detecting time ([bE-31] to [bE-40])" and the upper and lower limits at every time, and monitors the unsteady status according to the elapsed time from the start of operation.
・Does not operate while stopped. When operation is restarted after stopping once, monitoring restarts from zero seconds.



■Correspondence table between set point (operation time) and upper and lower limit levels

Set point		Upper limit at object code	Lower limit at target code
Abnormal time detection operating time 1	bE-31	bE-41	bE-51
Abnormal time detection operating time 2	bE-32	bE-42	bE-52
Abnormal time detection operating time 3	bE-33	bE-43	bE-53
Abnormal time detection operating time 4	bE-34	bE-44	bE-54
Abnormal time detection operating time 5	bE-35	bE-45	bE-55
Abnormal time detection operating time 6	bE-36	bE-46	bE-56
Abnormal time detection operating time 7	bE-37	bE-47	bE-57
Abnormal time detection operating time 8	bE-38	bE-48	bE-58
Abnormal time detection operating time 9	bE-39	bE-49	bE-59
Abnormal time detection operating time 10	bE-40	bE-50	bE-60

・For the setting of "Non-steady time detection operation time 1 [bE-31]" to "Non-steady time detection operation time 10 [bE-40]", set the elapsed time with operation starting set to zero.
・Regarding the upper and lower limit levels, "Non-steady time detection upper limit level 1 [bE-41]" and "Non-steady time detection lower limit level 1 [bE-51]" are applied respectively for less than [bE-31], and "Non-steady time detection upper limit level 10 [bE-50]" and "Non-steady time detection lower limit level 10 [bE-60] are applied respectively for [bE-40] and later.
・Set the [bE-31] to [bE-40] as shown below. Otherwise, the subsequent settings are ignored and the end of the valid part is the terminal setting.
0≦[bE-31]≦[bE-32]≦[bE-33]≦[E-34]≦[bE-35]≦[bE-36]≦[bE-37]≦[bE-38]≦[bE-39]≦[bE-40]
・The % criteria for the upper and lower limits are based on the full scale of 100 % of the target selected in [bE-02] for non-stationary detection.

Execution step of non-stationary detection automatic tuning

1. Pre-setting of parameters
   (1) Set "Non-steady detecting selection [bE-01]" to "Frequency mode (01)" or "Time mode (02)" according to the desired operation.
   (2) Set the non-stationary object [bE-02] to the data you want to monitor.
   (3) Set each measurement point according to the mode set in (1) (see below). In operation, the monitor data specified in (2) is acquired when passing through these set points.

bE-01	Automatic measurement point
Disabled (00)	- (Disabled)
Enabled (frequency mode) (01)	Measuring point (frequency): [bE-10] [bE-12] [bE-14] [bE-16] [bE-18]
Enabled (time mode) (02)	Measuring point/time: [bE-31] to [bE-40]

   (4) Set the allowable range for automatic-tuning in "Non-stationary tuning allowable range [bE-04]". The value set here is reflected to the value of the upper and lower limit levels to be saved as the allowable range width based on the automatic acquisition value.

2. Implementation of automatic measurement (operation)
   ・Set "Non-stationary detecting auto-tuning selection [bE-03]" to "Enable (01)".
   ・Start operation in the actual operating environment. During operation, pass the measurement point set in the previous section (3) several times. In the time mode, repeat the operation several times from the stop state.

3. Setting and Checking at End of Measurement
   ・Stop operation and set "Non-steady detection auto-tuning selection [bE-03]" to "Disable (00)".
   ・Check that the following parameters (upper limit and lower limit level) have been updated. (If the measurement fails, it is not updated.)

bE-01	Automatic measurement point
Disabled (00)	- (Disabled)
Enabled (frequency mode) (01)	Upper limit: [bE-21] to [bE-25] Lower limit: [bE-26] to [bE-30]
Enabled (time mode) (02)	Upper limit: [bE-41] to [bE-50] Lower limit: [bE-51] to [bE-60]

・During automatic tuning, the non-stationary detection function is disabled.
・Automatically acquired data will be saved at the timing when "Auto-tuning selection [bE-03]" is changed from "Enabled (01)" to "Disabled (00)". However, if the data from the automatic acquisition is not confirmed, the value is not updated.

■Unsteady detection related parameters

Code	Item	Description	Data	Initial value
bE-01	Unsteady detection enable	Disabled	00	00
		Enabled: Specifies the steady state according to the output frequency. (Frequency mode)	01	
		Enabled: The steady state is specified according to the elapsed time of operation. (time mode)	02	
bE-02	Unsteady detection target	Select the data to be monitored by this function.	Refer to "9.16.3 Selecting the monitor to be output"	dA-01
bE-03	Unsteady detection auto tuning selection	Disabled	00	00
		Enabled: Automatically acquires the value specified by [bE-02] according to the setting of [bE-01] during operation and saves the value to the upper/lower limit level.	01	
bE-04	Unsteady detection tuning tolerance	At [bE-03]=(01), the obtained value ± [bE-04] is saved to the upper/lower limit.	0.00 to 100.00 % Note	0.10
bE-05	Unsteady upper level detecting action	Nothing	01	01
		Trip at "Non-stationary upper limit detection error [E121]"	02	
		The stop command is forcibly issued. After the stop, the motor trips with "Non-stationary upper limit detection error [E121]."	03	
bE-06	Unsteady upper level detecting time	Sets the time from when the data specified in [bE-02] exceeds the upper limit of non-stationary detection until the data is judged as non-stationary.	0.00 to 600.00 s	0.00
bE-07	Unsteady lower level detecting action	Nothing	01	01
		Trip at "Non-stationary lower limit detection error [E122]"	02	
		The stop command is forcibly issued. After the stop, the motor trips with "Non-steady lower limit detection error [E122]."	03	
bE-08	Unsteady lower level detecting time	Sets the period from when the data specified in [bE-02] falls below the lower limit of non-stationary detection until the data is judged as non-stationary.	0.00 to 600.00 s	0.00
bE-10	Unsteady detection minimum frequency	Sets the fixed point of the steady-state range in the frequency mode ([bE-01]=(01)).	0.00 to Max. frequency Hz	0.00
bE-12	Unsteady detection intermediate frequency 1			
bE-14	Unsteady detection intermediate frequency 2			
bE-16	Unsteady detection intermediate frequency 3			
bE-18	Unsteady detection maximum frequency			
bE-21	Upper limit at minimum frequency	Specifies the upper limit of the steady-state range in frequency-mode ([bE-01]=(01)). Set point-by-point for [bE-10] to [bE-18].	-100.00 to 100.00 % Note	0.00
bE-22	Upper limit at intermediate frequency 1			
bE-23	Upper limit at intermediate frequency 2			
bE-24	Upper limit at intermediate frequency 3			
bE-25	Upper limit at maximum frequency			
bE-26	Lower limit at minimum frequency	Specifies the lower limit of the steady-state range in frequency-mode ([bE-01]=(01)). Set point-by-point for [bE-10] to [bE-18].		
bE-27	Upper limit at intermediate frequency 1			
bE-28	Lower limit at intermediate frequency 2			
bE-29	Lower limit at intermediate frequency 3			
bE-30	Lower limit at maximum frequency			
bE-31	Unsteady time detection operating time 1	Sets the stipulated points of the steady-state area in the time-mode ([bE-01]=(02)). Set the operation start to zero and the elapsed time from there.	0.00 to 600.00 s	0.00
bE-32	Unsteady time detection operating time 2			
bE-33	Unsteady time detection operating time 3			
bE-34	Unsteady time detection operating time 4			
bE-35	Unsteady time detection operating time 5			
bE-36	Unsteady time detection operating time 6			
bE-37	Unsteady time detection operating time 7			
bE-38	Unsteady time detection operating time 8			
bE-39	Unsteady time detection operating time 9			
bE-40	Unsteady time detection operating time 10			

Code	Item	Description	Data	Initial value
bE-41	Unsteady time detection upper level 1	Specifies the upper limit of the steady-state range in time-mode ([bE-01]=(02)). Set point-by-point for [bE-31] to [bE-40].	-100.00 to 100.00 % Note	0.00
bE-42	Unsteady time detection upper level 2			
bE-43	Unsteady time detection upper level 3			
bE-44	Unsteady time detection upper level 4			
bE-45	Unsteady time detection upper level 5			
bE-46	Unsteady time detection upper level 6			
bE-47	Unsteady time detection upper level 7			
bE-48	Unsteady time detection upper level 8			
bE-49	Unsteady time detection upper level 9			
bE-50	Unsteady time detection upper level 10			
bE-51	Unsteady time detection lower level 1	Specifies the lower limit of the steady-state range in time-mode ([bE-01]=(02)). Set point-by-point for [bE-31] to [bE-40].		
bE-52	Unsteady time detection lower level 2			
bE-53	Unsteady time detection lower level 3			
bE-54	Unsteady time detection lower level 4			
bE-55	Unsteady time detection lower level 5			
bE-56	Unsteady time detection lower level 6			
bE-57	Unsteady time detection lower level 7			
bE-58	Unsteady time detection lower level 8			
bE-59	Unsteady time detection lower level 9			
bE-60	Unsteady time detection lower level 10			
CC-01 CC-02 CC-07	Output terminal function	Unsteady exceeded Upper limit/[ABU]: [bE-02] Outputs when the specified data continuously exceeds the upper limit of unsteady detection for the period set to [bE-06].	082	002 001 017
		Unsteady fall below Lower limit/[ABL]: [bE-02] Outputs when the specified value is continuously below the lower limit for non-stationary detection for the period set to [bE-08].	083	
dC-31	Unsteady detection value monitor	[bE-02] Displays the specified monitor value.	-100.00 to 100.00 % Note	-
dC-32	Unsteady detection upper level monitor	Displays the current value of the upper limit level.		
dC-33	Unsteafy detection lower level monitor	Displays the current value of the lower limit level.		

Note: Assume that the full scale of the target selected in "Non-stationary object [bE-02]" is 100%.

9.12 Output the operating status to the terminals

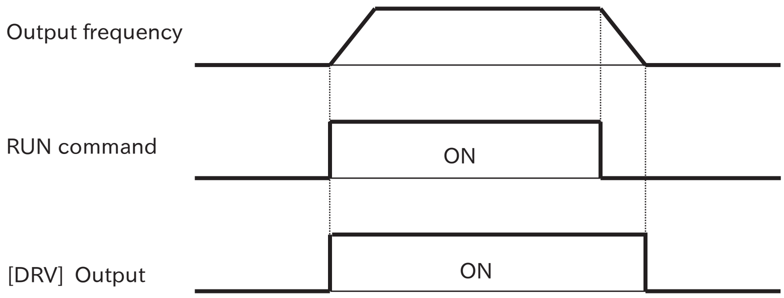
9.12.1 Output signal during operation

・By assigning "In-operation [DRV](001)" to any of the "output terminal function selections ([CC-01], [CC-02], and [CC-07])", the inverter-in-operation signal can be output.

・In addition to the normal operation of the motor, if the motor is in the status of outputting voltage during DC braking, etc. the "Operation in Progress [DRV](001)" signal will ON.

・During retry wait or DC braking standby, the [DRV] signal is not output because no voltage is output to the motor.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	During operation [DRV]: This signal is output when the inverter is outputting to the motor.	001	002 001 017



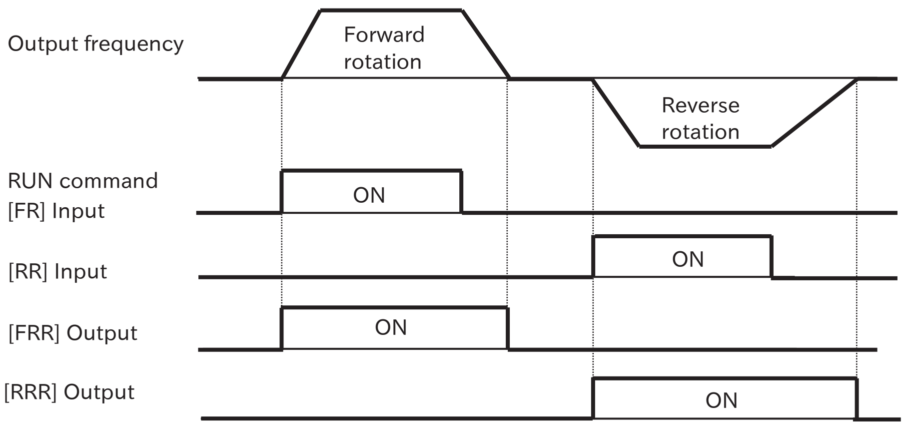
9.12.2 Output signal during forward or reverse rotation

・By assigning "Forward run in progress [FRR](008)" or "Reverse run in progress [RRR](009)] to any of "output terminal function selection ([CC-01], [CC-02], and [CC-07])," the output of the inverter forward run in progress/reverse run in progress signal is enabled.

・[FRR] The signal is outputted only during forward operation and the [RRR] signal is outputted only during reverse running.

・The "Forward operation in progress [FRR]"/ "Reverse run in progress [RRR]" signal will not be output during DC voltage output to the motor by DC braking.

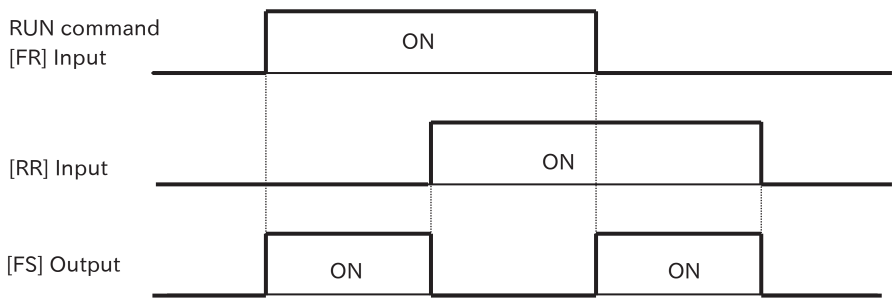
Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	During forward operation [FRR]: This signal is output during the inverter forward operation.	008	002 001 017
		During reverse operation [RRR]: This signal is output during inverter reverse operation.	009	



9.12.3 Output signal RUN command

- RUN command signals can be output by assigning "RUN command signals [FS](031)" to any of the "Output terminal function selections ([CC-01], [CC-02], and [CC-07])."
- The [FS] signal is outputted while the inverter is accepting the operation command.
- [FS] Even if the RUN command destination is other than the [FR]/[RR] input terminal, the signal is outputted according to the RUN command acceptance status.
- When an RUN command is input from the input terminal, if "Forward rotation [FR]" and "Reverse rotation [RR]" are input at the same time, a command mismatch will occur and a stop command will be issued. In this situation, "RUN command [FS]" will not be outputted.
- Besides the output for normal motor rotation, the [FS] signal is output even when DC voltage is being output to the motor by DC braking, etc.

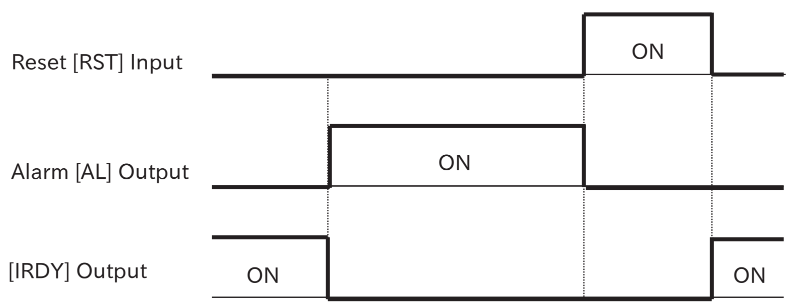
Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	RUN command active [FS]: This signal is output when an operation command is input.	031	002 001 017



9.12.4 Output signal when operation preparation is completed

- The operation preparation completion signal can be output by assigning "Operation preparation completion [IRDY](007)" to one of the "output terminal function selections ([CC-01], [CC-02], and [CC-07])".
- The [IRDY] signal is issued when the inverter is ready to accept RUN commands.
- If the "Operation ready [IRDY] signal is not output, the product will not operate even if an RUN command is input.
- This signal is turned OFF when the unit is not ready to start when the power is turned on, when the input voltage is insufficient, when the unit is tripping, when the free-operation stop command is executed, or when STO is input.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Operation ready [IRDY]: This signal is output when the inverter is ready to accept RUN commands.	007	002 001 017

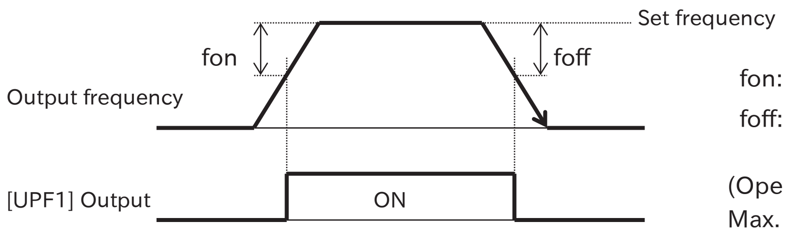


9.13 Compare the output frequency and output it to the terminal

9.13.1 Output signal when the frequency reaches the target

- By assigning "[UPF1](002" to any of the "output terminal function selections ([CC-01], [CC-02], and [CC-07])", when the set output frequency is reached, a signal can be output.
- When the output frequency reaches the valid frequency command, [UPF1] is output.
- If the frequency command is an analog input command, "Constant speed reaching [UPF1]" may not be output stably. This may be improved by ON/OFF delaying function of the OUT jack. For details, see section 9.16.2, Delay and Hold the Output Signal.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Constant-frequency reached [UPF1]: This signal turns ON when the output frequency reaches the set frequency.	002	002 001 017



fon: 1% of Max. frequency

foff: 2% of Max. frequency

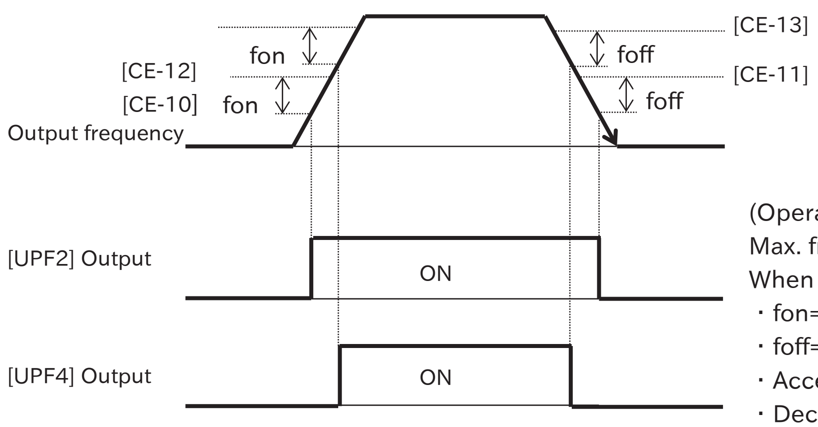
(Operation example)
Max. frequency 60Hz
When set frequency=50Hz

- fon=60×0.01=0.6Hz
- foff=60×0.02=1.2Hz
- Acceleration: ON at 50-0.6=49.4Hz
- Deceleration: OFF at 50-1.2=48.8Hz

9.13.2 Output signal when the output frequency exceeds the set value

- Signals over the set frequency can be output by assigning "Set frequency or more [UPF2](003)"/ "Set frequency or more 2 [UPF4](005)" to any of "Output terminal function selection ([CC-01], [CC-02], or [CC-07])".
- This signal turns ON when the output frequency exceeds the setting of "Acceleration arrival frequency 1 [CE-10]" and turns OFF when the [UPF2] signal falls below the setting of "Deceleration arrival frequency 1 [CE-11]."
- This signal turns ON when the output frequency exceeds the setting of "Acceleration arrival frequency 2 [CE-12]" and turns OFF when the [UPF4] signal falls below the setting of "Deceleration arrival frequency 2 [CE-13]."
- Signals above two set frequencies "[UPF2] above set frequency"/"above set frequency 2 [FA4]" are operated independently and can be outputted separately.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Set frequency overreached [UPF2]: This signal turns ON when the output frequency exceeds the [CE-10] setting and turns OFF when the output frequency falls below [CE-11].	003	002 001 017
		Set frequency overreached 2 [UPF4]: This signal turns ON when the output frequency exceeds the [CE-12] setting and turns OFF when the output frequency falls below [CE-13].	005	
CE-10	Arrival frequency 1 value setting during acceleration	[UPF2] turns ON when the output frequency exceeds this setting during acceleration.	0.00 to 590.00 Hz	0.00
CE-11	Arrival frequency 1 value setting during deceleration	During deceleration, [UPF2] turns OFF when the output frequency falls below this setting.		
CE-12	Arrival frequency 2 during acceleration	[UPF4] turns ON when the output frequency exceeds this setting during acceleration.		
CE-13	Arrival frequency 2 during deceleration	During deceleration, [UPF4] turns OFF when the output frequency falls below this setting.		



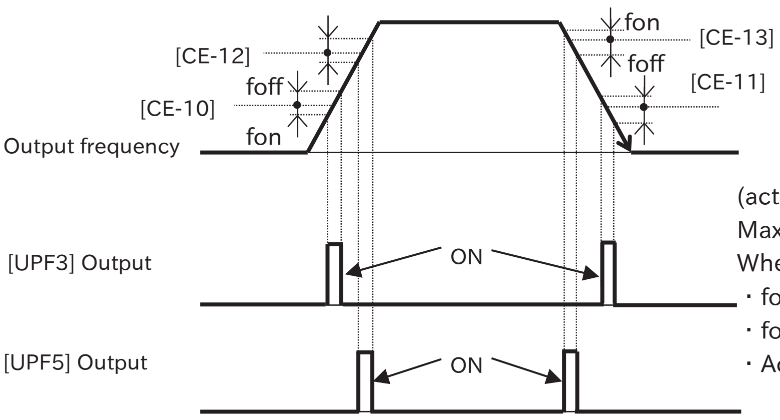
fon: 1% of Max. frequency
foff: 2% of Max. frequency

(Operation example)
Max. frequency 60Hz
When set [CE-10]=[CE-11]=50Hz
- fon=60×0.01=0.6Hz
- foff=60×0.02=1.2Hz
- Acceleration: ON at 50-0.6=49.4Hz
- Deceleration: OFF at 50-1.2=48.8Hz

9.13.3 Output signal when the output frequency is near the set value

- By assigning "Set frequency only [UPF3](004)"/"Set frequency only 2 [UPF5](006)" to any of the "Output terminal function selections ([CC-01], [CC-02], and [CC-07])", it is possible to output a signal when the output frequency becomes near the set frequency.
- The [UPF3] signal is turned ON when the output frequency reaches "Acceleration arrival frequency 1 [CE-10]" during acceleration or "Deceleration arrival frequency 1 [CE-11]" during deceleration. After that, it becomes OFF when the output frequency is away from [CE-10]/[CE-11] due to acceleration/deceleration.
- When the output frequency reaches "Acceleration arrival frequency 2 [CE-12]" during acceleration or reaches "Deceleration arrival frequency 2 [CE-13]" during deceleration, the [UPF5] signal turns ON. After that, it becomes OFF when the output frequency is away from [CE-12]/[CE-13] due to acceleration/deceleration.
- The signals "set frequency only [UPF3]"/"set frequency only 2 [UPF5]" output around the two set frequencies are operated independently, and can be output separately.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Set frequency reached [UPF3]: This signal turns ON when the output frequency reaches [CE-10] during acceleration or [CE-11] during deceleration.	003	002 001 017
		Set frequency reached 2[UPF5]: This signal turns ON when the output frequency reaches [CE-12] during acceleration or [CE-13] during deceleration.	005	
CE-10	Arrival frequency 1 value setting during acceleration	The [UPF3] signal turns ON when the output frequency reaches this setting during acceleration.	0.00 to 590.00 Hz	0.00
CE-11	Arrival frequency 1 value setting during deceleration	If the output frequency reaches this setting during deceleration, the [UPF3] signal turns ON.		
CE-12	Arrival frequency 2 during acceleration	The [UPF5] signal turns ON when the output frequency reaches this setting during acceleration.		
CE-13	Arrival frequency 2 during deceleration	If the output frequency reaches this setting during deceleration, the [UPF5] signal turns ON.		



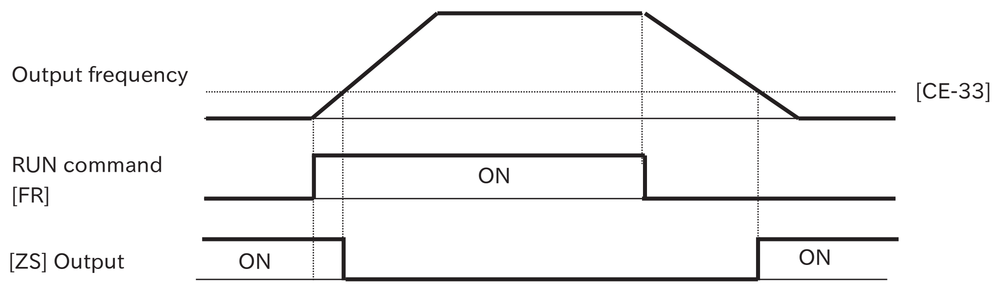
fon: 1% of Max. frequency
foff: 2% of Max. frequency

(actual ON/OFF frequency)
Max. frequency 60Hz
When set [CE-10]=[CE-11]=50Hz
- fon=60×0.01=0.6Hz
- foff=60×0.02=1.2Hz
- Acceleration: ON at 50-0.6=49.4Hz
  OFF with 50+1.2=51.2Hz
- Deceleration: ON at 50+0.6=50.6Hz
  OFF with 50-1.2=48.8Hz

9.13.4 Output signal when the output frequency becomes near 0Hz

- 0Hz detection signal can be output by assigning "0Hz detection [ZS](040)" to one of the "output terminal function selections ([CC-01], [CC-02], and [CC-07])".
- When the output frequency of the inverter drops below the level set in "0Hz detection value level [CE-33]", the [ZS] signal is output.
- [ZS] The time constant of the temporary delay filter can be set in "Output frequency-related terminal function filter time constant (ZS) [CE-60)". If the output frequency fluctuates around the frequency set in [CE-33], adjust [CE-60].
- During 0Hz operation such as when stopped or during DC braking, the "0Hz detection [ZS]" signal becomes ON because frequency is 0Hz.
- When encoder feedback is used, this signal is output after determining the actual motor speed. For details of encoder feedback, refer to "9.5.11 Using Encoder Feedback".

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Zero speed detection [ZS]: Output frequency outputs analog disconnection signal	040	002 001 017
CE-33	Zero speed detection level	The [ZS] signal turns ON when the output frequency falls below this setting.	0.00 to 100.00 Hz	0.00
CE-60	Output frequency related filter for terminal function	[ZS] Sets the time constant of the temporary delay filter for the signal.	0 to 2000 ms	20



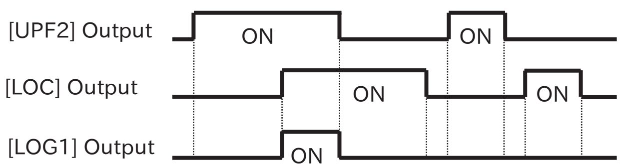
9.13.5 Output by combining two output signals

- Since the logical operation of the output signal can be performed inside the inverter, various signals can be output by combining the operation of the output terminal function.
- There are three types of logical operators that can be selected: logical AND (AND), logical OR (OR), and exclusive OR (XOR).
- Target all output signals. However, the logical operation result ([LOG1] to [LOG3]) cannot be the operation target.

Code	Item	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	Logical operation result 1 to 3 ([LOG1] to [LOG3]): The logical operation of the output signal selected by the logical operation target 1 and the logical operation object 2 is performed, and the result is output.	062 063 064	002 001 017
CC-40 CC-43 CC-46	Selection LOG1 to LOG3 selection 1	Selects logical operation target 1.	Select output terminal function (except [LOG1] to [LOG3])	000
CC-41 CC-44 CC-47	Selection LOG1 to LOG3 selection 2	Selects logical operation destination 2.		
CC-42 CC-45 CC-48	Selection LOG1 to LOG3 operator selection	AND operation (logical AND) of target 1 and target 2 is outputted.	00	00
		OR operation (logical OR) of target 1 and target 2 is outputted.	01	
		Outputs XOR operations (exclusive-OR) of target 1 and target 2.	02	

■(e.g. 1) Logical AND operation example

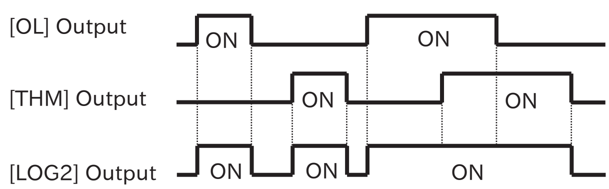
- If the output current drops when the output frequency is greater than or equal to the pre-set value, set [LOG1] to ON and output from the output terminal [UPF].



(Setting example)
- Output terminal function [UPF] selection [CC-01] = logical operation result 1 [LOG1]
- LOG1 selection 1 [CC-40] = above set frequency [UPF2]
- LOG1 selection 2 [CC-41] = Low current signal ling [LOC]
- LOG1 operator selection [CC-42]=AND(00)

■(e.g. 2) Logical OR operation example

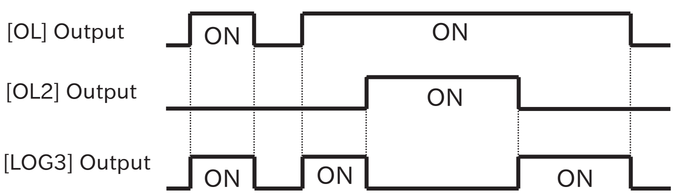
- "Output current goes out of range. Signal that becomes ON in either overload or electronic thermal overload condition" is set to [LOG2], and output from output terminal [UPF].



(Setting example)
- Output terminal function [UPF] selection [CC-01] = logical operation result 2 [LOG2]
- LOG2 selection 1 [CC-43] = Overload warning [OL]
- LOG2 selection 2 [CC-44] = electronic thermal alarm (motor) [THM]
- LOG2 operator selection [CC-45]=OR(01)

■(e.g. 3) Logical exclusive or (XOR) operation example

- Set the "Signal when the output current is within the specified range" to [LOG3] and output from the output terminal [DRV].



(Setting example)
- Output terminal function [DRV] selection [CC-02] = logical operation result 2 [LOG3]
- LOG3 selection 1 [CC-46] = Overload warning [OL]
- LOG3 selection 2 [CC-47] = Overload notice 2 [OL2]
- LOG3 operator selection [CC-48]=XOR(02)

9.14 Perform positioning operation

9.14.1 Absolute position control

- HF-620 is equipped with an absolute position control function that enables simple positioning operation by feeding back pulse signals from external encoders and other devices to the drive.
- In absolute position control,
  (1) Position reference
  (2) Speed command (Frequency command)
  (3) Acceleration time and deceleration time
  After moving to the target position according to the direction, it becomes a direct current braking state. After that, the DC braking status is held until the operation command is OFF.
- Frequency command and acceleration/deceleration command in absolute position control follow those selected at that time.
- If the position command is small, deceleration → positioning may occur without reaching the speed command value.
- The direction of the operation command (forward/reverse) has no meaning as the rotation direction in the absolute position control mode. Operates as a signal for operation and stop. The rotation direction is forward if (target position-current position) is positive, or reverse if negative.
- If the origin return operation (described later) is not performed, if "Current position memory at power shutdown [AE-61]" is "disabled (00)", the position at power-on will be treated as the origin ("Current position monitor [dA-20]" = 0). When [AE-61] is "valid (01)", the position at the last power-off ([dA-20]) is treated as the present position.
- When the deviation between the position command and the present position ([dA-20]) is 0, the positioning operation is performed on the spot when the operation command is ON.
- The position command can be switched from "Position command selection 1 [CP1](076)" to "Position command selection 4 [CP4](079)" of the input terminal function in 16 steps of "Position command 0 [AE-20]" to "Position command 15[AE-50]. You can also change/save the currently selected position command by changing/saving "Position command setting (monitor) [FA-20]".
- When using this function, set "Vector control mode selection [AA123]" to "Absolute position control mode (02)" or "High resolution absolute position control mode (03)".
- This function requires the use of encoder feedback.
- When "Vector control mode selection [AA123]" is set to "high-resolution absolute position control mode (03)", control is performed by the number of pulses of 4 multipliers used for the internal calculation. Set the multi-stage position command and position range specification with an accuracy of 4 multipliers.
- The current position counter is not cleared by trip reset or reset signal input.
- In absolute position control, if the input terminal function "Clear position error [PCLR]" is assigned, the present position counter is cleared by ON of the [PCLR] input terminal.
- In the absolute position control mode, the input terminal function "Torque control enable [ATR]" does not function. (Torque control does not work.)
- When changing the position command with [FA-20], simply change the value with the dial. The value will be reflected as the command value. However, if SET button is not used to save the data, the display returns to the previous state when the power is turned on again.

Code	Item	Description	Data	Initial value
dA-08	Detect speed monitor	Monitors the feedback detection speed.	-590.00 to 590.00 Hz	-
dA-20	Current position monitor	Monitor the current position.	For AA123≠03: -268435455 to 268435455 pls For AA123=03: -1073741823 to 1073741823 pls	
FA-20	Position reference setting (Monitor)	Monitors or changes the setting of the currently selected position command destination. When you change or save [FA-20], the settings of the currently selected position commands 0 to 15 are also changed/saved.		
AA123	Vector control mode selection	Absolute position control mode	02	00
		High-resolution absolute position control mode	03	
AE-04	Positioning completed range setting	When the present position falls within the range of the target position ± [AE-04], the [POK] signal will be outputted assuming that the positioning is complete. (4 multiplication setting)	0 to 10000 pls	50
AE-05	Positioning completed delay time setting	Specify how long it takes for the [POK] signal to be output after positioning is complete.	0.00 to 10.00 s	0.00
AE-15	Creep speed setting	Set the low-speed operation just before the completion of positioning.	Min. frequency [Hb130] to 10.00 Hz	5.00
AE-16	Position displacement at creep speed	Set the move distance to operate at the [AE-15] speed.	0 to 16384 pls	2560
AE-17	Positioning restart range	When the present position is out of the range of the target position ± [AE-17] after the completion of positioning, the positioning operation is performed again. (4 multiplication setting)	0 to 10000 pls	0
AE-20	Position command 0	Set the position command for the multi-stage position command respectively.	[AE-52] to [AE-54]	0
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 control range (Forward)	Set the position control range on the forward rotation side. If [AE-56] is "Limit (00)", the motor trips due to "Position control range error [E104]" if the present position counter exceeds this setting.	For AA123≠03: 0 to 268435455 pls For AA123=03: 0 to 1073741823 pls	268435455
AE-54	Position control range (Reverse)	Set the position control range on the reverse side. If [AE-56] is "Limit (00)", the motor trips due to "Position control range error [E104]" if the present position counter exceeds this setting.	For AA123≠03: -268435455 to 0 pls For AA123=03: -1073741823 to 0 pls	-268435455
AE-56	Position control mode selection	Limit: Position range specification ([AE-52], [AE-54]) is enabled.	00	00
		No limit: Shortest position control is enabled.	01	

Code	Item	Description	Data	Initial value
AE-64	Deceleration stop distance calculation gain	Adjustment is made for the stop distance at deceleration stop.	50.00 to 200.00 %	100.0
AE-65	Deceleration stop distance calculation bias	Adjusts the output frequency during positioning operation.	0.00 to 655.35 %	0.00
AF101	DC braking selection	Set "Disable (00)". With the position control function, DC braking is automatically applied when positioning is complete even if "Disabled (00)".	00	00
AF105	DC braking force	Set the DC braking force at completion of positioning.	0 to 100 %	50
CA-55	Multistage input determination time	This is the time until the position command is determined when the multi-stage position command switching is performed.	0 to 2000 ms	0
CA-90	Pulse input target function selection	Set "Speed Feedback (02)".	02	01
CA-01 to CA-08	Input terminal function	Multistage position settings selection 1 to 4 [CP1]/[CP2]/[CP3]/[CP4]: Select the position command in the combination of ON/OFF of the pin functions.	076([CP1]) 077([CP2]) 078([CP3]) 079([CP4])	-
CC-01 CC-02 CC-07	Output terminal function	Positioning complete [POK]: When the present position falls within ±[AE-04] of the target position, this signal is turned ON.	043	002 001 017

Operation procedure of absolute position control function

1. Pre-setting of parameters

(1) Wire the encoder and set the related parameters. For details, refer to "9.5.11 Using Encoder Feedback".

(2) To enable the absolute position control function, set "Pulse-input detection target selection [CA-90]" to "Velocity Feedback (02)", and "Vector Control Mode Selection [AA123]" to "Absolute Position Control Mode (02)" or "High Resolution Absolute Position Control Mode (03)".

(3) Set "DC braking selection [AF101]" to "Disabled (00)" (In absolute position control, DC braking is automatically activated when positioning is complete even if [AF101] is "Disabled (00)"). Set the DC braking force at standstill [AF105] so that the required braking force can be obtained when positioning is completed.

(4) The rotation direction in absolute position control is forward if the position deviation (target position-current position) is positive, or reverse if it is negative. Therefore, the input of "Forward rotation [FR]" or "Reverse rotation [RR]" does not mean the direction of rotation and operates only as the input signal for operation/stop.

(5) Set "Creep speed setting [AE-15]" and "Creep speed movement [AE-16]" according to the operation pattern. In addition, set 0.00Hz for the frequency lower limit [bA103]. 0.00 If it is not Hz, that value is the lower limit value of [AE-15].

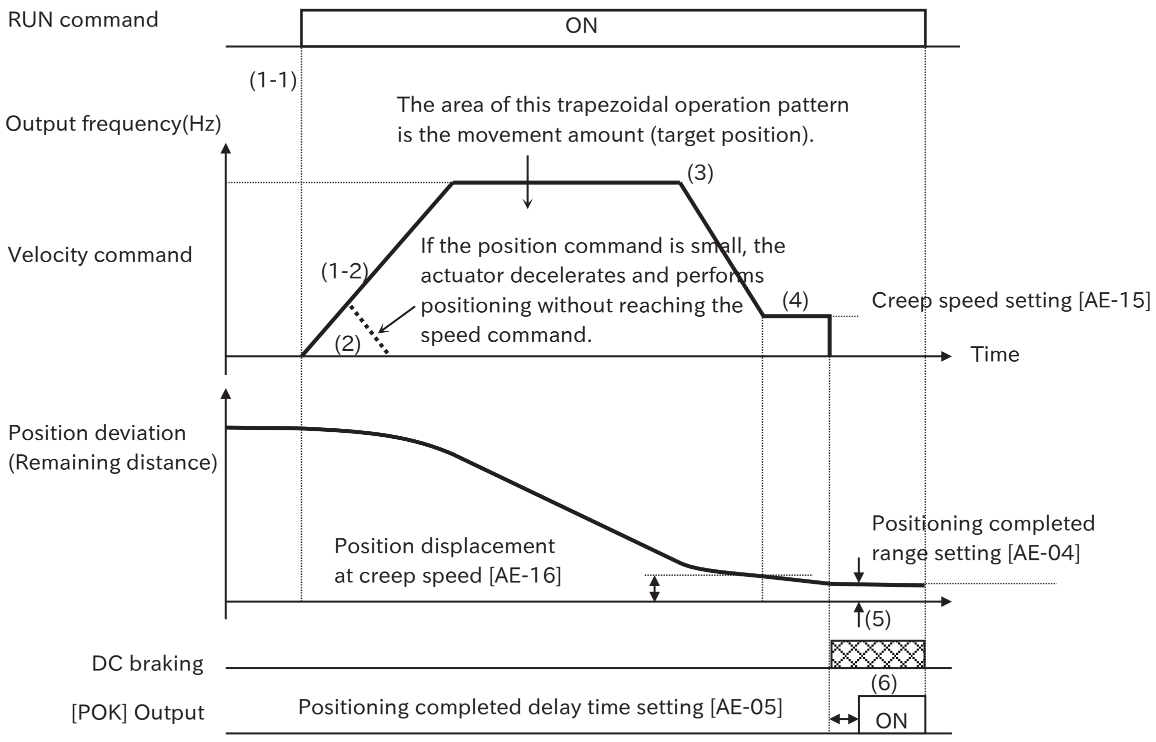
(6) Set "Positioning completion area setting [AE-04]" with the number of 4 multiplied pulses (the number when the A-phase 1 pulse cycle is 4 pulses). When the present position falls within ±[AE-04] of the target position, the "Positioning complete [POK]" signal turns ON. [POK] Assign signals to output pins as required.

(7) Set the target position of positioning operation, speed command (frequency command), acceleration time and deceleration time. The target position is set to "Position command 0 [AE-20]" to "Position command 15 [AE-50]" and selected by the combination of "Position command selection 1 to 4 ([CP1] to [CP4])" of the input terminal function. The speed command (frequency command) and acceleration/deceleration time follow the frequency command and acceleration/deceleration time setting from each command selection destination when an operation command is input.

(8) When "Limit (00)" is set to "Positioning mode selection [AE-56]", the position range designation is enabled. Set the position control range to "Position range specification (forward rotation side) [AE-52]" and "Position range specification (reverse rotation side) [AE-54]." When the present position is out of the specified position range, the inverter trips due to "Position control range over error [E104]". When "Do not limit (01)" is set to [AE-56], the position range designation is disabled and the shortest position control function is enabled. For details, refer to "Minimum position control function" in this section.

2. Positioning operation

・The figure below shows the positioning operation when the RUN command is turned ON.



(1) When an RUN command is input (1-1), the positioning operation is automatically started in the trapezoidal operation pattern shown in the above figure according to the position command, speed command (frequency reference), acceleration time, and deceleration time selected from each command destination at that time.(1-2) The rotation direction is forward if the position deviation (target position-current position) is positive, or reverse if it is negative.

(2) Accelerate according to the acceleration time until the speed command (frequency reference) is reached. At this time, if the movement amount to the target position is small, the actuator decelerates before reaching the speed command (broken line in the figure).
If the movement amount is smaller than "creep speed movement amount [AE-16]", it will move to the target position with "creep speed setting [AE-15]", and if the movement amount is within "positioning complete range setting [AE-04]", DC braking will operate on the spot.

(3) From the target position, deceleration starts before the move distance at deceleration + creep-speed travel distance [AE-16].

(4) It decelerates and operates at that speed when the output frequency becomes "creep speed setting [AE-15]". If the motor revolution becomes unstable in the low speed range, increase [AE-15].

(5) When the present position reaches within the target position ± "Positioning complete range setting [AE-04]", DC braking will operate. DC braking is released when the operation command is OFF.
DC braking after stopping is not controlled to hold the position, so the stop position may be shifted when external force is applied. Use an external brake if position retention is required.

(6) After the present position reaches within the target position ± "Positioning completion range setting [AE-04]", after the "Positioning completion delay time setting [AE-05]" has elapsed, the "Positioning completion [POK]" will be outputted.

・For single-phase pulsing ([CA-91]=03), the position is not counted if the motor is rotated while no operation command is input. To prevent the position from shifting while the motor is stopped, prevent the motor shaft from rotating while the motor is stopped by braking or change to the 90° phase difference pulse input or forward/reverse command and pulse so that the motor is counted even when the motor is stopped.

・For single-phase pulses ([CA-91]=03), if the rotation direction command is switched during operation, an error may occur in the position counting due to the time difference between the switching of the direction of the inverter's output frequency and the switching of the actual motor rotation direction. In position control with single-phase pulses, stop it securely and then change the rotation direction.

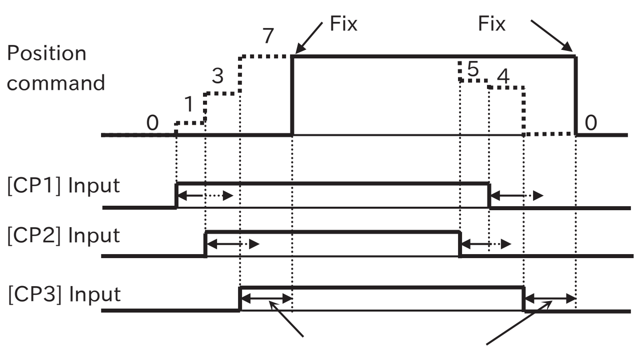
Multi-stage position command switching function

- The position command can be selected from "Position command 0 [AE-20]" to "Position command 15[AE-50]" by combining "Position command selection 1 [CP1](076)" to "Position command selection 4 [CP4](079)" of the input terminal function with the multi-stage position command switching function.
- Position commands 0 to 15 are set at an absolute position with reference to the origin.
- If there is no assignment of [CP1] to [CP4] to the input terminal, "Position command 0 [AE-20]" is the position command.
- When inputting position command selection 1 to 4, the time until the input terminal status (position command selection) is confirmed can be adjusted with "Multi-stage input confirmation time [CA-55]". Incorrect selection due to the input time difference of position command selection 1 to 4 can be prevented. The selection will be confirmed after the [CA-55] setting has elapsed without any changes. Note that the input response will be worse if the settling time is increased.

Code	Item	Description	Data	Initial value
AE-20 to AE-50	Position command 0 to position command 15	Set position command 0 to 15. If the value is positive, it will be in the forward direction. If it is negative, it will be in the reverse direction. (The setting range is limited to "Position range designation (reverse rotation side) [AE-54]" to "Position range designation (forward rotation side) [AE-52]".)	[AE-52] to [AE-54]	0
AE-52	Position control range (Forward)	Set the position control range on the forward rotation side. If [AE-56] is "Limit (00)", the motor trips due to "Position control range error [E104]" if the present position counter exceeds this setting.	For AA123≠03: 0 to 268435455 pls For AA123=03: 0 to 1073741823 pls	268435455
AE-54	Position control range (Reverse)	Set the position control range on the reverse side. If [AE-56] is "Limit (00)", the motor trips due to "Position control range error [E104]" if the present position counter exceeds this setting.	For AA123≠03: -268435455 to 0 pls For AA123=03: -1073741823 to 0 pls	-268435455
CA-55	Multistage input determination time	This is the time until the position command is determined when the multistage position command switching is performed.	0 to 2000 ms	0
CA-01 to CA-08	Input terminal function	Multistage position settings selection 1 to 4 ([CP1]/[CP2]/[CP3]/[CP4]): Select the position command in the combination of ON/OFF of the pin functions.	076([CP1]) 077([CP2]) 078([CP3]) 079([CP4])	-

Position command	CP4	CP3	CP2	CP1
Position command 0	OFF	OFF	OFF	OFF
Position command 1	OFF	OFF	OFF	ON
Position command 2	OFF	OFF	ON	OFF
Position command 3	OFF	OFF	ON	ON
Position command 4	OFF	ON	OFF	OFF
Position command 5	OFF	ON	OFF	ON
Position command 6	OFF	ON	ON	OFF
Position command 7	OFF	ON	ON	ON
Position command 8	ON	OFF	OFF	OFF
Position command 9	ON	OFF	OFF	ON
Position command 10	ON	OFF	ON	OFF
Position command 11	ON	OFF	ON	ON
Position command 12	ON	ON	OFF	OFF
Position command 13	ON	ON	OFF	ON
Position command 14	ON	ON	ON	OFF
Position command 15	ON	ON	ON	ON

Using [CP1] to [CP3] as an input connector



Teaching operation function

・This function rotates and stops the motor optional and stores the position as a position command in an arbitrary position command.
・In position teaching, use "Teach selection [AE-60]" to store the "Present position monitor [dA-20]" to "Position command 0 [AE-20]" to "Position command 15[AE-50].

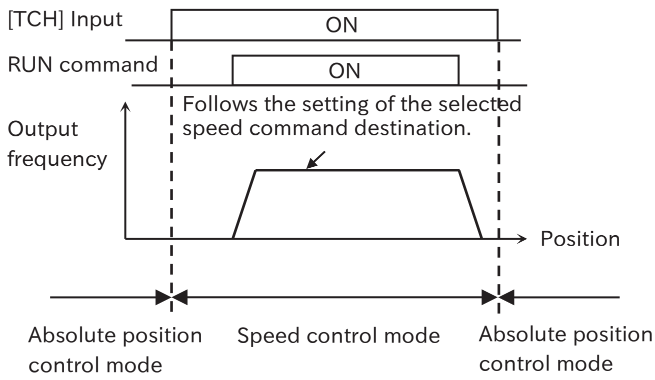
■Basic operation of teaching

(1) Move the workpiece to the position to be memorized by normal operation or manually to adjust the position.
(2) Key [AE-60] to select X00 to X15, and then press SET.
Thus, the position data of "Present Position Monitor [dA-20]" is stored in the corresponding position command. (X00=[AE-20] to X15=[AE-50] is supported. Refer to the table below for details.)

■Example of teaching procedure during absolute position control operation

(1) Select the position command number to be set in "Teach selection [AE-60]" (No SET key is pressed).
(2) Move the workpiece. Turn ON the input terminal function "Teach signal [TCH]" to enable velocity control, and then input the RUN command. The speed command and acceleration/deceleration time depend on the selection status at this time.
(3) When the workpiece reaches the target position, select the position command to be set with [AE-60] and press SET. Thus, the present position is saved in the position command destination (see the table below) set in "Teach selection [AE-60]" (the saving of the position itself is independent of ON/OFF status of the [TCH] input terminal).
(4) To store the position continuously, repeat from step (1).
Note: The [AE-60] setting is not saved. If power shutdown or resetting is performed, "X00(00)" will occur.

[AE-60] Set value	Position command to be set
00: X00	[AE-20]: Position command 0
01: X01	[AE-22]: Position command 1
02: X02	[AE-24]: Position command 2
03: X03	[AE-26]: Position command 3
04: X04	[AE-28]: Position command 4
05: X05	[AE-30]: Position command 5
06: X06	[AE-32]: Position command 6
07: X07	[AE-34]: Position command 7
08: X08	[AE-36]: Position command 8
09: X09	[AE-38]: Position command 9
10: X10	[AE-40]: Position command 10
11: X11	[AE-42]: Position command 11
12: X12	[AE-44]: Position command 12
13: X13	[AE-46]: Position command 13
14: X14	[AE-48]: Position command 14
15: X15	[AE-50]: Position command 15



Code	Item	Description	Data	Initial value
AE-60	Teach-in function target selection	The "Present position monitor [dA-20]" is stored in the corresponding position command.	00 to 15	00
CA-01 to CA-08	Input terminal function	Teaching signal[TCH]: With this signal turned ON, the teaching operation function operates by inputting an operation command.	110	-

・Regardless of the control mode or operation status, if you select "X00(00)" to "X15(15" in "Teach selection [AE-60]" and press SET key, the corresponding position command ([AE-20] to [AE-50]) will be changed with the content of "Present position monitor [dA-20]".
・Do not use [AE-60] for purposes other than position teaching.

Minimum position control function

・When "OFF limit (01)" is selected in "Positioning mode select [AE-56]", the rotational direction is determined so that the travel distance to the target position is the shortest for applications like the turntable shown in the figure below.

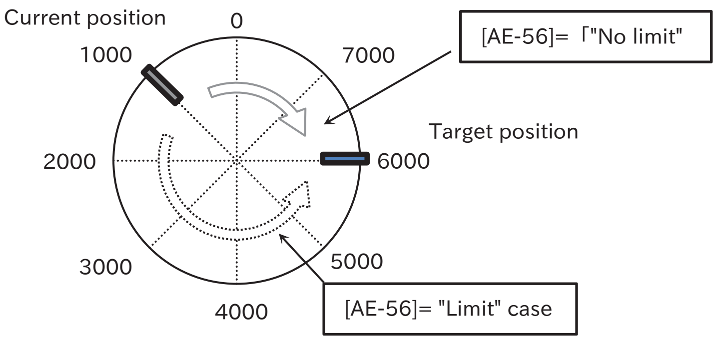
■Application example) Turntable with 8 positioning points

・Assume that an attempt is made to move from the present position (1000 pls) to the target position (6000 pls) of a turntable whose position area is set as shown below. (Be sure to set each positioning point within the position range.)

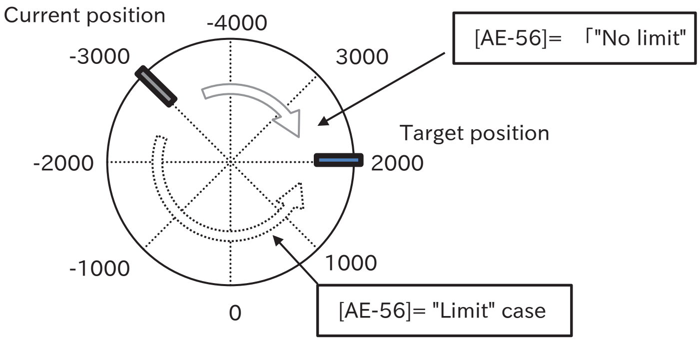
Position control range (Forward) [AE-52] = 7999
Position range designation (Reverse) [AE-54] = 0

- [AE-56] = "Limit (00)"(Target position)-(Present position) = +5000 pls, so rotate in the forward direction.
- [AE-56] = "Do not limit (01)" will cause the actuator to move in the reverse direction in which the movement distance in the forward direction is smaller than that in the reverse direction.

Forward move: + 5000 pls
Reverse move: -3000 pls



Note: Depending on the position range setting, the following settings can also be made.
[AE-52] = +3999
[AE-54] = -4000



・If "Positioning mode selection [AE-56]" = "No limit (01)", "Position control range error [E104]" will not occur.
・In the above cases, when moving from 7000 pls position to 1000 pls position, the position 7999 pls will move from the present position counter to 1000 pls position instead of 8000 pls.

Positioning restart function

- With this function, positioning operation is performed automatically again if the position is misaligned due to external force during DC braking after positioning of the position control operation is completed.
- This function is activated when the present position is out of the range of the target position ± "positioning restart range setting [AE-17]".
- When [AE-17] is set to other than 0 pls, this function is enabled. [It does not work for AE-17] = 0 pls.
- This function does not operate when the RUN command is turned OFF after the completion of positioning.
- Set [AE-17] in the same way as [AE-04] in 4 multiplications (A-phase 1 pulse cycle is 4 pulses).
- Depending on the setting of "Positioning restart range setting [AE-17]" and "Positioning completion range setting [AE-04]", the repositioning function may start and stop repeatedly. Set and adjust so that [AE-17]>[AE-04] is selected to prevent frequent start/stop operations.
- Do not use this function if the brake is used to hold the stop position. Brake opening and closing may become frequent and the load may drop or overload trip may occur.

Code	Item	Description	Data	Initial value
AE-04	Positioning completed range setting	When the present position falls within the range of the target position ±[AE-04], the [POK] signal will be outputted assuming that the positioning is complete. (4 multiplication setting)	0 to 10000 pls	50
AE-17	Positioning restart range	When the present position is out of the range of the target position ±[AE-17] after the completion of positioning, the positioning operation is performed again. (4 multiplication setting)		0

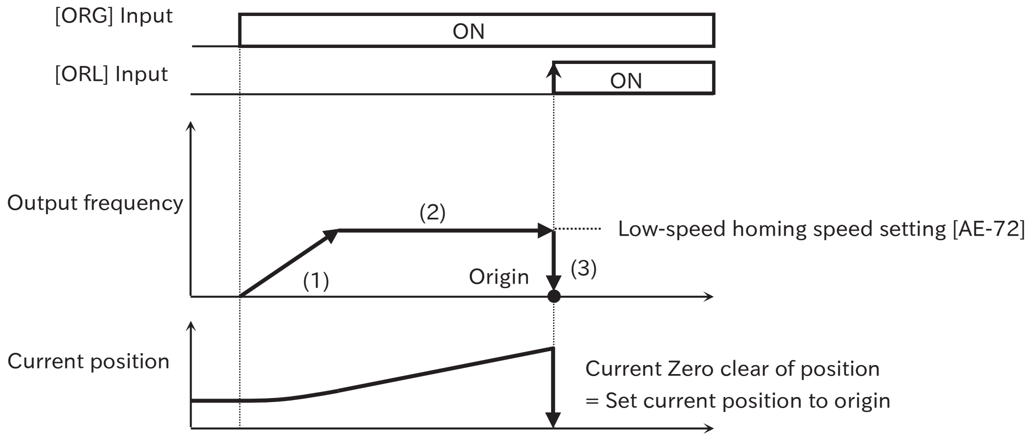
Function signal of homing function

- Three types of origin return operations can be selected by "Origin return mode selection [AE-70]".
- When using the home-return function, assign "home limit signal [ORL](080)" and "home-return start signal [ORG](081)" to the input terminals. [ORL] Input a home signal using a limit sensor, etc. to the input terminal.
- Origin return rotation direction is selected by "Origin return direction selection [AE-71]". When origin return ends, the current position is cleared to zero.
- The operation when the [ORG] connector is ON can be changed by setting "ORG Pin Operation Selection [AE-74]". If "No operation command (00)" is set, the [ORG] input terminal must be turned ON and the RUN command must be input further in order to initiate the home-return operation. When "RUN command multiplexed (01)" is set, ON of the [ORG] input terminal will immediately initiate Home Return operation.
- In relation to origin return, please also use the current position clear function, current position preset function, and position data hold function at power shutdown, which are described below, in combination according to the application.
- Assign "Pulse input Z [PLZ](109)" to "Input terminal function [ES] selection [CA-06]" and input Z pulse of encoder to input terminal [ES] when "Home return mode selection [AE-70]" is set to "High-speed Home return 2 (02)".

Code	Item	Description	Data	Initial value
dA-20	Current position monitor	The value of this monitor is cleared to zero when the power is turned off and return to origin is completed. It is also possible to change to an arbitrary value by the current position preset function described later or save to the internal memory of the current position by the current position storage function when the power is turned off.	For AA123≠03: -268435455 to +268435455 pls For AA123=03: -1073741823 to +1073741823 pls	-
AE-70	Homing function selection	Low-speed homing	00	00
		High-speed homing 1	01	
		High-speed homing 2	02	
AE-71	Homing direction selection	The direction of rotation when returning to the origin is taken as the forward direction.	00	01
		The direction of rotation when returning to the origin is assumed to be the reverse direction.	01	
AE-72	Low-speed homing speed setting	Set the speed of the low-speed origin return mode.	0.00 to 10.00 Hz	5.00
AE-73	High-speed homing speed	Set the speed of high-speed origin return mode.	0.00 to Max. frequency Hz	5.00
AE-74	ORG action selection	RUN command input source none	00	01
		RUN command input source combined use	01	
CA-01 to CA-08	Input terminal function	Home limit [ORL]: Input signal from the home limit switch, etc. during home return operation.	080	-
		Origin return start signal[ORG]: When this signal is turned ON in absolute position control, the home-return operation starts.	081	
		Pulse-input Z[PLZ]: Accepts Z-phase pulse input.	109	

■Low-speed homing ([AE-70] = 00)

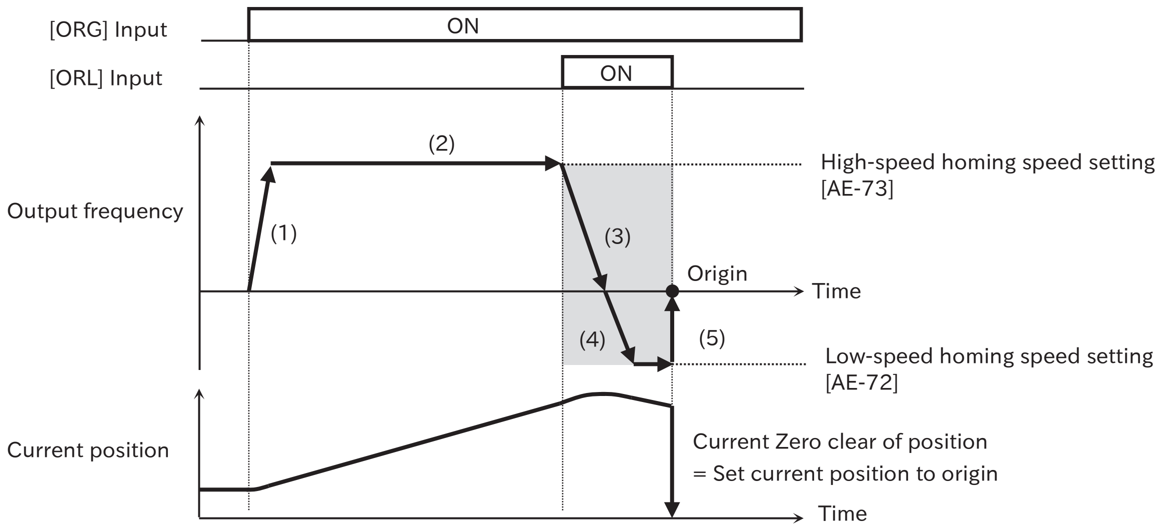
・The following figure explains the operation when "Origin return mode selection [AE-70]" is "Low speed origin return (00)" and "ORG terminal operation selection [AE-74]" is "Operation command also (01)".



(1) When the "Origin return start signal [ORG]" input terminal becomes ON, the actuator accelerates in the direction of "Origin return direction selection [AE-71]". At this time, do not input the operation command because the absolute position control starts.
(2) Run at "Low-speed zero return speed [AE-72]".
(3) When the "Home limit [ORL]" input terminal is ON, the "Present position monitor [dA-20]" is cleared to zero. At the same time, DC braking operates. [ORG] OFF the INPUT terminal to cancel DC braking.

■High-speed homing 1 ([AE-70] = 01)

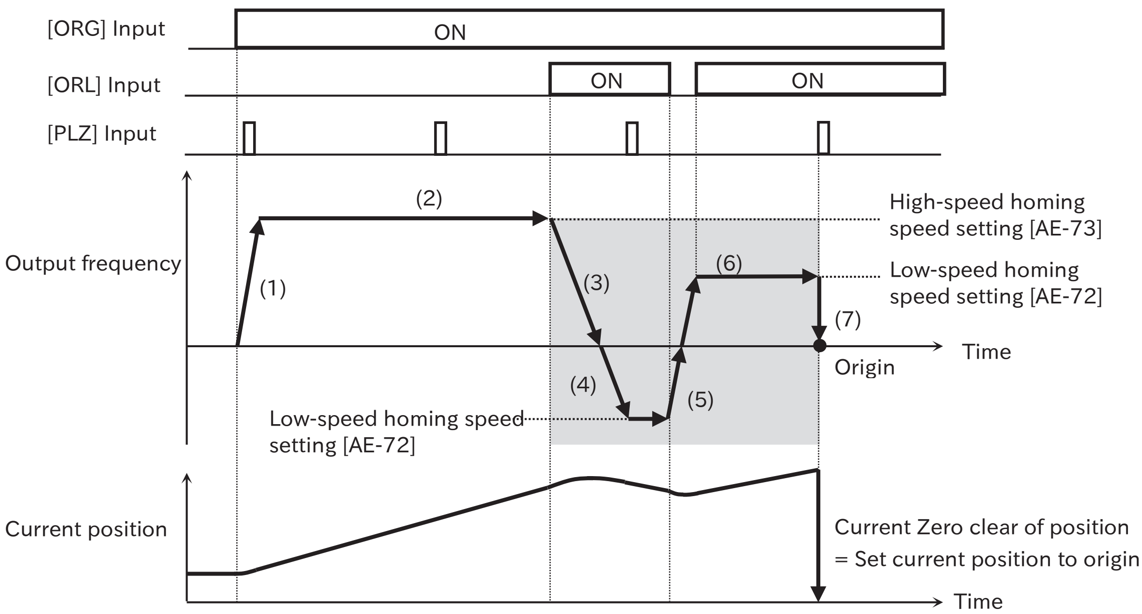
・The following figure shows the operation when "Home Return Mode Selection [AE-70]" is "High-speed Home Return 1 (01)" and "ORG Terminal Operation Selection [AE-74]" is "RUN Command (01)".



(1) When the "Origin return start signal [ORG]" input terminal becomes ON, the actuator accelerates in the direction of "Origin return direction selection [AE-71]". At this time, do not input the RUN command because the absolute position control starts.
(2) Run at "high-speed home return speed [AE-73]"
(3) When the "Home limit [ORL]" input terminal is ON, decelerating starts.
(4) After stopping, re-accelerate in the direction opposite to "Origin return direction selection [AE-71]" and run at "Low-speed Origin return velocity [AE-72]".
(5) [ORL] When the input terminal is OFF, "Present Position Monitor [dA-20]" is cleared to zero. At the same time, DC braking operates. [ORG] OFF the INPUT terminal to cancel DC braking.

■**High-speed homing 2 ([AE-70] = 02)**

・The following figure shows the operation when "Home Return Mode Selection [AE-70]" is "High-speed Home Return 2 (02)" and "ORG Terminal Operation Selection [AE-74]" is "RUN Command (01)".



(1) When the "Origin return start signal [ORG]" input terminal becomes ON, the actuator accelerates in the direction of "Origin return direction selection [AE-71]". At this time, do not input the RUN command because the absolute position control starts.
(2) Run at "high-speed home return speed [AE-73]"
(3) When the "Home limit [ORL]" input terminal is ON, decelerating starts.
(4) After stopping, re-accelerate in the direction opposite to "Origin return direction selection [AE-71]" and run at "Low-speed Origin return velocity [AE-72]".
(5) [ORL] When the terminal is OFF, decelerating starts.
(6) Accelerate in the direction of "Origin return direction selection [AE-71]" and run at "Low speed origin return speed [AE-72]". To do this, ON the [ORL] connector again.
(7) [ORL] When the first Z-pulse ("pulse input Z [PLZ]" input terminal) is input after the input terminal is turned ON, the "present position monitor [dA-20]" is cleared to zero. At the same time, DC braking operates. [ORG] OFF the INPUT terminal to cancel DC braking.

Home position setting by the current position clear function

- Assign "current position clear [PCLR](072)" to the input terminal and ON the terminal to clear "current position monitor [dA-20]" to zero.
- Move to the home position in advance and set the [PCLR] terminal to ON to fix the home position.
- "Clearance of position deviation[PCLR]", if "Vector control mode selection [AA123]" is set to "Velocity Feedback (02)", the "Pulse-input detection target selection [CA-90]" will be enabled regardless of the "Vector control mode selection [AA123]" setting.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	Clearing present position [PCLR]: If "Pulse-input detection target selection [CA-90]" is "Velocity Feedback (02)", "Present Position Monitor [dA-20]" will be cleared to zero when this signal is turned ON.	072

Home position setting by current position preset function

- The current position preset function overwrites the position data set in "Preset position data [AE-62]" to the current position. It can be used to restart from the middle of the positioning process, etc.
- This function is used when the home position set by the "home limit signal [ORL]" input terminal or the "pulse input Z [PLZ]" input terminal and the actual home position are offset.
- By assigning "Position data preset [PSET](085)" to the input terminal and ON the terminal, "Present position monitor [dA-20]" can be set to "Preset position data [AE-62]".
- Overwriting is performed at ON of the [PSET] connector.
- 「Position data presetting[PSET] If "Vector control mode selection [AA123]" is set to "Velocity Feedback (02)", the "Pulse-input detection target selection [CA-90]" will be enabled regardless of the "Vector control mode selection [AA123]" setting.

Code	Item	Description	Data	Initial value
AE-52	Position control range (forward)	Set the position control range on the forward rotation side. When [AE-56] is 00, if the present position counter exceeds this setting, it will trip due to "Position control range error [E104]".	For AA123≠03: 0 to 268435455 pls For AA123=03: 0 to 1073741823 pls	268435455
AE-54	Position control range (reverse)	Set the position control range on the reverse side. When [AE-56] is 00, if the present position counter exceeds this setting, it will trip due to "Position control range error [E104]".	For AA123≠03: -268435455 to 0 pls For AA123=03: -1073741823 to 0 pls	-268435455
AE-62	Pre-set position data	Set the position data preset value. (The setting range is limited to "Position range designation (reverse rotation side) [AE-54]" to "Position range designation (forward rotation side) [AE-52]".)	[AE-52] to [AE-54]	0
CA-01 to CA-08	Input terminal function	Position data preset [PSET]: When "Speed Feedback (02)" is selected for "Pulse-input detection target selection [CA-90]", "Present Position Monitor [dA-20]" is set to [AE-62] when this signal is turned ON.	085	-

Current position memory function when the power is shut off

- When "Current position storage at power shutdown [AE-61]" is set to "Enabled (01)", the value of "Current position monitor [dA-20]" is saved in the inverter internal memory when the power is shut down, and the value stored at the next power on is set as the current position.
- If the motor is rotated while the power is turned off, the position at that time will not be counted, resulting in a position shift. Therefore, when using this function, use a brake, etc. to prevent the motor from rotating when the power is cut off.
- Even if the motor is restrained by the brake when the power is cut off, the positional deviation may accumulate due to backlash of the rotating shaft, etc. Therefore, check the operation of the application, and eliminate the positional shift by the power supply restoration function, etc., if necessary.

Code	Item	Description	Data	Initial value
AE-61	Power-off Current position memory	Disabled: Do not save position data when power is cut off.	00	00
		Enabled: The current position is memorized when the power is cut off, and the position memorized when the power is turned on next time is set as the current position.	01	

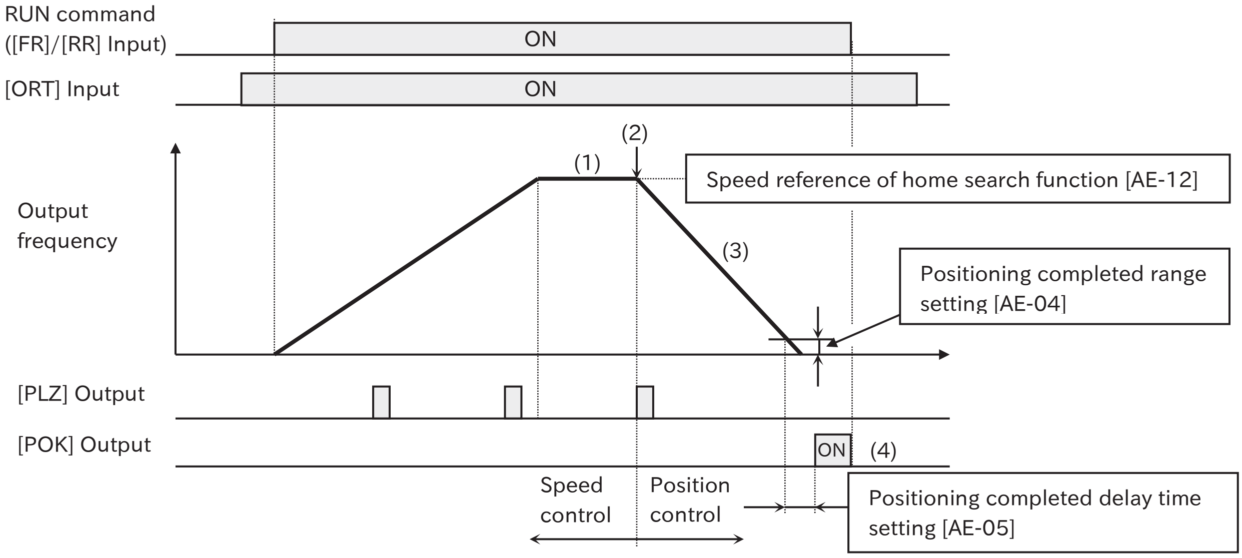
Forward/reverse drive stopping function ([FOT]/[ROT])

- This function is used to prevent deviation from the operating range by a signal from the control range limit switch.
- When "Forward drive stop [FOT](082)" of the input terminal function is input, the torque limit on the forward reverse side is limited to 10% when "Forward drive stop [ROT](083)" is input. It can be applied as a limit switch at the mechanical end.
- [FOT]/[ROT] is enabled when "Control method [AA121]" is "Vector control without sensor (IM) (08)".

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	Forward drive stopped [FOT]: When the control method [AA121] is "sensorless vector control (IM) (08)", if this signal is turned ON, the forward torque limit is limited to 10%.	082
		Reverse drive stopped [ROT]: When the control method [AA121] is "sensorless vector control (IM) (08)", if this signal is turned ON, the torque limit on the reverse side is limited to 10%.	083

9.14.2 Orientation function

- In absolute position control, orientation control can be performed.
- Set "Vector control mode [AA123]" to "Speed-torque control mode (00)" and use it.
- This function allows positioning at any point during one rotation of the motor. It can be used for tool change of machine tool spindle, etc.
- Absolute position control, for encoder feedback, see also "9.14.1 Controlling to the absolute position of the reference point (absolute position control)" and "9.5.11 Using encoder feedback".
- The Z pulse (single rotation position signal) is used as the reference signal for positioning. When connecting an encoder to the control terminal block, assign the input terminal function "Pulse input Z [PLZ](109)" to the input terminal [ES] and input Z pulses.



(1) When the RUN command is ON while the "Orientation [ORT]" input terminal is ON, the actuator accelerates to the "Orientation speed setting [AE-12]" and enters constant speed operation. In this case, the operation direction follows the "Orientation direction setting [AE-13]".
(If it is during operation, if it is the same as the operation direction set to [AE-13], the speed will change to the orientation speed when the [ORT] input terminal is turned ON, and if it is different, it will re-accelerate according to the setting of [AE-13] after decelerating stop.)

(2) After reaching the orientation velocity set in [AE-12], it will switch to position control when the first Z-pulse is detected.

(3) Position control will be performed with "Orientation stop position [AE-11]" plus one revolution for forward rotation and "Orientation stop position [AE-11] + one revolution for reverse rotation as the target. (Does not follow deceleration time setting.)

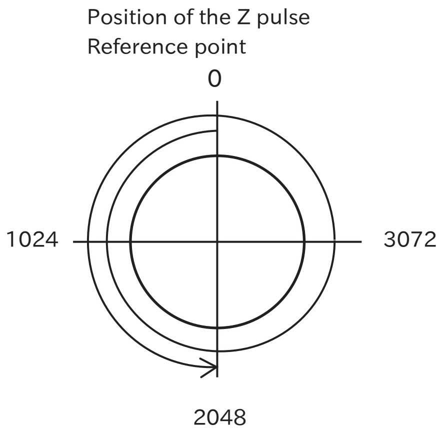
(4) After "Positioning completion delay time setting [AE-05]" elapses after the remaining number of pulses falls within "Positioning completion range setting [AE-04]", the "Positioning completion [POK]" signal is outputted. DC braking operation is performed after positioning is completed. DC braking operation and [POK] will continue until the operation command is OFF.

- If the "Orientation velocity setting [AE-12]" is large and the "Positioning complete range setting [AE-04]" is small, overshoot may occur and the "Positioning complete [POK]" signal may not be outputted. If this happens, reduce the [AE-12] or increase the [AE-04].

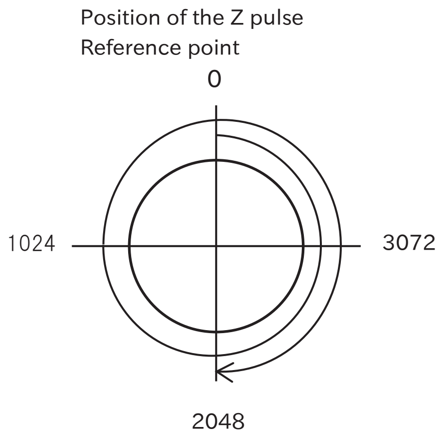
Code	Item	Description	Data	Initial value
AA123	Vector control mode selection	Mode of speed control to torque control	00	00
AE-04	Positioning completed range setting	Encoder 4 multiplication equivalent value	0 to 10000 pls	50
AE-05	Positioning completed delay time setting	Specify how long it takes for the [POK] signal to be output after positioning is complete.	0.00 to 10.00 s	0.00
AE-10	Stop position selection of home search function	Parameter setting ([AE-11])	00	00
		Communication Options	01	
AE-11	Stop position of home search function Note:1	Set the stop position for orientation control.	0 to 4095	0
AE-12	Speed reference of home search function Note:2	Sets the output frequency during orientation control.	0.00 to 120.00 Hz	5.00
AE-13	Direction of home search function	Starts in the forward direction during orientation control.	00	00
		Starts in the reverse direction during orientation control.	01	
CA-01 to CA-05	Input terminal function	Orientation [ORT]: Orientation control starts when the operation signal is turned ON while this signal is ON.	069	-
CA-06	Input terminal function [ES] selection	Pulse-input Z[PLZ]: Accepts Z-phase pulse input.	109	033
CA-81	Encoder constant setting	Set the number of pulses.	1 to 65535 pls	512
CA-82	Encoder phase sequence selection	A phase lead	00	00
		B phase lead	01	
CA-90	Pulse input target function selection	Disable	00	01
		Pulse input frequency directive	01	
		Velocity feedback	02	
		Pulse count	03	
CA-91	Pulse input mode selection	90° phase difference pulse input	00	03
		Forward and reverse command and pulse input	01	
		Single phase pulse input	03	
CC-01 CC-02 CC-07	Output terminal function	Positioning complete [POK]: When the present position falls within ±[AE-04] of the target position, this signal is turned ON.	043	002 001 017

Note: 1. The orientation stop position is set as one rotation 4096 division (0 to 4095) from the reference point in the forward direction, regardless of the number of pulses of the encoder. The reference point is the point where Z pulse is input, and the stop target position is arranged as shown in the figure below when viewed from the motor shaft load side. (For positive-phase connection)

2. Do not set the orientation speed setting to a high frequency, as the deceleration operation will be in the positioning state within two rotations. Overvoltage protection may trip or overshoot.



Forward rotation



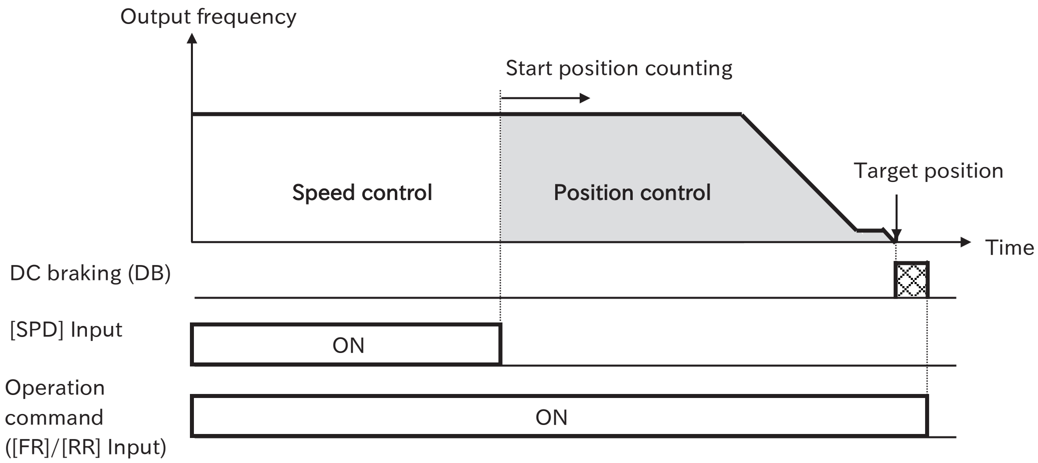
Reverse rotation

Note: When looking at the motor shaft from the motor shaft load side

9.14.3 Switching operation between speed control and position control

- In the absolute position control mode, when the "Speed/position switching [SPD](084)" of the input terminal function is turned ON, the normal frequency operation (speed control operation) is performed. The rotation direction follows the direction command at the time of operation command.
- [SPD] While the input terminal is ON, the present position counter is 0. If the [SPD] input terminal is turned OFF during operation, the unit switches to position control operation from that point.
- If the position command when switching from speed control to position control is 0, stop operation starts on the spot.
- [SPD] While the input terminal is ON, the actuator moves in the direction dependent on the operation command. When switching from speed control to position control, pay attention to the sign of the operation command.

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	Speed/position switching [SPD]: When this signal is ON, it runs in velocity control, and when it becomes OFF, it switches to position control operation.	084

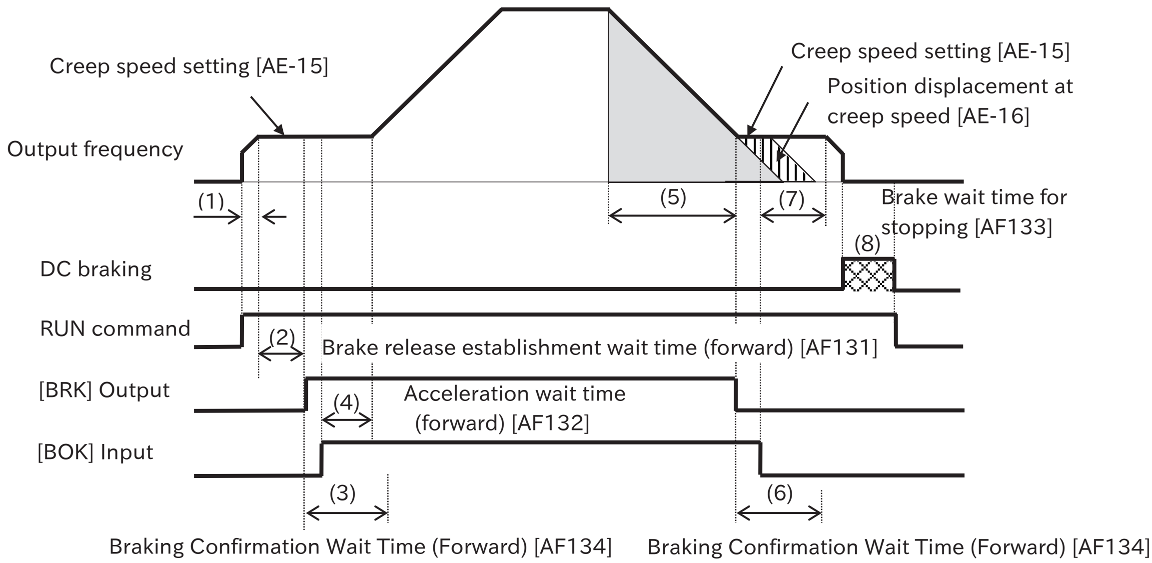


9.14.4 Operate absolute position control and brake control in conjunction

- If "Brake control selection [AF130]" = "Brake control enable (01)" or "Brake control enable (forward/reverse individual setting) (02)" is set in the absolute position control mode, the absolute position control and brake control are automatically linked.
- Setting [AF130] to "Braking Control Enable (Forward/Reverse Individual)" (02) allows you to set a different operation between forward and reverse rotation. When "Braking control enable (01)" is set to [AF130], the forward setting ([AF131] to [AF137]) is enabled for both forward and reverse.
- This section describes when "Brake control selection [AF130]" = "Brake control enable (01)". When this function is used in reverse rotation with "Brake control selection [AF130]" = "Brake control enable (forward/reverse individual setting) (02)", replace [AF131] to [AF136] with the reverse setting ([AF138] to [AF143]).
- When using this function, assign "Brake release [BRK](037)" to the output terminals.
- To operate this function while interlocking by inputting a confinement/release check signal from the external brake to the inverter, assign "Brake check [BOK](037)" to the input terminal and set "Brake check wait time ([AF134]/[AF141])". Also, assign "Braking error [BER](038)" to the output terminals as required.
- 『9.7.10 Perform related settings referring to "Start/Stop" and "9.14.1 Control to Absolute Position of Reference Point Reference (Absolute Position Control)" respectively.
- At deceleration, when the "creep rate setting [AE-15]" is reached, the "brake release [BRK]" signal is OFF, and the brake is restrained and the motor is stopped. For this reason, it will be stopped before the "creep-speed travel distance [AE-16]" at the largest from the actual target position. Considering the accuracy of the stopping position, set "creep-speed movement [AE-16]" and "positioning completion area setting [AE-04]."

Code	Item	Description	Data	Initial value
AE-14	DC braking control selection for simple positioning	Simple positioning DB control disabled	00	00
		Simple positioning DB control enabled	01	
AF130	Brake control enable	Brake control enabled	01	00
		Brake control enabled (Forward/Reverse individual setting)	02	
AF131	Brake release wait -motor (Forward)	Set the time from when the brake release frequency is reached until the output current reaches the brake release current.	0.00 to 5.00 s	0.00
AF138	Brake release wait -motor (Reverse)			
AF132	Brake wait time for accel. (Forward)	[BOK] Set the mechanical delay from ON of the input terminal (or the [BRK] signal to the release of braking).		
AF139	Brake wait time for accel. (Reverse)			
AF133	Brake wait time for stopping (Forward)	[BRK] Sets the mechanical delay between OFF and braking.		
AF140	Brake wait time for stopping (Reverse)			
AF134	Brake confirmation signal wait -motor (Forward)	[BRK] After the signal is output, set the time longer than the time until the release completion signal output from the brake turns ON the [BOK] input terminal of the inverter.		
AF141	Brake confirmation signal wait -motor (Reverse)			
AF136	Brake release current -motor (Forward)	Sets the output current that enables brake release.	(0.00 to 2.00)× Inverter rated output current A	1.00× rated output current
AF143	Brake release current -motor (Reverse)			
AA123	Vector control mode selection	Absolute position control mode	02	00
		High-resolution absolute position control mode	03	
AE-04	Positioning completed range	When the present position falls within the range of the target position ± [AE-04], the [POK] signal will be outputted assuming that the positioning is complete. (4 multiplication setting)	0 to 10000 pls	50
AE-15	Creep speed setting	Set the low-speed operation just before the completion of positioning.	Min. frequency [Hb130] to 10.00 Hz	5.00
AE-16	Position displacement at creep speed	Set the move distance to operate at the [AE-16] speed.	0 to 16384 pls	2560

Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Braking confirmation [BOK]: Check this input signal as an answerback of the [BRK] signal to the external brake.	037	002 001 017
CC-01 CC-02 CC-07	Output terminal function	Brake release [BRK]: This signal is for restraining/releasing the external brake.	037	
		Braking error [BER]: This relay is ON when a sequence error occurs in the brake control function. With ON of this signal, the inverter trips with "Brake error [E036]".	038	



(1) When an RUN command is issued, the inverter accelerates to the creep-speed setting [AE-15].
The rotation direction is forward if (current position-target position) is positive, and reverse if negative.
In addition, if the target position is within ± "Positioning completion area [AE-04]", it will be stopped on the spot without releasing the brakes. Whether to perform DC braking depends on the [AE-14] setup.

(2) After the output frequency reaches the "creep velocity setting [AE-15]" and the time "Brake release establishment wait time (forward) [AF131]" has elapsed, the "Brake release [BRK]" signal turns ON.
However, if the output current at this time is less than the "brake release current (forward rotation side) [AF136]", the [BRK] signal will not be ON, the "brake error [E036]" trip will occur instead, and the "brake error [BER]" signal will be turned ON.

(3) The operation differs depending on whether "Braking confirmation [BOK]" is assigned to the input terminal.
[BOK] With assignment: After the [BRK] signal turns ON, the inverter does not accelerate and waits for the [BOK] input terminals to become ON during the "Braking Confirmation Wait Time (Forward) [AF134]". If the [BOK] input terminal does not turn ON within the waiting time, a "Braking error [E036]" trip will occur and the "Braking error [BER]" signal will be ON.
[BOK] No assignment: After the [BRK] signal turns ON, go to step (4).

(4) [BOK] When the time of "Acceleration wait time (forward side)[AF132]" has elapsed after the input terminals ON (or after the [BRK] signal is turned ON), the motor accelerates to the set frequency again. If the movement to the target position is small, deceleration starts while reaching the set frequency.

(5) Deceleration starts at the position before (movement during deceleration + creep speed movement [AE-16]) from the target position. The inverter decelerates to the "creep-speed setting [AE-15]" and OFF [BRK].

(6) The operation differs depending on whether "Braking confirmation [BOK]" is assigned to the input terminal.
[BOK] With assignment: After the [BRK] signal turns OFF, the inverter does not decelerate and waits for the [BOK] input terminals to become OFF during the "Braking Confirmation Wait Time (Forward) [AF134]". If the [BOK] input terminal does not turn OFF within the waiting time, a "Braking error [E036]" trip will occur and the "Braking error [BER]" signal will be ON. [BOK] No assignment: After the [BRK] signal turns OFF, proceed to step (7).

(7) [BOK] After the input terminal OFF (or [BRK] signal is turned OFF), the Motor decelerates to 0Hz again when the "Stop wait time (forward)[AF133]" or the "Creep velocity move distance [AE-16]" travel time elapses, whichever is longer.

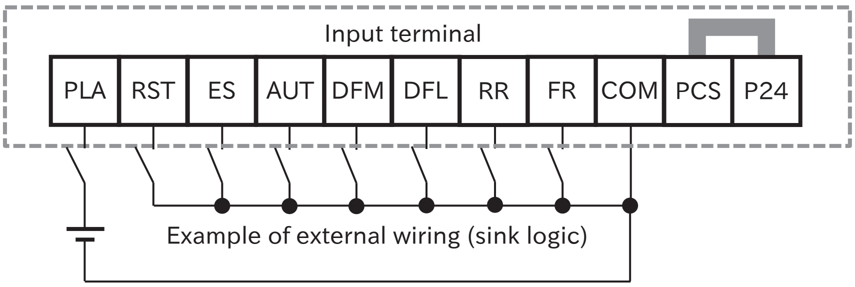
(8) After stopping, the inverter follows the setting of "Simple positioning DB control at braking control [AE-14]". If "simple positioning DB control disabled (00)", it will be shut off. When "Simple positioning DB control enabled (01)" is selected, DC braking is activated, and when the operation command is OFF, the output shuts off.

9.15 Input signal

9.15.1 Input signal function

- Input connectors [FR] through [PLA] are intelligent input connectors. By assigning the functions in the input terminal function list shown on the next page to "Input terminal function selection ([CA-01] to [CA-08])", the functions specified for input terminals [FR] to [PLA] are assigned. For details of each function, refer to the chapter in the reference column of the input pin function list.
- For input terminals [FR] through [PLA], either a-contact (NO) input or b-contact (NC) input can be selected individually according to the setting of "Input terminal a/b (NO/NC) selection ([CA-21] to [CA-28])".
  - Contact a (NO): ON when the contact is closed, OFF when the contact is opened
  - Contact b (NC): OFF when the contact is closed, ON when the contact is opened
- The same function cannot be assigned to multiple input pins. When assignment is set to multiple pins, the last assigned pin is enabled, and the previous assignment is "No assignment [no]".
- The electrical specifications of input terminal [PLA] differ from those of input terminals [FR] through [RST]. For details, refer to the table below and "5.4.1 Configuration of Control Circuit Terminals".
- When receiving encoder feedback or using an external thermistor, the input terminal function assigned to some pins is disabled depending on the setting of the parameter related to each. For details, refer to "9.5.11 Using Encoder Feedback" or "9.10.8 Monitoring Motor Temperature".

Code	Item	Description	Data
CA-01 to CA-08	Input terminal function	Assign the input terminal function to input terminals [FR] through [PLA]. The [CA-01] to [CA-08] settings correspond to the [FR]-[PLA] connectors.	Refer to "List of Input Terminal Functions" in this section
CA-21 to CA-28	Input terminal active state	Operates as a-contact (NO: normally open).	00
		Operates as a b-contact (NC: normally closed).	01



Input terminal [PLA] only voltage input (common always [COM] terminal)

Input terminal	Electric Characteristics
[FR] to [AUT]	ON: Min. 18V OFF: Max. 3V Max. allowable voltage: 27V Load current: 5mA (24V) Internal resistance: 4.7kΩ
[ES], [RST]	Input-pulse: min. 0.3Hz to max. 32kHz ON: Min. 18V OFF: Max. 3V Max. allowable voltage: 27V Load current: 8mA (24V) Internal resistance: 3kΩ
[PLA]	Input-pulse: min. 0.3Hz to max. 32kHz ON: Min. 4V OFF: Max. 1V Max. allowable voltage: 27V Internal resistance:11kΩ

■Table of input terminal functions

Function No.	Symbol	Function name	Reference
000	no	Not use	-
001	FR	Forward rotation	9-2
002	RR	Reverse rotation	
003	DFL	Multi speed selection 1	9-11 9-30
004	DFM	Multi speed selection 2	
005	DFH	Multi speed selection 3	
006	DHH	Multi speed selection 4	
007	SF1	Multi speed Bit-1	9-12 9-30
008	SF2	Multi speed Bit-2	
009	SF3	Multi speed Bit-3	
010	SF4	Multi speed Bit-4	
011	SF5	Multi speed Bit-5	
012	SF6	Multi speed Bit-6	
013	SF7	Multi speed Bit-7	
014	ADD	Trigger for frequency addition	9-18
015	AUT	Main/Sub speed reference change	9-16
016	STA	3-wire Start	9-3
017	STP	3-wire Stop	
018	F/R	3-wire forward/reverse	
019	AHD	Analog command holding	9-20
020	UP	Remote control speed-up function	9-19
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022	UDC	Remote control Speed data clearing	
023	F-OP	Force operation	9-8 9-21
024	SET	2nd-motor control	9-95
028	RST	Reset	9-214
029	JOG	Jogging	9-13
030	DB	External DC braking	9-78
031	AD2	2-stage Acceleration/Deceleration	9-24
032	MBS	Free run stop	9-77
033	ES	External fault	9-154
034	USP	Unattended start protection	9-155
035	CS	Commercial power supply change	9-82
036	SFT	Soft-Lock	7-17
037	BOK	Answer back from Brake	9-84
038	OLR	Overload restriction selection	9-131
039	KHC	Accumulated input power monitor clear	10-7
040	OKHC	Accumulated output power monitor clear	10-8
041	PID	Disable PID1	9-112
042	PIDC	PID1 integration reset	
043	PID2	Disable PID2	9-125
044	PIDC2	PID2 integration reset	
051	SVC1	Multi set-point selection 1	9-108
052	SVC2	Multi set-point selection 2	
053	SVC3	Multi set-point selection 3	
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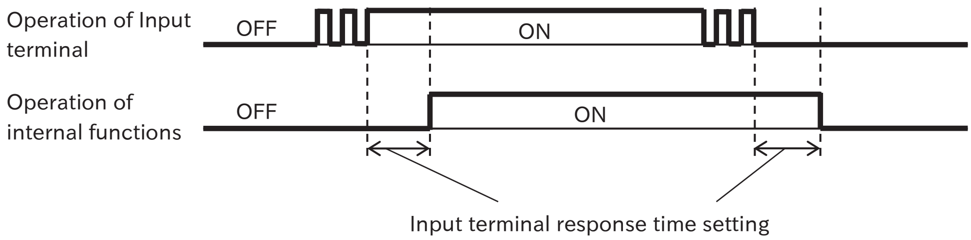
055	PRO	PID gain change	9-114
056	PIO1	PID output switching 1	9-124
058	SLEP	SLEEP condition activation	9-117
059	WAKE	WAKE condition activation	
060	TL	Torque limit enable	9-59
061	TRQ1	Torque limit selection bit 1	9-60
062	TRQ2	Torque limit selection bit 2	
063	PPI	P/PI control mode selection	9-65 9-67
064	CAS	Control gain change	
067	ATR	Permission of torque control	9-55
068	TBS	Torque Bias enable	9-64
069	ORT	Home search function	9-200
071	LAC	Acceleration/Deceleration cancellation	9-23
072	PCLR	Clearance of position deviation	9-197
076	CP1	Multistage position settings selection 1	9-190
077	CP2	Multistage position settings selection 2	
078	CP3	Multistage position settings selection 3	
079	CP4	Multistage position settings selection 4	
080	ORL	Limit signal of Homing function	9-194
081	ORG	Start signal of Homing function	9-194
082	FOT	Forward Over Travel	9-198
083	ROT	Reserve Over Travel	
084	SPD	Speed/position switching	9-201
085	PSET	Position data presetting	9-197
086	-	Reserved	-
087			
088			
089			
090			
091			
092			
093			
097	PCC	Pulse counter clearing	9-211
098	ECOM	EzCOM activation	11-25
099	-	Reserved	-
100	HLD	Acceleration/Deceleration disable	9-25
101	REN	RUN enable	9-34
102	DISP	Display lock	7-21
103	PLA	Pulse input A	9-211
104	PLB	Pulse input B	
105	EMF	Emergency-force drive activation	9-90
107	COK	Contactor check signal	9-86
108	DTR	Data trace start	12-3
109	PLZ	Pulse input Z	9-194 9-200
110	TCH	Teach-in signal	9-191

9.15.2 Adjust the response of the signal input

- Setting the response time to the input signal can prevent false input due to chattering or noise.
- Response time can be set for each input terminal.
- All input signals ON/OFF immediately depending on the conditions. However, chattering may occur depending on the selected signal. Use this for holding/delaying such signals.
- Response time is ignored at power ON and at resetting. For example, if the power is turned on with the "Forward rotation [FR]" input terminal turned ON, the operation starts immediately after the internal reset process, regardless of the response-time setting.

Code	Item	Description	Data	Initial value
CA-41 to CA-48	Input terminal response time	Sets ON of the inputterminal and the response time (detection delay time) at OFF. The [CA-41] to [CA-48] settings correspond to the [FR]-[PLA] connectors.	0 to 400 ms	2



9.15.3 Adjust the analog input

- From the [VRF] and [IRF] terminals in HF-620 Analog input can be performed. [VRF] The terminal is "[VRF] terminal input switching [Cb-08]" and the [IRF] terminal can be switched between analog voltage input and analog current input by setting "[IRF] terminal input switching [Cb-18]".
- The [VRF] terminal is set to analog voltage input and the [IRF] terminal is set to analog current input after factory-shipped condition or initialization.
- The analog start-end function allows you to change any analog input range to any frequency command range (or torque command, PID feedback input, etc.).
- When both the start and end quantities are set to 0.00Hz, the analog start and end functions are disabled and the analog inputs operate from 0.00Hz to the highest frequency.
- 9.8V and current inputs are factory-adjusted to the full scale of the input voltage by 19.8mA. Make fine adjustments as necessary.

■ [VRF] terminal analog input adjustment parameters

Code	Item	Description	Data	Initial value
Cb-01	[VRF] Filter time constant	Sets the primary filter for analog input.	1 to 500 ms	500
Cb-03	[VRF] Start value	Set the frequency command value when the analog input value is [Cb-05]. Set the maximum frequency as a percentage of 100%.	0.00 to 100.00 %	0.00
Cb-04	[VRF] End value	Set the frequency command value when the analog input value is [Cb-06]. Set the maximum frequency as a percentage of 100%.		100.00
Cb-05	[VRF] Start rate	Set the start voltage/current of the analog command as a percentage of 10 VDC or 20 mA as 100 %.	0.0 to [Cb-06] %	0
Cb-06	[VRF] End rate	Set the end voltage/current of the analo command as a percentage of 10V or 20mA as 100%.	[Cb-05] to 100.0 %	100.00
Cb-07	[VRF] Start value selection	The command value between the start quantity [Cb-03]: 0.0% to [Cb-05] is the [Cb-03] setting value.	00	01
		0%: The reference between 0.0% to [Cb-05 is 0.00Hz.	01	
Cb-08	[VRF] Input selection	[VRF] Analog voltage input to the terminal is possible.	01	01
		[VRF] Analog current input to the terminal is possible.	02	
Cb-30	[VRF] Voltage/current bias adjustment	[VRF] Fine-adjust the input value by applying a bias to the analog input from the terminal.	-100.00 to 100.00 %	0.00
Cb-31	VRF] Voltage/current adjustment gain	[VRF] Apply gain to the analog input from the terminal to fine-tune the input value.	0.00 to 200.00 %	100.00

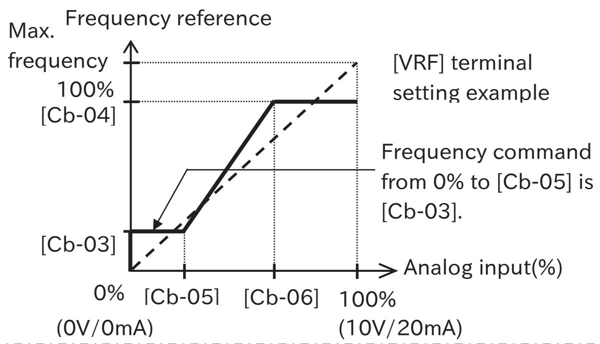
■ [IRF] terminal analog input adjustment parameters

Code	Item	Description	Data	Initial value
Cb-11	[IRF] Filter time constant	Sets the primary filter for analog input.	1 to 500 ms	500
Cb-13	[IRF] Start value	Set the frequency command value when the analog input value is [Cb-15]. Set the maximum frequency as a percentage of 100%.	0.00 to 100.00 %	0.00
Cb-14	[IRF] End value	Set the frequency command value when the analog input value is [Cb-16]. Set the maximum frequency as a percentage of 100%.		100.00
Cb-15	[IRF] Start rate	Set the start voltage/current of the analogue command as a percentage of 10V or 20mA as 100%.	0.0 to [Cb-16] %	20.0
Cb-16	[IRF] End rate	Set the end voltage/current of the analogue command as a percentage of 10V or 20mA as 100%.	[Cb-15] to 100.0 %	100.0
Cb-17	[IRF] Start value selection	The command value between the start quantity [Cb-13]: 0.0% to [Cb-15] is the [Cb-13] setting value.	00	01
		0%: The reference between 0.0% to [Cb-15 is 0.00Hz.	01	
Cb-18	[IRF] Input selection	[IRF] Analog voltage input to the terminal is possible.	01	02
		[IRF] Analog current input to the terminal is possible.	02	
Cb-32	[IRF] Voltage/current bias adjustment	[IRF] Fine-adjust the input value by applying a bias to the analog input from the terminal.	-100.00 to 100.00 %	0.00
Cb-33	[IRF] Voltage/current adjustment gain	[IRF] Apply gain to the analog input from the terminal to fine-tune the input value.	0.00 to 200.00 %	100.00

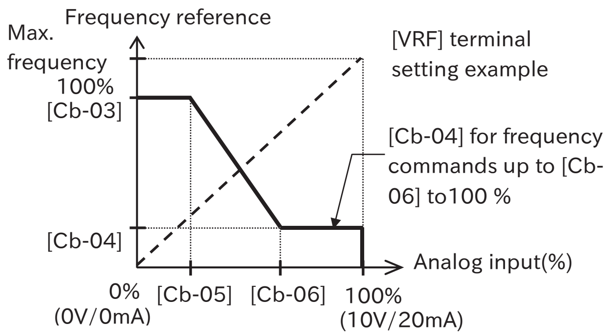
Setting example of analog input start selection

- By setting "[VRF] terminal start selection [Cb-07]" or "[IRF] terminal start selection [Cb-17]", it is possible to select the operation outside the setting of analogue input.
- The operation selected in [Cb-07] or [Cb-17] differs depending on the relation between the starting quantity and the end quantity. For details of operation in each setting, see the example in the figure below.

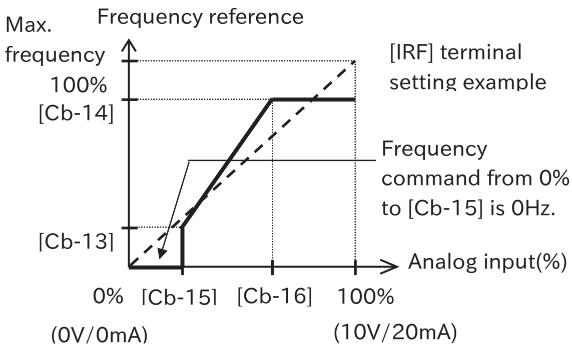
(e.g. 1-1) Start selection = Start amount (00)
Start amount < End amount



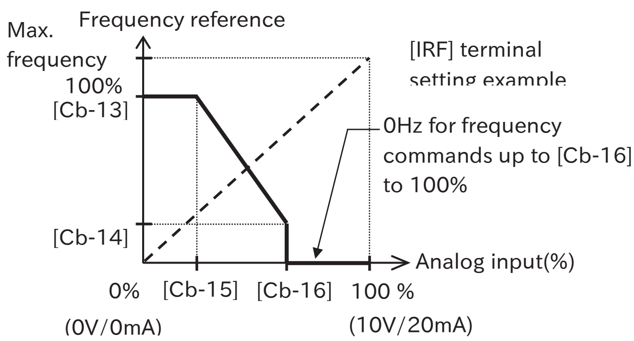
(e.g. 1-2) Start selection = Start amount (00)
Start quantity > End quantity



(e.g. 2-1) Start selection = 0% (01)
Start amount < End amount



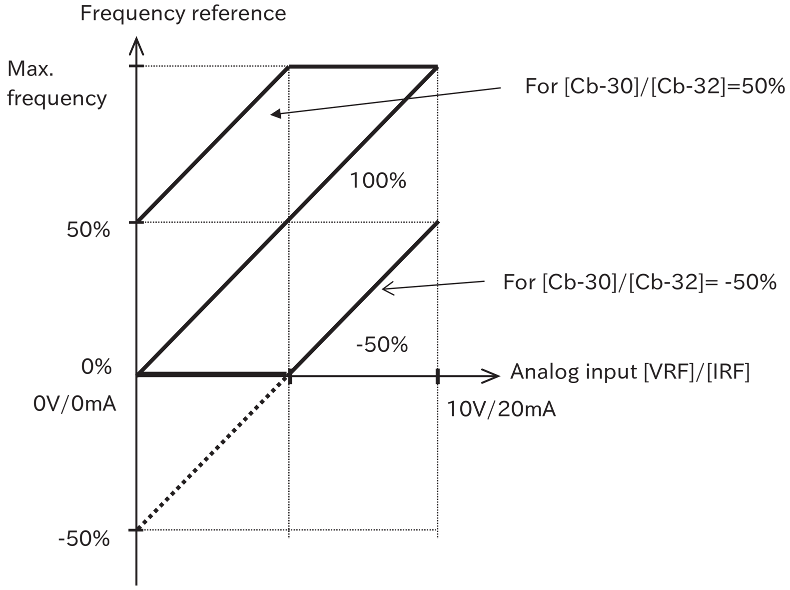
(e.g. 2-2) Start selection = 0% (01)
Start quantity > End quantity

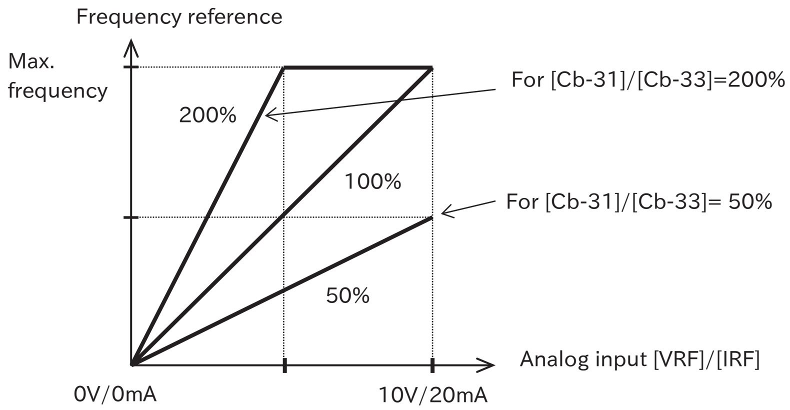


Fine adjustment by analog input adjustment gain

- If there is a deviation in the command value input from the analog input, fine adjustment can be performed by bias/gain adjustment as shown below.
- Use this function as a fine adjustment when there is a deviation even in the analog start/end function.
- When performing fine adjustment of analog input, adjust the start rate/end amount/start ratio/end ratio setting of each analog input as the initial setting value. Fine adjustment may be difficult.
- 9.8V and current inputs are factory-adjusted to the full scale of the input voltage by 19.8mA. Make fine adjustments as necessary.

■Analog input bias adjustment





Code	Item	Description	Data	Initial value
Cb-30	[VRF] Voltage/current bias adjustment	[VRF] Fine-adjust the input value by applying a bias to the analog input from the terminal.	-100.00 to 100.00 %	0.00
Cb-31	[VRF] Voltage/current adjustment gain	[VRF] Apply gain to the analog input from the terminal to fine-tune the input value.	0.00 to 200.00 %	100.00
Cb-32	[IRF] Voltage/current bias adjustment	[IRF] Fine-adjust the input value by applying a bias to the analog input from the terminal.	-100.00 to 100.00 %	0.00
Cb-33	[IRF] Voltage/current adjustment gain	[IRF] Apply gain to the analog input from the terminal to fine-tune the input value.	0.00 to 200.00 %	100.00

Command content selection and input scale at analog input

- The table below shows the command selection parameters that can be analog input and the full scale range at analog input.
- The input ranges in the table below apply when the Start amount/Start ratio parameter is set to 0% and the End amount/End ratio is set to 100% for each analog input.
- 9.8V and current inputs are factory-adjusted to the full scale of the input voltage by 19.8mA. Make fine adjustments as necessary.
- Refer to the table for details of each function listed in the table below.

Code	Item	Full scale of each command at analog input	Reference
AA101, AA102, AA201, AA202	Main/Sub speed reference enable	0.00 to Max. frequency Hz	9-6
Ad-01, Ad-11	Torque command and torque bias input selection	0.0 to 500.0 %	9-57 9-64
Ad-40	Speed limit input source selection at torque control	0.00 to Max. frequency Hz	9-57
AH-07, AH-42, AH-46, AJ-07	PID set-point input source selection	0.00 to 100.00 %	9-102 9-123
AH-51, AH-52, AH-53, AJ-12	PID feedback input source selection		9-103 9-123
AH-70	PID1 feedforward selection		9-103
bA101, bA201	Upper frequency limit source selection	0.00 to Max. frequency Hz	9-32
bA110, bA210	Torque limit selection	0.0 to 500.0 %	9-59
CA-70	Speed reference source selection when [F-OP] is active	0.00 to Max. frequency Hz	9-21
PA-22	Simulation Mode: Simulation mode: Optional output selection for the output current monitor	(0.00 to 3.00) ×Inverter rated output current A	8-13
PA-24	Simulation Mode: Simulation mode: Optional output selection for the DC bus voltage monitor	200V class: DC0.0 to 450.0 V 400V class: DC0.0 to 900.0 V	
PA-26	Simulation Mode: Simulation mode: Optional output selection for the output voltage monitor	200V class: DC0.0 to 300.0 V 400V class: DC0.0 to 600.0 V	
PA-28	Simulation Mode: Simulation mode: Optional output selection for the output torque monitor	0.0 to 500.0 %	
PA-30	Simulation Mode: Simulation mode: Optional frequency matching start enable setting	0.00 to Max. frequency Hz	

Analog input filter

- When the frequency command is performed by an external analog signal, the analog input filter time constant can be set for voltage input or current input.
- This setting is effective for noise rejection of analog input signals. If stable operation cannot be achieved due to the influence of noise, increase the setting value.
- When using analogue input for PID control system, please note that if this setting is increased, PID control will respond more slowly, so it may not be the desired property.

Code	Item	Description	Data	Initial value
Cb-01	[VRF] Filter time constant	Set the primary filters for the analog input [VRF].	1 to 500 ms	500
Cb-11	[IRF] Filter time constant	Set the primary filters for the analog input [IRF].		

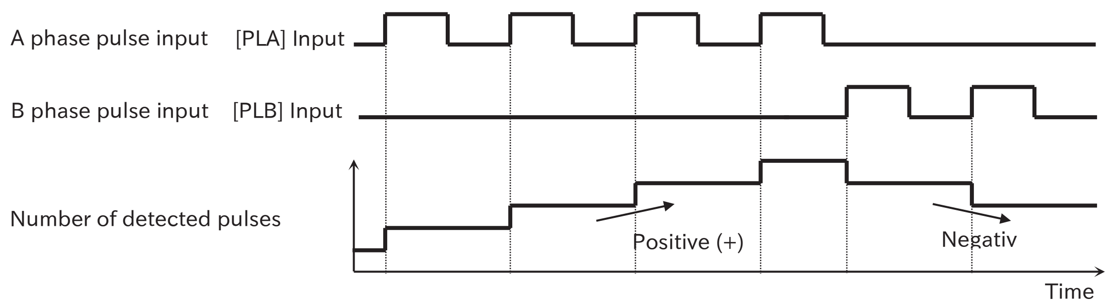
9.15.4 Pulse count function

- The pulse count function includes the terminal input monitoring mode and the phase coefficient monitoring mode.
- When "Pulse input detection target selection [CA-90]" is set to "Disabled (00)" to "Speed Feedback (02)", the terminal input monitoring mode is enabled. When [CA-90] is set to "Pulse Count (03)", the phase factor monitoring mode is enabled.
- To perform pulse counting in pin input monitoring mode, assign "Pulse input A [PLA]" and "Pulse input B [PLB]" to the multi-function input terminals. However, if "Pulse input frequency (01)" or "Speed feedback (02)" is selected for [CA-90], the input terminals [RST] and [PLA] will be dedicated terminals for each function, so assign them to any of the input terminals [FR] to [ES].
- When performing pulse counting in phase coefficient monitoring mode, connect so that input terminal [RST] is the B-phase pulse input and input terminal [PLA] is the A-phase pulse input. There is no need to set the [PLA] input jack and [PLB] input jack.
- The acquired pulses can be monitored by the pulse counter monitor as a cumulative counter. When the "Pulse counter clear [PCC]" input pin is turned ON, the accumulated counter can be cleared.
- Maximum input pulse in phase factor monitoring mode is the maximum 32kpps (approx. 50% Duty).
- The accumulated counter value cannot be memorized. After the power is turned on, it becomes zero.
- The maximum. input pulse in terminal input monitoring mode depends on the setting of the input terminal response function [CA-41] to [CA-48].

Code	Item	Description	Data	Initial value
dA-28	Pulse count monitor	Displays the counter accumulated value.	0 to 2147483647	-
CA-01 to CA-08	Input terminal function	Pulse counter clear [PCC]: Clears the accumulated value of pulse count.	097	-
		Pulse-input A [PLA]: Accepts A-phase pulse input.	103	
		Pulse-input B [PLB]: Accepts pulse input of phase B.	104	
CC-01 CC-02 CC-07	Output terminal function	[PCMP]: Pulse count compare match output signal is output.	044	002 001 017
CA-90	Pulse input target function selection	Disable	00	01
		Pulse input frequency directive	01	
		Velocity feedback	02	
		Pulse count	03	
CA-91	Pulse input mode selection	90° phase difference pulse input	00	03
		Forward and reverse command and pulse input	01	
		Single phase pulse input	03	
CA-97	Pulse counter compare match output ON value	The [PCMP] signal is turned ON when the pulse count reaches this setting.	0 to 65535	0
CA-98	Pulse counter compare match output OFF value	The [PCMP] signal is turned OFF when the pulse count reaches this setting.		0
CA-99	Pulse counter compare match maximum value	When the number of pulses reaches the setting value, the internal counter is cleared. When this setting is 0, the pulse is one-shot.		65535

Terminal watch ([CA-90]=00 to 02)

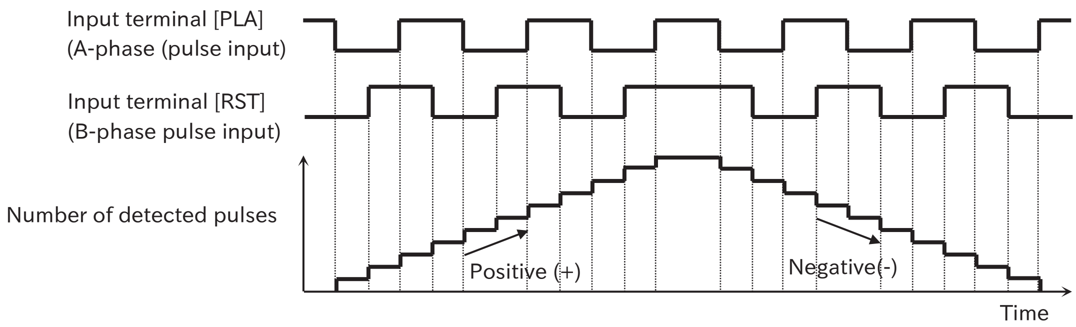
- Monitor ON of the "Pulse input A [PLA]" input terminal and the "Pulse input B [PLB]" input terminal.
- [PLA] Input terminal and [PLB] input terminal can be set to respective terminals by "Input terminal function selection ([CA-01] to [CA-08])". However, if "Pulse input frequency (01)" or "Speed feedback (02)" is selected for [CA-90], the input terminals [RST] and [PLA] will be dedicated terminals for each function, so assign them to any of the input terminals [FR] to [ES].



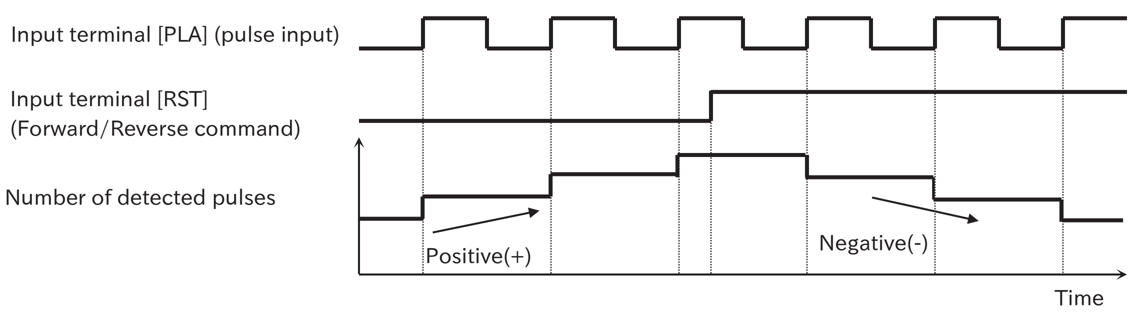
Phase factor monitoring mode ([CA-90]=03)

- The input terminal [RST] is the terminal for B-phase pulse input or forward/reverse command input, and the input terminal [PLA] is the terminal for A-phase pulse input or single-phase pulse input.

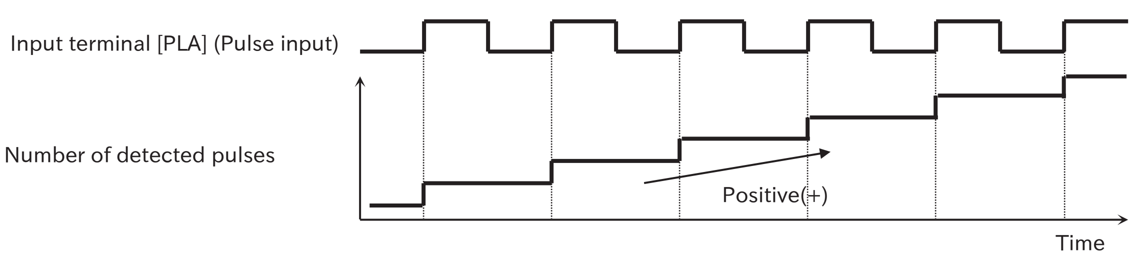
(1) Mode 0: 90° Phase angle ([CA-91]=00)



(2) Mode-1: Forward/reverse command and pulse-input ([CA-91]=01)



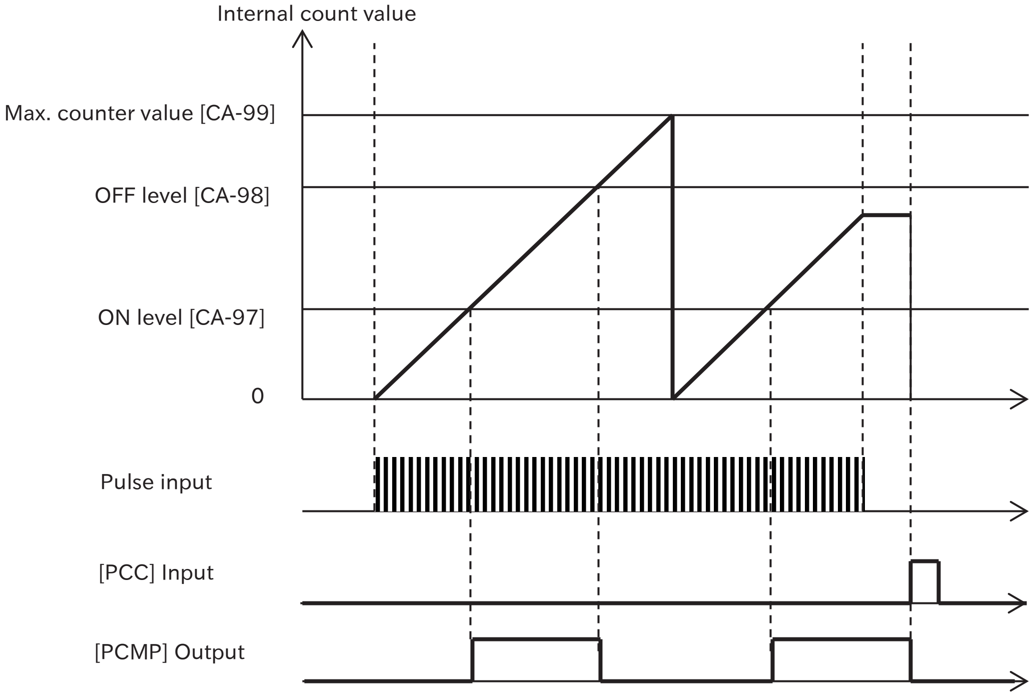
(3) Mode-3: Single-phase pulse input. ([CA-91]=03)



Compare match function

- The compare match function enables output of a signal corresponding to the number of counted pulses.
- When the number of pulses exceeds the "pulse count compare match output ON level [CA-97]", the "pulse count compare match output [PCMP]" signal is turned ON. Then, the counter advances further and if the pulse count compare match output OFF level [CA-98] is exceeded, the [PCMP] signal is turned OFF.
- The maximum value of pulse count can be set by "pulse count compare match output maximum value [CA-99]". When the pulse count reaches the maximum value, the count value starts counting from zero again.
- If the "Pulse counter clear [PCC]" input pin is turned ON during counting, the count value is cleared to zero.

■Pulse count operation example



Code	Item	Description	Data	Initial value
CA-01 to CA-08	Input terminal function	Pulse counter clear [PCC]: Clears the accumulated value of pulse count.	097	-
CC-01 CC-02 CC-07	Output terminal function	[PCMP]: Pulse count compare match output signal is output.	044	002 001 017
CA-97	Pulse counter compare match output ON value	The [PCMP] signal is turned ON when the pulse count reaches this setting.	0 to 65535	0
CA-98	Pulse counter compare match output OFF value	The [PCMP] signal is turned OFF when the pulse count reaches this setting.		0
CA-99	Pulse counter compare match maximum value	When the number of pulses reaches the setting value, the internal counter is cleared. When this setting is 0, the pulse is one-shot.		65535

9.15.5 Reset the alarm

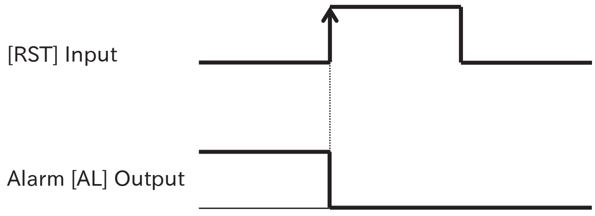
- By the Reset input terminal [RST](028) or Stop/Reset key on the control panel, Inverter trip release can be performed.
- [RST] The input terminal operates with an NO contact (NO) regardless of the setting of "Input terminal a/b(NO/NC) selection ([CA-21] to [CA-28])".
- "Reset selection [CA-72]" allows you to select the timing for releasing the trip by the [RST] input terminal. The [RST] terminal can also be enabled only at the trip release timing when an error occurs.
- Restart after reset operation can be selected in "Restart after reset release [bb-41]". For details, refer to "9.7.5 Restarting after a trip reset or power on".
- Do not use the "Reset [RST]" input terminal to shut off the inverter output. When output cutoff of the inverter is performed by signal input, use "Free-run stop [MBS]" of the input terminal function.
- [RST] Even if resetting by the input terminal, the internal data such as the electronic thermal-load factor, DBTR utilization factor, and present position counter are not cleared.
- If "Frequency at shut-off (00)" is set in "Start frequency selection at frequency retraction restart [bb-47]", even if a reset signal is inputted during retry wait, the frequency at shut-off will not be cleared and restart will be performed.

Code	Item	Description	Data	Initial value
bb-41	Restart mode after RST release Note	0Hz restart is performed.	00	00
		Perform frequency matching restart.	01	
		Frequency pull-in restart.	02	
		Restart is performed from the speed detected by the encoder signal.	03	
CA-72	Reset mode selection	In case of ON, trip release (operation 1, 3) Normal: Output shutoff Abnormal: Release trip	00	00
		In OFF, trip release (Operation 2, 3) Normal: Output shutoff Abnormal: Release trip	01	
		In ON, trip release (operation 1, 4) Normal: Disabled Abnormal: Release trip	02	
		In OFF, trip release (Operation 2, 4) Normal: Disabled Abnormal: Release trip	03	
CA-01 to CA-08	Input terminal function	Reset [RST]: Performs a reset operation.	028	-

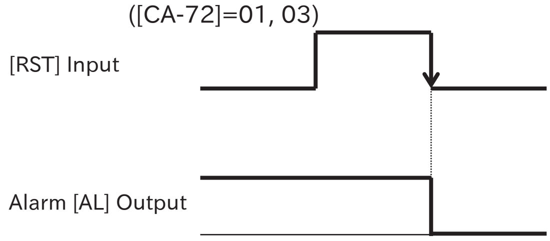
Note: For details, refer to "9.7.5 Restarting after a trip reset or power on".

■Reset operation example

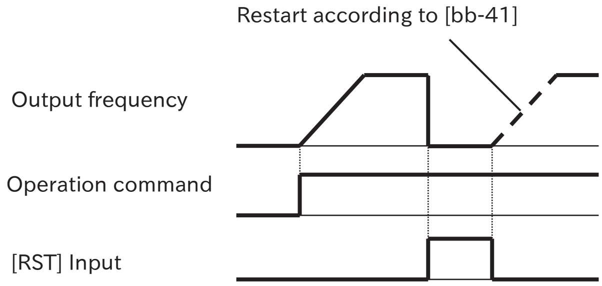
(e.g. 1) When tripping is canceled at ON
([CA-72]=00, 02)



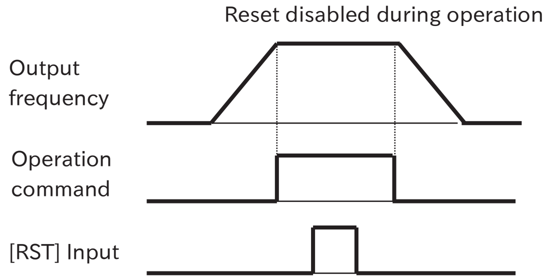
(e.g. 2) When tripping is canceled at OFF
([CA-72]=01, 03)



(e.g. 3) When resetting is enabled in normal status
([CA-72]=00, 01)



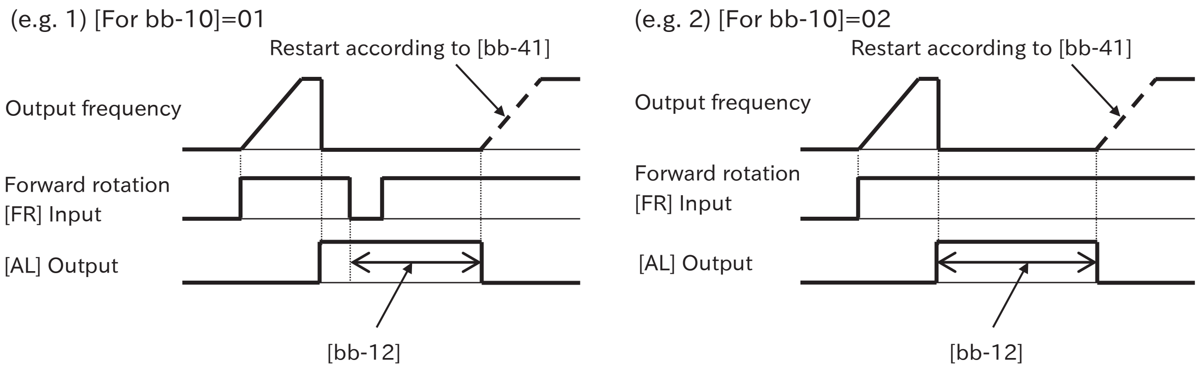
(e.g. 4) When normal reset is disabled
([CA-72]=02, 03)



9.15.6 Automatic reset

- When the automatic reset selection [bb-10] is enabled (01) in the operation command OFF, the reset is performed after the lapse of the "automatic reset standby time [bb-12]" from the time when the operation command is OFF.
- If [bb-10] is set to "Valid after set time (02)", resetting will be performed after [bb-12] has elapsed from when an error occurs.
- By setting "Alarm output selection when automatic reset is enabled [bb-11]" to "No output (01)," during automatic reset operation, the output of "Alarm signal [AL]" can be disabled.
- If the auto-reset is performed as many times as set in the auto-reset count setting [bb-13], the error will not be cleared and the unit will be in the trip status.
- 「When "Auto reset selection [bb-10]" is set to "Enable (01)" in the operation command OFF and "Operation command selection [AA111]" is set to "RUN key (02) on the operation panel", counting of the auto reset standby time starts from when an error occurs.
- Errors that cannot be cleared by the reset operation or errors that can be reported optional cannot be cleared by the automatic reset function. For errors that cannot be cleared, see "List of Errors Not Subject to Automatic Reset Function" in this section.
- If the counter is reset manually or the control power supply is turned on again, the number of automatic resets that had been counted internally is cleared.

■Example of automatic reset operation



Code	Item	Description	Data	Initial value
bb-10	Automatic error reset selection	Disabled	00	00
		Operation command OFF starts resetting.	01	
		Reset starts after set time	02	
bb-11	Alarm signal selection at automatic error reset	Output	00	00
		No output	01	
bb-12	Automatic error reset wait time	Sets the waiting time from when the reset starts until the actual reset is performed.	0 to 600 s	2
bb-13	Automatic error reset number	Sets the number of times to reset automatically.	0 to 10 times	3
bb-41	Restart mode after RST release Note	0Hz restart is performed.	00	00
		Perform frequency matching restart.	01	
		Frequency pull-in restart.	02	
		Restart at the detection speed.	03	

Note: For details, refer to "9.7.5 Restarting after a trip reset or power on".

■List of errors not covered by the automatic reset function

・For details of each error, see "15.2 Troubleshooting Protection Functions".

Error code	Name
E008	Memory error
E010	Current detector error
E011	CPU failure
E012	External trip error
E014	Earth fault error
E022	CPU communication failure
E030	IGBT(Driver) error
E035	Thermistor error
E069	Option 1 Error 9
E090	STO shut-off error
E091	STO internal error
E092	STO route 1 error
E093	STO route 2 error
E100	Encoder disconnection error

9.16 Output signal

9.16.1 Output signal function

- The output terminals [UPF], [DRV], and [MC]-[MB]/[MC]-[MA] are intelligent output terminals. By assigning the functions in the output terminal list shown on the next page to [CC-01], [CC-02], and [CC-07], the specified functions are assigned to the corresponding output terminals.
- For output terminals [UPF], [DRV], and [MC]-[MB]/[MC]-[MA], either a-contact (NO) input or b-contact (NC) input can be selected individually according to the settings of [CC-11], [CC-12], and [CC-17].
- Output terminals [UPF] and [DRV] are open-collector outputs, and output terminals [MC]-[MB]/[MC]-[MA]
  are c-contact relay outputs.
- When using c-contact relay, check the status of the power supply and open/close status of the relay output terminals.

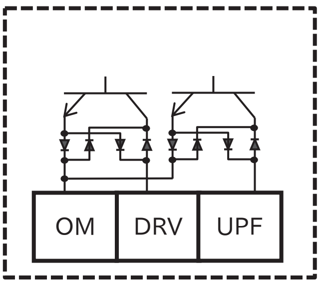
Code	Item	Description	Data	Initial value
CC-01	Output terminal [UPF] function	Assign the output terminal functions to the output terminals [UPF], [DRV], and [MC]-[MB]/[MC]-[MA]. [CC-01], [CC-02], The [CC-07] sets correspond to the output terminals.	Refer to "List of Output terminal Functions" in this section.	002
CC-02	Output terminal [DRV] function			001
CC-07	Output terminal [ML] function			017
CC-11	Output terminal [UPF] active state	Operates as a-contact (NO: normally open).	00	00
		Operates as a b-contact (NC: normally closed).	01	
CC-12	Output terminal [DRV] active state	Operates as a-contact (NO: normally open).	00	
		Operates as a b-contact (NC: normally closed).	01	
CC-17	Output terminal [ML] active state	Operates as a-contact (NO: normally open).	00	
		Operates as a b-contact (NC: normally closed).	01	

■Open collector output terminal specifications

Output terminal	Electrical Characteristics
UPF	Voltage-drop 4V or less at ON Allowable Max. 27V Permissible current carrying capacity 50mA
DRV	
OM	[UPF], Common terminal of [DRV] Permissible current carrying capacity100mA

Output terminal active state	Power state	Output terminal functions	Open collector operation
00 (NO contact)	ON	ON	Close
		OFF	Open
	Off	-	-
01 (NC contact)	ON	ON	Open
		OFF	Close
	Off	-	-

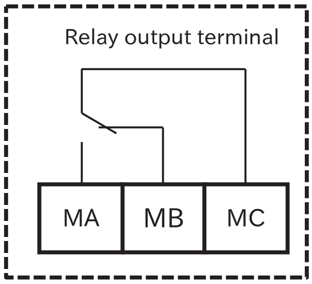
Open collector output terminal



Note: The names of the output terminal functions are an example of the assignment functions at the time of initial setting/initialization.

■Relay output terminal specifications

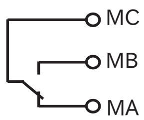
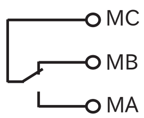
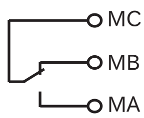
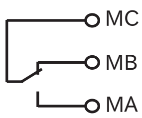
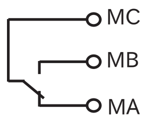
Output terminal		Electrical Characteristics	
		Resistive load	Inductive load
MB-MC	Max. contact capacity	AC250V, 2A DC30V, 3A	AC250V, 0.2A DC30V, 0.6A
	Min. contact capacity	AC100V, 10mA DC5V, 100mA	
MA-MC	Max. contact capacity	AC250V, 1A DC30V, 1A	AC250V, 0.2A DC30V, 0.2A
	Min. contact capacity	AC100V, 10mA DC5V, 100mA	



Note: The assignment function of the relay output terminals at the time of shipping/initialization is "Alarm signal [AL]".

Output terminal active state	Power state	Output of pin functions (Inverter alarm status)	Status output terminal	
			MA - MC	MB - MA
00 (b-contact) (Initial setting)	ON	ON (Alarm)	Close	Open
		OFF (Normal)	Open	close
	OFF	-	Open	Close
01 (a-contact)	ON	ON (Alarm)	Open	Close
		OFF (Normal)	Close	Open
	OFF	-	Open	Close

■Logic for relay output operation

	Power ON		Power OFF
CC-17	01 (Normal close)	00 (Normal open) (Initial setting)	-
Normal condition			
Abnormal condition			

■Table of output terminal functions

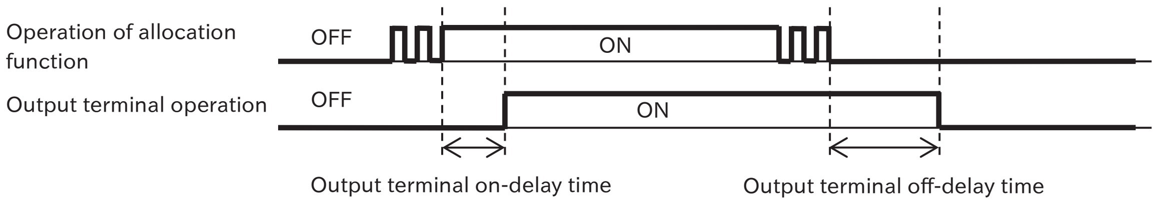
Function No.	Symbol	Function name	Reference
000	no	Not use	-
001	DRV	Running	9-179
002	UPF1	Constant-frequency reached	9-181
003	UPF2	Set frequency overreached	9-182
004	UPF3	Set frequency reached	9-183
005	UPF4	Set frequency overreached 2	9-182
006	UPF5	Set frequency reached 2	9-183
007	IRDY	Inverter ready	9-180
008	FRR	Forward rotation	9-179
009	RRR	Reverse rotation	
010	FREF	Speed command = Keypad is selected	9-8
011	REF	Run command = Keypad is selected	9-2
012	SETM	2nd-motor control is selected	9-95
016	OPO	Option output	-
017	AL	Alarm	9-159
018	MJA	Major failure	9-160
019	OTQ	Over-torque	9-59
021	UV	Undervoltage	9-139
022	TRQ	Torque limited	9-58
023	IPS	IP-nonstop function is active	9-149
024	RNT	Accumulated operation time over	9-170
025	ONT	Accumulated power-on time over	9-170
026	THM	Electronic thermal alarm (Motor)	9-163
027	THC	Electronic thermal alarm (Inverter)	9-164
029	WAC	Capacitor life warning	9-167
030	WAF	Cooling-fan life warning	9-168
031	FS	RUN command active	9-180
032	OHF	Heat sink overheat warning	9-166
033	LOC	Low-current indication	9-162
034	LOC2	Low-current indication 2	
035	OL	Overload warning notice	9-161
036	OL2	Overload warning notice 2	
037	BRK	Brake release	9-84 9-202
038	BER	Brake error	
039	CON	Contactor control	9-86
040	ZS	Zero speed detection	9-184
041	DSE	Speed over deviation	9-52
043	POK	Positioning completed	9-187
044	PCMP	Pulse count compare match output	9-213
045	OD	Over deviation for PID control	9-126
046	FBV	PID feedback comparison	9-127
047	OD2	Over deviation for PID2 control	9-126
048	FBV2	PID2 feedback comparison	9-127
049	NDc	Communication line disconnection	11-1
050	VRFDc	Analog VRF disconnection detection	9-172
051	IRFDc	Analog IRF disconnection Detection	
056	WCVRF	Window comparator VRF	9-172
057	WCIRF	Window comparator IRF	
062	LOG1	Logical operation result 1	9-185
063	LOG2	Logical operation result 2	
064	LOG3	Logical operation result 3	
069	-	Reserved	-
070	-		
071	-		
076	EMFC	Emergency-Force Drive indicator	9-93
077	EMBP	Bypass mode indicator	
078	WFT	Trace function waiting for trigger	12-3
079	TRA	Trace function data logging	
080	LBK	Low-battery of keypad	7-22
081	OVS	Over-Voltage power supply	9-165
082	ABU	Abnormal exceeded Upper limit	9-178
083	ABL	Abnormal fall below Lower limit	
088	FSC	STO input discrepancy	14-6
093	SSE	PID soft start error	9-116
094	SFM1	ST1 feedback monitor	14-6
095	SFM2	ST2 feedback monitor	
096	EDM	STO state monitor	14-4
097	WAP	Power module life warning	9-169
098	WAIC	Inrush circuit life warning	

Note: The "Optional Output [OPO]" is a future extension function and is not currently functioning. Do not assign this function.

9.16.2 Delay and hold the output signal

- An on delay time and an off delay time can be provided for each output terminal.
- All signals will ON/OFF immediately if the conditions are met. Depending on the selected signal, chattering may occur. Use this for holding/delaying such signals.

Code	Item	Description	Data	Initial value
CC-20	Output terminal [UPF] on-delay time	Sets the on delay time to the output terminal.	0.00 to 100.00 s	0.00
CC-22	Output terminal [DRV] on-delay time			
CC-32	Output terminal [ML] on-delay time			
CC-21	Output terminal [UPF] off-delay time	Sets the off delay time to the output terminal.		
CC-23	Output terminal [DRV] off-delay time			
CC-33	Output terminal [ML] off-delay time			



9.16.3 Select the monitor

- The monitor parameter list in the table below can be externally outputted from the [AMI] terminal or the [AMV] terminal.
- [AMI] Analog voltage output and analog current output are available from the terminals.
- [AMV] Analog voltage output and pulse output are available from the terminal.
- For the data with "(±)" written in the Remark column of the following table, the output range can be changed by setting "[FRQ] output data type selection [Cd-12]", "[AMI] output data type selection [Cd-22]" and "[AMV] output data type selection [Cd-32]". When "Absolute value (00)" is set, output is performed with a positive value of the absolute value. When "Signed (01)" is set, a negative value can also be output.
- To output a negative value by setting sign (01) to one of [Cd-12]/[Cd-22]/[Cd-32], the bias of the respective output needs to be adjusted with "[FRQ] bias adjustment [Cd-13]", "[AMI] bias adjustment (voltage/current common) [Cd-23]", or "[AMV] bias adjustment (voltage) [Cd-33]".
- The output range shown in the table below assumes that the bias adjustment for each output is 0% and the gain adjustment is 100%.
- [AMI] Switching between analog voltage output and analog current output of pins is performed by setting "[AMI] Pin Output Switching [Cd-26]".
- [AMV] Switching between analogue voltage output and pulse output of pins is performed by setting "[AMV] Pin Output Switching [Cd-36]".
- For details of analog voltage/current output, refer to "9.16.5 Analog Output of Monitor Data" and for details of pulse output, refer to "9.16.4 Pulse Output of Monitor Data".

■List of Configurable Monitor Parameters

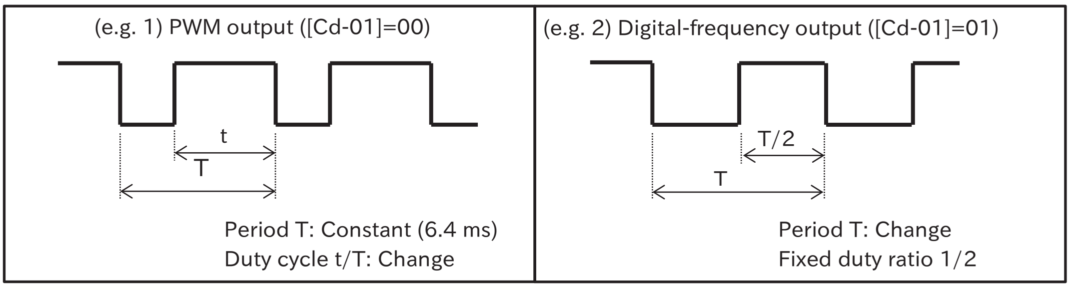
Code	Name	Output range (Corresponds to 0 to 10V/ 0 to 20mA/0 to 100%)	Remarks
dA-01	Output frequency monitor	0.00 to Max. frequency Hz	-
dA-02	Output current monitor	(0.00 to 2.00)× Inverter rated output current A	-
dA-04	Frequency command (after calculation) (signed) Note:1	0.00 to ±Max. frequency Hz	Output possible in (±)
dA-08	Detect speed monitor		
dA-12	Output frequency monitor (signed)		
dA-14	Frequency upper limit monitor	0.00 to Max frequency Hz	-
dA-15	Torque-command monitor (after calculation) Note:1,2	Torque reference× (-500.0 to 500.0 %) Note:3, 6	Output possible in (±)

Code	Name	Output range (Corresponds to 0 to 10V/ 0 to 20mA/0 to 100%)	Remarks
dA-16	Torque limit monitor Note:2	Torque reference× (0.0 to 500.0 %) Note:3	-
dA-17	Output torque monitor Note:2	Torque reference× (-500.0 to 500.0 %) Note:3, 6	Output possible in (±)
dA-18	Output voltage monitor (rms)	0 to Rated voltage×133% V	75% of full scale, equivalent to rating
dA-30	Input power monitor	0.00 to Inverter capacity×200% (kW)	-
dA-34	Output power monitor		
dA-40	DC bus voltage monitor	200V class: DC0.0 to 400.0 V 400V class: DC0.0 to 800.0 V	
dA-41	DBTR load ratio monitor	0.00 to 100.00 %	
dA-42	Electronic thermal load factor monitor (Motor)		
dA-43	Electronic thermal load factor monitor (Inverter)		
dA-61	Analog input [VRF] monitor		
dA-62	Analog input [IRF] monitor		
dA-70	Pulse input monitor	-100.00 to 100.00 %	Output possible in (±)
db-18	Reserved	-	-
db-19			
db-30	PID1 feedback value 1 monitor	-100.00 to 100.00 % Note:4	Output possible in (±)
db-32	PID1 feedback value 2 monitor		
db-34	PID1 feedback value 3 monitor		
db-36	PID2 feedback value [#2] monitor	-100.00 to 100.00 % Note:5	
db-42	PID1 target value monitor (after calculation)	-100.00 to 100.00 % Note:4	
db-44	PID1 feedback value monitor (after operation)		
db-50	PID1 output monitor		
db-51	PID1 deviation monitor	-200.00 to 200.00 %	
db-52	PID1 Deviation 1 Monitor		
db-53	PID1 deviation-2 monitor		
db-54	PID1 deviation-3 monitor		
db-55	PID2 output monitor	-100.00 to100.00 %	
db-56	PID2 deviation monitor	-200.00 to 200.00 %	
db-64	PID feed-forward input source monitor	0.00 to 100.00 %	
dC-15	Cooling fin temperature monitor	-20.0 to 200.0 ˚C	-
FA-01	Main speed reference setting (monitor)	0.00 to Max. frequency Hz	
FA-02	Sub speed reference setting (monitor)		
FA-15	Torque-command setting (monitor) Note:2	Torque reference x (-500.0 to 500.0 % Note:3	Output possible in (±)
FA-16	Torque-bias setting (monitor) Note:2		
FA-30	PID1 target setpoint 1 setting (monitor)	0.00 to 100.00 % Note:4	
FA-32	PID1 target setpoint 2 setting (monitor)		
FA-34	PID1 setpoint 3 setting (monitor)		
FA-36	PID2 target setpoint (monitor)	0.00 to 100.00 % Note:5	

Note: 1. (After calculation) means that it is after calculation of auxiliary speed, addition frequency, and torque bias.
2. Torque control related function is enabled when the setting of "Control method [AA121]" is "Vector control without sensor (IM) (08)".
3. The torque reference (100%) can be selected in "Torque conversion method selection [HC115]". Refer to "9.6.3 Torque Command Operation" for details.
4. "PID1 Scale Adjust ([AH-04] to [AH-06]) will change the setting. For more information, please refer to "9.8.5 PID Units Converter Function".
5. "PID2 Scale Adjust ([AJ-04] to [AJ-06]) will change the setting. For more information, please refer to "9.8.5 PID Units Converter Function".
6. The data range of the monitor may exceed 500.0% depending on the torque command and torque bias settings. In this case, adjust the output gain and bias referring to "9.16.4 Pulse Output of Monitor Data" or "9.16.5 Analog Output of Monitor Data".

9.16.4 Pulse output of monitor data

- Monitored values such as output frequency and output current can be pulsed from the [AMV] terminal. If this happens, set the parameter of the monitor you want to output to "[FRQ] terminal output selection [Cd-03]". For the parameters that can be set, see "9.16.3 Selecting the monitor to be output".
- To perform pulse output, select "Pulse (03)" for "[AMV] Pin Output Selection [Cd-36]."
- PWM output (e.g. 1) or Digital-frequency output (e.g. 2) can be selected by setting "[FRQ] Pin Output Type Selection [Cd-01]". Be sure to set the "[FRQ] Terminal Reference Frequency [Cd-02]" when using the digital frequency output.
- Use an analog meter when using PWM output. Use a digital frequency counter when using digital frequency output.
- The output-characteristics when biasing is adjusted change according to the setting of "Analog adjustment gain reference selection [Cd-06]". See "PWM/Digital-Frequency Output Gain/Bias Adjustment" in this section for more information.
- When "Analog Monitor Adjustment Mode Select [Cd-10]" is set to "Enable (01)", the pulse output function is in the adjustment mode, and the value set to "Output Level [Cd-15] in [FRQ] adjustment mode" is output. Please use it for checking the gain/bias setting of the pulse output and for adjusting the external device, etc.
- For digital-frequency output, the output cannot exceed the max. output range (32kHz) of the [AMV] connector.
- [AMV] When using analog voltage output ("[AMV] terminal Output Selection [Cd-36]" = "Voltage (01)"), refer to "9.16.5 How to Analog Output Monitor Data".



Code	Item	Description	Data	Initial value
Cd-01	[FRQ] Output wave form selection	PWM output (6.4 ms Period)	00	01
		Digital frequency output	01	
Cd-02	[FRQ] Output base frequency (at frequency output)	Set the output frequency at full scale when "Frequency (01)" is selected for [Cd-01].	0 to 32000 Hz	1440
Cd-03	[FRQ] Output monitor selection	[AMV] Select PWM or digital-frequency output from the terminals.	『9.16.3 See "Selecting the Monitor to Output".	dA-01
Cd-06	Analog adjust gain basis selection	Bias quantity standard	00	00
		Full scale fixed	01	
Cd-10	Analog monitor adjustment mode enable	Adjustment mode of the analog monitor is invalid.	00	00
		Adjustment mode of analog monitor is effective.	01	
Cd-11	[FRQ] Output filter time constant	[AMV] Filters PWM/ digital-frequency output from a terminal.	1 to 500 ms	10
Cd-12	[FRQ] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-13	[FRQ] Bias adjustment	Adds bias to PWM/ digital-frequency data. Adjusts the zero-point.	-100.0 to 100.0 %	0.0
Cd-14	[FRQ] Gain adjustment	Apply gain to PWM/ digital-frequency data and adjust the data inclination.	-1000.0 to 1000.0 %	100.0
Cd-15	Adjustment mode [FRQ] output level	When [Cd-10] is set to "Enable (01)" and "Pulse (03)" is selected in "[AMV] Terminal Output Switching [Cd-36]", set the level output from the [AMV] terminal.	-100.0 to 100.0 %	100.0
Cd-16	Pulse input/output scale conversion value coefficient	When "Pulse Input Monitor [dA-70]" is selected in [Cd-03], the input pulse frequency is scaled and outputted.	0.01 to 100.00	1.0
Cd-36	[AMV] Output type selection	[AMV] PWM signal or digital-frequency signal is output from the terminal.	03	01

PWM/ Digital-frequency output-gain/bias adjustment

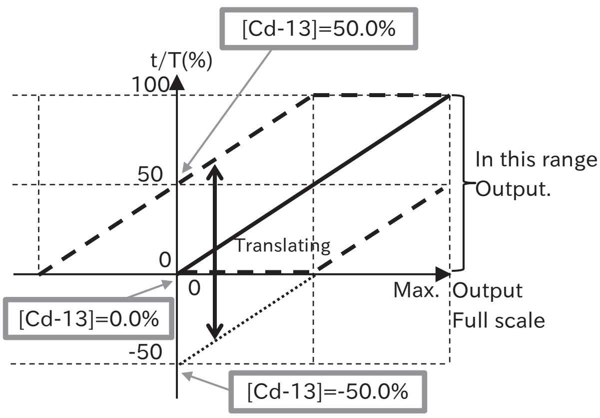
- When "Pulse (03)" is selected in "[AMV] terminal Output Switching [Cd-36]", you can set the addition of the bias by "[FRQ] Bias Adjustment [Cd-13]" and the output gain by "[FRQ] Gain Adjustment [Cd-14]" for the output from the [AMV] pin.
- The output-characteristics when biasing is adjusted change according to the setting of "Analog adjustment gain reference selection [Cd-06]".
- If the output of the parameter selected in "[FRQ] Pin Output Selection [Cd-03]" is negative, you can select whether to use the absolute value or the signed value as it is in "[FRQ] Output Data Type Selection [Cd-12]."
- Adjustments made using [Cd-13] and [Cd-14] are valid regardless of the selection of "[FRQ] Terminal Output Type Selection [Cd-01]".

Code	Item	Description	Data	Initial Setting
Cd-01	[FRQ] Output wave form selection	PWM Out (6.4ms Period)	00	01
		Digital frequency output	01	
Cd-06	Analog adjust gain basis selection	Bias amount reference: The bias amount was adjusted.	00	00
		Full scale fixed	01	
Cd-12	[FRQ] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-13	[FRQ] Bias adjustment	Adds bias to PWM/ digital-frequency data. Adjusts the zero-point.	-100.0 to 100.0 %	0.0
Cd-14	[FRQ] Gain adjustment	Apply gain to PWM/ digital-frequency data and adjust the data inclination.	-1000.0 to 1000.0 %	100.0

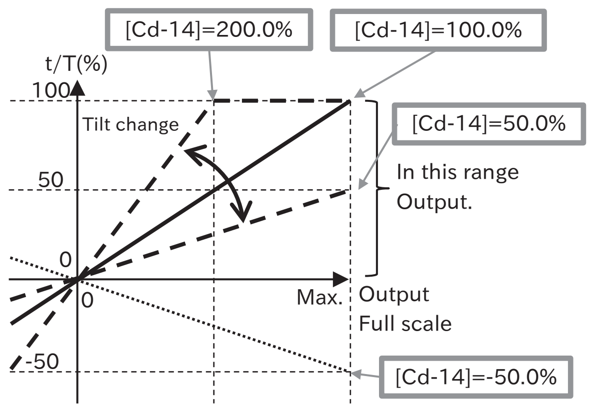
■**When [Cd-01] is set to "PWM (00")**

(1) When "Analog adjustment gain reference selection [Cd-06]" = "Bias quantity reference (00)"

・You can translate the output characteristic by adding "[FRQ] Bias Adjust [Cd-13]" to PWM output.
・Regardless of the bias setting value, if the gain setting value is the same, the slope of the output characteristics will be the same.
The figure below shows the output-characteristics when "[FRQ] gain adjust [Cd-14]" is 100.0%.

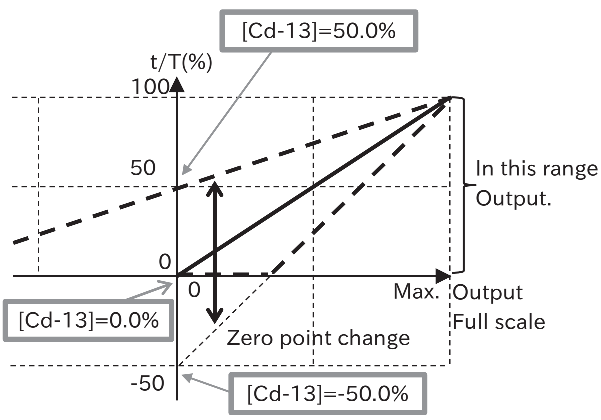


・The slope of the output characteristic can be changed by multiplying PWM output by "[FRQ] Gain Adjust [Cd-14]".
・If the gain settings are the same, the slope of the output characteristics will be the same even if the bias settings are changed.
The figure below shows the output-characteristics when "[FRQ] bias adjustment [Cd-13]" is 0.0%.

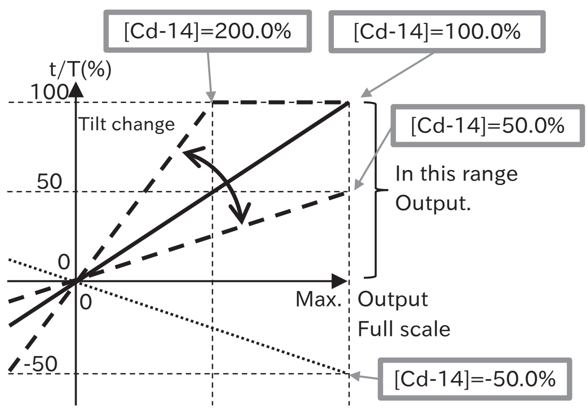


(2) When "Analog adjustment gain reference selection [Cd-06]" = "Full scale fixed (01)"

・"[FRQ] bias adjustment [Cd-13]" can be added to the zero point of PWM outputting.
・Depending on the bias setting, the slope of the output characteristic changes so that 0 to 100% of the output full scale becomes the bias setting to 100% of the duty ratio.
The figure below shows the output-characteristics when "[FRQ] gain adjust [Cd-14]" is 100.0%.



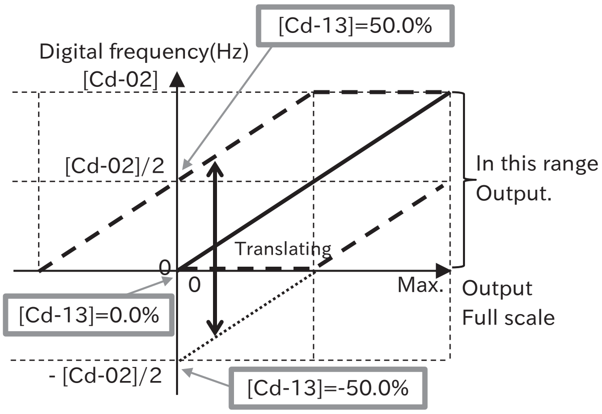
・The slope of the output characteristic can be changed by multiplying PWM output by "[FRQ] Gain Adjust [Cd-14]".
・Note that even if the gain setting value is the same, the slope of the output characteristics changes depending on the bias setting.
The figure below shows the output-characteristics when "[FRQ] bias adjustment [Cd-13]" is 0.0%.



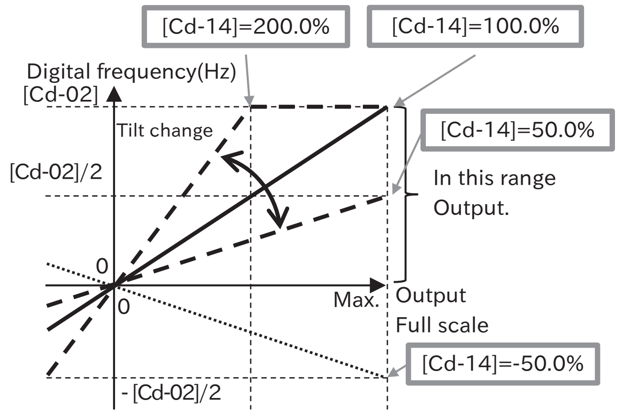
■When [Cd-01] is set to "Frequency (01)"

(1) When "Analog adjustment gain reference selection [Cd-06]" = "Bias quantity reference (00)"

- The output characteristic can be translated by adding "[FRQ] Bias Adjust [Cd-13]" to the digital frequency output.
- Regardless of the bias setting value, if the gain setting value is the same, the slope of the output characteristics will be the same.
- The figure below shows the output-characteristics when "[FRQ] gain adjust [Cd-14]" is 100.0%.

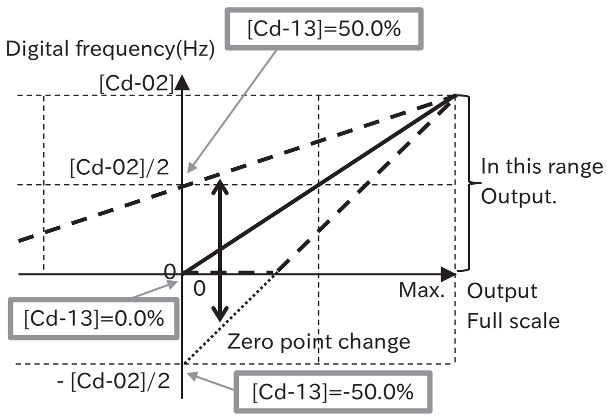


- The slope of the output characteristic can be changed by multiplying the digital-frequency output by "[FRQ] Gain Adjust [Cd-14]".
- If the gain settings are the same, the slope of the output characteristics will be the same even if the bias settings are changed.
- The figure below shows the output-characteristics when "[FRQ] bias adjustment [Cd-13]" is 0.0%.

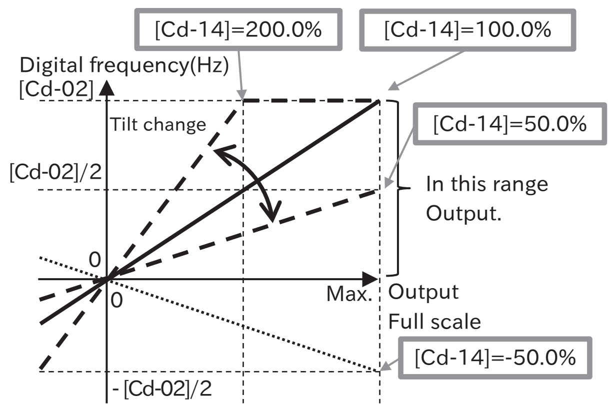


(2) When "Analog adjustment gain reference selection [Cd-06]" = "Full scale fixed (01)"

- It is possible to add "[FRQ] bias adjustment [Cd-13]" to the zero point of digital frequency output.
- Depending on the bias setting, the slope of the output characteristic changes so that 0 to 100% of the output full scale becomes the bias setting value of the digital frequency to [Cd-02].
- The figure below shows the output-characteristics when "[FRQ] gain adjust [Cd-14]" is 100.0%.



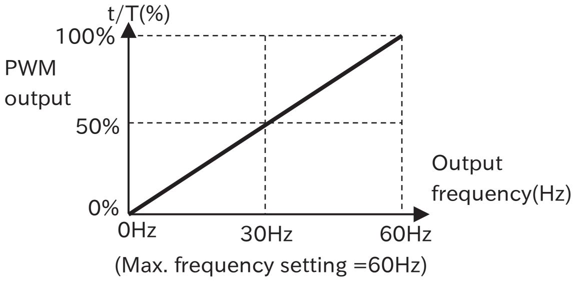
- The slope of the output characteristic can be changed by multiplying the digital-frequency output by "[FRQ] Gain Adjust [Cd-14]".
- Note that even if the gain setting value is the same, the slope of the output characteristics changes depending on the bias setting.
- The figure below shows the output-characteristics when "[FRQ] bias adjustment [Cd-13]" is 0.0%.



■Typical adjustment

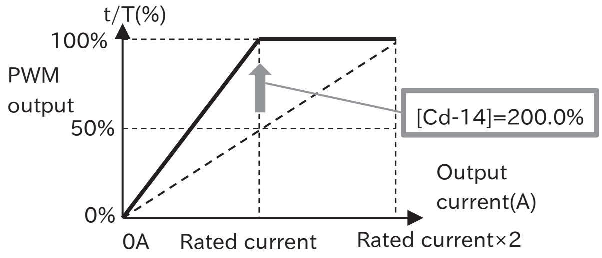
(e.g. 3-1) PWM output of "Output frequency monitor [dA-01]"

・When the bias amount is set, there is no need to change the gain setting because the output characteristics are translated while maintaining the slope.
Setting: [Cd-13]=0.0%, [Cd-14]=100.0%



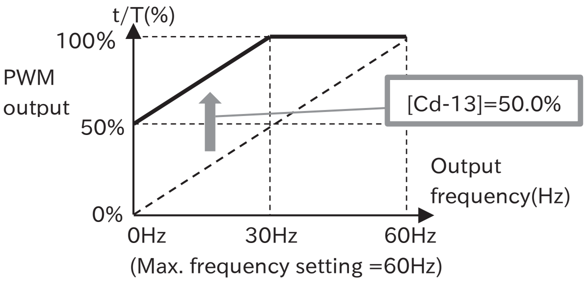
(e.g. 2) PWM output of "Output current monitor [dA-02]"

・When the output current is the rated current, assume that PWM output is 100%.
Since the full scale of [dA-02] is 200%, the rated current output = 100% PWM output at the gain setting of 200%
Setting: [Cd-13]=0.0%, [Cd-14]=200.0%



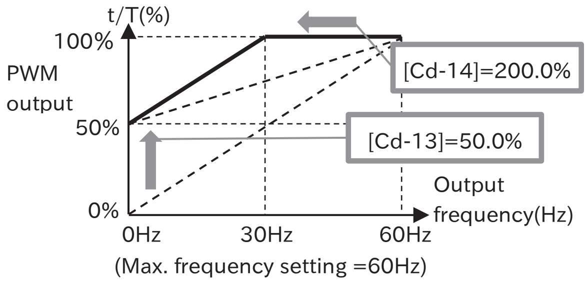
(e.g. 3-1) PWM output of "Output frequency monitor [dA-01]"
When [Cd-06] = "Bias quantity reference (00)")

・50 to 100% of PWM power is specified as 0Hz to maximum frequency/2.
・When the bias amount is set, there is no need to change the gain setting because the output characteristics are translated while maintaining the slope.
Setting: [Cd-13]=50.0%, [Cd-14]=100.0%



(e.g. 3-2) PWM output of "Output frequency monitor [dA-01]"
([Cd-06] = "Full scale fixed (01)")

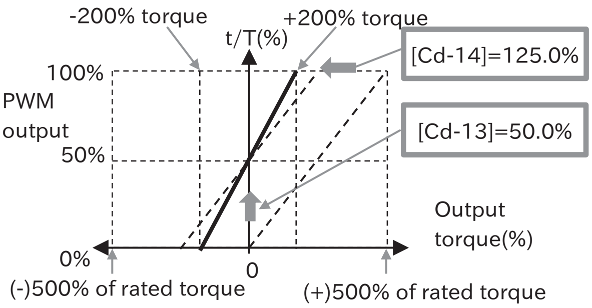
・50 to 100% of PWM power is specified as0 Hz to maximum frequency/2.
・The slope of the output characteristics changes according to the bias amount. If [Cd-13] is set to 50.0%, 50 to 100% of PWM output is the highest frequency from 0Hz, so set as follows.
Setting: [Cd-13]=50.0%, [Cd-14]=200.0%



(e.g. 4-1) PWM output of "Output torque monitor [dA-17]" (signed)

・When [Cd-06] is based on the bias quantity, the signed output torques are 0 to ±200%, and PWM output is 0 to 100%.
・In such cases, set the values so that -200 to 0% and 0 to 200% of the output torque are 0 to 50% and 50 to 100% of PWM output, respectively. Since the full scale of [dA-17] is ±500%, set as shown below.

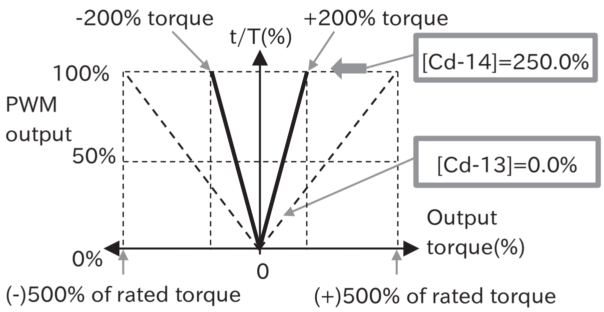
[Cd-13]: Since PWM power is 50% at the center of the output torque range (-200 to 200%) (output torque = 0%), set 50%.
[Cd-14]: Since gain setting value x 100%/500% = 50%/200%, set 125%.
Setting: [Cd-12]=01, [Cd-13]=50.0%, [Cd-14]=125.0%



(e.g. 4-2) PWM output (absolute value) of "Output torque monitor [dA-17]"

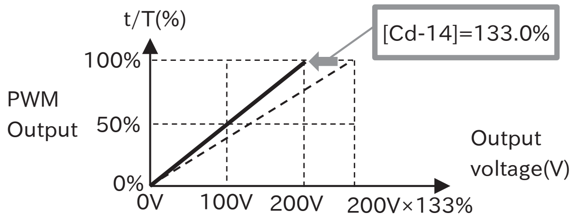
・Assume that output torques of 0% to ±200% are absolute values. PWM output is 0% to 100%.
・In such cases, the output torques of-200 to 0% and 0 to 200% are both 0 to 100% of PWM output. Set them as shown below.

[Cd-13]: Set 0% since output torque0% = PWM output 0%.
[Cd-14]: Since gain setting value x 100%/500% = 100%, set 250%.
Setting: [Cd-12]=00, [Cd-13]=0.0%, [Cd-14]=250.0%



(e.g. 5) PWM output of "Output Voltage Monitor (RMS)[dA-18]"

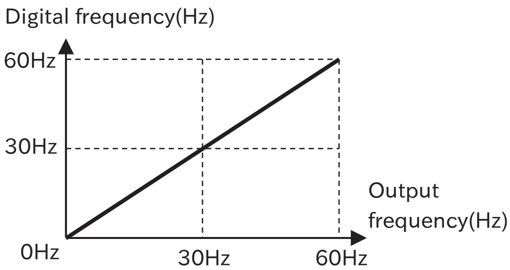
・When the output voltage is the rated output voltage, assume that PWM output is 100%. Since the full scale of [dA-18] is the rated output voltage x 133%, set the gain to 133% so that 100% PWM output is obtained at the rated output voltage of 100%, as shown in the figure below.
Setting: [Cd-13] = 0.0%, [Cd-14] = 133.0%



(When the rated output voltage =200V)

(e.g. 6) Digital frequency output of "Output frequency monitor [dA-01]"

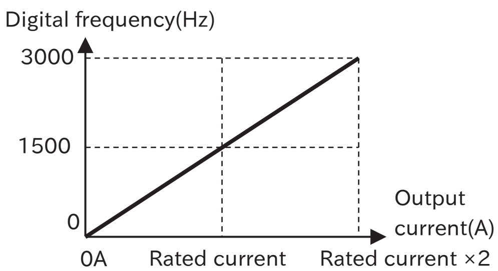
・Outputs the digital frequency output so that the maximum value corresponds to the highest frequency.
If the maximum frequency setting is 60Hz, set it to [Cd-02]=60Hz].
Setting: [Cd-02]=60Hz, [Cd-13]=0.0%、[Cd-14]=100.0%



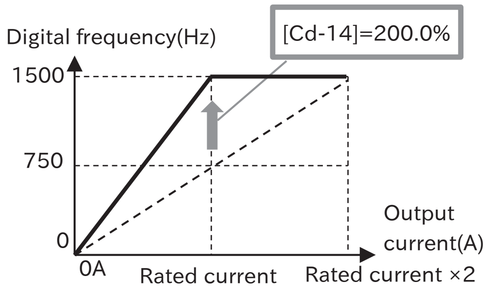
(e.g. 7) Digital-frequency output of "Output current monitor [dA-02]"

・There are the following two methods when outputting in 1500Hz when a current equivalent to the inverter rated current is flowing.

(1) Since the full scale of [dA-02] is the rated inverter current × 2, if it is [Cd-02]=3000Hz], the output current is equivalent to the rated current and it becomes the digital-frequency output 1500Hz as shown in the figure below.
Setting: [Cd-02]=3000Hz, [Cd-13]=0.0%
[Cd-14]=100.0%



(2) When the max. digital-frequency output is [Cd-02]=1500Hz], the [dA-02] full scale is set to 200% of the gain setting because the inverter rated current × 2.
Setting: [Cd-02]=1500Hz, [Cd-13]=0.0%
[Cd-14]=200.0%



Analog monitor adjustment mode (for pulse output)

・When "Analog monitor adjustment mode selection [Cd-10]" is set to "Enabled (01)", the analog monitor adjustment mode is enabled. This function applies to all outputs from the [AMI] and [AMV] terminals.
・When "Pulse (03)" is selected in "[AMV] Terminal Output Switching [Cd-36]", the output from the [Ao2] Pin is fixed at the output set in "[FRQ] Output Level [Cd-15]" for the monitor full scale value selected in "[FRQ] Pin Output Selection [Cd-03]".
・The minimum output of [Cd-15] changes according to the setting of "[FRQ] output data type selection [Cd-12]". 0.0% when "Absolute value (00)" is set, and-100.0% when "Signed (01)" is set.

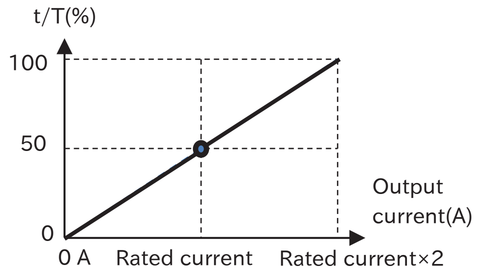
Code	Item	Description	Data	Initial value
Cd-10	Analog monitor adjustment mode enable	Adjustment mode of the analog monitor is invalid.	00	00
		Adjustment mode of analog monitor is effective.	01	
Cd-12	[FRQ] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-15	Adjustment mode [FRQ] output level	When [Cd-10] is set to "Enable (01)" and "Pulse (03)" is selected in "[AMV] Terminal Output Switching [Cd-36]", set the level output from the [AMV] terminal.	-100.0 to 100.0 %	100.0
Cd-36	[AMV] Output type selection	[AMV] PWM signal or digital-frequency signal is output from the terminal.	03	01

■(e.g.) Adjusting PWM output of the output current monitor
・Adjust to output at 100% PWM output at the rated inverter current.

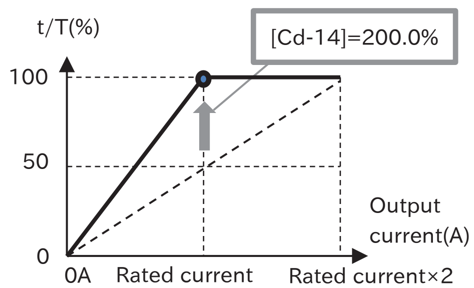
Code	Name	Output range (Corresponds to 0 to 10 VDC/0 to 20 mA/0 to 100 %)
dA-02	Output current monitor	(0.00 to 2.00)×Inverter rated output current A

(1) Set [Cd-01] to "PWM(00" and [Cd-03] to "Output current monitor [dA-02]". When [Cd-10] is set to "Enable (01)", the [Cd-15] setpoint is outputted from the [AMV] terminal in PWM form.

(2) If the reference point you want to output is the rated current value, set the point at half of it because the full scale of [dA-02] is (0.00 to 2.00) × the inverter rated current.
First, by setting [Cd-15] to 50.0% (equivalent to the rated inverter current), a PWM with a 50% duty, which is the output when the rated current (= rated current × 2.0×50.0%) is output from the [AMV] terminal.



(3) Then use [Cd-14] to adjust the tilt. Change the [Cd-14] to adjust PWM to the point where 100% duty is generated. Under these conditions, if [Cd-14] is set to 200.0%, the duty cycle is 100% at the rated inverter current as shown in the figure on the right.



(4) When [Cd-10] is returned to "Disable (00)", the analog monitor adjusting mode is finished, and PWM output based on the actual output current is started from the [AMV] terminal.

Pulse input monitor scale conversion

- In "[FRQ] terminal Output Selection [Cd-03]", "Pulse Input Monitor [dA-70]" can be selected.
- [dA-70] is valid only when "Pulse input detection target selection [CA-90]" is set to "Pulse input frequency command (01)". For details, refer to section 10.2.2, Monitoring Analog Input and Pulse Input.
- If "[FRQ] Pin Output Type Selection [Cd-01]" is "PWM(00," PWM output is performed with the duty ratio equivalent to the value obtained by multiplying the monitored value (%) of [dA-70] by the "pulse input/output scale conversion value coefficient [Cd-16]."
- If [Cd-01] is set to "Frequency (01)", digital frequency is output at the frequency of the value obtained by multiplying [Cd-16] and [FRQ] terminal reference frequency [Cd-02] to the monitor value (%) of [dA-70].

Code	Item	Description	Data	Initial value
dA-70	Pulse input monitor	The frequency of the input pulse is displayed with the value of "pulse frequency scale [CA-92]" as 100%.	-100.00 to 100.00 %	-
Cd-01	[FRQ] Output wave form selection	PWM out (6.4 ms Period)	00	01
		Digital frequency output	01	
Cd-02	[FRQ] Output base frequency (at frequency output)	Set the output frequency at full scale when "Frequency (01)" is selected for [Cd-01].	0 to 32000 Hz	1440
Cd-03	[FRQ] Output monitor selection	[AMV] Select PWM or digital-frequency output from the terminals.	dA-70	dA-01
Cd-16	Pulse input/output scale conversion value coefficient	When "Pulse Input Monitor [dA-70]" is selected in [Cd-03], the input pulse frequency is scaled and outputted. [Cd-01]=「PWM(00)」: Duty cycle (%) = [dA-70]×[Cd-02] [Cd-01] ="Frequency (01)": Output pulse frequency(Hz) = [dA-70]×[Cd-02]×[Cd-16]	0.01 to 100.00	1.00

Pulse output filter time constant

- [AMV] A filter can be set for the pulse output from the terminal.
- Filter time constant of pulse output can be set by "[FRQ] Output filter time constant [Cd-11]".

Code	Item	Description	Data	Initial value
Cd-11	[FRQ] Output filter time constant	[AMV] Filters PWM/ digital-frequency output from a terminal.	1 to 500 ms	10

- [AMV] When using the analogue voltage output from the terminal ("[AMV] Pin Output Selection [Cd-36]" = "Voltage (01)"), the filter can be set with "[AMV] Output Filter Time Constant [Cd-31]". For details, refer to "9.16.5 Analog Output of Monitor Data".

9.16.5 Output monitor data in analog

- [AMI] Terminals can be switched between analog voltage-output and analog current-output by setting "[AMI] Terminal Output Switching [Cd-26]". [AMI] To use the analogue voltage/current output from the terminal, set the parameters of the monitor you want to output to "[AMI] Terminal Output Selection [Cd-04]". For the parameters that can be set, see "9.16.3 Selecting the monitor to be output".
- [AMV] Terminals can be switched between analog-voltage output and pulse-output by setting "[AMV] Terminal Output Switching [Cd-36]". [AMV] To use analog-voltage output from the terminal, set the parameters of the monitor that you want to output to "[AMV] Terminal Output Selection [Cd-05]". For the parameters that can be set, see "9.16.3 Selecting the monitor to be output".
- The output-characteristics when biasing is adjusted change according to the setting of "Analog adjustment gain reference selection [Cd-06]". For details, refer to "Analog output gain/bias adjustment" in this section.
- When "Analog Monitor Adjustment Mode Select [Cd-10]" is set to "Enable (01)", the analog output function is in adjustment mode, and the value set to "[AMI] output level in adjustment mode [Cd-25]" is output from the [AMI] terminal, and the value set to "[AMV] output level in adjustment mode [Cd-35]" is output from the [AMV] connector. Use this to check the analog output gain/bias setting or adjust the external device, etc.
- Analog output may not be stable immediately after power-on or power-off.
- [AMV] Refer to "9.16.4 Pulse Output of Monitor Data" when using pulse output from terminals ("[AMV] Terminal Output Select [Cd-36]" = "Pulse (03)").

■ [AMI] Parameters related to terminal analog output

Code	Item	Description	Data	Initial value
Cd-04	[AMI] Output monitor selection	[AMI] Select the data to be analog output (voltage/current) from the terminal.	『9.16.3 See "Selecting the Monitor to Output".	dA-01
Cd-06	Analog adjust gain basis selection	Bias quantity standard	00	00
		Full scale fixed	01	
Cd-10	Analog monitor adjustment mode enable	Adjustment mode of the analog monitor is invalid.	00	00
		Adjustment mode of analog monitor is effective.	01	
Cd-21	[AMI] Output filter time constant	[AMI] Apply a filter to the analog output (voltage/current) from the terminals.	1 to 500 ms	100
Cd-22	[AMI] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-23	[AMI] Bias adjustment (common to voltage/current)	[AMI] The bias is added to the analog output (voltage/current) from the terminal and the zero point is adjusted.	-100.0 to 100.0 %	20.0
Cd-24	[AMI] Gain adjustment (common to voltage/current)	[AMI] Apply a gain to the analog output (voltage/current) from the terminal and adjust the data slope.	-1000.0 to 1000.0 %	80.0
Cd-25	Adjustment mode [AMI] output level	With [Cd-10] set to "Enabled (01)", set the [AMI] terminal output-level.	-100.0 to 100.0 %	100.0
Cd-26	[AMI] Output type selection	[AMI] The analog voltage is output from the terminal.	01	02
		[AMI] The analog current is output from the terminal.	02	

■ [AMV] Parameters related to terminal analog output

Code	Item	Description	Data	Initial value
Cd-05	[AMV] Output monitor selection	[AMV] Select the data to output analog voltage from the terminal.	『9.16.3 See "Selecting the Monitor to Output".	dA-01
Cd-06	Analog adjust gain basis selection	Bias quantity standard	00	00
		Full scale fixed	01	
Cd-10	Analog monitor adjustment mode enable	Adjustment mode of the analog monitor is invalid.	00	00
		Adjustment mode of analog monitor is effective.	01	
Cd-31	[AMV] Output filter time constant	[AMV] Apply a filter to the analog voltage output from the terminal.	1 to 500 ms	100
Cd-32	[AMV] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-33	[AMV] Bias adjustment (voltage)	[AMV] The bias is added to the analog voltage output from the terminal and the zero point is adjusted.	-100.0 to 100.0 %	0.0
Cd-34	[AMV] Gain adjustment (voltage)	[AMV] Apply a gain to the analog voltage output from the terminal and adjust the data inclination.	-1000.0 to 1000.0 %	100.0
Cd-35	Adjustment mode [AMV] output level	With [Cd-10] set to "Enabled (01)", set the [AMV] terminal output-level.	-100.0 to 100.0 %	100.0
Cd-36	[AMV] Output type selection	[AMV] The analog voltage is output from the terminal.	01	01

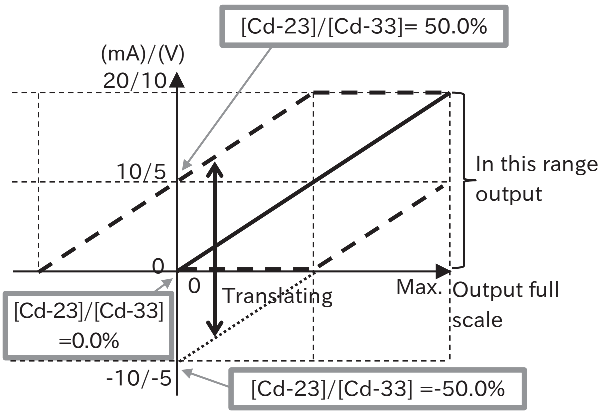
Analog output gain/bias adjustment

- [AMI] When analog voltage/current output is performed from the terminal or analog voltage output is performed from the [AMV] terminal, the gain/bias of the analog output can be adjusted according to the connected meter.
- The output-characteristics when biasing is adjusted change according to the setting of "Analog adjustment gain reference selection [Cd-06]".
- If the output range of the parameter selected in "[AMI] Terminal Output Selection [Cd-04]" or "[AMV] Pin Output Selection [Cd-05]" takes a negative value, you can select whether it should be an absolute value or treated as signed with "[AMI] Output Data Type Selection [Cd-22]" or "[AMV] Output Data Type Selection [Cd-32]".

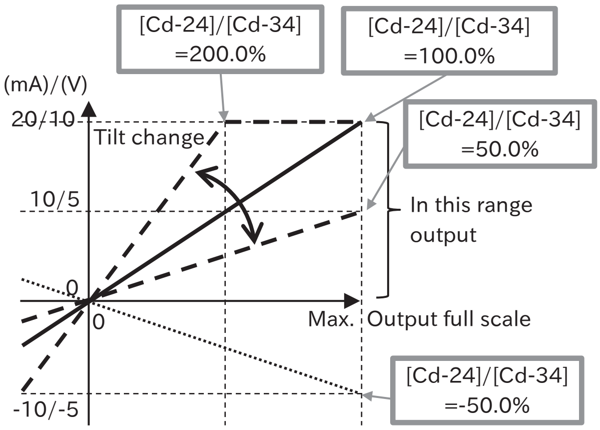
Code	Item	Description	Data	Initial value
Cd-06	Analog adjust gain basis selection	Bias quantity standard	00	00
		Full scale fixed	01	
Cd-22	[AMI] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-23	[AMI] Bias adjustment (common to voltage/current)	[AMI] The bias is added to the analog output (voltage/current) from the terminal and the zero point is adjusted.	-100.0 to 100.0 %	20.0
Cd-24	[AMI] Gain adjustment (common to voltage/current)	[AMI] Apply a gain to the analog output (voltage/current) from the terminal and adjust the data slope.	-1000.0 to 1000.0 %	80.0
Cd-32	[AMV] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-33	[AMV] Bias adjustment (voltage)	[AMV] The bias is added to the analog voltage output from the terminal and the zero point is adjusted.	-100.0 to 100.0 %	0.0
Cd-34	[AMV] Gain adjustment (voltage)	[AMV] Apply a gain to the analog voltage output from the terminal and adjust the data inclination.	-1000.0 to 1000.0 %	100.0

■When "Analog adjustment gain reference selection [Cd-06]" = "Bias quantity reference (00)"

- The output characteristic can be translated by adding "[AMI] bias adjustment (voltage/current common) [Cd-23]" or "[AMV] bias adjustment (voltage) [Cd-33]" to the analogue output.
- Regardless of the bias setting value, if the gain setting value is the same, the slope of the output characteristics will be the same.
- The figure below shows the output-characteristics when "[AMI] gain adjustment (voltage/current common) [Cd-24]"/"[AMV] gain adjustment (voltage) [Cd-34]" is 100.0%.

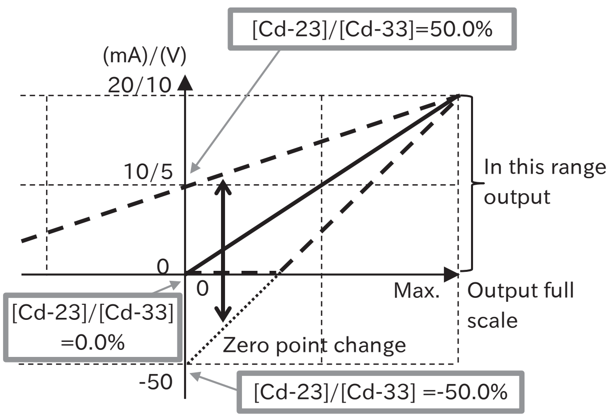


- The slope of the output characteristic can be changed by multiplying the analogue output by "[AMI] gain adjustment (voltage/current common) [Cd-24]" or "[AMV] gain adjustment (voltage) [Cd-34]".
- If the gain settings are the same, the slope of the output characteristics will be the same even if the bias settings are changed.
- The figure below shows the output-characteristics when "[AMI] bias adjustment (voltage/current common) [Cd-23]"/"[AMV] bias adjustment (voltage) [Cd-33]" is 0.0%.

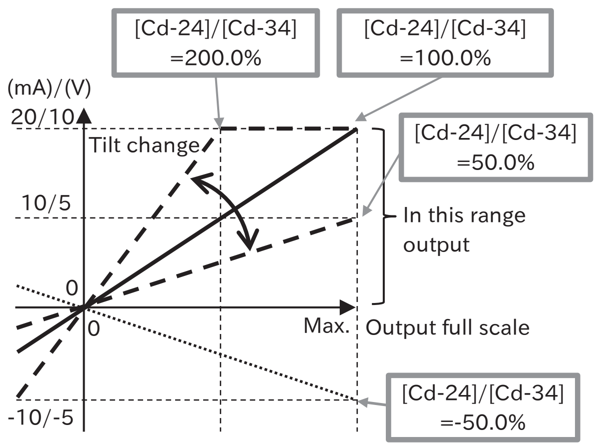


■When "Analog adjustment gain reference selection [Cd-06]" = "Full scale fixed (01)"

- You can add "[AMI] bias adjustment (voltage/current common) [Cd-23]" or "[AMV] bias adjustment (voltage) [Cd-33]" to the 0 points of the analogue output.
- Depending on the bias setting, the slope of the output characteristic changes so that 0 to 100% of the output full scale becomes the bias setting to 100% of the analog input.
- The figure below shows the output-characteristics when "[AMI] gain adjustment (voltage/current common) [Cd-24]"/"[AMV] gain adjustment (voltage) [Cd-34]" is 100.0 %.



- The slope of the output characteristic can be changed by multiplying the analogue output by "[AMI] gain adjustment (voltage/current common) [Cd-24]" or "[AMV] gain adjustment (voltage) [Cd-34]".
- Note that even if the gain setting value is the same, the slope of the output characteristics changes depending on the bias setting.
- The figure below shows the output-characteristics when "[AMI] bias adjustment (voltage/current common) [Cd-23]"/"[AMV] bias adjustment (voltage) [Cd-33]" is 0.0 %.

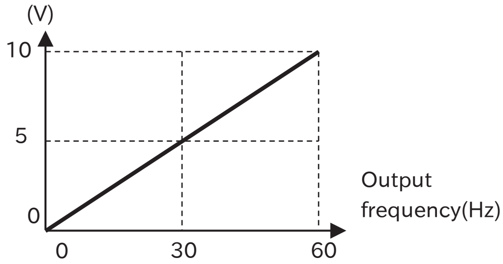


(e.g. 1) [AMI] voltage output of "Output frequency monitor [dA-01]"

・When the output frequency is from 0Hz to the highest frequency, 0 to 10V output is set from [AMI].

・Since the full scale of [dA-01] is the highest frequency, the gain setting should remain at 100% of the default setting.

Setting: [Cd-23]=0.0%、[Cd-24]=100.0%



((Max. frequency setting =60Hz)

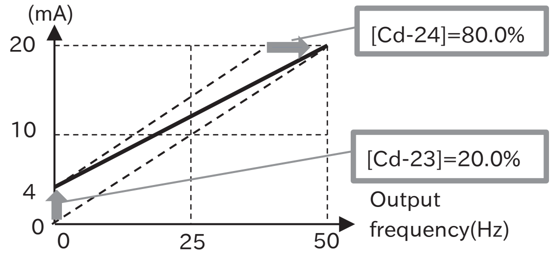
(e.g. 2) [AMI] current output of "Output frequency monitor [dA-01]" (When [Cd-06]="Bias quantity reference (00)")

・When the output frequency is from 0Hz to the highest frequency, 4 to 20mA current output from [AMI].

[Cd-33]: When output frequency =0Hz, the output 4mA is 20% of 20mA, so set 20%.

・Since the full scale of [Cd-34]:[dA-01] is the highest frequency (100%), set the value as a percentage of 20mA=100 (80% by 20-4)=16mA).

Setting: [Cd-23]=20.0%, [Cd-24]=80.0%



(Max. frequency setting =50Hz

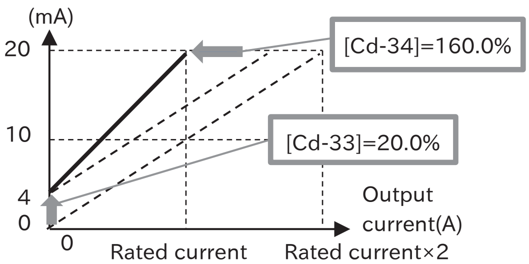
(e.g. 3-1) [AMV] current output of "Output current monitor [dA-02]" (When [Cd-06] = "Bias quantity reference (00)")

・When "Bias amount reference (00)" is selected for "Analog adjustment gain reference selection [Cd-06]", set 0A to rated current of inverter output current as 4 to 20mA output from the [AMV] terminal as follows.

[Cd-33]: When the inverter output current is 0 A, if the output from the [AMV] terminal is 4mA, set as 4mA/ 20mA=20%.

・Since the full scale of [Cd-34]:[dA-02] is 200%, set the value as a percentage of 20mA= 200 (160% by 20-4)=16mA).

Setting: [Cd-33]=20.0%、[Cd-34]=160.0%



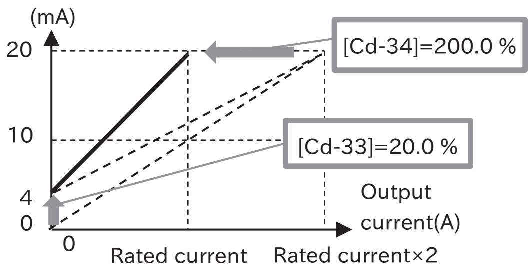
(e.g. 3-2) [Ao2] current output of "Output current monitor [dA-02]" ([Cd-06] = "Full scale fixed (01)")

・When "Full Scale Fixed (01)" is selected for "Analog Adjustment Gain Reference Select [Cd-06]", set 0 A to rated current of inverter output current as 4 to 20mA output from the [AMV] terminal as follows.

[Cd-33]: When the inverter output current is0 A, if the output from the [AMV] terminal is 4 mA, set as 4 mA/20 mA=20%.

・Since the full scale of [Cd-34]:[dA-02] is 200%, set it to 200% so that 100% (= rated current) is achieved.

Setting: [Cd-33]=20.0%, [Cd-34]=200.0%



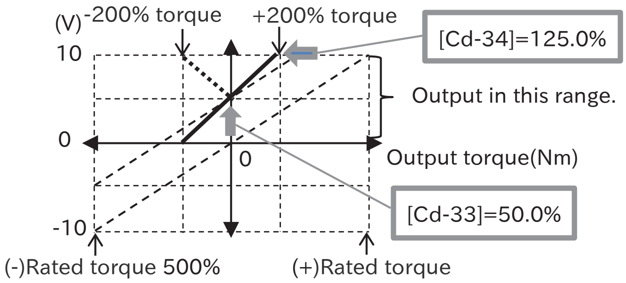
(e.g. 4) [dA-17] Output torque monitor [AMV] voltage output

・Assume that output torque of 0 to ±200% is signed and that output is 0 to 10V voltage from [AMV]. In this case, set so that-200 to 0% and 0 to 200% of the output torque become 0 to 50% and 50 to 100% of the voltage output, respectively. Since the full scale of [dA-17] is ±500 %, set as shown below.

[Cd-33]: Since the voltage output is 5V at the center of the output torque range (-200 to 200%) (output torque = 0%), set the value to 50%.

[Cd-34]: Since gain setting value x 100%/500% = 50%/200%, set 125%

Setting: [Cd-32]=01, [Cd-13]=50.0%、[Cd-14]=125.0%



Note: If [Cd-32] = "Absolute (00)" is set in the above example, 5 to 10V will be outputted for (-)torque-side 0 to-200% (black dotted line in the above figure).

Analog monitor adjustment mode (for analog output)

・When "Analog monitor adjustment mode selection [Cd-10]" is set to "Enabled (01)", the analog monitor adjustment mode is enabled. This setting applies to both the [AMI] and [AMV] terminals.
・[AMI] The output from the terminal is fixed to the full scale value of the monitor selected by "[AMI] Terminal Output Selection [Cd-04]" at the value set by "[Cd-25] Output Level in [AMI] Adjustment Mode."
・When "Voltage (01)" is selected in "[AMV] Terminal Output Switching [Cd-36]", the output from the [Ao2] Pin Output Selection [Cd-05] is fixed at the value set in "[AMV] Output Level [Cd-35]" for the full scale value of the monitor selected in "[AMV] Terminal Output Selection [Cd-05]".
・[Cd-25], The minimum output of [Cd-35] varies depending on the setting of "[AMI] output data type selection [Cd-22]" or "[AMV] output data type selection [Cd-32]". 0.0% when "Absolute value (00)" is set, and-100.0% when "Signed (01)" is set.

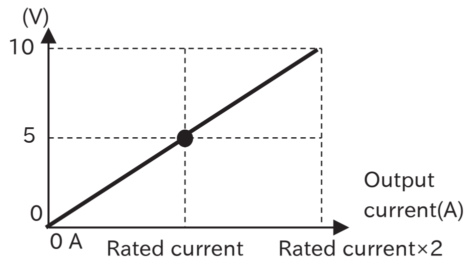
Code	Item	Description	Data	Initial Setting
Cd-10	Analog monitor adjustment mode enable	Adjustment mode of the analog monitor is invalid.	00	00
		Adjustment mode of analog monitor is effective.	01	
Cd-22	[AMI] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-32	[AMV] Data type selection	Outputs the absolute value of data.	00	00
		Signed data is output.	01	
Cd-25	Adjustment mode [AMI] output level	When [Cd-10] is set to "Enabled (01)", this sets the analog voltage/current level output from the [AMI] terminal.	-100.0 to 100.0 %	100.0
Cd-35	Adjustment mode [AMV] output level	When [Cd-10] is set to "Enable (01)", and when "[AMV] Terminal Output Switching [Cd-36]" is selected to "Voltage (01)," set the analogue voltage level output from the [AMV] terminal.		

■(Example) Adjusting the analog-voltage output from the [AMI] terminal of the output current monitor
・Adjust the analog voltage output to 100% output at the rated inverter current.

Code	Name	Output range (Corresponds to 0 to 10 VDC/0 to 20 mA/0 to 100 %)
dA-02	Output current monitor	(0.00 to 2.00)×Inverter rated output current A

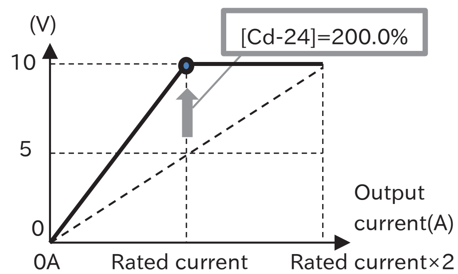
(1) Set [Cd-04] to "Output current monitor [dA-02]". When [Cd-10] is set to "Enable (01)", the [Cd-25] setting is outputted from the [AMI] terminal.

(2) If the reference point you want to output is the rated current value, set the point at half of that since the full scale of [dA-02] is the rated current x 2.00. First, by setting [Cd-25] to 50.0 % (equivalent to the rated inverter current), 5V that is the output when the rated current (= rated current x 2.00 x 50.0%) is output from the [AMI] terminal.



(3) Then use [Cd-24] to adjust the tilt. Change the [Cd-24] to adjust 10V output.

(4) When [Cd-10] is returned to "Disabled (00)", the analog -voltage output of the adjusted [AMI] starts.



Analog output filter

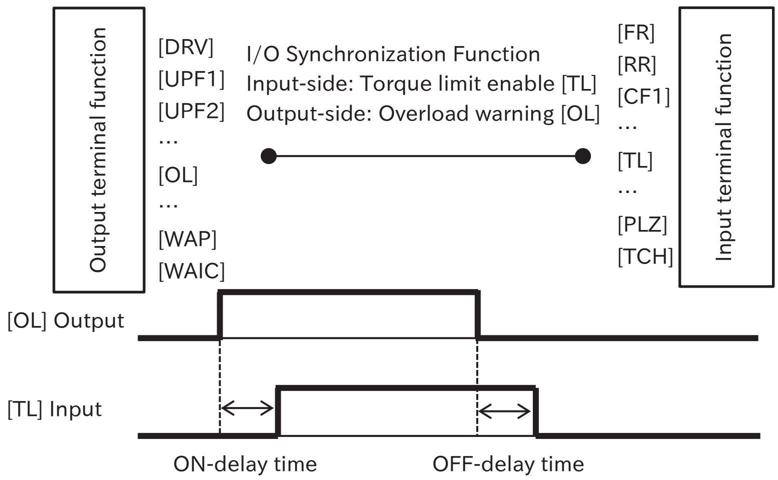
- [AMI] Filters can be set for analog voltage/current output from terminals or analog voltage output from [AMV] terminals.
- Filter time constant of analogue output can be set by "[AMI] Output filter time constant [Cd-21]" or "[AMV] Output filter time constant [Cd-31]".

Code	Item	Description	Data	Initial value
Cd-21	[AMI] Output filter time constant	[AMI] Sets the filter to the data of analog voltage output and analog current output from the terminal.	1 to 500 ms	100
Cd-31	[AMV] Output filter time constant	[AMV] Sets the filter to the data of analog voltage output from the terminal.		

- [AMV] When using pulse output from the terminal ("[AMV] Pin Output Selection [Cd-36]" = "Pulse (03)"), the filter can be set with "[FRQ] Output Filter Time Constant [Cd-11]". For details, refer to "9.16.4 Pulse Output of Monitor Data".

9.16.6 Input/Output synchronization function

- With the contact input/output synchronization function, information on the output terminal function can be synchronized with the input terminal function without going through physical wiring. The input terminal function is set in "Contact sync input selection ([CH-01] to [CH-06])", and the output terminal function is set in "Contact sync output selection ([CH-11] to [CH-16])", and the channel (combined output terminal function and input terminal function) can be set in six ways.
- ON/OFF status of the output pin function and the logical level of ON/OFF status of the input pin function can be inverted. Settings can be made for each channel (combination of output and input terminal functions).
- Delay times for ON/OFF can be set for each channel. If the operation is unstable, setting a longer delay time may solve the problem.
- You cannot duplicate the function except for " No assignment [no]". When the same function is selected, the channel that was selected first is changed to "No assignment [no]", and the channel that was set last becomes valid.

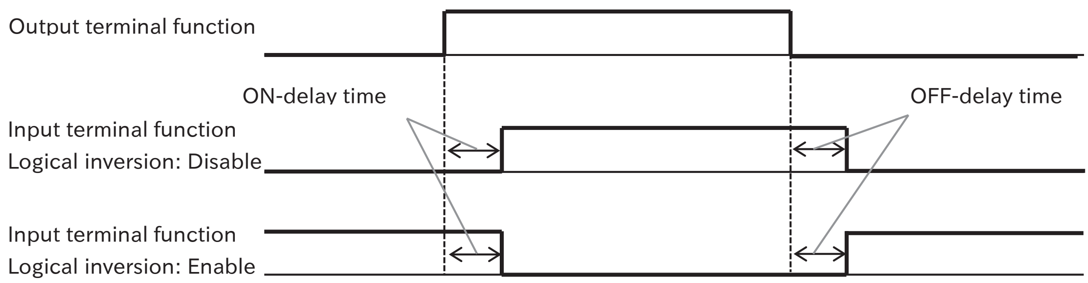


Code	Item	Description	Data	Initial value
CH-01 to CH-06	Sync input terminal function selection 1 to 6	Select the input function to be synchronized.	Refer to "List of Input Pin Functions" in "9.15.1 Functions Used for External Signal Input".	000
CH-11 to CH-16	Sync output terminal function selection 1 to6	Select the output function to synchronize.	See "List of Output Pin Functions" in "9.16.1 Using the External Signal Output Function".	00
CH-21 to CH-26	Sync terminal logic selection 1 to 6	Normally open: Logical inversion disabled	00	00
		Normally closed: Logical inversion enabled	01	
CH-30 CH-32 CH-34 CH-36 CH-38 CH-40	Sync terminal on-delay time 1 to 6	Sets the duration until ON status is confirmed when the status of the output function selected during sync contact output selection changes to OFF→ON.	0.00 to 100.00 s	0.00
CH-31 CH-33 CH-35 CH-37 CH-39 CH-41	Sync terminal off-delay time 1 to 6	Sets the duration until OFF status is confirmed when the status of the output function selected during sync contact output selection changes to ON→OFF.		

Logic inversion function

- The relation between the output pin function and ON/OFF of the input pin function can be inverted.
- The setting can be set for each channel by "Logical synchronous logical selection ([CH-21] to [CH-26])".

Code	Item	Description	Data	Initial value
CH-21 to CH-26	Sync terminal logic selection 1 to 6	Normally open: Logical inversion disabled	00	00
		Normally closed: Logical inversion enabled	01	

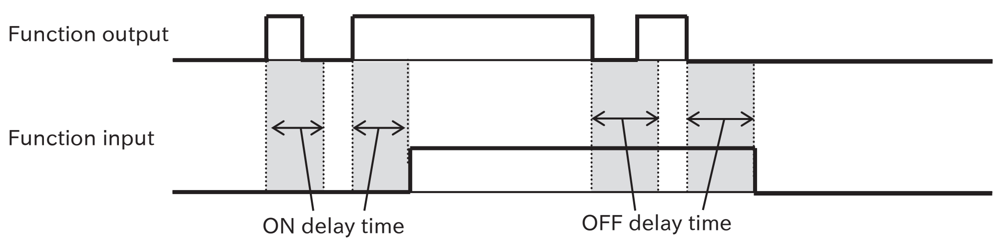


[CH-21] to [CH-26] Set value	ON/OFF status of outputting function	ON/OFF status of inputting function
Normally open (00)	OFF	OFF
	ON	ON
Normally closed (01)	OFF	ON
	ON	OFF

ON delay/OFF delay function

- A delay time can be set for each channel from the operation of the output pin function to the operation of the input pin function.
- The delay time can be set individually for the on-delay time from when the output pin function changes to OFF→ON until the input pin function turns ON (logic inversion: OFF) and for the off-delay time from when the output pin function changes to ON→OFF until the input pin function turns OFF (logic inversion: ON).

Code	Item	Description	Data	Initial value
CH-30 CH-32 CH-34 CH-36 CH-38 CH-40	Sync terminal on-delay time 1 to 6	Sets the duration until ON status is confirmed when the status of the output function selected during sync contact output selection changes to OFF→ON.	0.00 to 100.00 s	0.00
CH-31 CH-33 CH-35 CH-37 CH-39 CH-41	Sync terminal off-delay time 1 to 6	Sets the duration until OFF status is confirmed when the status of the output function selected during sync contact output selection changes to ON→OFF.		



Chapter 10 Monitor Functions

10

This chapter describes various types of data that can be monitored by the inverter's keypad or remote operator. For more information on using keypad to view the monitors, refer to "Chapter 7 Keypad and Related Functions".
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters, and pay attention to safety.

10.1 Operation data

10.1.1 Monitor the output frequency

Output frequency monitor [dA-01]

- Displays the output frequency of the inverter. "0.00" is displayed during stop.
  When the content of "Output frequency monitor [dA-01]" is displayed, "Frequency monitor LED [Hz]" on the keypad lights.
- [dA-01] displays the absolute value of the output frequency regardless of whether the rotation is forward or reverse. When checking the present rotational direction with the display content of the monitor, refer to "Output-frequency monitor (signed) [dA-12]".

Code	Item	Description	Data
dA-01	Output frequency monitor	Displays the output frequency of the inverter. "0.00" is displayed during stop. The "Frequency monitor LED [Hz]" of the keypad lights while this data is displayed.	0.00 to 590.00 Hz

Frequency reference monitor (after calculation) (signed) [dA-04]

- Displays the final frequency command value based on the results of main speed command, auxiliary speed command or calculation.
- This monitor displays the value before the upper/lower limiter or the maximum frequency limit is applied to the setting range.

Code	Item	Description	Data
dA-04	Frequency reference monitor (after calculation) (signed)	Displays the frequency reference value.	-590.00 to 590.00 Hz

Output frequency scale conversion monitor [dA-06]

- Displays the value obtained by converting "Output frequency monitor [dA-01]" with the factor set in "Frequency conversion gain [Ab-01]". Used when changing the display unit, such as changing the display from the output frequency to the motor rotation speed.
  (Example) Displays the motor rotation speed.
  Motor rotation speed N (min^{-1}) = (120×f (Hz)) / P (number of motor poles)
  Therefore, when [Ab-01] = 30.0 for a 4-pole motor, 1800 is displayed at 60Hz.

Code	Item	Description	Data	Initial value
dA-06	Output frequency scale conversion monitor	Displays the [dA-01]×[Ab-01] setting.	0.00 to 59000.00	-
Ab-01	Frequency conversion gain	[dA-06] Set the conversion factor for display.	0.01 to 100.00	1.00

Output-frequency monitor (signed) [dA-12]

- Displays the inverter output frequency in signed form.
- The positive value (+) is displayed for forward rotation and the negative value (-) is displayed for reverse rotation.
- "Output frequency monitor (signed) [dA-12]" is not subject to the frequency change during monitoring function. "Monitoring data change selection [UA-93]" is "Enabled (01)"You cannot change the frequency from the control panel while [dA-12] is displayed.

Code	Item	Description	Data
dA-12	Output frequency monitor (signed)	Displays the inverter output frequency in signed form. During stop, "0.00" is displayed. During forward rotation, the + value is displayed. During reverse rotation, the-value is displayed. "Monitor indicator [Hz]" on the control panel lights while this data is displayed.	-590.00 to 590.00 Hz

Frequency change function of monitor

- When "Monitor in progress data change selection [UA-93]" is "Enabled (01), "Main speed command selection [AA101]" is "Parameter setting (07)" and only during inverter operation, the frequency command can be changed by keypad on the operation panel while "Output frequency monitor [dA-01]"/"Output frequency conversion monitor [dA-06]" is displayed.
  By "Multi-speed command change during monitoring selection [UA-94]", disable/enable of monitoring frequency change function for multi-speed operation can be selected. When "Disable (00)" is set, this function is valid only when "Multi-speed 0 speed ([Ab110]/[Ab210])" is selected as the frequency command. When set to "Enabled (01)", this function is enabled for all multi-speed commands set to
- "Multi-speed 0th speed ([Ab110]/[Ab210])" to "Multi-speed 15th speed ([Ab-11]/[Ab-25])".
- When SET key is pressed after the frequency command is changed, the changed frequency command is stored in the inverter's internal memory.
- "Output frequency monitor (signed) [dA-12]" is not subject to the frequency change during monitoring function. "Monitoring data change selection [UA-93]" is "Enabled (01)"You cannot change the frequency from the control panel while [dA-12] is displayed.
  If "UP/DWN memory selection [CA-61]" is "Save (01)", after "Output frequency monitor [dA-01]"/ "Output frequency conversion monitor [dA-06]" is changed, please note that the changed frequency command value will be stored in the inverter internal memory when the power is cut off. For details, refer to "9.2.14 Increasing/Decreasing Frequency Command by Remote Control."
- Since "Output frequency setting (monitor) [FA-01]" is rewritten while displaying [dA-01]/[dA-06], there may be a time difference between key operation and display depending on acceleration/deceleration time setting.
- Frequency cannot be changed while the inverter is stopped, PID is operating, or in the individual input mode by pressing and holding SET key.
- When using the remote operator (OS-44 ver.2.0 onwards), the setting of this function is disabled.

Code	Item	Description	Data	Initial value
UA-93	Enable frequency changes through monitor display	The frequency command cannot be changed in Disable: [dA-01]/[dA-06]	00	00
		The frequency command can be changed in Enable: [dA-01]/[dA-06]	01	
UA-94	Enable multispeed frequency changes through monitor display	Disable: Only "Multi-speed 0 speed ([Ab110]/[Ab210])" can be edited.	00	00
		Enable: "Multi-speed 0 speed ([Ab110]/[Ab210])" to "Multi-speed 15 speed ([Ab-11]/[Ab-25])" can be edited	01	

10.1.2 Monitor the output current

Output current monitor [dA-02]

- Displays the output current flowing to the motor. The monitor lamp [A] on the control panel lights while the current monitor [dA-02] is displayed.
- First order lag filters can be set for the [dA-02] readout. If the display of [dA-02] is shaking in detail, adjust the time constant of the filter by referring to "Output current monitor filter time constant (dA-02 and similar communication data) [CF-61]".
- Depending on PWM type of the inverter, the lower the carrier frequency is, the more the value of the monitor may be shaken.
- "0.00" is displayed while output is stopped.

Code	Item	Description	Data	Initial value
dA-02	Output current monitor	Displays the output current from the inverter. The data is displayed as the rms value of the output current.	0.00 to 655.35 A	-
CF-61	Filter time constant for output current monitor (dA-02 and similar communication data)	Filters can be set for "Output current monitor [dA-02]".	0 to 1000 ms	300

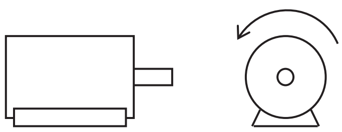
10.1.3 Monitor the rotation direction

Rotation direction monitor [dA-03]

- Displays the inverter operation direction. When the drive is running (forward or reverse), the "Running Indicator [RUN]" on the control panel lights.
- The rotation direction is determined by the operation command method and the sign of the frequency command.
- For 0Hz operation such as DC braking function, "Outputting 0Hz (01)" is displayed in [dA-03].

Code	Item	Description	Data
dA-03	Rotation direction monitor	Displays the inverter operation direction.	o (Stopped (00))
			d (0Hz outputting (01))
			F (Forward (02))
			r (During reverse rotation (03))

Generally, the motor rotates counterclockwise in the forward direction when viewed from the axial direction.



Forward rotation

10.1.4 Monitor the motor detect speed

Detect speed monitor[dA-08]

- Displays the actual rotation frequency fed back from the motor when performing speed control with sensor or position control.
- This monitor is enabled when "Velocity Feedback (02)" is set to "Pulse-input detection target selection [CA-90]".
- When using this monitor, set "IM motor pole selection [Hb103]" and "Encoder parameter setting [CA-81]" correctly. For details, refer to "9.5.11 Using Encoder Feedback".
- If the value of "Velocity detection value monitor [dA-08]" changes finely due to the effect of noises, etc., and the Velocity detection value is not stable, set "Velocity detection filter time constant [CA-86]" larger.

Code	Item	Description	Data	Initial value
dA-08	Detect speed monitor	Displays the actual rotation frequency during encoder feedback.	-590.00 to 590.00 Hz	-
CA-81	Encoder constant setting	Set the number of connected encoder pulses in the number of pulses (multiplied by 1) converted to one rotation of the motor.	1 to 65535 pls	512
CA-86	Speed feedback filter	Filter time constant for the detection speed by encoder pulse input.	0 to 1000 ms	20
CA-90	Pulse input target function selection	Velocity feedback	02	01
Hb103	IM motor pole selection	Set the number of motor poles.	00 to 23 (2 to 48 poles)	01

10.1.5 Monitor the torque command and output torque

Torque command monitor (after calculation) [dA-15]

- Displays the currently set torque command value used in torque control.
  This monitor is enabled when "Torque control enable [ATR]" of the input terminal function is ON and in torque control status.
- The torque equivalent to 100% of this monitor can be selected from the torque calculated by the motor constant, etc. or the torque equivalent to the rated current of the inverter by setting "Torque conversion method selection [HC115]". Refer to "9.6.3 Torque Command Operation" for details.
- This monitor displays the sum of the torque command value and the torque bias value. For details of the torque bias function, refer to "9.6.5 Operation by Adding Torque Command".

Code	Item	Description	Data
dA-15	Torque reference monitor (after calculation)	Displays the current torque command value.	-1000.0 to 1000.0 %

Torque limit monitor [dA-16]

- Displays the currently set torque limit value used in torque control.
- For details of the torque limit function, refer to "9.6.4 Limiting Torque to Move".

Code	Item	Description	Data
dA-16	Torque limit monitor	Displays the current torque limit value.	0.0 to 500.0 %

Output torque monitor [dA-17]

- In sensorless vector control, the output torque estimate during speed control/torque control is displayed.
- In this monitor, the regeneration is a negative value (-) when the motor runs in the forward direction with a positive value (+), and the regeneration is a positive value (-) when the motor runs in the reverse direction with a negative value (-).
- First order lag filters can be set for the [dA-17] readout. If the display of [dA-17] is shaking in detail, adjust the time constant of the filter in "Output torque monitor filter time constant (dA-17 and similar communication data) [CF-62]".
- The torque equivalent to 100% of this monitor can be selected from the torque calculated by the motor constant, etc. or the torque equivalent to the rated current of the inverter by setting "Torque conversion method selection [HC115]". Refer to "9.6.3 Torque Command Operation" for details.

Code	Item	Description	Data	Initial value
dA-17	Output torque monitor	Displays the output torque estimate.	-1000.0 to 1000.0 %	-
CF-62	Filter time constant for output torque monitor (dA-17 and similar communication data)	Filters can be set for "Torque output monitor [dA-17]".	0 to 1000 ms	100

10.1.6 Monitor the position control

Current position monitor [dA-20]

- Indicates the current position during position control. For details of the position control function, refer to "9.14 Performing Positioning Operation".
- When "Velocity Feedback (02)" is set to "Pulse-input detection target selection [CA-90]", this monitor is enabled. In addition, "Clear position error [PCLR]", "Preset position data [PSET]" and "Memorize present position at power-off [AE-61]" of the input terminal functions are also enabled. For details, refer to "9.14.1 Control to Absolute Position of Reference Point Reference Point (Absolute Position Control)".

Code	Item	Description	Data
dA-20	Current position monitor	Displays the current position during position control.	Absolute position control mode: -268435455 to 268435455 pls High-resolution absolute position control mode: -1073741823 to 1073741823 pls

10.1.7 Monitor the output voltage

Output voltage monitor (rms) [dA-18]

- The output voltage currently output to the motor can be checked in the Output Voltage Monitor (rms) [dA-18].
- The output-voltage displayed in [dA-18] is calculated.
- First order lag filters can be set for the [dA-18] readout. If the display of [dA-18] is shaking in detail, adjust the time constant of the filter by referring to "Output-voltage monitor filter time constant (dA-18 and similar communication data) [CF-63]".
- When the input voltage is low or "Motor rated voltage [Hb106]" is not set correctly, the correct value may not be displayed.

Code	Item	Description	Data	Initial value
dA-18	Output voltage monitor (rms)	Displays the voltage output to the motor.	0.0 to 800.0 V	-
CF-63	Output voltage monitor filter time constant (dA-18 and similar communication data)	Filters can be set for "Output voltage monitor (rms) [dA-18]."	0 to 1000 ms	100

10.1.8 Monitor the input power/integrated input power

Input power monitor [dA-30]

- Displays the power (instantaneous value) currently input to the inverter.
- First order lag filters can be set for the readout of "Input power monitor [dA-30]". If the display of [dA-30] is shaking finely, adjust the time constant of the filter using the "I/O power monitor filter time constant [CF-64]".

Code	Item	Description	Data	Initial value
dA-30	Input power monitor	Displays the input power (instantaneous value). The displayed value varies depending on the input power factor.	0.00 to 655.35 kW	-
CF-64	Input/Output power filter	Filters can be set for "Input-power monitor [dA-30]" and "Output-power monitor [dA-34]".	0 to 1000 ms	400

Integrated input power [dA-32]

- Displays the integrated data of the input power to the inverter.
  "Integrated input power display gain [UA-13]" can be used to convert the displayed content to gain.
  [dA-32] = [Actual cumulative incoming power (kWh)] /[UA-13)]
  (e.g.) When [UA-13] is 100 and [dA-32] is 1000, the actual cumulative incoming power is 100,000 kWh.
- This monitor value is stored in the internal memory of the inverter when the power supply is cut off. To clear the data, use one of the following methods.
  - Clear cumulative input power [UA-12] is changed to "Clear (01)", and the [dA-32] setting is cleared by pressing SET button on the control panel.
  - Assign "Clear integrated input power [KHC]" to the input terminal and ON the terminal to clear [dA-32] to zero.

Code	Item	Description	Data	Initial value
dA-32	Integrated input power monitor	Displays the integrated value of input power.	0.0 to 1000000.0 kWh	-
CA-01 to CA-08	Input terminal function	Clearing cumulative incoming power [KHC]: When this signal is turned ON, [dA-32] is cleared to 0.	039	-
UA-12	Integrated input power monitor clear	Disable: Clear Disable	00	00
		Clear execution: Pressing SET button on the control panel with this setting clears the "Integrated input power monitor [dA-32]" to zero. (This setting becomes "Invalid (00)" after clearing is executed.)	01	
UA-13	Display gain for the integrated input power monitor	Choose the zoom factor used for [dA-32].	1 to 1000	1

10.1.9 Monitor the output power/integrated output power from the Inverter

Output power monitor [dA-34]

- Displays the power (instantaneous value) currently output from the inverter to the motor.
- First order lag filters can be set as displayed in "Output power monitor [dA-34]". If the display of [dA-34] is shaking finely, adjust the time constant of the filter using the "I/O power monitor filter time constant [CF-64]".

Code	Item	Description	Data	Initial value
dA-34	Output power monitor	Displays the output power (instantaneous value).	0.00 to 655.35 kW	-
CF-64	Input/Output power filter	Filters can be set for "Input-power monitor [dA-30]" and "Output-power monitor [dA-34]".	0 to 1000 ms	400

Integrated output power monitor [dA-36]

- Displays the integrated output power from the inverter to the motor. "Integrated calculated power display gain [UA-13]" can be used to convert the displayed gain.
- [dA-36] = [Actual integral power (kWh)] /[UA-15)]
  (e.g.) When [UA-15] is 100 and [dA-36] is 1000, the actual cumulative power is 100,000 kWh.
- This monitor value is stored in the internal memory of the inverter when the power supply is cut off. To clear the data, use one of the following methods.
  - Clear cumulative power [UA-14] is changed to "Clear (01)", and the [dA-36] is cleared by pressing SET button.
  - When "Clear cumulative power output [OKHC]" is assigned to the input terminal and the terminal is turned ON, the [dA-36] value is cleared to zero.

Code	Item	Description	Data	Initial value
dA-36	Integrated output power monitor	Displays the integrated output power.	0.0 to 1000000.0 kWh	-
CA-01 to CA-08	Input terminal function	Clearing cumulative power consumption [OKHC]: When this signal is turned ON, [dA-36] is cleared to 0.	040	-
UA-14	Integrated output power monitor clear	Disable: Clear Disable	00	00
		Clear execution: When this setting is selected and SET button on the control panel is pressed, "Integral power monitor [dA-36]" is cleared to zero. (This setting becomes "Invalid (00)" after clearing is executed.)	01	
UA-15	Display gain for the Integrated output power monitor	Choose the zoom factor used for [dA-36].	1 to 1000	1

10.1.10 Monitor the DC bus voltage

DC bus voltage monitor [dA-40]

- Displays the DC voltage charged in the main circuit capacitor of the inverter (DC voltage between the [P] and [N] terminals of the inverter main circuit terminal block).
- During operation, the monitored value also fluctuates according to the actual DC voltage.
- If the DC voltage between P-N exceeds approx. DC400V (200V class)/approx. DC800V (400V class, an overvoltage error [E007] occurs.
- [E007] For more information on troubleshooting in case of occurrence, see 15.2 Troubleshooting Protection Features.

Code	Item	Description	Data
dA-40	DC bus voltage monitor	Displays the DC voltage between P-N of the inverter.	0.0 to 1000.0 Vdc

10.1.11 Monitor the load factor of the braking resistor

Braking resistor operation circuit (DBTR) load factor monitor [dA-41]

- Displays the duty factor of the braking resistor operation circuit (DBTR).
- To use the braking resistor operation circuit (DBTR), the "braking resistor operation circuit (DBTR) usage rate [bA-60]" and "braking resistor operation circuit (DBTR) selection [bA-61]" sets are required. For details, refer to "9.9.5 Suppressing overvoltage with a braking resistor".
- If this monitor value exceeds the value set in "Braking Resistor Operating Circuit (DBTR) Usage Rate [bA-60]", "Braking Resistor Overload Error [E006]" will occur.
- For details on troubleshooting when "Braking resistor overload error [E006]" occurs, refer to "15.2 Troubleshooting of protective functions".

Code	Item	Description	Data
dA-41	Brake resistor operation circuit (DBTR) load factor monitor	Displays the load factor of the braking resistor.	0.00 to 100.00 %

10.1.12 Monitor the electronic thermal load ratio

Electronic thermal load ratio monitor (Motor) [dA-42]

- Displays the electronic thermal load factor of the motor. If this monitor exceeds 100%, "Motor overload error [E005]" will occur.
- In order to perform the overload protection of the motor correctly, perform the basic setting of the motor and the electronic thermal function setting properly. For details, refer to "8.1.3 Setting Motor Nameplate Data to Parameters" and "8.1.4 Setting Electronic Thermal".
- For details on troubleshooting when "Motor overload error [E005]" occurs, refer to "15.2 Troubleshooting of protective functions".

Code	Item	Description	Data
dA-42	Electronic thermal load factor monitor (Motor)	Displays the electronic thermal load factor of the motor.	0.00 to 100.00 %

Electronic thermal load ratio monitor (Inverter) [dA-43]

- Displays the electronic thermal load factor of the inverter. If this monitor exceeds 100%, "Controller overload error [E039]" will occur.
- The electronic thermal function of the inverter is to protect the inverter itself. It is operating separately from the thermal function.
- The characteristics of the inverter electronic thermal are fixed for each inverter model, and there are no parameters for adjustment. Regardless of the setting, the rated current at ND rating is used as a reference. Even when "Light load (LD) (01)" is set to "Load spec. selection [Ub-03]", the increment of [dA-43] to the output current does not change.
- For details on troubleshooting when "Controller overload error [E039]" occurs, refer to "15.2 Troubleshooting of protective functions".

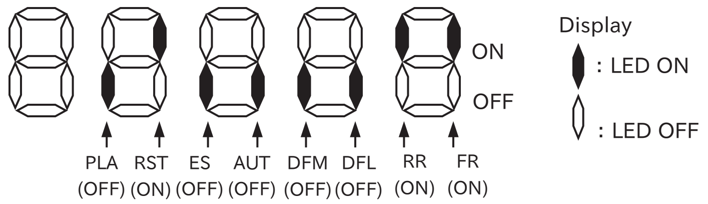
Code	Item	Description	Data
dA-43	Electronic thermal load factor monitor (Inverter)	Displays the electronic thermal load factor of the inverter.	0.00 to 100.00 %

10.2 Monitor the input/output terminal

10.2.1 Monitor the status of input/output terminals

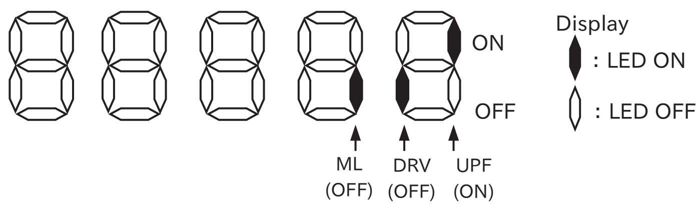
Input terminal monitor [dA-51]

- LED on the control panel lights up to indicate the input status of the input terminals.
- This monitor displays ON/OFF of the functional terminals. a/b(NO/NC) Not affected by selection.
- The response of this monitor is slow depending on the setting of "Input terminal response time ([CA-41] to [CA-48])".
- If the monitoring status does not change even when the terminal is turned ON/OFF, the control wire may be disconnected.
- When "Thermistor selection [Cb-40]" is set to "PTC (Resistance)" Enable (01)," OFF is maintained at all times regardless of the input status.
- The operation of the output terminal [UPF] when the safety function STO input terminal [ST1]/[ST2] and EDM function selector switch are ON can be checked in "Safety STO terminal monitor [dA-44]". For details, refer to section 14.1.3 Changing Status/Error Display by Setting.

Code	Item	Description	Data
dA-51	Input terminal monitor	The 7-segment LED on the control panel indicates ON/OFF status of the input terminals. (e.g.) Input terminal [RST], [RR], [FR]: ON Input terminal [PLA], [ES], [AUT], [DFM], [DFL]: OFF 	-

Output terminal monitor [dA-54]

- Indicates the output status of the output terminals with the positions of LED on the control panel.
- This monitor displays ON/OFF of the physical terminals. a/b(NO/NC) Not affected by selection.
- The response of this monitor is slow depending on the setting of "Output terminal on delay time ([CC-20]/[CC-22]/[CC-32])" and "Output terminal off delay time ([CC-21]/[CC-23]/[CC-33])".
- If the monitoring status does not change after the terminal is turned ON/OFF, the control wire may be disconnected.

Code	Item	Description	Data
dA-54	Output terminal monitor	The 7-segment LED on the control panel indicates ON/OFF status of the output terminals. (e.g.) Output terminal [UPF]: ON Output terminal [DRV], [ML] : OFF 	-

10.2.2 Monitor the analog input and pulse input

Analog input [VRF] monitor [dA-61] /Analog input [IRF] monitor [dA-62]

- [VRF]/[IRF] The analog voltage/current (0 to 10V/4 to 20mA) input to the pin is displayed as 0.00 to 100.00%.
- You can monitor A/D immediately after converting the analog signal.
- The unit is factory-adjusted so that MAX is slightly smaller than 10V/20mA, taking into account variations in the input circuitry.

Code	Item	Description	Data
dA-61	Analog input [VRF] monitor	[VRF] Indicates the analogue input 0 to MAX of the terminal as 0.00 to 100.00%.	0.00 to 100.00 %
dA-62	Analog input [IRF] monitor	[IRF] Indicates the analogue input 0 to MAX of the terminal as 0.00 to 100.00 %.	

Pulse input monitor [dA-70]

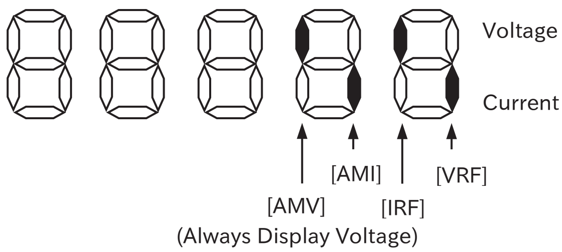
- This monitor operates only when "Pulse input detection target selection [CA-90]" is "Pulse input frequency command (01)," and displays the frequency of pulses input to input terminal [RST] (B-phase) and input terminal [PLA] (A-phase) in %, where "Pulse input frequency scale [CA-92]" is 100 %.
- When "Pulse-input detection target selection [CA-90]" is "Disabled (00)", the operation will not be performed.
- For details, refer to "9.2.8 Setting Frequency Reference from Pulse Input".
- When "Velocity Feedback (02)" is set to "Select Pulse-input Detection Object [CA-90]",Confirmation "Velocity detected value monitor [dA-08]" or "Present position monitor [dA-20]".
- If [CA-90] is set to "Pulse Count (03)", or if pulse is input to the input terminal function "Pulse Input A [PLA]" or "Pulse Input B [PLB]" assigned to any input terminal by setting [CA-90] to other than (03), confirmation "Pulse Counter Monitor [dA-28]".

Code	Item	Description	Data	Initial value
dA-70	Pulse input monitor	Displays the entered pulse frequency as a percentage of [CA-92] as 100%.	-100.00 to 100.00 %	-
CA-90	Pulse input target function selection	Setting when pulse input is used as frequency command.	01	01
CA-92	Pulse input frequency scale	Enter the pulse frequency equivalent to the highest frequency.	0.05 to 32.00 kHz	25.00

10.2.3 Monitor the status of analog input/output

Analog Input/Output status monitor [dA-60]

- The setting status of analog input and analog output can be checked.
- [AMV] For the terminal, pulse output and analog voltage output can be selected, but the voltage is always displayed on this monitor.
- The analogue input terminal [VRF]/[IRF] and analogue output terminal [AMI]/[AMV] can be changed in the selection status by "[VRF] terminal input switching [Cb-08]", "[IRF] terminal input switching [Cb-18]", "[AMI] terminal output switching [Cd-26]", and "[AMI] terminal output switching [Cd-36]. For details, refer to "9.15.3 Adjusting Analog Input", "9.16.4 Pulse Output of Monitor Data", and "9.16.5 Analog Output of Monitor Data".

Code	Item	Description	Data
dA-60	Analog Input/Output status monitor	The 7-segment LED on the control panel indicates the selection status of the analog input terminal [VRF]/[IRF] and analog output terminal [AMI]. 	-

10.2.4 Monitor the unsteady state of the analog output

Abnormal detection value monitor [dC-31]

・When the non-stationary detection function is used, the monitor data specified in "Non-stationary detection target [bE-02]" can be checked in "Non-stationary detection value monitor [dC-31]".
・For details of the non-stationary detection function, refer to "9.11.14 Detecting a State Different from the Steady State (Non-Steady Detection Function)".

Code	Item	Description	Data	Initial value
dC-31	Abnormal detection value monitor	The monitor data specified in [bE-02] is displayed.	-100.00 to 100.00 % Note	-
bE-02	Abnormal detection target	Select the data to be monitored by the non-stationary detection function.	『9.16.3 Refer to "Selecting the monitor to be output"	dA-01

Note: Assume that the full scale of the target selected in "Non-stationary object [bE-02]" is 100 %.

Abnormal detection upper level monitor [dC-32]

・The upper limit of the unsteady detection function can be checked in the current operation state.
・For details of the non-stationary detection function, refer to "9.11.14 Detecting a State Different from the Steady State (Non-Steady Detection Function)".

Code	Item	Description	Data
dC-32	Abnormal detection upper level monitor	Displays the current value of the upper limit level for the non-stationary detection function.	-100.00 to 100.00 % Note

Note: Assume that the full scale of the target selected in "Non-stationary object [bE-02]" is 100%.

Abnormal detection lower level monitor [dC-33]

・The lower limit of the unsteady detection function can be checked in the current operation state.
・For details of the non-stationary detection function, refer to "9.11.14 Detecting a State Different from the Steady State (Non-Steady Detection Function)".

Code	Item	Description	Data
dC-33	Abnormal detection lower level monitor	Displays the current value of the lower limit level for the non-stationary detection function.	-100.00 to 100.00 % Note

Note: Assume that the full scale of the target selected in "Non-stationary object [bE-02]" is 100%.

10.3 Monitor the status of inverter

10.3.1 Monitor the operation information for the inverter

Accumulated number of starts monitor [dC-20]

・Displays the number of times the inverter has started outputting to the motor from the stop state to the operation state.
・This data is stored in the internal memory of the inverter when the power supply is cut off.

Code	Item	Description	Data
dC-20	Accumulated number of starts monitor	Displays the number of times the inverter has started outputting to the motor from the stop state to the operation state.	1 to 65535 times

Accumulated number of power-on times monitor [dC-21]

・Displays the number of times the inverter has been turned on.
・This data is stored in the internal memory of the inverter when the power supply is cut off.
・It does not count when restarting due to an instantaneous power failure.

Code	Item	Description	Data
dC-21	Accumulated number of power-on times monitor	Displays the number of times the inverter has been turned on.	1 to 65535 times

Accumurated RUN time monitor [dC-22]

・The inverter enters the operating state and displays the accumulated time output to the motor.
・This data is stored in the internal memory of the inverter when the power supply is cut off.

Code	Item	Description	Data
dC-22	Accumulated RUN time monitor	Displays the total operation time of the inverter after shipment from the factory. This data is stored in the internal memory when the power supply is cut off.	0 to 1000000 hr

Accumulated power-on time monitor [dC-24]

・Displays the time the inverter has been powered on.
・This data is stored in the internal memory of the inverter when the power supply is cut off.

Code	Item	Description	Data
dC-24	Accumulated power-on time monitor	Displays the total energizing time of the inverter after shipping from the factory. This data is stored in the internal memory when the power supply is cut off.	0 to 1000000 hr

Accumulated cooling-fan run time monitor [dC-26]

・Displays the amount of time the inverter cooling fan has been running.
・This data is stored in the internal memory of the inverter when the power supply is cut off.
・"Cooling fan cumulative operation time monitor [dC-26]" can be cleared by setting "Cooling fan cumulative operation time clear selection [bA-71]"。 For details, see section 9.11.10, Outputting a Cooling Fan Life Warning.

Code	Item	Description	Data
dC-26	Accumulated cooling-fan run time monitor	Displays the accumulated operating time of the cooling fans.	0 to 1000000 hr

・[dC-20]/[dC-21]/[dC-22]/[dC-24]/[dC-26] is not cleared even if the parameter is initialized.

10.3.2 Monitor the cooling fin temperature

Cooling fin temperature monitor [dC-15]

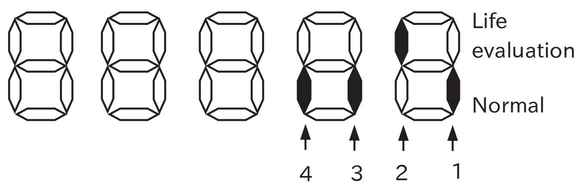
・Displays the cooling fin temperature near the main element of the inverter.
・If the cooling fin temperature exceeds 120˚C max, "Temperature error [E021]" will occur.

Code	Item	Description	Data
dC-15	Cooling fin temperature monitor	Displays the temperature of the cooling fins.	−20.0 to 200.0 ℃

10.3.3 Monitor the life assessment results

Life assessment monitor [dC-16]

・This indicator lights up on 7segLED of the control panel. It indicates the status of the life part.
・The following four conditions can be checked on the life diagnosis monitor.
1: Life of the electrolytic capacitor on the substrate
2: Cooling fan life
3: Power module life
4:Life of the inrush current prevention circuit
・The life can be diagnosed by "Capacitor Life Possible [WAC]", "Fan Life Indication [WAF]", "Power Module Life Indication [WAP]" and "Sudden Circuit Life Indication [WAIC]" of the output terminal function. For details, refer to "9.11.9 Outputting Warning of Electric Capacitor Life on Board", "9.11.10 Outputting Warning of Cooling Fan Life", and "9.11.11 Outputting Warning of Inverter Main Element Life".
・The life of the electrolytic capacitor on the board is calculated once every 10 minutes. If the power is turned ON/OFF repeatedly in this period or less, the service life cannot be diagnosed normally.
・When "Cooling fan operation selection [bA-70]" is set to other than "Always ON(00"), the fan is automatically stopped due to failure. Lifetime diagnostics are not performed while the fan is stopped. For details on cooling fan operation, see section 9.10.7, Selecting Cooling Fan Operation.
・The life diagnostic function of the cooling fan does not operate for models under the single-phase 200V class 0.75kW, under the three-phase 200V class 0.75kW, or under the three-phase 400V class 0.4kW, because the cooling fan is not installed.

Code	Item	Description	Data
dC-16	Life assessment monitor	The 7-segment LED on the control panel indicates the status of the life components. 1: Electrolytic capacitor on the substrate 2: Cooling fan 3: Power modules 4: Inrush current prevention circuit  	—

10.3.4 Monitor the operating mode of the inverter

Inverter load type selection status monitor [dC-01]

- Displays the current load specification selection status.
- The load specification of the inverter is changed in "Load specification selection [Ub-03]". For details, refer to "8.1.2 Changing Inverter Load Specifications".
- The rated current and current derating characteristics vary depending on the selection of the load specifications. Please also check them.

Code	Item	Description	Data
dC-01	Inverter load type status	Light Duty rating (LD) selected	01
		Normal Duty rating (ND) selected	02

Rated currrent monitor [dC-02]

- Displays the rated output current for the currently selected load specification.
- The load specification of the inverter is changed in "Load specification selection [Ub-03]". For details, refer to "8.1.2 Changing Inverter Load Specifications".
- The rated current and current derating characteristics vary depending on the selection of the load specifications. Please also check them.

Code	Item	Description	Data
dC-02	Rated current monitor	Displays the rated output current of the inverter in the currently selected load specification.	0.0 to 6553.5 A

IM/SM monitor [dC-45]

- Indicates whether the drive is set to run induction motor (IM) or synchronous (permanent magnet) motor (SM(PMM).
- The motor to be operated is changed by "Control method [AA121]". For details, refer to "9.5.1 Selecting Control Mode".
- Correct the motor using an inverter for operation, parameters related to motor specifications must be set before operation. Refer to "Chapter 8 Mandatory motor drive sets and commissioning".

Code	Item	Description	Data
dC-45	IM/SM monitor	Induction motor (IM) selected	00
		Synchronous (permanent magnets) motor (SM(PMM)) being selected	01

Auto-chuning mode monitor [dC-47]

- It is possible to check whether the executed auto-tuning was completed normally or aborted due to some factor.
- For details on auto-tuning, refer to "8.3 Auto-tuning of Motor".

Code	Item	Description	Data
dC-47	Auto-tuning mode monitor	Auto-tuning complete: The previous auto-tuning was successful, or auto-tuning has not been executed.	01
		Auto tuning failure: Last auto-tuning is finished in the middle.	02

Emergency-force drive mode monitor [dC-49]

- You can check whether the forced operation mode or bypass mode is operating.
- For details of the forced operation mode or bypass mode, refer to "9.7.12 Performing forced operation".

Code	Item	Description	Data
dC-49	Emergency-force drive mode monitor	Disabled: Not in forced operation mode and bypass mode.	00
		Forced operation: Operation is in progress in forced operation mode.	01
		Bypass: Operation in Bypass mode.	02

10.3.5 Monitor the frequency command destination and operation command destination

Main speed input source monitor [dC-07]

- The currently enabled main speed command destination can be checked.
- The main speed command destination changes according to the status of the input terminal function and other functions in addition to the setting of "main speed command selection [AA101]". For details, refer to "9.2 Selecting Frequency Reference".

Code	Item	Description	Data
dC-07	Main speed input source monitor	Terminal [VRF]	01
		Terminal [IRF]	02
		Keypad (Multi-Speed 0 [Ab110])	07
		Multi-speed 1 to 15 ([Ab-11] to [Ab-25])	09 to 23
		Jogging [AG-20]	24
		RS485 Setting	25
		Communication Options	26
		Pulse input	29
		PID operation	32
		Holding frequency by analog command holding function	34

Sub speed input source monitor [dC-08]

- The currently enabled auxiliary speed command destination can be checked.
- The frequency command destination varies depending on the status of the input terminal function and other functions in addition to the setting of "Auxiliary speed command selection [AA102]". For details, refer to "9.2 Selecting Frequency Reference".

Code	Item	Description	Data
dC-08	Sub speed input source monitor	Disable	00
		Terminal [VRF]	01
		Terminal [IRF]	02
		Control panel (Aux. speed setting [AA104])	08
		RS485 Setting	25
		Communication Options	26
		Pulse input	29
		PID operation	32

RUN command input source monitor [dC-10]

- The operation command destination currently enabled can be checked.
- Operation the command destination varies depending on the status of the input terminal function and other functions in addition to the setting of "Operation command selection [AA111]". Refer to "9.1 Operation Command Selection and Alarm Reset" for details.

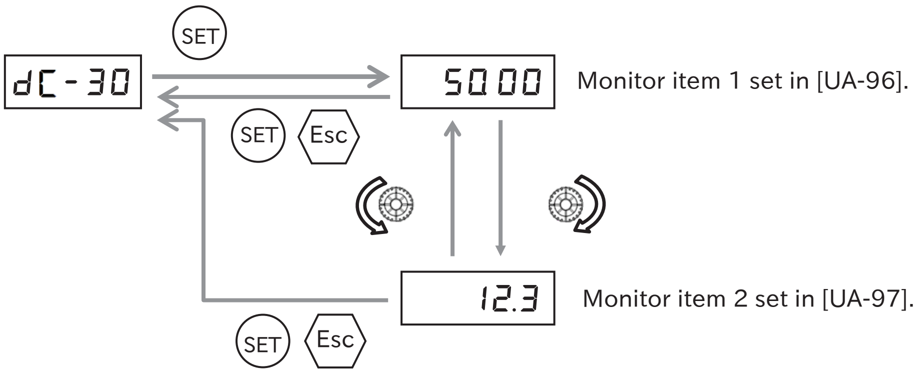
Code	Item	Description	Data
dC-10	RUN command input source monitor	Terminal [FR]/[RR]	00
		3 Wire ([STA]/[STP]/[F/R] terminal)	01
		Keypad (RUN-key)	02
		RS485 Setting	03
		Option	04

10.3.6 Monitor the dual monitor

Dual monitor [dC-30]

- You can set any two monitor items and switch between monitors by turning JOG dialing left and right. Set the function code of the monitor target to "2 kinds of monitor target item 1 [UA-96]" and "2 kinds of monitor target item 2 [UA-97]".
- Even if "Output frequency monitor [dA-01]" or "Output frequency conversion monitor [dA-06]" is set to "2 types monitor object item 1 [UA-96]" and "2 types monitor object item 2 [UA-97]" and "Monitoring in progress data change selection [UA-93]" is set to "Enabled (01)", the frequency cannot be changed from [dC-30].

Code	Item	Description	Data	Initial Setting
dC-30	Dual monitor	[UA-96], Monitor the two items set in [UA-97].	-	-
UA-96	Dual monitor parameter 1	Except [dC-30], you can set the parameters of the function grouping dA/db/dC/FA.	dA-**, db-**, dC-**, FA-** (excluding dC-30)	dA-01
UA-97	Dual monitor target 2 selection			dA-02



10.3.7 Monitor the warning of the inverter

Icon 2 LIM detailed monitor [dC-37]

- Displays the currently operating motor drive limit function.
- For details of each restricted function, refer to the items of each function in this manual.

Code	Item	Description	Data
dC-37	Detailed Icon 2 LIM Monitor	This is not a motor drive limit state.	00
		The overcurrent suppression function is operating.	01
		The overload restriction function is operating.	02
		The overvoltage suppression function is operating.	03
		The torque limit function is operating.	04
		The upper/lower limit function and frequency jump function are operating.	05
		The output frequency is set to less than the minimum frequency.	06

Icon 2 ALT detailed monitor [dC-38]

- Displays the advance notice function that is currently operating.
- For details of each notice function, refer to the items of each function in this manual.

Code	Item	Description	Data
dC-38	Detailed Icon 2 ALT Monitor	This is not the operation status of the advance notice function.	00
		An overload warning is output.	01
		Motor thermal warning is output.	02
		Controller thermal warning is output.	03
		Motor overheat warning is output.	04

Icon 2 RETRY detailed monitor [dC-39]

- Displays the current retry/restart status.
- For details of the retry function, see "9.7 Changing the Start and Stop Method" and "9.9 Using the Triple less Function".

Code	Item	Description	Data
dC-39	Detailed Icon 2 RETRY Monitor	No retry or restart is in progress.	00
		Retry operation is waiting.	01
		Waiting for a restart operation.	02

Icon 2 NRDY detailed monitor [dC-40]

- If the inverter cannot be operated, the cause is displayed.
- When "Icon 2 NRDY detailed monitor [dC-40]" displays "Ready status (00)", at the same time "Operation ready [IRDY]" is ON.
- To start operation, the displayed abnormal condition must be cleared. If multiple sources are occurring at the same time, the smaller number is displayed first.

  e.g.: When the "Free run stop [MBS]" input terminal is turned ON during trip.
  = "Trip (01)" is displayed in [dC-40].
  When the trip state is released, "Free run (08)" is displayed.

Code	Item	Description	Data
dC-40	Detailed Icon 2 NRDY Monitor	Operation preparation is complete. The "Operation ready [IRDY]" signal is ON.	00
		A trip has occurred.	01
		Power is lost or under-voltage.	02
		It is in the reset state or the reset release wait state.	03
		STO is enabled.	04
		Waiting until the internal processing of the inverter is completed.	05
		There is an inconsistency in the set data. (Warning)	06
		Abnormalities exist in sequence operation.	07
		Free Run Stop is valid.	08
		Operation is prohibited by the "Operation permission signal [REN]".	09

10.4 Monitor the PID control

PID rerated monitor [db-30] to [db-64]

・The following PID related data can be monitored. For details, refer to "9.8 Driving by PID Process Control".

Code	Item	Description	Data
db-30	PID1 feedback value 1 monitor	Displays the feedback data 1/2/3 of PID1. The data range and unit vary depending on the parameter setting.	-100.00 to 100.00 % Note:1
db-32	PID1 feedback value 2 monitor		
db-34	PID1 feedback value 3 monitor		
db-36	PID2 feedback value monitor	Displays the feedback data value of PID2. The data range and unit vary depending on the parameter setting.	-100.00 to 100.00 % Note:2
db-42	PID1 set-point monitor (after calculation)	Displays PID1 target value after the calculation performed according to the setting of "PID1 target value operator selection [AH-50]". The data range and unit vary depending on the parameter setting.	-100.00 to 100.00 % Note:1
db-44	PID1 feedback value monitor (after calculation)	Displays PID1 feedback data after the calculation performed according to the setting of "PID1 feedback data operator selection [AH-54]". The data range and unit vary depending on the parameter setting.	-100.00 to 100.00 % Note:1
db-50	PID1 output monitor	Displays PID after the limiter as a percentage of the maximum frequency as 100%.	-100.00 to 100.00 %
db-51	PID1 deviation monitor	Displays the final deviations used to control PID1.	-200.00 to 200.00 %
db-52	PID1 deviation 1 monitor	Displays the deviation between the target setpoint 1 of PID1 and the feedback data1.	
db-53	PID1 deviation 2 monitor	Displays the deviation between the target setpoint 2 of PID1 and the feedback data2.	
db-54	PID1 deviation 3 monitor	Displays the deviation between the target value-3 of PID1 and the feedback data-3.	
db-55	PID2 output monitor	Displays PID2 output.	-100.00 to 100.00 %
db-56	PID2 deviation monitor	Displays the deviations used to control PID2.	-200.00 to 200.00 %
db-61	Current PID P-Gain monitor	Displays the current P gain.	0.0 to 100.0
db-62	Current PID I-Gain monitor	Displays the current I gain.	0.0 to 3600.0 s
db-63	Current PID D-Gain monitor	Displays the current D gain.	0.00 to 100.00 s
db-64	PID feedforward monitor	Displays the feedforward command value.	0.00 to 100.00 %

Note: 1. "PID1 scale adjustment ([AH-04] to [AH-06])" changes the data-range.
For more information, please refer to "9.8.5 PID Units Converter Function".
2. "PID2 Scale Adjust ([AJ-04] to [AJ-06]) will change the setting.
For more information, please refer to "9.8.5 PID Units Converter Function".

10.5 Trip, retry and warning related information
10.5.1 Monitor the number of trips and trip history

Trip counter [dE-01]

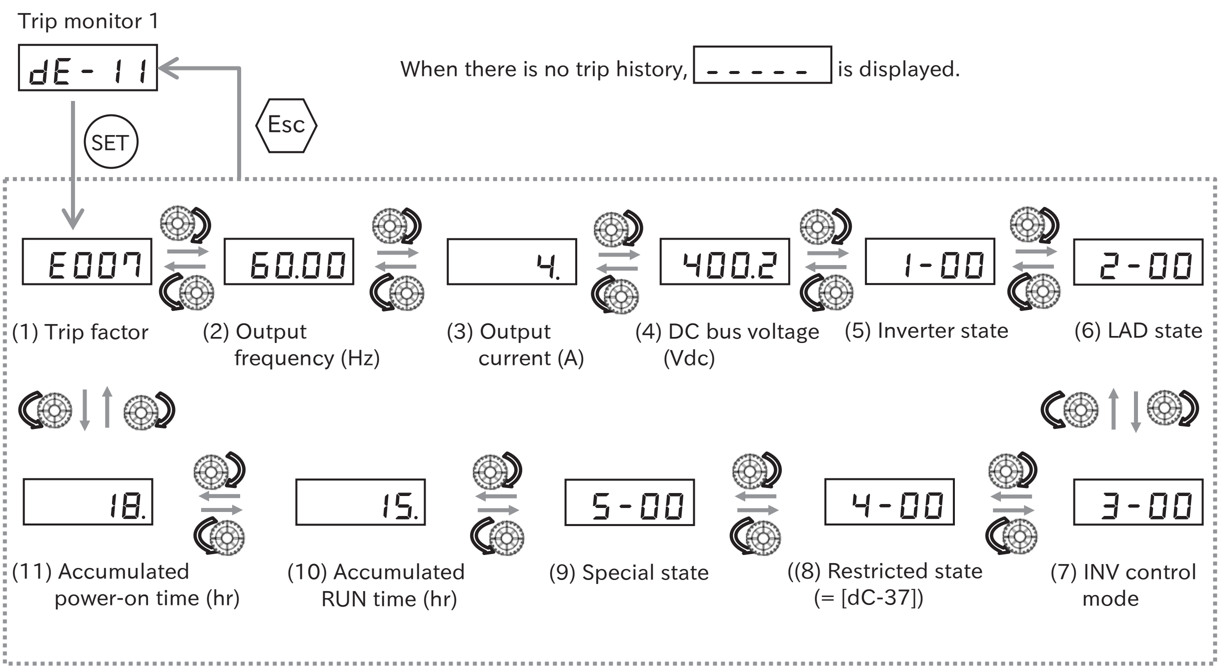
・Displays the number of times the inverter has tripped.
・This data is stored in the internal memory of the inverter when the power is shut off.

Code	Item	Description	Data
dE-01	Trip counter	Displays the number of times the inverter has tripped. This data is stored in the internal memory when the power is shut off.	0 to 65535 times

Trip monitor 1 to 10 ([dE-11] to [dE-20])

・The trip history data up to the past 10 times is displayed.
・This data is stored in the internal memory of the inverter when the power is shut off.
・The latest trip information can be monitored in "Trip monitor 1 [dE-11]".
・For details about what is displayed in "Trip monitor 1 to 10 ([dE-11] to [dE-20])", refer to "15.2 Troubleshooting for Protection Functions Related Error ".

Code	Item	Description	Data
dE-11 to dE-20	Trip monitor 1 to Trip monitor 10	Displays the following information when the inverter trips. (1) Trip factor (2) Output frequency (signed) (3) Output current (4) DC bus voltage (5) Inverter state (6) LAD state (7) Inverter control mode (8) Restricted state (=[dC-37]) (9) Special state (10) Accumulated RUN time (11) Accumulated power-on time This data is stored in the internal memory when the power is shut off.	-

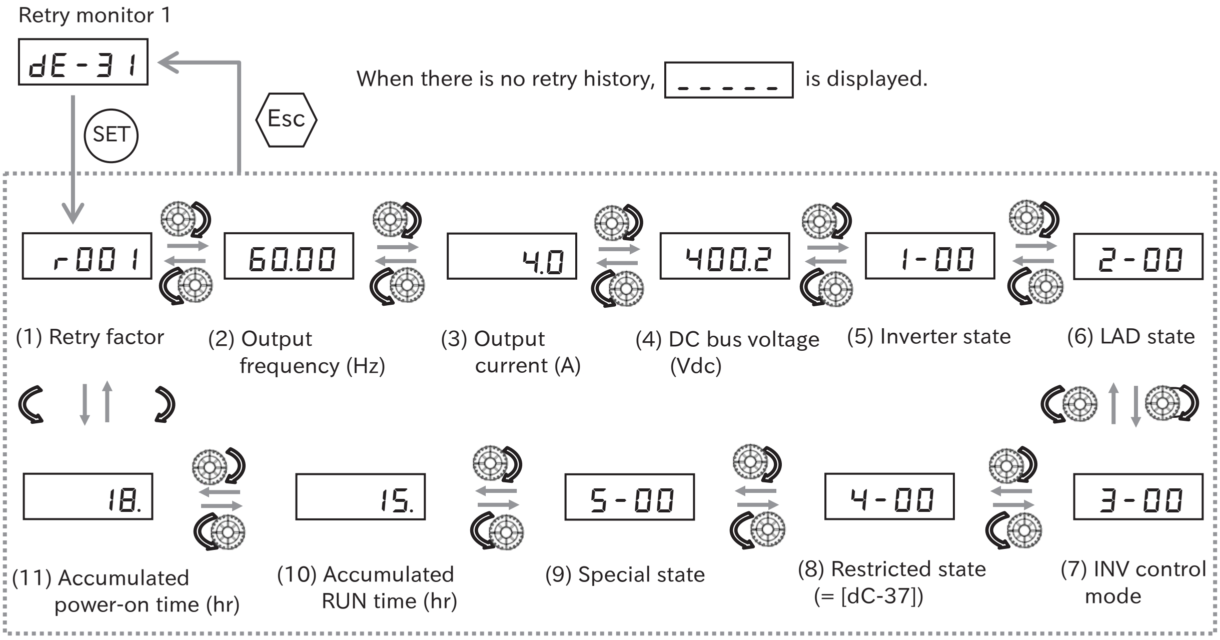


10.5.2 Monitor the retry history

Retry monitor 1 to 10 ([dE-31] to [dE-40])

- The trip history data up to the past 6 times is displayed.
- This data is stored in the internal memory of the inverter when the power is shut off.
- The latest trip information can be monitored in "Retry monitor 1 [dE-31]".
- For details about what is displayed in "Retry monitor 1 to 10 ([dE-31] to [dE-40])", refer to "15.2 Troubleshooting for Protection Functions Related Error ".

Code	Item	Description	Data
dE-31 to dE-40	Retry monitor 1 to Retry monitor 10	Displays the following information when the inverter retry. (1) Retry factor (2) Output frequency (signed) (3) Output current (4) DC bus voltage (5) Inverter state (6) LAD state (7) Inverter control mode (8) Restricted state (=[dC-37]) (9) Special state (10) Accumulated RUN time (11) Accumulated power-on time This data is stored in the internal memory when the power is shut off.	-



10.5.3 Monitor the warning information

Warning monitor [dE-50]

- A warning is displayed when the set parameter is inconsistent with other settings.
  During a warning, "Program LED [PRG]" on the keypad blinks until the data is corrected.
- Refer to "15.3.1 Warning Display" for details of the warning display.

Code	Item	Description	Data
dE-50	Warning monitor	A warning is displayed when the set parameter is inconsistent with other settings.	-

Chapter 11 Modbus Communication

11

HF-620 supports RTU for Modbus communication mode the physical layer as RS485.
This chapter describes the communication methods that can operate in RS485 communication.
Inter-inverter communication EzCOM function using Modbus protocol can also be used.
Select the communication function that you want to use and configure the settings.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

11.1 Modbu-RTU communication

11.1.1 Communication specifications and setting parameters

・HF-620 is standard-equipped with a RS485 compliant Modbus-RTU port. It can communicate with external networked control devices. The basic specifications and setting parameters of communication are as follows.
・In Modbus communication of HF-620, the data which does not fit in 1 word is set as "2 register length parameter", and there is the data which is constrained when accessing. For more information, see the exception code [27h] in "11.2.9 Exception Response".

■Modbus communication protocol

Item	Specifications	Remarks
Protocol	Modbus-RTU (Slaves)	-
Transmission speed	2400/4800/9600/19.2k/38.4k/57.6k/76.8k/115.2 kbps	Set by parameter
Communication method	Half-duplex communications.	-
Synchronous system	Asynchronous method	
Transmission code	Binary	
Transmission method	Transmit from low bit (LSB first)	
Compliant interface	RS485	
Data bit length	8 bits	
Parity	None/Even/Odd	Set by parameter
Stop bit length	1 bit/2 bits	
Starting method	One-Sided Activation by Host-Side Commands	-
Wait time	Silent interval + 0 to 1000 ms	Set by parameter
Connection type	1: N (N=max. 247) (Up to 32 units can be connected without repeaters (including master))	
Error checking	Overrun/Framing /CRC-16/ Horizontal Parity	-

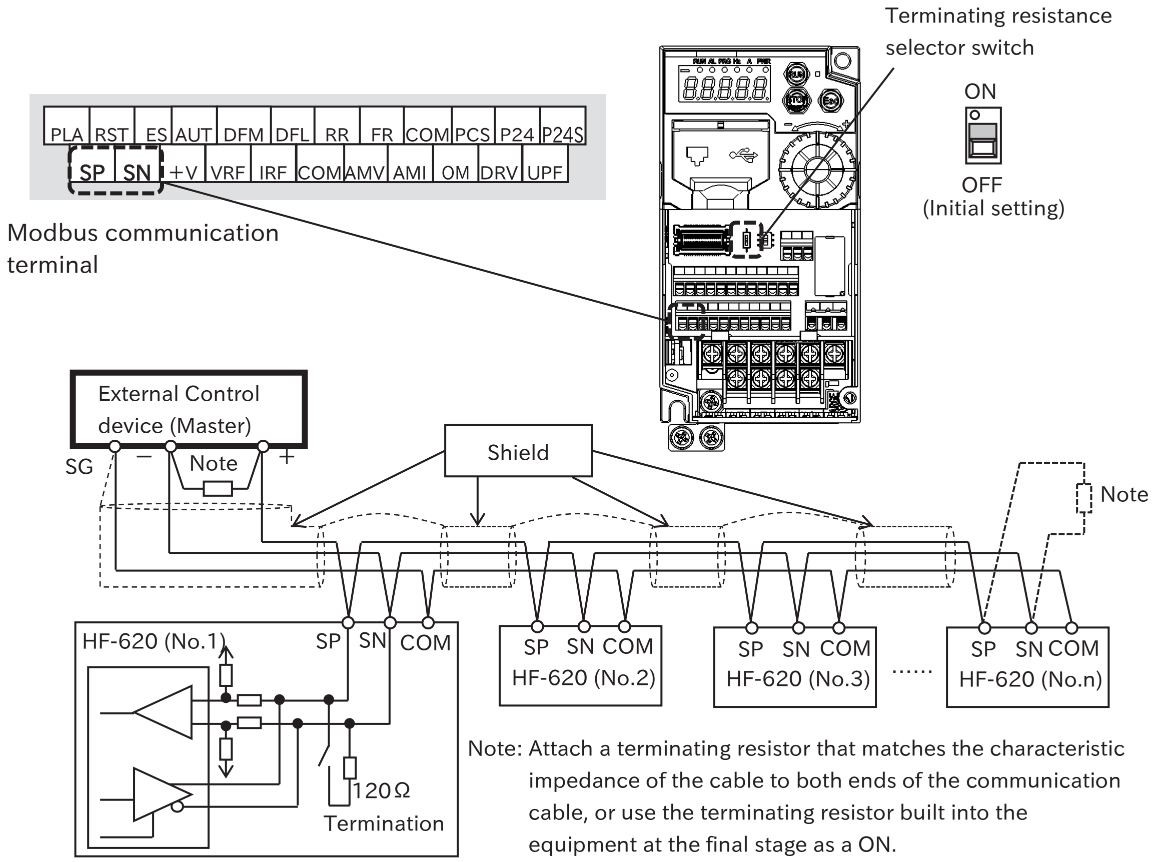
■Parameters related to Modbus communication

Code	Item	Description	Data	Initial value
AA101	Main speed input source selection	Set to Modbus communication	08	07
AA111	RUN command input source selection		03	02
CC-01 CC-02 CC-07	Output terminal function	Communication disconnection [NDc]: This signal is turned ON when a communication error occurs.	049	002 001 017
CF-01	RS485 communication baud rate selection (baud rate selection)	Set the communication transmission speed.	03 to 10	05
CF-02	RS485 communication node address	Assign the inverter station number.	1 to 247	1

Code	Item	Description	Data	Initial value
CF-03	RS485 communication parity selection	No parity	00	00
		Even parity	01	
		Odd parity	02	
CF-04	RS485 communication stop bit selection	1 bit	01	01
		2 bits	02	
CF-05	RS485 communication error selection	When communication error occurs, it trips at "RS485 communication error [E041]".	00	02
		When communication error occurs, after decelerating stop, trip at "RS485 communication error [E041]".	01	
		Ignore communication errors. No trip occurs.	02	
		Free-run stop will be performed in case of communication error. For the trip does not occur.	03	
		Decelerates to a stop when communication error occurs. No trip occurs.	04	
CF-06	RS485 communication timeout setting	If communication is interrupted and this set time has elapsed, the motor trips due to "RS485 communication error [E041]". When 0.00 s, timeout is not judged.	0.00 to 100.00 s	2
CF-07	RS485 communication wait time setting	Set the time until the inverter returns.	0 to 1000 ms	5
CF-08	RS485 communication mode selection	Use Modbus-RTU	00	01
		Use inter-inverter communication (EzCOM)	01	
		Inter-inverter communication (EzCOM) is used (control inverter)	02	
CF-11	Register data AV<=>% conversion function	Sets the response data unit to A (current) and V (voltage).	00	00
		Set the response data unit as a percentage of the rated value.	01	
CF-12	RS485 endianness selection	Big endian	00	00
		Little Endian	01	
		Special endian	02	
CF-20	EzCOM start node No.	Parameters related to inter-inverter communication (EzCOM) function. Refer to "11.4 Inter-inverter Communication EzCOM Function" for more information.	1 to 8	1
CF-21	EzCOM end node No.		1 to 8	1
CF-22	EzCOM start method selection		00, 01	00
CF-23	EzCOM number of data		1 to 5	5
CF-24 CF-27 CF-30 CF-33 CF-36	EzCOM destination address 1 to 5		1 to 247	1 2 3 4 5
CF-25 CF-28 CF-31 CF-34 CF-37	EzCOM destination registers 1 to 5		0000h to FFFFh	0000h
CF-26 CF-29 CF-32 CF-35 CF-38	EzCOM source registers 1 to 5			
CG-01	Register mapping function selection	Parameters related to Modbus mapping function. For more information, see "About 11.3 Modbus Mapping feature".	00, 01	00
CG-11 to CG-20	External register 1 to 10		0000h to FFFFh	0000h
CG-31 to CG-40	External register 1 to 10 format		00, 01	00
CG-51 to CG-60	External register 1 to 10 scaling		0.001 to 65.535	1.000
CG-71 to CG-80	Internal register 1 to 10		0000h to FFFFh	0000h

11.1.2 Communication wiring and connection

- The figure below shows an example of connecting Modbus communication wires. When multiple units are connected, each inverter is connected in parallel.
- Use a 3-wire shielded cable for connection between the twisted-pair cable for communication and ground. Connect the signal ground (SG) of the external controller to the [COM] terminal of the inverter.
- Attach terminating resistors that match the characteristic impedance of the cable to both ends of the communication cable. If the last stage is HF-620, turn ON the terminating resistor selector. When Modbus communication is performed with one inverter, turn ON the terminating resistor selector switch of that inverter. (The terminating resistor built into HF-620 is 120Ω.)

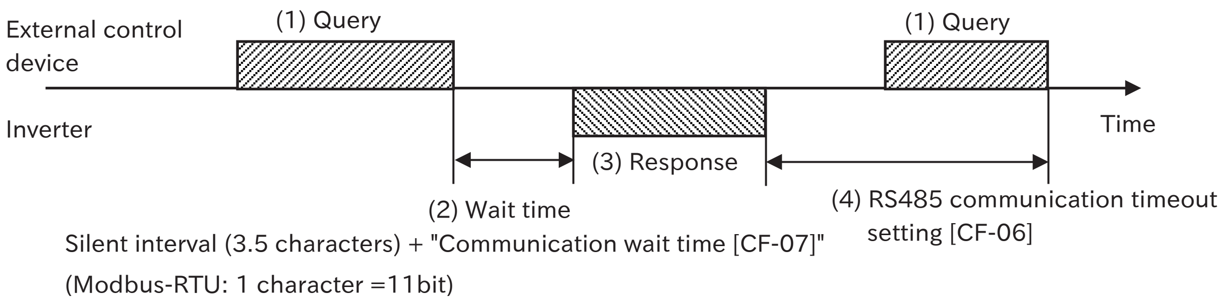


- Communication is possible using only a 2-wire twisted pair cable. However, communication may become unstable due to noise, which is not recommended.
- The communication cable must be separated from the high-voltage circuit such as the power line and alarm relay wiring and must not be laid in parallel.
- Communication may become unstable depending on the operating environment of the inverter, cables used for communication lines, and wiring conditions. In such a case, follow the instructions below.
  (1) Check that the terminating resistors are connected to both ends of the communication cable or, use a terminating resistor that matches the characteristic impedance of the cable.
  (2) Check the connection between the signal ground (SG) of the external control device (master) and the [COM] terminal of the inverters.
  (3) Normally, wire shields should be grounded at a single point SG the external controller or, change the grounding method of the wiring shield while checking whether communication is stable. (For example, grounding to the [L] terminal of any inverter, wiring shield grounding, etc.)
  (4) If the communication range is long (more than 100m), lower the transfer rate or insert a repeater.

11.1.3 Communication procedure

Communication procedure

・Modbus-RTU communication between the external controller and the inverter is performed as follows.



(1) A query message is sent from the external control device to the inverter.
(2) The inverter waits for the silent interval time and the setting time of "communication wait time [CF-07]" after receiving a query message.
(The silent interval is 3.5 characters long as the wait time determined in Modbus-RTU communication. For Modbus-RTU communication, 1 character is 11bit.)
(3) The response message is returned from the inverter to the external control device.
(4) After sending the response message, the inverter waits for the completion of receiving the following query message during the time set in "Communication timeout time [CF-06]". (If [CF-06] is 0.00 seconds, timeout judgment is not performed.) When a query message is received, the inverter performs processing according to the message, and then the operation shown in (2) is performed. When timeout occurs, the inverter will wait for the reception of a query message and will operate according to the setting of "Communication error selection [CF-05]".

・Monitoring of communication time-out starts after the first transmission/reception is established after power-on or reset. If transmission/reception has never been established, a communication timeout does not occur.

11.1.4 Message configuration

・A command message sent from the master to the slave is called a query, and a response message from the slave is called a response. The following shows the transmission format for queries and responses.

Query
Slave address
Function code
Query data
Error checking (CRC-16)

Response
Slave address for checking
Function code for checking
Response data
Error checking (CRC-16)

(1) Slave address (ommunication station number)

・The slave address is a number in the range of 1 to 247 that is set in advance for each inverter (slave). (Only the inverter matching the slave address of the query will fetch the query.)

・If "0" is specified for the slave address of the transmission destination on the master side, broadcasting (simultaneous broadcasting) to all stations can be performed. In the case of broadcast, all slaves receive data but do not return a response.

・Data cannot be read or looped back during a broadcast.

・In Modbus spec, the slave address is 1 to 247. However, if the slave address 250 to 254 is used in the master, broadcasting can be performed only for a particular slave address. (The slave does not return a response. The broadcast is valid only for the write command (05h, 06h, 0Fh, 10h).)

Slave address	Destination
250 (FAh)	Broadcast to slave addresses 01 to 09
251 (FBh)	General broadcast to slave addresses 10 to 19
252 (FCh)	Broadcast to slave addresses 20 to 29
253 (FDh)	Broadcast to slave addresses 30 to 39
254 (FEh)	Simultaneous broadcast to slave addresses 40 to 247

(2) Function code

・Specifies the function to be executed by the inverter in function code.

・The corresponding function code is shown below.

Function code	Function	Can be handled by one message Maximum number of data bytes	Can be handled by one message Maximum number of data items
01h	Read coil status	4	32 Coils (in bits)
03h	Read multiple registers	32	16 registers (in byte)
05h	Write to coil	2	1 Coil (in bits)
06h	Writing to holding registers	2	1 register (in byte)
08h	Loop-back Test	-	-
0Fh	Writing to multiple coils	4	32 Coils (in bits)
10h	Write multiple registers	32	16 registers (in byte)
17h	Read/write to multiple holding registers	32/32	16/16 Registers (in byte)

(3) Data

・Sends data related to function codes.

・The data transmission format varies depending on the function code.

・The following data formats are supported among the data used for Modbus communication.

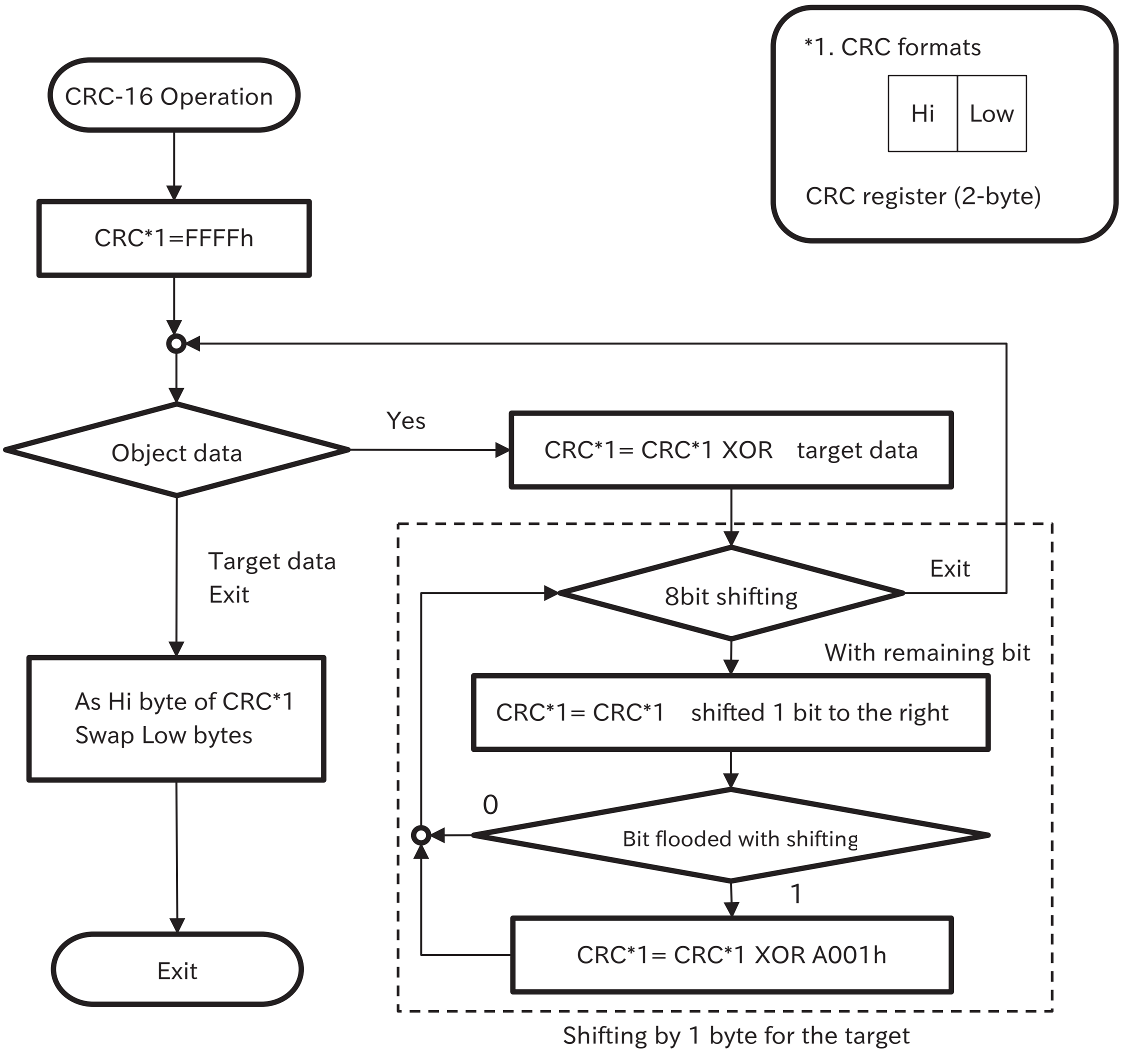
Data name	Description
Coil	2-value data that can be read/written (1-bit length)
Holding register	16-bit data that can be read/written

・In Modbus communication of HF-620, there is a restriction on writing to "2 register length parameter". For more information, see the exception code [27h] in "11.2.9 Exception Response".

(4) Error checking

- Modbus-RTU error checking uses CRC(Cyclic Redundancy Check).
- Generation polynomials of CRC-16 ($X^{16}+X^{15}+X^{2}+1$) are used to generate CRC.
- A CRC is a 16bit of data generated for a block of any length of data in 8bit.

＜CRC-16 calcuration procedure＞



(5) Communication time

- The response of the inverter after the inverter receives a query is as follows: Silent interval (3.5 characters) + "Communication wait time [CF-07]" + "Processing time (several ms) for response messaging etc.
- Always allow an interval of at least the silent interval (3.5 characters or more) between the reception of a response from the inverter and the transmission of the next query by the external control device.

(6) Normal response

- Responses are returned in the format-for-query format description in 11.2 Modbus-RTU Function Codes.

(7) Abnormal response

- If there is a fault (except communication error) in the content of the query, the inverter returns an exception response without performing anything.
- Check the function code of the response for error judgment. The function code of the exception response is 80h added to the function code of the query.
  For details on the error details, see "11.2.9 Exception response".

Configuring Exception Response Fields

Slave address
Function code
Excepton code
CRC-16

(8) No response

- The inverter ignores the query and does not return a response in the following cases:
  - When a broadcast (a query with a slave address of "0") is received.
  - When a communication error is detected in the query reception processing.
  - When the slave address of the query and the inverter setting slave address do not match.
  - When the time interval between the data comprising the message and the data is 3.5 characters or less.
  - When the data length of a query is invalid.
  - When the reception interval exceeds 1.5 characters in a frame.
  - When the error check code of the query does not match (CRC error).
  - When a group-based broadcast (a query with a slave address in the range of 250 to 254) is received.

- In the external control device, provide a timer to monitor response messages from the inverter, and provide retransmission processing or abnormality processing such as sending the same query again if there is no response message reply within a specific time.

11.2 Modbus-RTU function codes

11.2.1 Read status of coil [01h]

・Reads the status of the coil. (ON/OFF)

・The following shows an example when reading the status of the input terminals [FR] to [PLA] of the inverter for slave address 1. The status of input terminals [FR] through [PLA] are as follows.

Input terminal	FR	RR	DFL	DFM	AUT	ES	RST	PLA
Coil No.	0005h	0006h	0007h	0008h	0009h	000Ah	000Bh	000Ch
Coil status	ON	OFF	ON	OFF	OFF	OFF	ON	OFF

Query

No.	Field Name	e.g. HEX
1	Slave address Note:1	01
2	Function code	01
3	Coil-starting number (upper) Note:2	00
4	Coil-starting number (lower) Note:2	04
5	Coils (high) Note:3	00
6	Number of coils (low) Note:3	08
7	CRC-16 (high)	7C
8	CRC-16 (low)	0D

Coil start number = Coil number-1

Response

No.	Field Name	e.g. HEX
1	Slave address	01
2	Function code	01
3	Number of data bytes	01
4	Read Coil Data Note:4	45
5	CRC-16 (high)	90
6	CRC-16 (low)	7B

Input terminal [RST]
Input terminal [DFL]
Input terminal [FR]

45h＝0100 0101

Note: 1. Broadcast is not possible.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.
3. When the number of read-out coils exceeds 0 or 32, the exception response of the exception code [03h] is returned.
4. Data of the number of data bytes is transferred.

・The coil data of the response is the status of the coil number 0005h to 000Ch with the coil 0005h as LSB(0 bit. If the coil data is not 1byte(8 bit) units, the upper bit is extended by zeros to 1byte(8 bit) units.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Coil No.	000Ch	000Bh	000Ah	0009h	0008h	0007h	0006h	0005h
Coil status	OFF	ON	OFF	OFF	OFF	ON	OFF	ON
45h	0	1	0	0	0	1	0	1

・When reading the status of 16 consecutive coils from the coil number 0001h, the order of datum is as follows. Byte data in which data 1 is sent first.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data 1	0008h	0007h	0006h	0005h	0004h	0003h	0002h	0001h
Data 2	0010h	000Fh	000Eh	000Dh	000Ch	000Bh	000Ah	0009h

・When the read coil extends outside the range of the defined coil number, the coil data outside the range is sent as "0".

・If the command cannot be executed successfully, an exception response is returned. For details, see section 11.2.9, Exception Responses.

・Reading 0000h to 004Fh of the coil number can also be substituted by reading the holding register of the register number 3EBCh to 3EC0h. The following shows the bit-structure of a holding register 3EBCh. Refer to the "18.1.1 Modbus Coil Number List" for more information.

■(Example) Holding register 3EBCh bit-structure
(Holding register assignment status of coil number 0000h to 000Fh)

bit	Item	bit	Item
15	-	7	Input terminal DFL
14	-	6	Input terminal RR
13	-	5	Input terminal FR
12	Input terminal PLA	4	Trip reset [RST]
11	Input terminal RST	3	External trip [ES]
10	Input terminal ES	2	Emergency direction command
9	Input terminal AUT	1	Operation command
8	Input terminal DFM	0	-

11.2.2 Read holding register [03h]

- Reads the specified number of consecutive holding registers from the specified holding register number.
- The following shows an example of reading the source and output frequency (Holding register number =03E9h to 03EBh) of the latest trip information from the inverter of slave address 5.

Query

No.	Field Name	e.g. HEX	
1	Slave address Note:1	05	
2	Function code	03	
3	Register start number (upper) Note:2	03	Register start number = Register number-1
4	Register starting number (lower) Note:2	E8	
5	Number of holding registers (upper) Note:3	00	3 registers
6	Number of holding registers (lower) Note:3	03	
7	CRC-16 (high)	84	
8	CRC-16 (low)	3F	

Response

No.	Field Name	e.g. HEX	
1	Slave address	05	
2	Function code	03	
3	Number of data bytes Note:4	06	
4	Read register data 1 (upper)	00	0007h→07d→E07 (factor: overvoltage [E07])
5	Read register data 1 (lower)	07	
6	Read register data 2 (upper)	00	0000 1770h→6000d→60.0Hz(frequency)
7	Read register data 2 (lower)	00	H: hexadecimal d: decimal
8	Read register data 3 (upper)	17	
9	Read register data 3 (lower)	70	
16	CRC-16 (high)	A8	
17	CRC-16 (low)	61	

Note: 1. Broadcast is not possible.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.
3. Up to 16 registers (32 byte) can be read. Otherwise, an exception response with exception code [03h] is returned.
4. Data of the number of data bytes is transferred. In this example, there are 6 bytes for the three holding registers.

- If the command cannot be executed successfully, an exception response is returned.
For details, see section 11.2.9, Exception Responses.

11.2.3 Write to coil [05h]

・Write to one coil. The following table shows the coil status changes

Data	OFF to ON coiling	ON to OFF coiling
Change data (high)	FFh	00h
Change data (lower)	00h	00h

・The following shows an example of issuing an operation command to the inverter of the slave address 10.

・In order to operate by a command from Modbus communication, "Operation command selection [AA111]" must be set to "Modbus communication (03)" in advance. Coil No. of operation command is 0001h.

Query

No.	Field Name	e.g. HEX	
1	Slave address Note:1	0A	
2	Function code	05	
3	Coil address (upper) Note:2	00	Coil start number = Coil number-1
4	Coil address (lower) Note:2	00	
5	Change data (high)	FF	OFF to ON: FF00h
6	Change data (lower)	00	
7	CRC-16 (high)	8D	
8	CRC-16 (low)	41	

Response

No.	Field Name	e.g. HEX
1	Slave address Note:1	0A
2	Function code	05
3	Coil address (upper) Note:2	00
4	Coil address (lower) Note:2	00
5	Change data (high)	FF
6	Change data (lower)	00
7	CRC-16 (high)	8D
8	CRC-16 (low)	41

Note: 1. For broadcast, there is no response.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.

・If the command cannot be executed successfully, an exception response is returned. For details, see section 11.2.9, Exception Responses.

11.2.4 Write to holding register [06h]

- Writes data to one specified holding register.
- The following shows an example of writing 50.00Hz to "Multi-speed 0 speed [Ab110]" of the inverter of slave address 1.
- Since the data resolution is 0.01Hz for the holding register "2F4Eh" of [Ab110], the write data will be "5000(1388h" to set 50.00Hz.

Query

No.	Field Name	e.g. HEX
1	Slave address [Note:1]	01
2	Function code	06
3	Register address (upper) [Note:2]	2F
4	Register address (lower) [Note:2]	4D
5	Change data (high)	13
6	Change data (lower)	88
7	CRC-16 (high)	1C
8	CRC-16 (low)	5F

Register start number = Register number-1

1388h=5000d → 50.00 (Hz)

Response

No.	Field Name	e.g. HEX
1	Slave address [Note:1]	01
2	Function code	06
3	Register address (upper) [Note:2]	2F
4	Register address (lower) [Note:2]	4D
5	Change data (high)	13
6	Change data (lower)	88
7	CRC-16 (high)	1C
8	CRC-16 (low)	5F

Note: 1. For broadcast, there is no response.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.

- 「Acceleration time 1[AC120] Some parameters, such as "2-register length parameter", consist of two holding register numbers (upper and lower). If the setting value falls within the range of the lower register, writing only one register does not matter. If the setting value does not fall within the lower register range, write two registers at the same time with the write command [10h] of multiple holding registers. For more information on 2-register length parameter, see Exception code [27h] in "11.2.9 Exception response".
- If the command cannot be executed successfully, an exception response is returned. For details, see section 11.2.9, Exception Responses.

11.2.5 Loop-back test [08h]

- Used to check communication between master and slave. Any value can be used for test data.
- An example of a loopback test to the inverter at slave address 1 is shown below.

Query

No.	Field Name	e.g. HEX
1	Slave address [Note]	01
2	Function code	08
3	Test subcode (upper)	00
4	Test subcode (lower)	00
5	Data (high)	Optional
6	Data (Lower)	Optional
7	CRC-16 (high)	CRC
8	CRC-16 (low)	CRC

Response

No.	Field Name	e.g. HEX
1	Slave address [Note]	01
2	Function code	08
3	Test subcode (upper)	00
4	Test subcode (lower)	00
5	Data (high)	Optional
6	Data (Lower)	Optional
7	CRC-16 (high)	CRC
8	CRC-16 (low)	CRC

Note: Broadcast is not possible.

- The test subcode supports only echoing (00h, 00h) query data. Other commands are not supported.

11.2.6 Write to multiple coil [0Fh]

- Rewrite multiple consecutive coils.
- An example of changing the state of the input terminals [FR] through [PLA] of the inverter at slave address 1 is shown below. The status of input terminals [FR] through [PLA] are as follows.

Input terminal	FR	RR	DFL	DFM	AUT	ES	RST	PLA
Coil No.	0005h	0006h	0007h	0008h	0009h	000Ah	000Bh	000Ch
Pin status	ON	ON	ON	OFF	ON	OFF	OFF	OFF

Query

No.	Field Name	e.g. HEX
1	Slave address [Note:1]	01
2	Function code	0F
3	Coil-starting number (upper) [Note:2]	00
4	Coil-starting number (lower) [Note:2]	04
5	Coils (high) [Note:3]	00
6	Number of coils (low) [Note:3]	08
7	Number of data bytes [Note:3]	02
8	Written data (upper) [Note:4]	17
9	Written data (lower) [Note:4]	00
10	CRC-16 (high)	EA
11	CRC-16 (low)	F4

Coil start number = Coil number-1

17h=0001 0111

Input terminal [PLA]

Input terminal [FR]

Response

No.	Field Name	e.g. HEX
1	Slave address [Note:1]	01
2	Function code	0F
3	Coil-starting number (upper) [Note:2]	00
4	Coil-starting number (lower) [Note:2]	06
5	Number of coils (high)	00
6	Number of coils (Lower)	07
7	CRC-16 (high)	F4
8	CRC-16 (low)	08

Note: 1. For broadcast, there is no response.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.
3. The "number of data bytes" is not the number of cores, but the actual number of bytes to be written. The maximum number of data that can be written is 32 coils (4 byte). Otherwise, an exception response with exception code [03h] is returned.
4. Write data is set in the upper and lower bits, so even if the number of bytes that actually need to be changed is odd, add one byte of zero data to make it even.

- Input terminal function is internally processed by "OR" of terminal block input and communication input. However, "Input terminal monitor [dA-51]" only displays the data of the control terminal block.
- If the command cannot be executed successfully, an exception response is returned. For details, see section 11.2.9, Exception Responses.

11.2.7 Write multiple registers [10 h]

- Writes data to multiple consecutive holding registers.
- The following shows an example of writing 10.00 seconds to "Acceleration time setting (monitor) [FA-10]" of the inverter of slave address 1.
- Since the data resolution of the holding register "2B02h, 2B03h" of [FA-10] is 0.01 seconds, write data is set to "1000 (0000 03E8h" to set 10 seconds.

Query

No.	Field Name	e.g. HEX	
1	Slave address Note:1	01	
2	Function code	10	
3	Register start number (upper) Note:2	2B	Register start number = Register number-1
4	Register starting number (lower) Note:2	01	
5	Number of Registers (Upper) Note:3	00	
6	Number of Registers (Lower) Note:3	02	
7	Number of data bytes Note:3	04	
8	Change data 1 (upper)	00	0000 03E8h → 1000d → 10.00 (seconds)
9	Change data 1 (lower)	00	
10	Change data 2 (upper)	03	
11	Change data 2 (lower)	E8	
12	CRC-16 (high)	D8	
13	CRC-16 (low)	2C	

Response

No.	Field Name	e.g. HEX
1	Slave address Note:1	01
2	Function code	10
3	Register start number (upper) Note:2	2B
4	Register starting number (lower) Note:2	01
5	Number of registers (upper)	00
6	Number of Registers (lower)	02
7	CRC-16 (high)	19
8	CRC-16 (low)	EC

Note: 1. For broadcast, there is no response.
2. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.
3. The "number of data bytes" is not the number of holding registers but the actual number of bytes to be written. The largest number of data that can be written is 16 registers (32 byte). Otherwise, an exception response with exception code [03h] is returned.

- If the command cannot be executed successfully, an exception response is returned.
  For details, see section 11.2.9, Exception Responses.
- In Modbus communication of HF-620, there is a restriction on writing to "2 register length parameter".
- For more information, see the exception code [27h] in "11.2.9 Exception Response".

11.2.8 Writing to and reading from multiple holding registers [17h]

- In successionWrites to and reads from multiple holding registers continuously.
- The following shows an example of reading "Output frequency monitor [dA-01]" by writing 50.00Hz in "Main speed command setting (monitor) [FA-01]" of the inverter of slave address 1.

Query

No.	Field Name	e.g. HEX	
1	Slave address	01	
2	Function code	17	
3	Read register start number (upper) Note:1	27	Register start number = Register number-1
4	Read register start number (lower) Note:1	10	
5	Number of read registers (upper) Note:2	00	
6	Number of read registers (lower) Note:2	01	
7	Write register start number (upper) Note:1	2A	Register start number = Register number-1
8	Write register start number (lower) Note:1	FB	
9	Write register count (upper) Note:2	00	
10	Write register count (lower) Note:2	01	
11	Number of write data bytes	02	
12	Write data 1 (upper)	13	1388h = 5000d → 50.00Hz
13	Write data 1 (lower)	88	
14	CRC-16 (high)	77	
15	CRC-16 (low)	A3	

Response

No.	Field Name	e.g. HEX	
1	Slave address	01	
2	Function code	17	
3	Read data-byte count Note:2	04	
4	Read data 1 (upper)	13	1388h = 5000d → 50.00Hz
5	Read data 1 (lower)	88	
6	CRC-16 (high)	50	
7	CRC-16 (low)	E3	

Note: 1. Note that the start number has a value of 1 less. (Start Number)-Specifies the value of 1.
2. The "number of data bytes" is not the number of holding registers but the actual number of bytes to be written/read. The largest number of data items that can be written/read is 16 registers (32 byte). Otherwise, an exception response with exception code [03h] is returned.

- If the command cannot be executed successfully, an exception response is returned. For details, see section 11.2.9, Exception Responses.
- In Modbus communication of HF-620, there is a restriction on writing to "2 register length parameter". For more information, see the exception code [27h] in "11.2.9 Exception Response".

11.2.9 Exception response

- If an error occurs in the query, an exception response is returned.
- For non-broadcast queries, the master is requesting a response. The inverter must return a response corresponding to the query, but if an error occurs in the query, it returns an exception response.
- Exception responses are organized in the fields shown in the table below.

Field Configuration

Slave Address
Function Code
Exception Code
CRC-16

- The details of the field configuration are shown in the table below. The function code is 80h added to the query in response to an exception. The exception code indicates the cause of the exception response.

Function Code

Query	Exception Response
01h	81h
03h	83h
05h	85h
06h	86h
0Fh	8Fh
10h	90h
17h	97h

■ Exception code details

Cord	Description
01h	An unsupported function was specified.
02h	The specified address does not exist.
03h	The specified data is in an unacceptable format.
21h	Data is out of the setting range when writing to the holding register.
22h	The inverter is not permitting the function. ・An attempt was made to change the holding register for which change during operation is prohibited. ・Writing is performed to the holding register that is soft-locked. ・An attempt was made to change an input/output pin function that cannot be changed. ・An attempt was made to change a/b contact of the pin assigned the "Reset[RS]" input terminal function. ・An attempt was made to write to a register when auto-tuning was enabled. ・Attempted to write to the locked register while setting the password. Other
23h	A read-only holding register coil was written.
26h	Writing is performed during data writing or during data initialization.
27h	Only the upper-side register of "2-register length parameter" was accessed. In Modbus communication of HF-620, large data which does not fit in 1 word is set as "2 register length parameter", and there is a holding register which is constrained when accessing. For the target register of "2 register length parameter", see "18.2 Parameter /Modbus holding register". (Ex.) "Acceleration time setting (monitor)[FA-10]" is "2 register length parameter" of register number 2B02h, 2B03h. Only 2B03h of the lower word can be read/written to this register but reading/writing only 2B02h of the upper word will fail.
31h 32h	Error related to Modbus mapping function. For more information, see "About 11.3 Modbus Mapping feature".

11.2.10 Store the changes to the holding register

- When the write command (06h, 10h, 17h) to the holding register is executed, the written value becomes valid, but it is not memorized in the non-volatile memory inside the inverter, and the changed content disappears due to the power-off. To store the changes to the holding register in the non-volatile memory, execute the "Enter command" below or execute the "1-register write mode instruction".
- When changing motor control related parameters such as motor constants shown below, it is also necessary to execute enter command or motor constant recalculation command. If these instructions are not executed, the recalculate of the internal control variables by changing parameters will not be performed, so the motor operating characteristics will not change.

■List of parameters requiring internal control variable recalculate

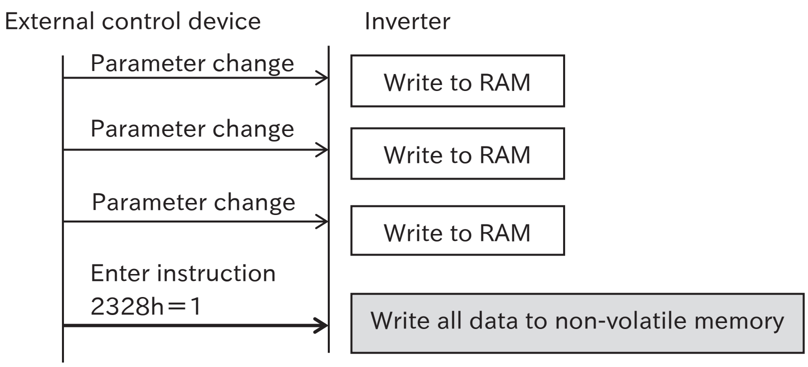
Code	Item	Code	Item
AA121	Control mode selection	Hb105	IM Maximum frequency
HA115	Async. Motor speed response	Hb106	IM motor rated voltage
Hb102	IM Motor Capacity Select	Hb108	IM Motor Rated Current
Hb103	IM motor pole selection	Hb162	Free-V/f frequency 7
Hb104	IM Base frequency	Hb110 to Hb118	Various IM motor parameters

Storage of changed data in the non-volatile memory by the enter command

- Execute the enter command when the changed data is stored collectively in the non-volatile memory, or when recalculation of the internal control variable by changing the motor constant, etc.
- All parameters are stored in the non-volatile memory by writing (0001h) to the holding register "Enter instruction (Data Flash write) [2328h]" using the holding register write command [06h], etc.
- The completion of the enter command should be judged by monitoring the "data writing in progress signal [0049h]".

Holding register	Write command	R/W	Operation details	Resolution
2328h	Enter instruction (Data Flash write)	W	01: Write all parameters	1

■Enter instruction

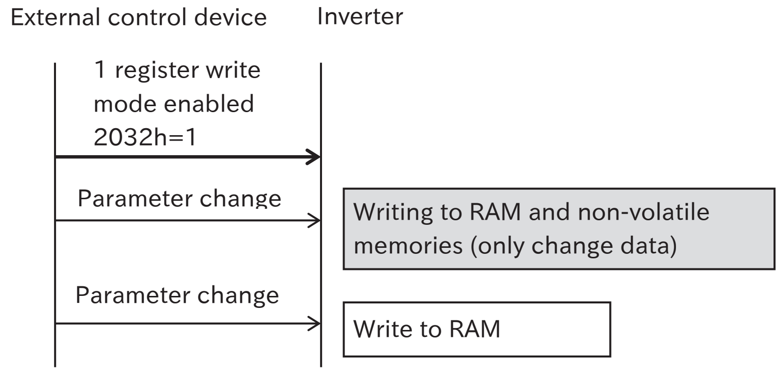


1 Storage of changed data in non-volatile memory by register write mode command

- Writing (0001h) to the "1 register write mode command [232Ah]" sets the data write mode.
- The data changed by the write to holding register command [06h] after the data write mode is shifted writes the data to both the memory for temporary save (RAM) and the non-volatile memory.
- The data write mode is released when a command other than the write command [06h] to the holding register is received after the data write mode is shifted.
- Determine the completion of the single write-mode command by monitoring the "data-writing in progress signal (coil-number 0049h)".

Holding register	Write command	R/W	Operation details	Resolution
232Ah	1 register write mode	W	01: Enable	1

■Write once mode command



Note: Write mode is valid only once parameter change.
If a command other than the hold register write command [06h] is issued, the write mode becomes invalid.

Changing the internal control constant by the motor constant recalculation command

- By writing (0001h) in the holding register "Motor constant recalculation command [2332h]" using the write command to the holding register [06h], etc., the recalculation of the internal control constants may be performed and the motor operating characteristics may be changed.

Holding register	Write command	R/W	Operation details	Resolution
2332h	Motor constants recalculate (No Motor Constant Standard Data Expansion)	W	01: Enable	1

Caution
Failure

Prohibited

DO

- Do not turn off the inverter during writing to the non-volatile memory by the "enter command" and the "single write mode command". Data will not be stored correctly if the power is turned off. Whether or not data is being written should be judged by monitoring "data writing in progress signal (coil-number 0049h)".

- Since the storage element of the inverter has a limit on the number of rewrites, the life of the inverter may be shortened if the above-mentioned writing command is used abundantly. Write commands should be minimized. In particular, please be careful not to execute this command periodically and continuously due to loop processing of external control equipment, etc.

11.2.11 Holding register endian selection

- The endian of communication is the byte data sequence of communication 1-word data to be transmitted and received. In HF-620, the endianness can be set for the data part of the transmit/receive frame.
- Depending on the specifications of the external control device, it may be necessary to swap the upper and lower bytes of word data when reading/writing holding registers. Changing the Endian selection may eliminate the need for these processes. Refer to the operation manual of the external control device for details.
- Endian selection is valid only for holding register read/write function codes ([03h], [06h], [10h], [17h]) and option commands for optional communication ([03h], [06h], [10h], [51h], [52h], and [53h]). In addition, only the data part of the query/response is affected.
- When using the PC software「SAFS001」, select "Big Endian (00)" (default). Other settings will not work properly.
- Endian selection does not function in trip history monitor (register number 03E9h to 04AEh), and it is read as big endian. When using the trip history monitor, set [CF-12] to "Big Endian". When "Little Endian" or "Special Endian" is selected, perform data sorting properly when reading data with an external control device, etc.

Code	Item	Description	Data	Initial value
CF-12	RS485 endianness selection	The order of byte data in the data section is big endian.	00	00
		Byte data in the data section is lined up with little endian.	01	
		The order of byte data in the data part is special endian.	02	

Order of byte data for each endian setting

- The following shows the data order for Modbus (I/O) communication with 1-word data =0102h and 2-word data =0102 0304h.

■For 1-register length parameter

Byte order of transmission and reception	Big endian	Little endian	Special endian
1	01	02	01
2	02	01	02

■For 2-register length parameter

Byte order of transmission and reception	Big endian	Little endian	Special endian
1	01	04	03
2	02	03	04
3	03	02	01
4	04	01	02

For each endian selection Example of Holding Registry Write Query/Response

・Endian Selection When Big Endian, Little Endian, or Special Endian is set, the first deceleration time [F003]"= 3000 sec] in "2 Register Length Parameter" and the "RUN Key Operation Direction Selection [F004]"= 01 (Forward)" in "1 Register Length Data" are written in [10h]. The following are examples of queries.

Query		Endian			
No.	Field Name	Big	Little	Special	
1	Slave address	01	01	01	
2	Function code	10	10	10	
3	Register start number (upper)	11	11	11	
4	Register start number (lower)	04	04	04	
5	Number of registers (upper)	00	00	00	
6	Number of Registers (lower)	03	03	03	
7	In bytes	06	06	06	
8	Write data 1 (upper)	00	E0	93	[F003] is "2 register length parameter" and the resolution is 0.01 seconds. Therefore, write-data is 3000.00 seconds =300000d=000493E0h.
9	Write data 1 (lower)	04	93	E0	
10	Write data 2 (upper)	93	04	00	
11	Write data 2 (lower)	E0	00	04	
12	Write data 3 (upper)	00	01	00	[F004] = 0001h writing when in forward direction
13	Write data 3 (lower)	01	00	01	
14	CRC-16 (high)	EB	65	EB	
15	CRC-16 (low)	DB	B4	DD	

11.3 Modbus mapping function

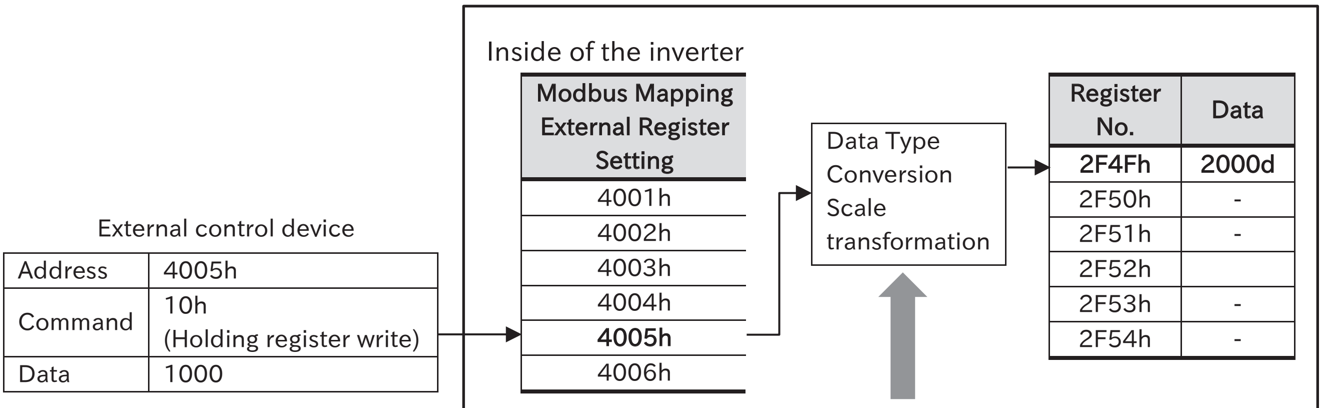
11.3.1 Set Modbus mapping function

- With Modbus mapping function, register numbers, data types, and data scales specified by communication commands from external control devices can be converted to any register numbers and data scales in HF-620 inverters. This enables replacement of the inverter without changing the communication program on the external control device side.
- The register number and data of up to 10 registers can be converted.
- If the external register number is already used as the internal register number of the inverter, Modbus mapping setting takes precedence. When accessing the internal registers of the disabled drive, perform Modbus mapping settings separately to indirectly access the registers.

Code	Item	Description	Data	Initial value
CG-01	Register mapping function selection	Register mapping function disable	00	00
		Enable Modbus Register map function enables	01	
CG-11 to CG-20	External register 1 to 10	Set the register number used in the communication program of the external control device, etc. 0000h is judged as not being set.	0000h to FFFFh	0000h
CG-31 to CG-40	External register format 1 to 10	The data type of the external register is unsigned word data.	00	00
		The data type of the external register is signed word data.	01	
CG-51 to CG-60	External register 1 to 10 scaling	Data specified from the external control device x this setting value = Inverter internal data. Writing: External data × Write this setting to the internal register Read: Internal data/Read this setting as external data	0.001 to 65.535	1.000
CG-71 to CG-80	Internal register 1 to 10	Set Modbus register number of the inverter. 0000h is judged as not being set.	0000h to FFFFh	0000h

Setting up Modbus mapping

(1) Set the register number of the external control device in "External register 1 to 10 ([CG-11] to [CG-20])". If "0000" is set, no processing is performed.
(2) Set the data type of the external control device in "External register format 1 to 10 ([CG-31] to [CG-40]."
(3) In "Scaling 1 to 10 ([CG-51] to [CG-60]), set the magnification when receiving from an external control device and loading it into the inverter. Conversely, it is divided when reading internal data.
(4) Set Modbus register number in the inverter to be actually accessed in "Internal Registers 1 to 10 ([CG-71] to [CG-80])".
Note: Refer to "18.2 List of Parameter /Modbus Holding Registers" for Modbus register number of the inverter.
(5) Set "Communication endianness selection [CF-12]" as required. For details, see section 11.2.11, Endian Selection of Holding Register.
(6) Set "Register Mapping Function Select [CG-01]" to "Enable (01)". When the parameters related to Modbus mapping function have been set or changed, be sure to turn the power OFF and then ON again. If the power is not turned on again, the settings and changes made by Modbus mapping function will not be reflected.



Mapping 1setting example

Code	Item	Setting example
CG-11	External register	4005h
CG-31	External register format	00(unsigned word)
CG-51	Scaling	2.00
CG-71	Internal register 1	2F4Fh

Note: An external register 4005h is mapped to an inverter-internal register 2F4Fh and an external data 1000d is written.
The data type of the external data is regarded as unsigned, and 2000d obtained by multiplying the scale by 2.00 is written to the internal register. (In the case of data reading, internal data is returned to the external control device at 1/2.)

Handling Modbus mapping function errors

・If there is an error in Modbus mapping setting, the exception response of the exception code below is returned. If an exception response occurs, review the external or internal register settings.

Code	Description
31h	・When the external register is set but the internal register setting is not set to "0000". ・A holding register number that does not exist in the internal address is set. ・The external register settings are duplicated.

・As shown in the figure below, if the register number already used in the inverter is set as an external register, the same register number used in the inverter cannot be accessed.

Example: When 2EEFh is set to an external register, the "1st stop method selection [AA115]" whose internal register number is 2EEFh from another external register (3000h in the following table) cannot be accessed.

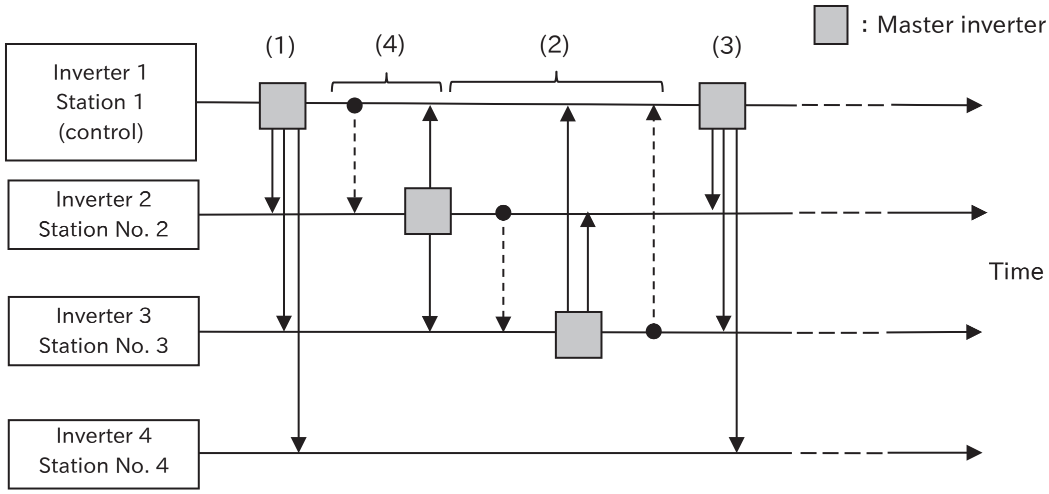
External register setting CG-11 to CG-20	Internal register setting CG-71 to CG-80
-	-
2EEFh	2EECh
-	-
-	-
3000h	2EEFh
-	-

Internal register number	Parameter	
2EEBh	AA111	RUN command input source selection, 1st-motor
2EECh	AA-12	RUN-key command rotation direction
2EEDh	AA-13	STOP-key enable
2EEEh	AA114	RUN direction restriction selection, 1st-motor
2EEFh	AA115	STOP mode selection 1st-motor
2EF5h	AA121	Control mode selection 1st-motor

11.4 Inter-inverter communication EzCOM function

11.4.1 EzCOM

- Inter-inverter communication function EzCOM is a function that uses Modbus-RTU communication to perform inter-communication between Inverters (HF--620, HF-430NEO) without external control devices such as PC and PLC.
- By issuing a notification from one inverter to another, such as changing the frequency command or changing the operation/stop status, coordinated operation between the inverters is enabled without external control devices.
- The operation of EzCOM is outlined below. (When four inverters are connected)
- During EzCOM communication, the inverters share the roles of "control inverter," "master inverter," and "slave inverter." Be sure to install the inverter of station number 1. The inverter becomes the "management inverter".
- When EzCOM communication starts, "control inverter" will gradually switch "master inverter". At this time, all other than "master inverter" are set to "slave inverter".



(1) When EzCOM communication starts, the inverter specified by the administrative inverter becomes the "master inverter". In the example above, Inverter 1 = Management Inverter = Latest master inverter.
The master inverter (inverter 1) writes its own holding register data into the holding registers of other inverters according to the setting. Up to five writes can be set.

(2) When writing of inverter 1 is completed, the master inverter switches to inverter 2. Like the master inverter 1, the master inverter (inverter 2) writes its own holding register data into the holding registers of other inverters according to the setting.

(3) When the switching of the master inverter is one cycle for all specified inverters, the inverter 1 is switched to the master inverter again.
(Up to eight master inverters can be set.)

(4) (1) to (3) is repeated.

- Like normal Modbus communication (RS485), connect the [SP]/[SN]/[L] terminals of the inverters for EzCOM communication (the [CM1] terminals of SJ series P1) respectively. (Turn ON the terminating resistors of the inverters at both ends that constitute EzCOM communication.)
- Up to eight master inverters can be set for EzCOM communication.
- Up to five writes can be set from each master inverter.
(Data can also be written to the inverter that does not become the master (inverter 4 in the example of the above figure).)

11.4.2 EzCOM setting

- In the inverter-to-inverter communication function EzCOM, each inverter connected by communication is switched to a master inverter, so that mutual communication can be performed by only multiple inverters without external control equipment such as PC and PLC.
- During EzCOM communication, the inverters share the roles of "control inverter," "master inverter," and "slave inverter." The setting items change in "Management Inverter" and other cases. Refer to the following section and set the appropriate settings for each of the inverters that make up EzCOM.

■Common setting items of inverters for EzCOM

<table>
<tr><th>Code</th><th>Item</th><th>Description</th><th>Data</th><th>Initial value</th></tr>
<tr><td>CF-01</td><td>RS485 communication baud rate selection</td><td rowspan="3">Use the same setting for the inverters for EzCOM.</td><td rowspan="3">-</td><td>05</td></tr>
<tr><td>CF-03</td><td>RS485 communication parity selection</td><td>00</td></tr>
<tr><td>CF-04</td><td>RS485 communication stop bit selection</td><td>01</td></tr>
<tr><td>CF-05</td><td>RS485 communication error selection</td><td rowspan="3">Refer to the sample EzCOM communication time chart in this section for setting.</td><td rowspan="3">-</td><td>02</td></tr>
<tr><td>CF-06</td><td>RS485 communication enable setting</td><td>2</td></tr>
<tr><td>CF-07</td><td>RS485 communication wait time setting</td><td>5</td></tr>
</table>

■Setting items of management inverter (station No.1)

<table>
<tr><th>Code</th><th>Item</th><th>Description</th><th>Data</th><th>Initial value</th></tr>
<tr><td>CF-02</td><td>RS485 communication node address</td><td>Set station No. 1 to the control inverter.</td><td>1</td><td>1</td></tr>
<tr><td>CF-08</td><td>RS485 communication mode selection</td><td>Inter-inverter communication (EzCOM) is used (control inverter).</td><td>03</td><td>01</td></tr>
<tr><td>CF-20</td><td>EzCOM start node No.</td><td>Set the start station number of the master inverter.</td><td rowspan="2">1 to 8</td><td rowspan="2">1</td></tr>
<tr><td>CF-21</td><td>EzCOM end node No.</td><td>Set the finish station number of the master inverter.</td></tr>
<tr><td rowspan="2">CF-22</td><td rowspan="2">EzCOM start method selection</td><td>Activation via the "EzCOM activation [ECOM]" inputterminal</td><td>00</td><td rowspan="2">00</td></tr>
<tr><td>Constant communication</td><td>01</td></tr>
<tr><td>CF-23 to CF-38</td><td>EzCOM Write Data-Related Parameter</td><td>The control inverter can also send data as a "master inverter." Refer to the next table "Setting items of master inverter".</td><td>-</td><td>-</td></tr>
<tr><td>CA-01 to CA-08</td><td>Input terminal function</td><td>EzCOM activation [ECOM]:
When the "[ECOM] terminal (00)" is set to [CF-22], EzCOM communication is performed when this terminal is turned ON.</td><td>098</td><td>-</td></tr>
</table>

■Setting items of master inverter (station No. 1 to 8)

<table>
<tr><th>Code</th><th>Item</th><th>Description</th><th>Data</th><th>Initial value</th></tr>
<tr><td>CF-02</td><td>RS485 communication node address</td><td>For the station number setting of the master inverter for EzCOM communication, set the station number set in [CF-20] to [CF-21] of the control inverter.</td><td>1 to 247</td><td>1</td></tr>
<tr><td>CF-08</td><td>RS485 communication mode selection</td><td>Use inter-inverter communication (EzCOM)</td><td>02</td><td>01</td></tr>
<tr><td>CF-23</td><td>EzCOM number of data</td><td>Sets the number of writes to the holding register.</td><td>1 to 5</td><td>5</td></tr>
<tr><td>CF-24</td><td>EzCOM destination address 1</td><td rowspan="4">Set the station number and holding register number of the station to write data to, and the holding register number of the write data of the own station. Maximum 5 sets can be set.
Note: In the destination register and the source register, specify a register address of-1 from the register number.</td><td>1 to 247</td><td>1</td></tr>
<tr><td>CF-25</td><td>EzCOM destination register 1</td><td rowspan="2">0000h to FFFFh</td><td rowspan="2">0000h</td></tr>
<tr><td>CF-26</td><td>EzCOM source register 1</td></tr>
<tr><td>CF-27</td><td>EzCOM destination address 2</td><td>1 to 247</td><td>2</td></tr>
</table>

Code	Item	Description	Data	Initial value
CF-28	EzCOM destination register 2	Set the station number and holding register number of the station to write data to, and the holding register number of the write data of the own station. Maximum 5 sets can be set. Note: In the destination register and the source register, specify a register address of-1 from the register number.	0000h to FFFFh	0000h
CF-29	EzCOM source register 2			
CF-30	EzCOM destination address 3		1 to 247	3
CF-31	EzCOM destination register 3		0000h to FFFFh	0000h
CF-32	EzCOM source register 3			
CF-33	EzCOM destination address 4		1 to 247	4
CF-34	EzCOM destination register 4		0000h to FFFFh	0000h
CF-35	EzCOM source register 4			
CF-36	EzCOM destination address 5		1 to 247	5
CF-37	EzCOM destination register 5		0000h to FFFFh	0000h
CF-38	EzCOM source register 5			

EzCOM communication settings

1. Common setting of inverters for EzCOM communication

(1) Set Modbus communication settings ([CF-01], [CF-03], and [CF-04]) of the inverters to the same setting.

(2) Set [CF-05], [CF-06], and [CF-07] by referring to EzCOM communication time chart and notes in this section.

2. Setting of management inverter (station No.1)

(3) To perform EzCOM communication, set "Communication station No. selection [CF-02]" to (1), and provide an inverter with "Inter-inverter communication (EzCOM control) (03)" set to "Communication method selection [CF-08]". This inverter becomes "management inverter".

(4) Set the first and last station numbers of the inverter to be operated as a "master inverter" to "EzCOM starting INV station No. [CF-20]" and "EzCOM ending INV station No. [CF-21]", respectively. Also, set it so that [CF-20] ≦ [CF-21] is set.
(In EzCOM communication time chart, [CF-20]=01, [CF-21]=04.)

(5) EzCOM communication start timing can be selected in "EzCOM start selection [CF-22]". When "Continuous communication (01)" is set, "Management inverter" starts EzCOM communication as soon as the power is turned on. If the power-on of another inverter is delayed, communication time-out occurs in "control inverter", so please ensure that the start-up timing of the other inverter comes first so that it does not happen. When the "[ECOM] terminal (00)" is set, EzCOM communication starts when the "EzCOM start [ECOM]" inputterminal is turned ON.

3. Setting of master inverter and slave inverter

(6) For the inverter that becomes the "master inverter", it is necessary to set a continuous station number out of 1 to 8. Set the station number set in [CF-20] to [CF-21] of the "control inverter" in order in the "communication station number selection [CF-02]" of the inverter which becomes the "master inverter". The station No. of the inverter that does not become the "master inverter" should be a station No. other than [CF-20] to [CF-21] of the "control inverter".

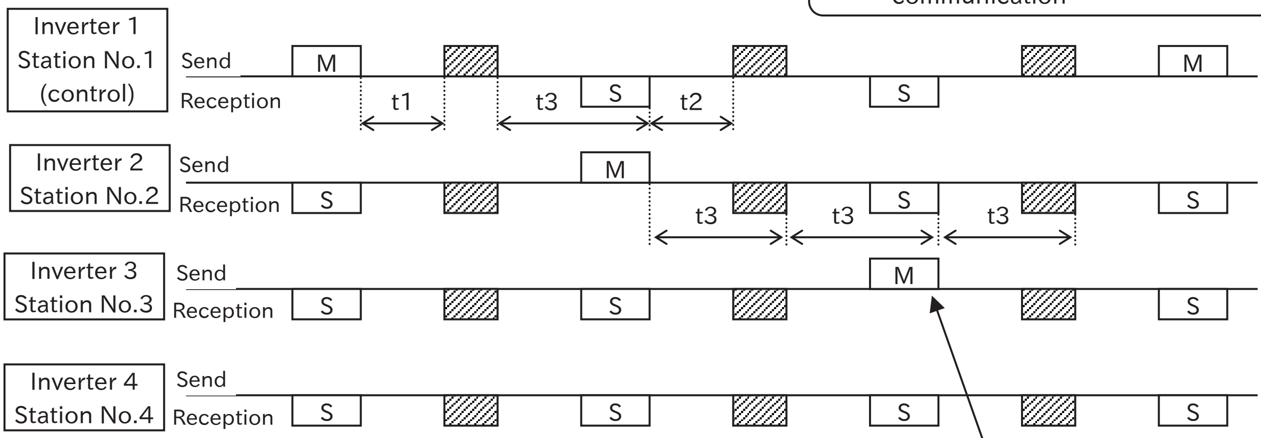
(7) Set "Inter-inverter communication (EzCOM) (02)" to "Communication method selection [CF-08]" of all the inverters participating in EzCOM communication, except for "Management Inverter".

(8) Set the data-information ([CF-23] to [CF-38]) to be written from the master inverter to the slave inverter for each of "master inverter".

■Sample EzCOM communication time chart

- EzCOM communication is configured with 4 node addresses 1 to 4.
- Station numbers 1 to 3 become the master inverter.
- Station No. 4 is a slave only and does not become a master inverter.

M Master data write communication
Master switching instruction
S Receive data in slave of write communication



t1: Silent interval + "Communication wait time [CF-07]"
t2: Silent interval + "Communication wait time [CF-07]"
t3: "Communication time-out time [CF-06]"

Station No.	Register	Data
02	××××	××××
02	××××	××××
03	××××	××××
03	××××	××××
04	××××	××××

Up to five data writes can be specified.

- The master switching command is sent from the management inverter at the timing shown below.
  - When the control inverter is the master inverter, after t1 shown in the figure above has elapsed since data write communication was completed.
  - When the control inverter is a slave inverter, after a lapse of t2 shown in the above figure after completion of receiving data transmission communication.
- If data reception cannot be completed within the "Communication timeout time [CF-06]" setting time, the timeout will be calculated from the start of reception wait (in t3 above). The operation at that time follows "Communication error selection [CF-05]".
- If a setting other than "ignore (02)" is set to [CF-05] in the management inverter, communication between the inverters will be stopped when a communication time-out occurs in the management inverter. In this case, turn on the power supply of the control inverter again.
- Be sure to set the [CF-06] of the control inverter to a value other than 0.00 (recommended 1 second or longer). If 0.00 is set, EzCOM function will be stopped if data cannot be received from the master inverter due to timeout. If it stops, turn the power supply of the control inverter OFF and then ON again, or reset it using the "Reset [RST]" inputterminal.
- Do not set 2327h (enter command (2328h-1)) and 2329h (1 register write mode (232Ah-1)) in the destination register.
- In data write communication by the master inverter, the destination slave station number is set, but it is actually transmitted to all stations by broadcast communication. A slave that is not specified as a transmission destination on the master side will receive data once, but the received data will be discarded internally.

Chapter 12 PC Software

12

This chapter describes an outline of the "Inverter configuration software "SAFS001" as well as parameter descriptions of the Inverter. (Supported language: Japanese)
Before conducting a test run, please read "Chapter 1 Safety Instructions/Risks" carefully and pay attention to safety.

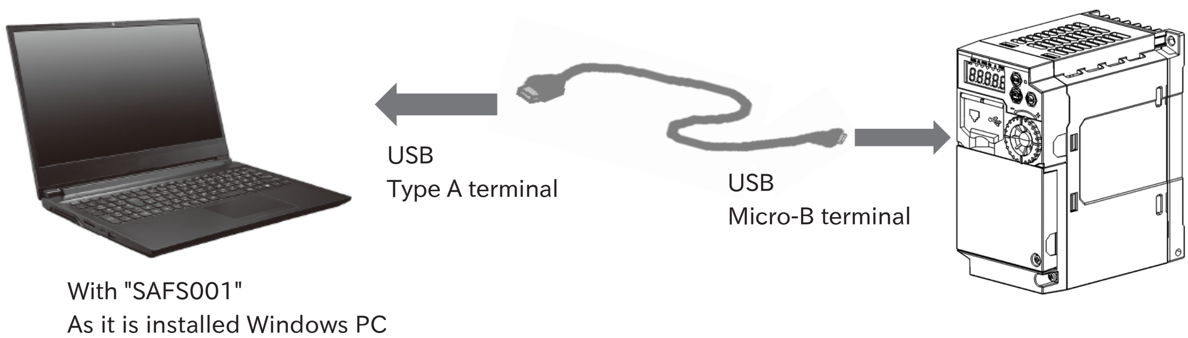
12.1 PC software

・In the inverter setting software "SAFS001", parameter setting and management of the inverter, graph-display of the monitor data, are performed. The main functions are listed below.

Item	Description
Operation Screen	Sets the frequency command and starts/stops operation. The state of the intelligent terminal can also be checked.
Parameters set function	Various parameter settings can be made, such as setting parameters individually and searching for changed parameters from the factory default settings. Parameters can be saved and read in CSV format.
Monitor function	The specified monitor data can be displayed in a table format or in a graph format with the horizontal axis as the time. Monitor data can be saved and read in PMG format or CSV format file.
Tracing function	Parameters and triggers can be set to graph the data when the trigger is activated. The recorded trace data can be saved and read in a CSV format file.

・Refer to the Inverter Setting Software "SAFS001" Manual for detailed information about "SAFS001" functions.
・The most recent version of「SAFS001」, and the User's Manual can be downloaded from our website.
https://japan.sumitomodrive.com/en-jp
(Note that member registration is required in advance for downloading.)

Connecting PC and Inverter



12.2 Trace function

12.2.1 Trace function data logging

・The trace function is used to acquire and accumulate the inverter monitor data under the set conditions.

・The accumulated data (trace accumulated data) can be uploaded to PC using "SAFS001" for graphing and saving.

・When using the tracing function, refer to the Inverter Setting Software "SAFS001" Manual (No. DM2505E) for more information.

■Specifications

Item	Description
Number of trace data	Monitor data: Up to 8 data I/O signal: Up to 8 signals (selected from Input/Output terminal functions)
Trace accumulated data size	8 Kbytes
Sampling time (cycle)	Select from 0.2, 0.5, 1, 2, 5, 10, 50, 100, 500, 1000 ms
Number of sampling points	It varies depending on the number of trace data, the number of signals, and the data size of the parameter to be traced. 953 points for ex. "Number of traced data: 4, Number of signals: 1, Data size: all 2 bytes"
Trace start methods	Parameter setting, input terminal function "Data tracing start signal [DTR]"
Trigger condition	・2 conditions (4 conditions in combination) settable ・Select from trip and trace data (monitor data and signal) ・Trigger level and trigger point can be set.
Other	・Output pin function "Tracing function trigger wait signal[WFT]" ・Output pin function "Tracing function tracing in progress signal[TRA]" ・Graphing and saving of accumulated data by "SAFS001"

■Flow up to execute of tracing function

No.	Description	Remarks
1	Enable the tracing function. "Tracing function selection [Ud-01]" = "Enable (01)"	『12.3.2 Refer to "Trace function related parameters".
2	Set the monitor data count and I/O signal count to be traced. 「Number of trace data setting [Ud-03]」「Number of trace signals setting [Ud-04]」	
3	Select the parameter code of the monitor data to be traced. "Tracing data selection ([Ud-10] to [Ud-17])"	
4	Selects whether the traced I/O is an input-pin or an output-pin function. "Trace signal I/O selection ([Ud-20], [Ud-23], [Ud-26], [Ud-29], [Ud-32], [Ud-35], [Ud-38], [Ud-41])」	
5	Selects I/O (I/O pin function) to be traced. Input: "Trace signal input pin selection" ([Ud-21], [Ud-24], [Ud-27], [Ud-30], [Ud-33], [Ud-36], [Ud-39], [Ud-42])」 Output: "Trace signal output pin selection" ([Ud-22], [Ud-25], [Ud-28], [Ud-31], [Ud-34], [Ud-37], [Ud-40], [Ud-43])」	
6	Select and set the trigger condition. Trace trigger selection ([Ud-50], [Ud-54]) "Trigger action selection at trace data trigger ([Ud-51], [Ud-55])" "Trigger level at trace data trigger ([Ud-52], [Ud-56])" "Trigger Operation Selection at Tracing Signal Triggering ([Ud-53], [Ud-57])" 「Trigger condition selection [Ud-58]」	
7	Select the sampling time (cycle).「Sampling time setting [Ud-60]」	
8	Start tracing. "Tracing start [Ud-02]" = "Start (01)" (Tracing can also be started from the input terminal function "Data tracing start [DTR]" or "SAFS001".)	
9	When tracing is completed, the trace stop status Note;1,2 is entered, and [Ud-02] is automatically changed to "Stop (00)".	
10	Use "SAFS001" to read, graph, and save trace accumulated data.	"SAFS001"is required.

Note: 1. When the inverter power supply is cut off, the trace accumulation data is erased.

2. Do not stop during tracing because tracing may not be performed normally.

12.2.2 Trace function related parameters

・When using the tracing function, refer to the Inverter Setting Software "SAFS001" Manual for more information.

Code	Item	Description	Data	Initial value
Ud-01	Trace function enable	Disable	00	00
		Enable	01	
Ud-02	Trace start	Stop tracing.	00	00
		Starts tracing and waits for a trigger.	01	
Ud-03	Number of trace data setting	Select the number of data to trace.	0 to 8	1
Ud-04	Number of trace signals setting	Selects how many I/O are traced.	0 to 8	1
Ud-10 to Ud-17	Trace data 0 to 7 selection	Select the monitor parameter to be traced.	Reference trace object data	dA-01
Ud-20, Ud-23 Ud-26, Ud-29 Ud-32, Ud-35 Ud-38, Ud-41	Trace signal 0 to 7 I/O selection	Input pins are tracing targets. When "Input (00)" is selected, the following parameters are valid. [Ud-21], [Ud-24], [Ud-27], [Ud-30] [Ud-33], [Ud-36], [Ud-39], [Ud-42]	00	00
		The output terminal is the tracing target. When "Output (01)" is selected, the following parameters are valid. [Ud-22], [Ud-25], [Ud-28], [Ud-31] [Ud-34], [Ud-37], [Ud-40], [Ud-43]	01	
Ud-21, Ud-24 Ud-27, Ud-30 Ud-33, Ud-36 Ud-39, Ud-42	Trace signal 0 to 7 input pin function selection	Set the input pin function to be traced.	『18.2.6 "List of Multi-function Input Pin Functions".	001
Ud-22, Ud-25 Ud-28, Ud-31 Ud-34, Ud-37 Ud-40, Ud-43	Trace signal 0 to 7 output pin function selection	Set the output pin functions to be traced.	『18.2.7"List of Multi-function Output Pin Functions".	001
Ud-50 Ud-54	Trace trigger 1/2 selection acceptance	Trip generation is triggered.	00	00
		Triggers trace data.	01 to 08	
		Trigger the trace signal.	09 to 16	
Ud-51 Ud-55	Trigger 1/2 motion production selection at trace data trigger	When "Trace data (01 to 08)" is selected for [Ud-50]/[Ud-54], the trace data is recorded when a rising trigger is detected.	00	00
		When "Trace data (01 to 08)" is selected for [Ud-50]/[Ud-54], the trace data is recorded when a falling trigger is detected.	01	
Ud-52 Ud-56	Trigger 1/2 bell setting at trace data trigger	When "Tracing data (01 to 08)" is selected for [Ud-50]/[Ud-54], adjust the trigger level with the max. value of each selected monitor parameter set to 100%.	0 to 100 %	0
Ud-53 Ud-57	At trace signal trigger Trigger 1/2 action selection	When "Trace signal (09 to 16)" is selected for [Ud-50]/[Ud-54], trace data is recorded with the signal ON.	00	
		When "Trace signal (09 to 16)" is selected for [Ud-50]/[Ud-54], trace data is recorded with the signal OFF.	01	

Code	Item	Description	Data	Initial value
Ud-58	Trigger condition selection	Trace data is recorded when trace trigger 1 is met.	00	00
		Trace data is recorded when trace trigger 2 is met.	01	
		Recording when either of trigger 1 or trigger 2 is satisfied.	02	
		Recording when both trigger 1 and trigger 2 are met.	03	
Ud-59	Trigger point setting	Determine the trigger point for tracing data recording.	0 to 100 %	0
Ud-60	Sampling time setting	Get at the set interval. 02 (0.5ms), 03 (1ms), 04 (2ms), 05 (5ms) 06 (10ms) 07 (50ms), 08 (100ms), 09 (500ms), 10 (1,000ms)	02 to 10	03
CA-01 to CA-08	Input terminal function	Data tracing start signal[DTR]: [DTR] When the input terminal becomes ON, data tracing starts regardless of the trigger setting.	108	-
CC-01 to CC-07	Output terminal function	Tracing function trigger wait signal[WFT]: When the tracing function is enabled and the unit is in the trigger wait status, this signal is turned ON.	078	-
		Trace function data logging When data tracing is started and operating, this signal is turned ON.	079	

■Data to be traced

・Set the monitor parameters below to "Tracing data 0 to 7 selection ([Ud-10] to [Ud-17])".

Code	Item	Size of the data (bytes)	Code	Item	Size of the data (bytes)
dA-01	Output frequency monitor	4	db-36	PID2 feedback value monitor	4
dA-02	Output current monitor	2	db-42	PID1 target value monitor (after calculation)	4
dA-04	Frequency reference (after calculation) (signed)	4	db-44	PID1 feedback data monitor (after calculation)	4
dA-08	Detect speed monitor	4	db-50	PID1 output monitor	2
dA-12	Output frequency monitor (signed)	4	db-51	PID1 deviation monitor	2
dA-14	Frequency upper limit monitor	4	db-52	PID1 Deviation 1 Monitor	2
dA-15	Torque reference monitor (after calculation)	2	db-53	PID1 deviation-2 monitor	2
dA-16	Torque limit monitor	2	db-54	PID1 deviation-3 monitor	2
dA-17	Output torque monitor	4	db-55	PID2 output monitor	2
dA-30	Input power monitor	2	db-56	PID2 deviation monitor	2
dA-34	Output power monitor	2	db-64	PID feed-forward input source monitor	4
dA-40	DC bus voltage monitor	2	dC-15	Cooling fin temperature monitor	2
dA-41	DBTR load ratio monitor	2	FA-01	Main speed reference setting (monitor)	4
dA-42	Electronic thermal load factor monitor (Motor)	2	FA-02	Sub speed reference setting (monitor)	4
dA-43	Electronic thermal load factor monitor (Inverter)	2	FA-15	Torque reference setting (monitor)	2
dA-61	Analog input [VRF] monitor	2	FA-16	Torque bias setting (monitor)	2
dA-62	Analog input [IRF] monitor	2	FA-30	PID1 target setpoint 1 setting (monitor)	4
dA-70	Pulse input monitor	2	FA-32	PID1 target setpoint 2 setting (monitor)	4
db-30	PID1 feedback value 1 monitor	4	FA-34	PID1 setpoint 3 setting (monitor)	4
db-32	PID1 feedback value 2 monitor	4	FA-36	PID2 target setpoint (monitor)	4
db-34	PID1 feedback value 3 monitor	4			

■Time of trace data

・The time of trace data depends on the "number of trace data [Ud-03]", "number of trace signals [Ud-04]", "sampling time setting [Ud-60]" and the data size of the monitor parameter to be traced.

Ud-03	Tracing data times Note			
	Ud-60: 01 (0.2ms) (Min.)		Ud-60: 10 (1,000ms) (Min.)	
	For all 4 bytes	For all 2 bytes	For all 4 bytes	For all 2 bytes
1	344ms (1,724 point)	576ms (2,880 point)	1,724s (1,724 point)	2,880s (2,880 point)
2	190ms (953 point)	344ms (1,724 point)	953s (953 point)	1,724s (1,724 point)
3	131ms (656 point)	245ms (1,228 point)	656s (656 point)	1,228s (1,228 point)
4	100ms (500 point)	190ms (953 point)	500s (500 point)	953s (953 point)
5	80ms (402 point)	155ms (778 point)	402s (402 point)	778s (778 point)
6	67ms (336 point)	131ms (656 point)	336s (336 point)	656s (656 point)
7	57ms (288 point)	113ms (568 point)	288s (288 point)	568s (568 point)
8	50ms (252 point)	100ms (500 point)	252s (252 point)	500s (500 point)

Note: When "Tracing signal count selection [Ud-04]" is other than 0.
(**** point) indicates the number of sampling points.

Chapter 13 Communication Option

13

This chapter describes the precautions for using the communication options.
For details on using the communication options, refer to the manuals for the respective communication options.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters, and pay attention to safety.

13.1 Communication option

13.1.1 Communication option unit

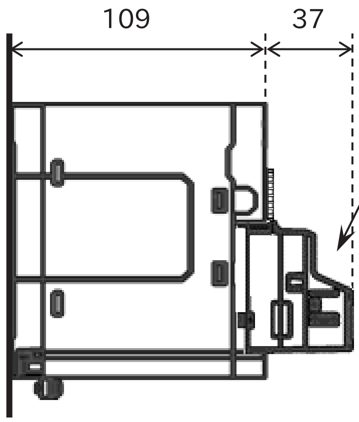
・The following communication option are available on HF-620.
・For details on how to install the communication option unit, refer to manual.

Product Name	Content
C1-CCL-H	CC-Link communication unit

■ Notes on depth dimensions

・When mounting an option unit on a HF-620, the depth dimensions change as shown below.

(e.g.) HF6202-A20 (three-phase 200V class 0.2kW)



Chapter 14 Safety Function STO

14

This chapter describes the safety function STO (Safe Torque Off) defined in the functional safety IEC61800-5-2.
For further information on functional safety, refer to the separate "Safety Function Guide (No. DM2503E)".
For details of the installation, wiring, and the various functions of the inverter, refer to the corresponding chapters.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

14.1 Using the safety function STO (Safe Torque Off)

14.1.1 STO function

・The HF-620 is equipped with the STO (Safe Torque Off) function defined in IEC61800-5-2. This function is equivalent to stop category 0 defined in IEC60204-1.
・STO function is enabled by turning on the HF-620 and starting the inverter. Special operations such as switches are not required.

Standard	Remarks
EN ISO 13849-1	CAT. 3, PL e
IEC61800-5-2 EN61800-5-2	SIL 3
UL1998	Diagnostic software class 1
IEC 60204-1	Stop Cat. 0

⚠ ・This guide explains only the outline of the STO function. When this product is handled as a functional safety certified product, be sure to check the separate "Safety Function Guide (No. DM2503E)" and implement the items required as a functional safety system (verification, validation, etc.).
The information given in safety function guide takes precedence.

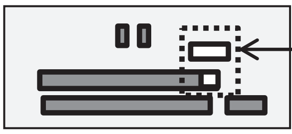
Wiring and operation procedure of safety function

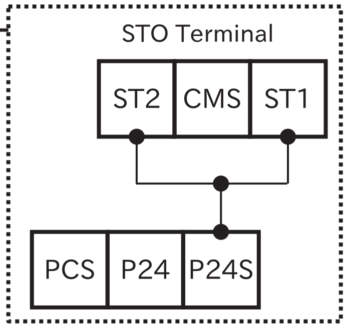
- Input of STO signal is performed by redundant input of STO input terminals [ST1] and [ST2]. When voltage is applied to each input terminal and current flows, operation of safety path is enabled. (When shipped from the factory, operation is always enabled.)
- The voltage for inputting STO signal can be selected from the inverter's internal power supply ([P24S] terminal) or an external +24V power supply.
- STO function is enabled and the output to the motor is shut off by turning OFF either of the external switches for STO signal input as shown in the wiring diagram on the next page.

Symbol	Name	Description	Electrical characteristics
P24S	+24V output power supply terminal (STO dedicated terminal)	+ 24V power supply dedicated for [ST1]/[ST2] input. Not used when the STO input voltage is supplied from an external power supply.	Maximum output current: 100mA
CMS	Common for +24V output power supply terminal (STO dedicated terminal)	Common terminal for [P24S].	
[ST1]/[ST2]	STO input terminal Note	Input terminal for STO signal.	[ST1]/[ST2] – [CMS] voltage: ON voltage Min. 15V OFF voltage Max. 5V Max. allowable voltage 27V Load current 5.8mA (at 27V) Internal resistance : 4.7kΩ
UPF	Output terminal [UPF]	When EDM switch is turned ON, output terminal [UPF] becomes "STO state monitor output [EDM]".	Open collector output ([UPF] to [OM]) Max. allowable voltage: 27V Max. allowable current: 50mA Voltage drop when turned on: 4V or less
OM	Common for output terminal	Common terminal for output terminal [UPF].	

Note: Corresponding to "Digital input type 1" defined in IEC61131-2.

Control circuit terminal

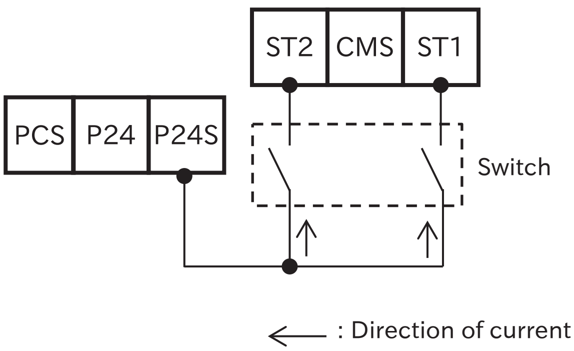




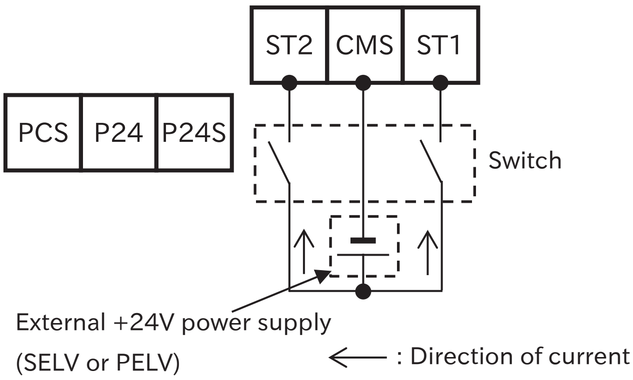
Connection of STO input terminal

- STO function is disabled by the short-circuit wire when shipped from the factory.
- Always activate the STO function using both STO inputs ([ST1]/[ST2]).

■When using internal power supply



■When using external power supply



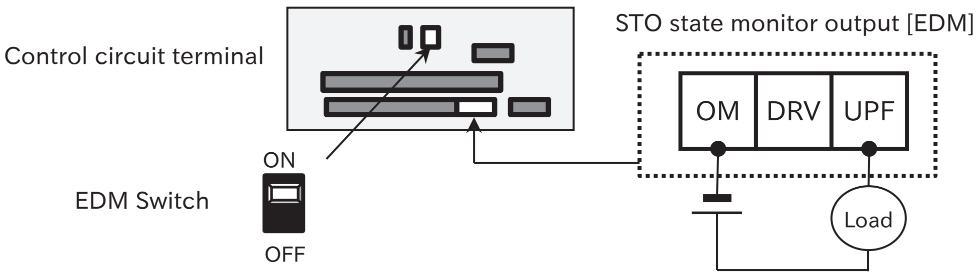
STO Status Retention Function (not supported as the safety function)

- The retention function that retains the STO status of internal safety path even if STO input is canceled is not implemented as a safety circuit. Therefore, if a RUN command is given after cancellation of STO input or STO input is canceled while the command is given, the inverter starts output to the motor.
- Hence, to satisfy the requirements about cancellation of emergency stop specified in IEC60204-1, either of the following measures has to be taken.
  - (1) At the same time as STO input, set the RUN command to the inverter to stopped status.
  - (2) Configure the system so that STO input to HF-620 is canceled when system reboot is required by the user.

> ⚠ · By parameter settings, display of the keypad depending on ON/OFF status of [ST1]/[ST2] terminals, the error display at trip, etc. can be selected. For details, refer to "14.1.3 STO Status Indication".

14.1.2 STO state monitor output (EDM signal)

- When using STO state monitor output (EDM signal), turn ON EDM switch near the control circuit terminal. "Output terminal [UPF] function [CC-01]" is automatically changed to "STO state monitor output [EDM](096)". At the same time, "Output terminal [UPF] active state [CC-11]" become "Normally Open (00)".
- "STO state monitor output [EDM]" is the output signal for monitoring the input status of STO signal and failure detection status on the internal safety path. It is not permitted to activate the safety function using this signal.



Code	Name	Description	Data	Initial value
CC-01 CC-02 CC-07	Output terminal function	STO state monitor output [EDM] : Monitors the input status of STO signals and the fault output status on the internal safety path.	096	002 001 017

- For operation of [ST1]/[ST2] terminals and [EDM] signal against failure detection status, refer to the matrix below. [EDM] signal turns ON only when both STO inputs are correctly input, and internal failure is not detected.

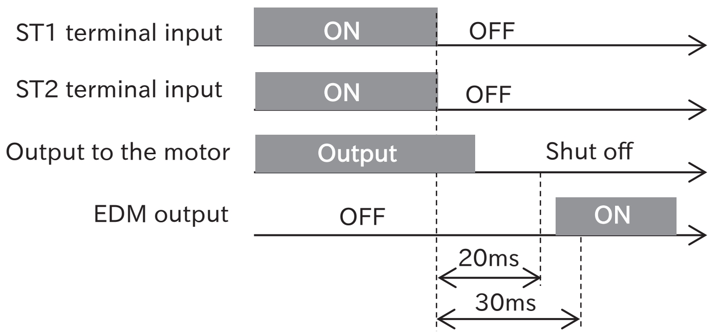
Signal	Status 1	Status 2	Status 3	Status 4	Status 5
[ST1] terminal Note	STO	Operation permitted	STO	Operation permitted	STO or Operation permitted
[ST2] terminal Note	STO	STO	Operation permitted	Operation permitted	STO or Operation permitted
Failure detection	None	None	None	None	Detected
[EDM] signal	ON	OFF	OFF	OFF	OFF
Output to the motor	OFF	OFF	OFF	Operation permitted	OFF

Note: [ST1]/[ST2] terminal input state and contact state: Operation permitted = Contact ON, STO = Contact OFF

・The operation of the safety function STO input terminals [ST1]/[ST2] and the output terminal [UPF] when the EDM switch is ON can be checked with the "Safety STO terminal monitor [dA-44]". For details, refer to "14.1.3 Changing Status Display/Error Indication by Settings".
・When EDM switch is turned OFF from ON, "Output terminal [UPF] function [CC-01]" is automatically changed to "Not use [no]".

■STO Timing Chart

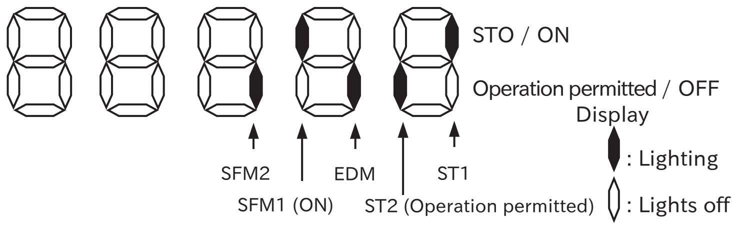
・The timing chart of the output to the motor and [EDM] signal for STO input terminals [ST1]/[ST2] is shown below. The output to the motor is shut off within 20ms after [ST1] and [ST2] are turned off.



14.1.3 STO status indication

- The indication of the keypad according to [ST1]/[ST2] input status or errors can be changed by "STO input display selection [bd-01]" setting.
- The function shown below is a referenced signal to monitor the input status of STO signal and the failure detection status of the internal safety path. It is not permitted to activate the safety function using this signal.

■STO related monitor

Code	Name	Description	Data
dA-44	Safety STO terminal monitor	The 7-segment LED on the keypad indicates the input status of the [ST1]/[ST2] terminals and the ON/OFF status of the output terminal functions [EDM]/[SFM1]/[SFM2]. (e.g.) [ST1] terminal: STO [SFM1] output: ON [ST2] terminal: Operation permitted [EDM], [SFM2] output: OFF 	-
dA-45	Safety STO monitor	Displays the input status of the STO terminal input.For details, refer to the table in this section "Safety STO monitor [dA-45]" and status indication the keypad".	-

■STO related parameter

Code	Name	Description	Data	Initial value
bd-01	STO input display selection	Warning (display): When input of both [ST1] and [ST2] is STO (input contact point is OFF), "StO" is shown on the keypad.	00	01
		Warning (without display): When input of both [ST1] and [ST2] is STO (input contact point is OFF), any warnings are not shown on the keypad.	01	
		Trip: When input of both [ST1] and [ST2] is STO (input contact point is OFF), "STO shut off error [E090]" occurs. Note: Even if either [ST1] or [ST2] is STO, [E090] error does not occur.	02	
bd-02	STO input change time (release)	Set the allowable time for which input status when either [ST1] or [ST2] is released from STO is different. (e.g.: [ST1]=ON, [ST2]=OFF) When there is a difference between the switching time of [ST1] and [ST2], set the time that the system can allow the difference. When it is set to 0.00, the determination of allowable change time becomes invalid.	0.00 to 60.00 s	0.01

Code	Name	Description	Data	Initial value
bd-03	Display selection during STO input change time	Warning (display): Displays a warning during [bd-02]/[bd-05] after the difference between the states of [ST1] and [ST2] occurs.	00	01
		Warning (without display): Does not display a warning during [bd-02]/[bd-05] after the difference between the states of [ST1] and [ST2] occurs.	01	
bd-04	Action selection after STO input change time	Maintain current status: When the allowable time set in [bd-02]/[bd-05] is exceeded after the difference between the states of [ST1] and [ST2] occurs, display a warning.	00	00
		Disable: When the allowable time set in [bd-02]/[bd-05] is exceeded after the difference between the states of [ST1] and [ST2] occurs, does not display a warning.	01	
		Trip: When the allowable time set in [bd-02]/[bd-05] is exceeded after the difference between the states of [ST1] and [ST2] occurs, "STO path 1 error [E092]" or "STO path 2 error [E093]" occurs.	02	
bd-05	STO input change time (shutoff)	[Set the allowable time for which input status when either [ST1] or [ST2] is shutted off from operation permission state is different. (e.g.: [ST1]=OFF, [ST2]=ON) When there is a difference between the switching time of [ST1] and [ST2], set the time that the system can allow the difference. When it is set to 0.00, the determination of allowable change time becomes invalid.	0.00 to 60.00 s	0.01
bd-06	Warning release mode selection	Keep warning display	00	00
		Release warning display	01	
bd-07	Warning release mode selection	Set the time displayed a waring again after release a warning.	1 to 30 s	30
CC-01 CC-02 CC-07	Output terminal funciton	STO input discrepancy [FSC]: When the input states of [ST1]/[ST2] does not match, [FSC] signal is turned off.	088 Note	002 001 017
		ST1 feedback monitor [SFM1]: The input state of [ST1] terminal can be checked with [SFM1] signal. When [ST1] terminal is turned on, [SFM1] signal also turn on. When [ST1] terminal is turned off, [SFM1] signal also turn off.	094 Note	
		ST2 feedback monitor [SFM2]: The input state of [ST2] terminal can be checked with [SFM2] signal. When [ST2] terminal is turned on, [SFM2] signal also turn on. When [ST2] terminal is turned off, [SFM2] signal also turn off.	095 Note	

Note: For details of functions, refer to the separate "Safety Function Guide (No. DM2503E)".

■"Safety STO monitor [dA-45]" and status indication the keypad

dA-45 Note:1	Keypad status display Note:1	Condition Note:2	Description
00	(No indication)	<1>	Both [ST1] and [ST2] are operation permission state (contact point is ON) and inverter output is available.
01	P-1A	<2>	When both [ST1] and [ST2] are operation permission state (contact point is ON), only [ST2] changes to STO state (contact point is OFF). Then, [ST1] remains operation permission state during "STO input change time (shutoff) [bd-05]".
02	P-2A	<3>	When both [ST1] and [ST2] are operation permission state (contact point is ON), only [ST1] changes to STO state (contact point is OFF). Then, [ST2] remains operation permission state during "STO input change time (shutoff) [bd-05]".
03	P-1b	<5>	(1) This status is displayed when "P-1C" or "P-1A" status is continue for the time set in "STO input change time [bd-02]/[bd-05]". (2) When both [ST1] and [ST2] are "Operation permitted" state (contact point is ON), only [ST2] changes to STO state (contact point is OFF). Then [ST2] is operation permission state (contact point is ON) again.
04	P-2b	<6>	(1) This status is displayed in the P-2C or P-2A status after "STO input change time [bd-02]/[bd-05]". (2) When both [ST1] and [ST2] are operation permission state (contact point is ON), only [ST1] changes to STO state (contact point is OFF). Then [ST1] operation permission state (contact point is ON) again.
05	P-1C	<7>	From the status that both [ST1] and [ST2] is STO state (contact point is OFF), only [ST2] changes to operation permission state (contact point is ON). Then, [ST1] remains STO state (contact point is OFF) during "STO input change time (release) [bd-02]".
06	P-2C	<8>	From the status that both [ST1] and [ST2] is STO state (contact point is OFF), only [ST1] changes to operation permission state (contact point is ON). Then, [ST2] remains STO state (contact point is OFF) during "STO input change time (release) [bd-02]".
07	STO	<4>	Both [ST1] and [ST2] are "STO" state (contact point is OFF).

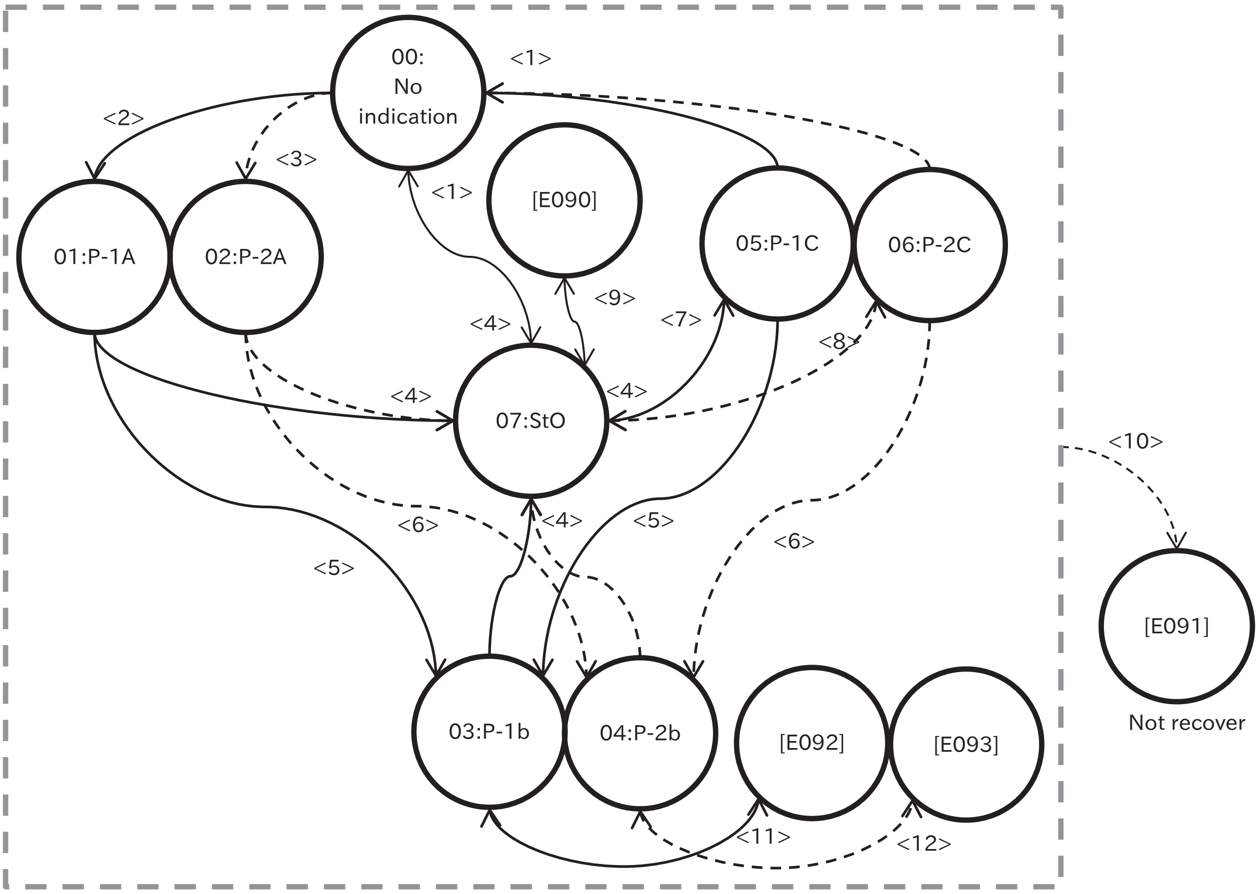
Note: 1. "Safety STO monitor [dA-45]" and status indication of keypad can be displayed or hidden by the parameter settings of [bd-01], [bd-03], and [bd-04].
2. For details, refer to the figure in this section "State transition diagram".

■STO rerated error

Error code	Name	Condition Note	Description
E090	STO shut off error	<9>	When "STO input display selection [bd-01]" is set to "Trip (02)", the error occurs when both [ST1] and [ST2] terminals become STO state.
E091	STO internal error]	<10>	The error occurs when internal failure is found. It cannot be canceled by reset operation.
E092	STO path 1 error	<11>	When "Action selection after STO input change time [bd-04]" is set to "Trip (02)", the error occurs when the inverter state is changed to "P-1b".
E093	STO path 2 error	<12>	When "Action selection after STO input change time [bd-04]" is set to "Trip (02)", the error occurs when the inverter state is changed to "P-2b".

Note: For details, refer to the figure in this section "State transition diagram".

■State transition diagram



Chapter 15 Troubleshooting

15

This chapter describes errors caused by the protection function, warnings caused by the warning function, and troubleshooting when something is wrong.
Read this chapter first when the inverter does not operate as intended or a problem occurred.
Address these issues according to the circumstances by referring to the next and subsequent sections.

15.1 Self-diagnosis of problems

15.1.1 Procedure for checking when a problem occurs

・If a trip, warning, or trip has not occurred, but the display is different from the normal display, or if it does not operate as intended, follow the procedure below to perform troubleshooting.

Descriptions of the trouble	References
✔ When a trip occurs and an error such as "E001" is displayed on the control panel. ✔ When a trip occurs and the inverter restarts.	『15.2 See "Troubleshooting Protection Features" to resolve the cause.
✔ When a warning occurs and a warning such as "102" is displayed on the operation panel.	『15.3.1 Refer to "Warning indication" and eliminate the cause.
✔ When an unusual display or unusual content is displayed on the control panel.	『15.3.2 Refer to "Other indications" and eliminate the cause.
✔ If it does not work well as the above-mentioned trip, warning, other indications, etc. as follows. "Some parameters are not displayed" "Cannot be set" "Operation does not start even if operation or frequency command is input" "Operation is possible, but frequency does not increase" "The motor vibrates and distorts"•••••etc.	『15.4 See "When you think something is wrong" to solve the cause.

If the above does not solve the problem !

・Consult the retailer from whom the watch was purchased or our sales.
・When making an inquiry, please contact us after confirming the following items.
(1) Inverter model
(2) Serial number (MFG No.)
(3) Time of purchase
(4) Descriptions of inquiries

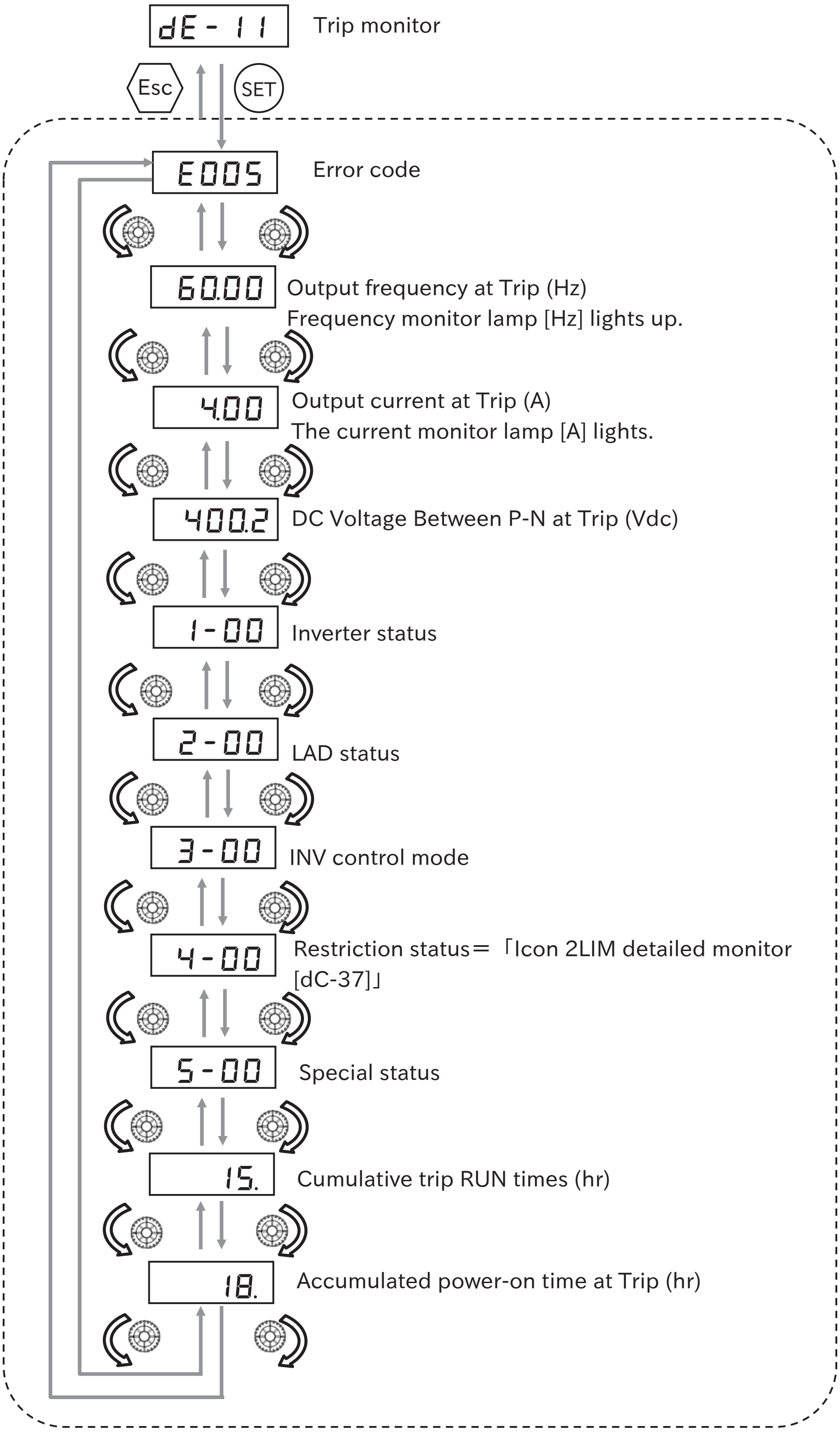
15.2 Troubleshooting protection functions

15.2.1 Check the trip information

- The inverter trip history can be displayed up to the last 10 times.
- "Trip Monitor ([dE-11] to [dE-20])" allows you to refer to the error code and detailed information such as the output frequency at trip, output current, DC voltage between P-N, and inverter status. In addition, the latest trip history is displayed in "Trip Monitor 1 [dE-11]".
- Refer to the table below for the trip status (inverter status, LAD status, INV control mode, restriction status (="Icon 2LIM detailed monitor [dC-37]"), and special status).
- Release the trip (reset) by pressing the (a) STOP/RESET key. (b) ON→OFF the "Reset [RS] input terminal assigned to the input terminal. (c) Turn the power OFF and ON again. (Some error causes cannot be reset by (a) or (b). For details, refer to the remedy for each error.)

Code	Item	Description	Data
-	Inverter status	Displays the inverter operation management status when an error occurs. Initialization (00), Earth fault detection (01), Stop (02) Operation standby (03), operation preparation (04) operation (05), Stop standby (06), Retry standby (07), Retry (08)	-
-	LAD status	Displays LAD (acceleration/deceleration) status when an error occurs. Cut-off (00), Min. speed (01), Accelerate (02), Decelerate (03), Constant speed (04), Restart (05)	-
-	INV control	Displays the inverter control status when an error occurs. Interruption (00), Speed Control (01), Start (02), DC Braking (03), Position Control (06), Torque Control (07), Restart (08), Magnetic Pole Position Detection (09), Earth Fault Detection (10), Non-rotation Measurement (11)	-
dC-37	Icon 2 L LIM detail monitor (= Restriction status)	Not in the motor drive limit state	00
		Overcurrent suppression in progress	01
		Overload restriction in progress	02
		Overvoltage suppression in progress	03
		Torque limited	04
		Upper/lower limit limiter, jump frequency, setting limit in progress	05
		Minimum frequency setting limit in progress	06
-	Special status	Indicates the special functions that were operating when an error occurred. Not in special function state (00) During auto-tuning (01) During simulation mode (02) During EMF mode (04), BYP mode (05)	-
dE-01	Trip count monitor	Monitors the number of trips.	0 to 65535 (times)
dE-11 to dE-20	Trip monitor 1 to Trip monitor 10	The following information is displayed when an error occurs. (1)Trip factor, (2) output frequency (signed), (3) output current (4)DC between P-N, (5) Inverter status, (6) LAD status (7)INV control mode., (8) Limit state., (9) Special state. (10)Cumulative time during RUN, (11) Cumulative power ON time This data is stored in the internal memory when the power supply is cut off.	-
CA-01 to CA-08	Input terminal function	Reset [RST]: Resetting operation is performed with ON of this signal. If tripped, trip state is canceled.	028

Trip Monitor Display



- When forced shutdown by hardware of the inverter occurs, information at the time of error occurrence may not be acquired accurately.
- If an error occurs during output shutdown and a trip condition occurs, the value of each data may become 0.
- In case of a ground fault or instantaneous overcurrent, the current value may be recorded low.
- Trip monitor and trip count monitor can be cleared by historical initialization.
- A negative value for the output frequency indicates that an error occurred during reverse rotation.

15.2.2 Check retry information

・Retry history of the inverter can be displayed up to 10 times in the past.
・"Retry Monitor ([dE-31] to [dE-40])" allows you to refer to the error code that caused the retry and the detailed information such as the output frequency, output current, DC voltage between P-N, and the status of the drive during the retry. Also, the most recent retry history is displayed in "Retry monitor 1 [dE-31]".
・Refer to the table below for the status at retry (inverter status, LAD status, INV control mode, restriction status (= "Icon 2LIM detailed monitor [dC-37]") and special status).

Code	Item	Description	Data
-	Inverter status	Displays the inverter operation management status when a retry occurs. Initialization (00), Earth fault detection (01), Stop (02) Operation standby (03), operation preparation (04) operation (05), Stop standby (06), Retry standby (07), Retry (08)	-
-	LAD status	Displays LAD (acceleration/deceleration) status when a retry occurs. Cut-off (00), Min. speed (01), Accelerate (02), Decelerate (03) Constant speed (04), Restart (05)	-
-	INV control	Displays the inverter control status when a retry occurs. Interruption (00), Speed Control (01), Start (02) DC Braking (03), Position Control (06), Torque Control (07) Restart (08), Magnetic Pole Position Detection (09) Earth Fault Detection (10), Non-rotation Measurement (11)	-
dC-37	Icon 2 L LIM detail monitor (= Restriction status)	Not in the motor drive limit state	00
		Overcurrent suppression in progress	01
		Overload restriction in progress	02
		Overvoltage suppression in progress	03
		Torque limited	04
		Upper/lower limit limiter, jump frequency, setting limit in progress	05
		Minimum frequency setting limit in progress	06
-	Special status	Displays the special function that was operating when the retry occurred. Not in special function state (00) During auto-tuning (01) During simulation mode (02) During EMF mode (04), BYP mode (05)	-
dE-31 to dE-40	Retry monitor 1 to Retry monitor 10	Displays the following information when a retry occurs. (1)Trip factor, (2) output frequency (signed), (3) output current, (4)DC between P-N, (5) Inverter status (6) LAD status, (7)INV control mode., (8) Limit state. (9) Special state, (10)Cumulative time during RUN (11) Cumulative power ON time This data is stored in the internal memory when the power supply is cut off.	-

・The contents of the retry monitor display are the same as the trip monitor. 『15.2.1 Refer to "Checking trip information".

15.2.3 Troubleshooting for protection functions related error

Error No. and Retry No. list

・Refer to the table below for the error code and retry code and the corresponding error content.
・Refer to the relevant section in this section for details of each error.

Error No.	Retry No.	Error name	Page
E001	r001	Overcurrent error	15-6
E005	-	Motor overload error	15-7
E006	-	Regenerative brake overload error	15-8
E007	r007	Overvoltage error	15-8
E008	-	Memory error Note	15-9
E009	r009	Undervoltage error	15-9
E010	-	Current detector error	15-9
E011	-	CPU error Note	15-10
E012	-	External trip	15-10
E013	-	USP error	15-10
E014	-	Ground fault error Note	15-11
E015	-	Input overvoltage error	15-11
E019	-	Temperature detector error	15-11
E021	-	Temperature error	15-11
E022	-	CPU communication error	15-12
E024	-	Input phase loss	15-12
E025	-	Main circuit error	15-12
E026	-	Analog input level over error	15-12
E030	-	IGBT(Driver) error Note	15-13
E034	-	Output phase loss	15-13
E035	-	Thermistor error	15-13
E036	-	Brake error	15-14
E038	-	Overload error at low speed	15-14
E039	-	Controller overload error	15-15
E040	-	Operator keypad disconnection error	15-15

Error No.	Retry No.	Error name	Page
E041	-	RS485 communication error	15-16
E042	-	RTC error	15-16
E060	-	Option error 0	15-16
E061	-	Option error 1	
E062	-	Option error 2	
E063	-	Option error 3	
E064	-	Option error 4	
E065	-	Option error 5	
E066	-	Option error 6	
E067	-	Option error 7	
E068	-	Option error 8	
E069	-	Option error 9	
E090	-	STO shutoff error	15-16
E091	-	STO internal error	15-17
E092	-	STO path 1 error	
E093	-	STO path 2 error	
E100	-	Encoder disconnection error	15-17
E104	-	Positioning range error	15-17
E105	-	Speed deviation error	15-18
E107	-	Excessive speed error	15-18
E110	-	Contactor error	15-18
E120	-	PID soft start error	15-18
E121	-	Abnormal upper detecting error	15-18
E122	-	Abnormal lower detecting error	15-19

Note: These errors are major failure and these errors could not be canceled with keypad and input terminal function "Reset [RST]".When major failure is occurred, the output terminal function [MJA] turns ON. For details, see "9.11.2 Output Major Failure Signal".

List of trip codes and their contents, possible causes and remedies

E001 Overcurrent error

- Shuts off the inverter output and trips, when detecting a large output current exceeding the overcurrent level.
- Overcurrent level can be set by "Overcurrent detection level [bb160]". In factory setting, [bb160] is set to 2.2 times the rated output current at ND rating regardless of ND/LD rating setting.
- When a large output current exceeding the overcurrent level is detected, the inverter can perform to retry for a certain number of times without tripping by the parameter setting.

Generation status	Possible causal	Example of remedy
Sudden occurrence during operation	Steep load fluctuation occurs	・The overcurrent [bA122] suppression function and the stall prevention [bA120] function are enabled to suppress the overcurrent. ・When using vector control, it may be improved by adjusting "Velocity Response [HA115]".
	Motor hunting	・It may be improved by setting "IM motor capacity selection [Hb102]", "IM motor pole selection [Hb103]" correctly or by performing auto-tuning. ・It may be improved by adjusting the "stabilization parameter [HA110]".
Generated during acceleration	・The acceleration time is short. ・Insufficient acceleration torque ・Load inertia is large ・High friction torque	・Acceleration torque failure can be alleviated by increasing the acceleration time [FA-10]. ・If acceleration torque is required, you may improve it by adjusting "manual torque boost amount [Hb141]", or changing the control method with "control method [AA121]", etc. ・It may be improved by reviewing the load conditions.
Occurred during deceleration	・Deceleration time is short ・Failure regenerative torque ・Load inertia is large	・Lengthening the deceleration time [FA-12] can alleviate failure regenerative torque. ・If regenerative torque is required, you may need to adjust the manual torque boost [Hb141], change the control method with the control method [AA121], etc. ・It may be improved by reviewing the load conditions.
Generated immediately after operation command input	・Occurrence of a ground fault ・Motor output wire is short-circuited or out of phase. ・Output element failure	・If this happens even when the power is turned on by the inverter alone after disconnecting the output line to the motor, there is a possibility of failure. ・If the output line to the motor is disconnected and no longer occurs, the wiring and motor must be checked.
	・Motor is captive ・Load inertia is large	・It may occur if the rotation of the motor is restricted. ・The above countermeasures for "Occurring during Acceleration" may be improved.
Generated immediately after power-on	・Output element failure ・Current detector failure	・The output element or current detector may be faulty. ・Investigation and repair are required.
Generated after prolonged use	Changes in the system environment	It may also reduce the motor load and improve system maintenance, for example, by cleaning the fan being driven or by removing clogged ducts.
	Aging degradation	If the problem is not solved by reducing the load, etc., the parts that have reached the end of their life may deteriorate over time. The Inverter replacement is required.

E005 Motor overload error

- Shuts off the inverter output and trips when the electronic thermal function detects a motor overload monitoring the inverter output current.
- Time until motor overload error and the behavior after motor overload error is changed according to the setting of the motor rated current and the electronic thermal function. Note

Generation status	Possible causal	Example of remedy
Occurred during a certain period of operation	Heavy load continued	・It may be improved by reviewing the operating conditions and improving the load conditions. ・If the "Electronic Thermal Level [bC110]" setting is not appropriate, it may be improved by reviewing the setting.
	The thermal setting is high.	・It may be improved by performing auto-tuning to set "IM motor capacity selection [Hb102]", "IM motor pole selection [Hb103]", etc. ・It may be improved by adjusting the "stabilization parameter [HA110]".
Generated during acceleration	・Insufficient acceleration torque ・Load inertia is large ・High friction torque	・Acceleration torque failure can be alleviated by increasing the acceleration time [FA-10]. ・If acceleration torque is required, you may improve it by adjusting "manual torque boost amount [Hb141]", or changing the control method with "control method [AA121]", etc. ・It may be improved by reviewing the load conditions.
	The function to suppress the overcurrent is activated.	An overcurrent may have occurred. Review the acceleration time [FA-10] and load conditions.
Occurred during deceleration	Load inertia is large	・Lengthening the deceleration time [FA-12] can alleviate failure regenerative torque. ・If regenerative torque is required, you may need to adjust the manual torque boost [Hb141], change the control method with the control method [AA121], etc.
	Overvoltage suppression function is activated.	As a result of suppressing overvoltage, current may grow. Review the deceleration time [FA-12] and load conditions.
Generated after prolonged use	Changes in the system environment	It may also reduce the motor load and improve system maintenance, for example, by cleaning the fan being driven or by removing clogged ducts.
	Aging degradation	If the problem is not solved by reducing the load, etc., the parts that have reached the end of their life may deteriorate over time. The inverter replacement is required.

Note: When "Electronic thermal decrease function enable [bC112]" is "Disable (00)", the inverter does not accept a reset operation for 10 seconds. Wait for a while before performing a reset operation.
When [bC112] is "Enable (Linear decrement) (01)" or " Enable (Time constant decrement) (02)", it can be reset immediately after error occurs. However, the overload accumulated value is not cleared and the value continue to decrease after reset operation.
Therefore, when the inverter is restarted immediately after reset operation, the overload accumulated value may quickly reach 100% and the error may occur again. In this case, wait for a while before restarting.

E006 Regenerative brake overload error

・Shuts off the inverter output and trips, when the braking resistor operation circuit (DBTR) usage rate exceeds the usage rate specified in "Dynamic brake use ratio [bA-60]".

Generation status	Possible causal	Example of remedy
Occurred during deceleration	・Deceleration time is short. ・Load inertia is large. ・Braking resistor capacity is small.	・If the inertia of the load is suddenly decelerated, it may be improved by increasing the deceleration time [FA-12]. ・If the deceleration time [FA-12] cannot be shortened, the selection of the resistor must be reviewed.
Generated when driving	・Continuation of regenerative operation ・Braking resistor capacity is small.	The resistor may not be fully consumed due to the high regenerative power returned from the motor. The load conditions must only be reviewed and the resistor selection must be reviewed.
	Be turned by external force	The resistor may not be fully consumed because the regenerative power returned from the motor increases when the fan is driven by a strong wind or a load is unloaded by a crane. The load conditions must only be reviewed and the resistor selection must be reviewed.
Generated by repeated operation	Frequent operation cycles	・There is a possibility of improvement by reducing the frequency of operation cycles. ・Adjusting the deceleration time [FA-12] or reviewing the selection of the resistor may also improve the performance.

E007 Overvoltage error

・Shuts off the inverter output and trips, when detecting a high DC bus voltage exceeding the overvoltage level.
・Overvoltage level is approx. DC400V (200V class) or approx. DC800V (400V class).
・When a high DC bus voltage exceeding the overvoltage level is detected, the inverter can perform to retry for a certain number of times without tripping by the parameter setting.

Generation status	Possible causal	Example of remedy
Occurred during deceleration	・Deceleration time is short. ・Load inertia is large.	・If the load is decelerating rapidly, it may be improved by increasing the deceleration time [FA-12]. ・If the deceleration time [FA-12] cannot be shortened, it is necessary to review the load conditions, enable the overvoltage suppression function [bA140] or the overexcitation function [bA146], use a braking resistor, a regenerative braking unit, or a regenerative converter, etc.
Generated when driving	Load inertia is large.	If the inertia of the load is large, the regenerative power returned from the motor is high, so it is likely to be overvoltage. It is necessary to review the load conditions, enable the overvoltage suppression function or the overexcitation function, use a braking resistor, regenerative braking unit, or a regenerative converter.
	Motor is running by external force (Fan, Crane)	If the motor speed is higher than the inverter output frequency (rotational speed), it is liable to become overvoltage. It is necessary to review the load conditions, enable the overvoltage suppression function [bA140] or the overexcitation function [bA146], use a braking resistor, regenerative braking unit, or a regenerative converter.
Occurred during the stop	Abnormal power voltage	The power supply voltage may be rising or fluctuating. It may be improved by reviewing the power supply environment or by inserting the input-side AC reactor.
Occurred during the drooping control	Mutual interference caused by two motors strictly controlling each other	When two motors driving the same axis are controlled by two inverters, the control may diverge because they attempt to output torque from each other. One control may be improved by P control. See 9.6.7 Moving a single load with multiple motors (true-ping control).

E008 Memory error

- Shuts off the inverter output and trips, when the internal memory has problems.
- "CPU error [E011]" may be issued instead.
- The reset operation is not accepted. A power on reset is required.
- When the inverter recovers by a power on reset, make sure the parameter setting is correct.

Generation status	Possible causal	Example of remedy
Occurs sometime after the power is turned on	Noise contamination	To prevent external noise, it may be necessary to take noise countermeasures such as moving the noise source away or inserting a shielding plate.
Generated after unintentional power shutdown (main power supply, external +24V power supply)	Power shutdown during memory access	・Data must be recovered using data backed up beforehand by the remote operator (OS-44 ver.2.0 onwards) or PC software. ・If you cannot recover, you must initialize the data. See "7.2.2 Initialization Parameters". ・If it cannot be restored by initialization, the inverter replacement is required.

E009 Undervoltage error

- Shuts off the inverter output and trips, when detecting a low DC bus voltage below the undervoltage level to prevent the temperamental circuit operation
- Undervoltage level is approx. DC173V (200V class) or approx. DC345V (400V class).
- When a low DC bus voltage below the undervoltage level is detected, the inverter can perform to retry for a certain number of times without tripping by the parameter setting.
- Undervoltage error during stop can be disabled by a parameter setting.

Generation status	Possible causal	Example of remedy
There was a power failure.	The power supply voltage dropped.	If the internal power supply does not completely turn off, you can restart after power is restored by setting the retry function.
Generated by driving	・The power supply voltage dropped. ・Insufficient power capacity	If the power supply voltage drops or the power supply capacity is insufficient, the power supply environment must be reviewed.
Inverter does not start	Insufficient power supply voltage	Supply power according to the voltage class of the inverter.
Generated after prolonged use	・Changes in the system environment ・Deterioration of the capacitor ・Circuit failure	If undervoltage occurs frequently, it may be of life or malfunction. The inverter replacement is required.

E010 Current detector error

- Shuts off the inverter output and trips, when detects abnormally on the built-in current sensor.

Generation status	Possible causal	Example of remedy
Generated after power-on	The current detection circuit is broken.	If this happens again even after resetting the error, the current detection circuit may be faulty. The inverter replacement is required.
	Have a noise source nearby	If there is a noise source nearby, it may be improved by taking measures against noise, such as moving the noise source away or inserting a shielding plate.
Generated after prolonged use	The current detection circuit is broken.	If this happens again even after resetting the error, the current detection circuit may be faulty. The inverter replacement is required.

E011 CPU error

・Shuts off the inverter output and trips, when the internal CPU has problems or malfunction.

Generation status	Possible causal	Example of remedy
Suddenly occurred	Internal CPU is corrupted.	・It may be recovered by turning on the power supply again. When it is restored, initialization must be executed. See "7.2.2 Initialization Parameters". ・If it does not recover, it may be malfunctioning. The inverter replacement is required.
	Have a noise source nearby	If there is a noise source nearby, it may be improved by taking measures against noise, such as moving the noise source away or inserting a shielding plate.
Occurs during data writing.	Inconsistent data	It may be recovered by turning on the power supply again. When it is restored, initialization must be executed. See "7.2.2 Initialization Parameters".

E012 External trip

・Shuts off the inverter output and trips, when the inverter receive an signal from an external equipment to input terminal which is assigned "External fault [ES]".

Generation status	Possible causal	Example of remedy
Unintentionally generated	・The terminal logical is reversed. ・Wrong wiring	・The operation status from the external device and external device must be checked, and the "External failure [ES]" terminal assignment to the input terminal function, setting of a/b contact, external trip command by communication, etc. must be reviewed. ・a/b contacts of the terminals can be changed in the settings of the inverters.

E013 USP error

・Shuts off the inverter output and trips, when the inverter power is turned on while applied an RUN command.
・Unattended start protection function is valid when input terminal function "Unattended start protection [USP]" is turned on or "[USP] active selection [CA-73]" is "Enable (01)".
・RUN command detection is executed for 2 second after the power is turned on.

Generation status	Possible causal	Example of remedy
Unintentionally generated	Timing of entering operation command is fast.	Review the sequence for entering the operation command. After the power is turned on, it is necessary to wait for at least 2 seconds before turning on the operation command.
	Operation command is not released	Operation command must be released when the power is turned on.
	Attempting to move by a command other than a terminal	When the power restoration restart prevention function is enabled, commands such as operation panel and communication commands are also subject to errors. After the power is turned on, it is necessary to wait for at least 2 seconds before turning on the operation command.

E014 Ground fault error

- The inverter instantly protects from ground-fault, when detects the ground fault between the inverter output and the motor on power up.
- The function does not work while inverter trips.
- Enable/disable of the ground fault detection can be selected by "Detect ground fault selection[bb-64]" setting.
- When the external ＋24V power supply has been turned on prior to the main power supply(R, S, T), the ground fault detection function is activated at the time the main power supply is turned on.

Generation status	Possible causal	Example of remedy
Generated by turning on the power	・Ground fault in wiring and motor ・Insulation deterioration of motor	・Disconnect the wires to the motor and check the motor and wiring after shutting off the power. Ground fault or insulation degradation is suspected. ・Turning on the power with the ground fault condition may cause a failure. Check the motor and motor wiring without turning on the power.

E015 Input overvoltage error

- When "Power supply overvoltage selection [bb-61]" is "Error (01)", the inverter trips when persist overvoltage condition for more than 100 seconds while the inverter is in stop status.
- Input overvoltage level can be set by "Power supply overvoltage level setting [bb-62]".

Generation status	Possible causal	Example of remedy
Generated after power-on	Receiving voltage is high.	Review of the power supply environment is required.
Generated after prolonged use	The power supply becomes unstable.	The power supply environment may have changed due to equipment replacement, etc. Review of the power supply environment is required.

E019 Temperature detector error

- The inverter trips when there is a problem in the temperature detector circuit such as disconnection.

Generation status	Possible causal	Example of remedy
Generated after power-on	The temperature detection circuit is disconnected or has failed.	The temperature detection circuit has failed. The inverter replacement is required.

E021 Temperature error

- Shuts off the inverter output and trips, when the internal temperature is above the threshold.

Generation status	Possible causal	Example of remedy
Occurred during operation	Have a high carrier frequency	When the carrier frequency is high, the internal temperature of the inverter rises easily. Decrease the setting of "Carrier frequency [bb101]".
	Fins are clogged	If the fins are clogged, cooling performance will be reduced. Cleaning the fins may improve them.
	・Use in high-temperature environments ・Poor ambient cooling	It may be improved by improving the operating environment and cooling environment.
	Not satisfying normal installation conditions	Incorrect installation of the inverter may cause a failure. Install the product correctly according to this manual.
Generated after prolonged use	The temperature detection circuit has failed.	If an error occurs continuously after resetting, the temperature detection circuit has failed. The inverter replacement is required.

E022 CPU communication error

・Shuts off the inverter output and trips, when occurs a communication error in an internal CPU.

Generation status	Possible causal	Example of remedy
Suddenly began to occur	Internal CPU is corrupted.	・Reset operation, power restoration, or initialization operation may recover the unit. When it is restored, initialization must be executed. See "7.2.2 Initialization Parameters". ・If it does not recover, it may be malfunctioning. The inverter replacement is required.
	Have a noise source nearby	If there is a noise source nearby, it may be improved by taking measures against noise, such as moving the noise source away or inserting a shielding plate.

E024 Input phase loss

・Shuts off the inverter output and trips, when detects a phase loss of input side of main circuitry.
・Enable/disable of the input phase loss detection can be selected by "Input phase loss detection enable [bb-65]" setting.
・The single-phase inverters shut off the power when input phase loss. In this case, set [bb-65] to "Disable (00)".

Generation status	Possible causal	Example of remedy
Generated after power-on	Poor contact or disconnection of the power input line	It is necessary to shut off the power supply and check the wiring condition of the power input line and the breaker. This can also occur if the power supply voltage is defective, the contact is defective, or the screw is not tightened properly.
	A model using three-phase power supply and single-phase input.	For models using a three-phase power supply, connect all three phases of the power input wires.
Generated after prolonged use	Poor contact or disconnection of the power input line	Improvements may be made due to poor contact caused by loose screws or by improving abnormalities in the circuit breaker.

E025 Main circuit error

・Shuts off the inverter output and trips, when occurs a malfunction on the main circuit board.

Generation status	Possible causal	Example of remedy
Generated after power-on	Have a noise source nearby	If there is a noise source nearby, it may be improved by taking measures against noise, such as moving the noise source away or inserting a shielding plate.
	The main circuit board is faulty.	If the main circuit board is faulty, the inverter replacement is required.

E026 Analog input level over error

・When "[VRF] input selection [Cb-08]" or "[IRF] input selection [Cb-18]" is "Current (02)", the inverter trips when excessive current come into the analog input terminal [VRF]/[IRF].
・Power off the inverter when occurs this error, and check the wiring connection of analog input.

Generation status	Possible causal	Example of remedy
Generated when a command is issued by analog current input.	Miswiring to control wiring	Check the wiring of the analog current input after the power is turned off.

E030 IGBT(Driver) error

- At the time of an instantaneous overcurrent from motor or external braking resistor, or the main element failure the inverter turns off the output to protect the main element.

Generation status	Possible causal	Example of remedy
Generated immediately after operation	・Occurrence of a ground fault ・Motor output wire is short-circuited.	After the power is cut off, it is necessary to check the output line to the motor, disconnection of the motor, etc. If this happens when the motor wiring is removed, it is malfunctioning and needs to be repaired.
	Motor rotation constrained	If the motor is restrained during operation, a large current may flow. You need to eliminate the cause.
	The output element is defective.	If the output element fails, the inverter replacement is required.
Generated immediately after power-on	The output element is defective.	
Occurred during operation	The external braking resistor connection terminal is short-circuited or a braking resistor less than the minimum connection resistance value is connected.	After shutting off the power supply, it is necessary to check the braking resistor wiring and resistance. If this happens even when the braking resistor and motor output wire are disconnected, it is malfunctioning and must be repaired.
	Motor rotation constrained	If the motor is restrained during operation, a large current may flow. You need to eliminate the cause.

E034 Output phase loss

- Shuts off the inverter output and trips, when a loose connection, disconnection of output line, disconnection inside the motor, etc., are detected.
- Enable/disable of the output phase loss detection can be selected by "Output phase loss detection enable [bb-66]" setting.
- Detection of output phase loss is executed in the section of output frequency 5Hz to 100Hz.

Generation status	Possible causal	Example of remedy
Generated immediately after operation	Contact or disconnection of motor output wire or motor has occurred.	・It is necessary to shut off the power supply and check the wiring condition of the output wire and the motor. This can also occur due to dielectric breakdown of the motor or improper screw tightening. ・Be sure to connect all three phases of the motor output wire.
Generated after long-time operation	Contact or disconnection of motor output wire or motor has occurred.	It is necessary to shut off the power supply and check the wiring condition of the motor output wire and motor. If any of the screws are loose, retighten them to improve the problem.

E035 Thermistor error

- Shuts off the inverter output and trips, when an abnormal temperature is observed with an external thermistor.
- When "Thermistor type selection [Cb-40]" is "PTC (01)", the input terminal [AUT] become for external PTC type thermistor. In this case, "Input terminal [AUT] function [CA-05]" setting is invalid.
- The threshold of abnormal temperature can be set by "Thermistor error level [bb-70]" and "Thermistor gain adjustment [Cb-41]".
- When [Cb-40] is "PTC (01)", this error is occurred when the external thermistor is disconnected and re-generated after trip reset. In this case, it is required to connect the thermistor or short between [AUT] terminal and [COM] terminal.

Generation status	Possible causal	Example of remedy
The motor is generating heat.	Motor is not cooling well	Cooling environment should be improved
	Heavy load conditions continue	The drive environment of the motor must be reviewed.
Motor does not generate heat	Incorrect setting of thermistor function	It may be improved by reviewing the "thermistor error level [bb-70]" and "thermistor adjusting [Cb-41]" sets.
	Thermistor is defective	The thermistor must be repaired.
	Malfunction due to noise	This may be improved by noise suppression measures such as wiring separation.

E036 Brake error

- Shuts off the inverter output and trips, when the inverter cannot detect whether the input function "Answer back from brake [BOK]" is ON or OFF during "Brake release wait time ([AF131], [AF134])" after the inverter has output a "Brake release [BRK]".
- When [BOK] is not assigned to "Input terminal function([CA-01] to [CA-08])", this error is not occurred.

Generation status	Possible causal	Example of remedy
Generated after operation	Break in the signal wire	Check the wires of the "Braking Check Signal [BOK]" input terminals and whether signals are present.
	Setting the Brake Function	Reconsider the brake confirmation wait time and input terminal logical according to the signal sequence.

E038 Overload error at low speed

- When the inverter operate lower than 0.2Hz, shuts off the inverter output and trips when the electronic thermal function detects a motor overload monitoring the inverter output current to prevent the main element failure.

Generation status	Possible causal	Example of remedy
Generated at low-speed output	Heavy motor load	It is necessary to reduce the load in the low-speed range. If the error occurs frequently, it is necessary to select an inverter with a larger capacity for the motor.

E039 Controller overload error

- Shuts off the inverter output and trips when the thermal electronic function detects an inverter(controller) overload monitoring the inverter output current.
- When the controller overload error occurs, reset command cannot be accepted for 10 seconds.
- There is no user parameter for controller (inverter) overload protection. the controller overload detection is according to the rated output current at ND rating. It is impossible to change the time until controller overload error and the behavior after controller overload error like "Motor overload error [E005]".
- Regardless the setting of "Load type selection [Ub-03]", ND rated derating is applied. For detail, see "17.3 Current Derating".

Generation status	Possible causal	Example of remedy
Occurred during a certain period of operation (or during acceleration)	Heavy load continued	It may be improved by reviewing the operating conditions and improving the load conditions.
	The load (ND/LD) was changed, and the carrier frequency was changed, resulting in an overload due to current derating.	Improvements may be made by lowering the carrier frequency setting, overload, overcurrent limit or other operating conditions, or by improving the load conditions.
Generated during acceleration	・Insufficient acceleration torque ・Load inertia is large ・High friction torque	・Acceleration torque failure can be alleviated by increasing the acceleration time [FA-10]. ・If acceleration torque is required, you may improve it by adjusting "manual torque boost amount [Hb141]", or changing the control method with "control method [AA121]", etc.
	The function to suppress the overcurrent is activated.	An overcurrent may have occurred. Review the acceleration time [FA-10] and load conditions.
Occurred during deceleration	Failure regenerative torque	・Lengthening the deceleration time [FA-12] can alleviate failure regenerative torque. ・If regenerative torque is required, you may need to adjust the manual torque boost [Hb141], change the control method with the control method [AA121], etc.
	Overvoltage suppression function is activated.	As a result of suppressing overvoltage, current may grow. Review the deceleration time [FA-12] and load conditions.
Generated after prolonged use	Changes in the system environment	It may also reduce the motor load and improve system maintenance, for example, by cleaning the fan being driven or by removing clogged ducts.
	Aging degradation	If the problem is not solved by reducing the load, etc., the parts that have reached the end of their life may deteriorate over time. The Inverter replacement is required.

E040 Operator keypad disconnection error

- Shuts off the inverter output and trips, when occurs this error between optional remote operator and inverter due to noises, loose connection or disconnection.
- Enable/disable of the timeout detection between optional remote operator and inverter can be selected by "Action selection at keypad disconnection [UA-20]" setting.

Generation status	Possible causal	Example of remedy
Occurred after communication starts	・Poor contact ・Disconnection	Check the wiring to see if the connection is correct.
	Noise contamination	Noise suppression measures such as wiring separation may improve the wiring.

E041 RS485 communication error

・Shuts off the inverter output and trips, when RS485 communication timeout occurs because of a malfunction due to noises, loose wire connection, wiring disconnection, etc.
・Enable/disable of the RS485 communication timeout detection can be selected by " RS485 communication error selection [CF-05]" setting.
・This error may occur even if the communication settings with the connected control device do not match. In this case, the connection is not normally established and an error occurs in the host device. It is required to check the RS485 communication setting ([CF-01] to [CF-08]).

Generation status	Possible causal	Example of remedy
Occurred after communication starts	・Poor contact ・Disconnection	Check the wiring to see if the connection is correct.
	Noise contamination	Noise suppression measures such as wiring separation may improve the wiring.

E042 RTC error

・Shuts off the inverter output and trips, when the RTC data incorporated in the remote operator(VOP) has returned to the initial data.

Generation status	Possible causal	Example of remedy
Occurred at power-on	The remote operator (OS-44 Ver.2.0 onwards) batteries run out.	This error occurs when the inverter power is turned on again if the battery is exhausted. It is canceled by changing the battery and setting the date and time.

E060 to E069 Option error 0 to 9

・Shuts off the inverter output and trips, when the inverter detects errors in the option mounted in the optional slot.

Generation status	Possible causal	Example of remedy
Generated when option was installed.	The connector is not firmly engaged.	The option may not be installed correctly. Make sure that the option is installed properly.
	There is a mistake in the use.	The details of the error differ for each option. For details, refer to the user's guide for each option.

E090 STO shutoff error

・When "STO input display selection [bd-01]" is "Trip (02)", shuts off the inverter output and trips when both [ST1] terminal and [ST2] terminal are off (=STO state).
・When it is not required to trip at STO state, [bd-01] should be set to "Warning (display) (00)" or "Warning (without display) (01)".
・For details of safety function related error, see "Safety Function Guide (No. DM2503E)".

Generation status	Possible causal	Example of remedy
Safety function is used.	The safety function system is faulty.	・If the error is not cleared even when the contact is turned ON, check that the wiring and STO signal input are normal. ・If this occurs in an unexpected situation, execute a function confirmation test (proof test). For more information, refer to the separate volume, "Safety Function Guide (No. 2503E)".

E091 STO Internal error

・Shuts off the inverter output and trips when a failure is detected in the safety path inside WJ-C1.
・After this error occurs, the internal safety path keeps STO state until power off.
・For details of safety function related error, see "Safety Function Guide (No. DM2503E)".

Generation status	Possible causal	Example of remedy
Safety function is used.	The safety function system is faulty.	A dangerous failure may have occurred in the safety path inside the inverter. Stop the system, shut off the output to the motor, and then execute a function check test (proof test). For more information, refer to the separate volume, "Safety Function Guide (No. DM2503E)".

E092 STO Path1 error

E093 STO Path2 error

・When "Action selection after STO input change time [bd-04]" is "Trip (02)", shuts off the inverter output and trips when either [ST1] terminal or [ST2] terminal is off.
・When it is not required to trip at STO state, [bd-04] should be set to "Maintain current status (00)" or "Disable (01)".
・For details of safety function related error, see " Safety Function Guide (No. DM2503E)".

Generation status	Possible causal	Example of remedy
Safety function is used.	The safety function system is faulty.	・Check that the wiring and STO signal input are normal. ・Check that STO Input Switching Allowable Time (Return) [bd-02], and STO Input Switching Allowable Time (Shutoff) [bd-05] sets are appropriate.

E100 Encoder disconnection error

・Shuts off the inverter output and trips, when the inverter detect an encoder wiring disconnection.

Generation status	Possible causal	Example of remedy
Generated by turning on the power	Encoder wire or encoder error	・Check the encoder signal and wiring for any abnormality. ・Check whether the power-on and startup of the encoder are not delayed with respect to the power-on of the inverter.
Sudden occurrence during operation	Encoder wire or encoder error	Check the encoder signal and wiring for any abnormality.
Generated when the power is cut off or [E100] is added to the error history every time the power is turned on.	Encoder power supply error	Check whether the encoder power is lost before the inverter.

E104 Positioning range error

・Shuts off the inverter output and trips, when he actual position exceeds the preset position range set by "Position control range setting (forward) [AE-52]" and "Position control range setting (reverse) [AE-54]".

Generation status	Possible causal	Example of remedy
Occurred during operation	Insufficient torque	It may be improved by reviewing the operating conditions and improving the load conditions.
	Sliding due to faulty encoder setting	Check the installation of the encoder. Review any factors that may cause slippage.
	Encoder setting error	Check the encoder constant and other settings.
	Electronic gear setting error	Check the electronic gear setting again.

E105 Speed deviation error

・When "Speed deviation error mode selection [bb-82]" is "Error (01)", shuts off the inverter output and trips when the deviation between the frequency reference and the feedback speed exceeds the deviation specified in "Speed deviation error detection level [bb-83]".
・When this error is occurred, output terminal function "Speed over deviation [DSE]" is turned on.

Generation status	Possible causal	Example of remedy
Occurred during operation	Insufficient torque	It may be improved by reviewing the operating conditions and improving the load conditions.
	Sliding due to faulty encoder setting	Check the installation of the encoder. Review any factors that may cause slippage.
	Encoder setting error	Check the encoder constant and other settings.
	Electronic gear setting error	Check the electronic gear setting again.

E107 Excessive speed error

・Shuts off the inverter output and trips when the motor speed rises over a preset value set by "Over-speed detection level [bb-80]" for the time set by "Over-speed detection time [bb-81]".

Generation status	Possible causal	Example of remedy
Occurred during operation	Insufficient torque	It may be improved by reviewing the operating conditions and improving the load conditions.
	Encoder setting error	Check the encoder constant and other settings.
	Electronic gear setting error	Check the electronic gear setting again.

E110 Contactor error

・When output terminal function "Contactor check signal [COK]" is assigned to one of "Input terminal function ([CA-01] to [CA-08])", shuts off the inverter output and trips when [COK] is not turned on/off for the time set by "Contactor response check time [AF123]" after operation of "Contactor control [CON]".

Generation status	Possible causal	Example of remedy
[COK] did not ON during the contactor check period when starting	Incorrect wiring	Check the intelligent input setting and wiring.
	Contactor response failure	Check the operation including the contactor response time.
[COK] did not OFF during contactor check when stopped	Incorrect wiring	Check the intelligent input setting and wiring.
	Contactor response failure	Check the operation including the contactor response time.

E120 PID soft start error

・When "PID soft start error detection enable [AH-81]" is "Enable(Error) (01)", shuts off the inverter output and trips when a PID feedback value is not achieved a threshold level within the determined time.
・The time until trip can be set by "PID soft start time [AH-80]", and The threshold level of PID feedback value can be set by "PID soft start error detection level [AH-82]".

Generation status	Possible causal	Example of remedy
Occurred during operation	Target value too low	It may be improved by reviewing the setting of "PID soft start target level [AH-76]".
	The wire is broken.	PID feedback may not be entered properly. Check the wires and check "PID1 Feedback Data Monitor (after calculation) [db-44]".

E121 Abnormal upper detecting error

E122 Abnormal lower detecting error

・When "Abnormal upper level detecting action [bE-05]" and "Abnormal lower level detecting action [bE-05]" are "Trip (01)" or "Trip after deceleration stop (02)", shuts off the inverter output and trips when the value displayed on monitor function specified in "Abnormal detection target[bE-02]" exceeds or falls below the steady operation range.
・When the value exceeds the range, "Abnormal upper detecting error [E121]" is generated.
・When the value falls below the range, "Abnormal lower detecting error [E122]" is generated.

Generation status	Possible causal	Example of remedy
Occurred during normal operation	The setting of the steady state operation range is incorrect.	The range setting of the monitor value considered to be abnormal may be incorrect. The setting parameters of the detection area differ depending on the setting of "Non-stationary detection selection [bE-01]", so check whether the setting is correct.

15.3 Troubleshooting the warning function

15.3.1 Warning display

- If the set parameter is inconsistent with other settings, a warning is displayed and the program lamp [PRG] flashes.
- The warning display and warning display conditions are shown below. When a warning is displayed, refer to the contents of the table to correct the parameter. (Even if an operation command is input, it will not automatically rewrite to the correct value.)
- The latest warning is stored in "Warning monitor [dE-50]". If no warning occurs, "_ _ _ _ _" is displayed.

Warning Code	Warning reconditions		
102	First highest frequency [Hb105]	<	1st frequency upper limiter [bA102]
103	First highest frequency [Hb105]	<	1st frequency lower limiter [bA103]
106	First highest frequency [Hb105]	<	1st Main Speed Command Setting (Monitor) [FA-01]
107	First highest frequency [Hb105]	<	1st Aux. Speed Set Setting (Monitor) [FA-02]
202	2nd highest frequency [Hb205]	<	2nd frequency upper limiter [bA202]
203	2nd highest frequency [Hb205]	<	2nd frequency lower limiter [bA203]
206	2nd highest frequency [Hb205]	<	2nd main speed command setting (monitor) [FA-01]
207	2nd highest frequency [Hb205]	<	Secondary speed command setting (monitor) [FA-02]

15.3.2 Other display

・During resetting, under-voltage condition, or while the restart function is standby for retrying, the operation panel is displayed as follows.

Name	Description	Display Operators
During reset	This is displayed during reset (when the "Reset [RS]" input terminal is ON or when the trip status is reset by pressing STOP/RESET button).	Rotate SSSSS
Under-voltage standby	Displayed during under voltage standby and power shutdown.	- - - - -
External +24V power is being supplied	Appears when only the external +24V power supply is operating.	24u
Retry wait in progress	Displayed when the restart function is running.	00000
Restricting operation command	This message is displayed when the restricted operation command is input while the operation direction is restricted by the "Operation direction limit selection [AA114]".	00000
Data initializing	When "Pattern 0" is set for "Default selection [Ub-02]", this item is displayed during data initialization.	', 00
	When "Pattern 1" is set for "Default selection [Ub-02]", this item is displayed during data initialization.	', 01
	When "Pattern 3" is set for "Default selection [Ub-02]", this item is displayed during data initialization.	', 03
	Displayed during initialization of the trip history.	', HC
	⇕ Displayed alternately	
	When "Light load (LD)" is set to "Load spec. selection [Ub-03]", it is displayed during initialization.	',-L-
	When "Standard load (ND)" is set to "Load spec. selection [Ub-03]", it is displayed during initialization.	',-n-
No data	This is displayed when there is no relevant data. (trip monitor, warning monitor)	_ _ _ _ _
Communication error	Appears when a problem occurs between the external digital operator and the inverter.	Blink ‾ ‾ ‾ ‾ ‾
Auto-tuning OK	Appears when auto-tuning ends normally.	_ _ _ _ o
Auto-tuning NG	Displayed when auto-tuning fails.	_ _ _ _ J
Functional safety STO shut-off	Displayed when STO input/display selection [bd-01] is "Warning (with indication) (00)", and when [ST1]/[ST2] is both Open and STO blocked.	StO
Functional safety ST1/ST2 mismatch	Depending on ON/OFF timing of [ST1]/[ST2], one of [P-1A]/ [P-1b]/[P-2A]/[P-2b]/[P-1C]/[P-2C] is displayed depending on the settings of "STO Input Allowable Time Input Indication Selection [bd-03]" and "STO Input Allowable Time After Operation Selection [bd-04]". For more information, see "14.1 Using Safety Function STO (Safe Torque Off".	P- 1A P- 2A P- 1b P- 2b P- 1C P- 2C

15.4 Others

15.4.1 Troubleshooting other than trip occurrence and warning

- The inverter has not tripped, but we gathered examples of remedies when it does not operate as expected.
- If there are any events in the "Problems occurring" column, refer to the respective chapters in the "Check details" column or the next page for the remedies.
- If you cannot solve the problem by checking the following information, please use the contact information on the back cover.

	Issues that may exist	Confirmation details
1	A trip or warning has occurred. The operation panel display is different from normal.	『15.2 Refer to "Troubleshooting Protection Functions" and "15.3 Troubleshooting Warning Functions" to clear the cause of the trip or warning.
2	The operation panel does not light even when the main power is turned on. (The power indicator [PWR] does not light.)	Check "S1: The power does not turn on (the power indicator [PWR] on the main unit does not light)."
3	The operation indicator [RUN] on the control panel does not light even when an operation command is inputted.	Confirmation "S2: Operation command setting or operation command is incorrect".
4	When the operation command is ON, the operation indicator [RUN] lights up to indicate the operation status, but it does not operate according to the intended frequency command. (The [FA-01] display is 0Hz, does not operate at the intended frequency for the analogue voltage/current that is actually being inputted, etc.)	Confirmation "S3: Frequency command setting or frequency command is incorrect".
5	The operation command and frequency command are input correctly, but the motor does not drive.	Confirmation "S4: Frequency-output cutoff/limit function is activated".
6	The motor is driven but not driven at the intended frequency. ([FA-01] indicates the frequency command value actually entered, but the motor speed is not the intended output, the output frequency becomes oscillatory or unstable, etc.)	Depending on the situation, "S5: The motor speed does not increase." "S6: Motor rotates in reverse." "S7: Output-frequency becomes unstable." "S8: Torque is not generated." Check
7	The parameter to be set is not displayed or the parameter cannot be set.	Confirmation "S9: The parameter to be set is not displayed" or "S10: The control panel cannot be operated or the parameter cannot be set."
8	Other problems other than the above have occurred.	Check after "S11: Noise is noisy for motors and machines" and address the issue. If the problem persists, use the contact information on the back cover.

S1: The power does not turn on. (The power indicator [PWR] on the main unit does not light.)

Possible causal	Example of remedy	Reference
Power is not turned on.	Check that the power supply satisfying the specifications is supplied to the inverter power input side.	17-2 17-3 17-4
[P+], [P1/+1] The short-circuit bar or DC reactor between the terminals is disconnected.	[P+], [P1/+1] Connect the short-circuit bar or DC reactor between the terminals correctly.	5-3
The power input wiring is broken or the connection terminals are loose.	Review the wiring status.	-
External power +24V is input, but main power is not input.	When the external power +24V is applied, the parameter settings can be changed, but the motor cannot be driven. Input the main circuit power supply.	5-3 5-16

S2: Operation command setting or operation command is incorrect

Possible causal	Example of remedy	Reference
The motor does not drive even when an operation command is input.	If the operation indicator [RUN] on the control panel does not light up when an operation command is inputted, the operation command is not recognized. Check the contents of this table.	-
You want to drive the motor by pressing RUN key. However, the setting, etc. is incorrect.	Check that the setting of "Operation command selection [AA111]" is "Operation panel RUN key. (02)". LED to the right of RUN key lights when the actuator can be operated using RUN key on the control panel.	9-1
	STOP/RESET buttons on the control panel can be enabled or disabled using the "STOP key selection [AA-13]". Check this parameter.	9-5
[FR]/[RR] You want to move the unit using the input connector or [STA]/[STP]/[F/R] input connector, but the setting is wrong.	Check that the setting of "Operation command selection [AA111]" is "[FR]/[RR] terminal (00)" or "3 wire (01)".	9-2 9-3
	ON either of them when the operation command is executed at the [FW]/[RV] input terminal. (If both are ON, it is judged as a stopping command.)	9-2
	Check if the [CA-01] to [CA-08] setting is correct.	9-204
	Monitor the status of the input terminals in the Input Terminal Monitor [dA-51] and confirm that there is no problem with the wiring.	10-11
"Forced command switching [F-OP]" input terminal is ON.	If the "Forced command switching [F-OP]" function is not required, turn OFF those inputs.	9-4 9-21
Settings or wiring other than the above are incorrect.	Check the setting of "Operation command selection [AA111]", the setting of input terminal function assignment and the wiring. For details, refer to "9.1 Operation Command Selection and Alarm Reset".	-

S3: Frequency command setting or frequency command is incorrect

Possible causal	Example of remedy	Reference
The frequency command is not recognized.	If the setting of the frequency command cannot be changed with [FA-01] or the set frequency command is not displayed in [FA-01], the frequency command is not recognized correctly. Check the contents of this table.	-
The frequency command destination is incorrect.	Check if "Main speed command selection [AA101]" is set correctly.	9-7
Frequency reference is 0Hz.	When "Main speed command selection [AA101]" is "[VRF] terminal input (01)" or "[IRF] terminal input (02)", measure the voltage/current input to the [VRF]/[IRF] terminal with a tester, etc., and check whether the input voltage/current and wires are correct.	5-16
	When "Main speed command selection [AA101]" is "Parameter setting (07)", set the frequency command in [FA-01].	9-8
	When performing multi-speed operation ([DFL] to [DHH] and [SF1] to [SF7]), set the frequency command correctly to [Ab110]/ [Ab-11] to [Ab-25].	9-10
When the frequency command is analog input or pulse input, the motor drives at a value different from the input command value.	Check whether the settings of "Main speed command selection [AA101]", [VRF]/[IRF] terminal analogue input adjustment parameter ([Cb-01] to [Cb-33]), pulse input adjustment parameter ([CA-90] to [CA-96]), etc. are correct.	9-9 9-15 9-207
"Forced command switching [F-OP]" input terminal is ON	If the "Forced command switching [F-OP]" function is not required, turn OFF those inputs.	9-4 9-21
The main circuit wiring is disconnected or incorrect.	Check the main circuit wiring for disconnection or incorrect connection.	-
Settings or wiring other than the above are incorrect.	Check if there is any mistake in the function assignment and wiring of the control circuit terminal block. For details, refer to "9.2 Selecting Frequency Reference".	-

S4: Frequency-output cutoff/limit function is activated.

Possible causal	Example of remedy	Reference
The "Reset [RST]" connector is ON.	[RST] If the input-terminal is ON, the product will be in the reset-state and operation commands will not be accepted. [RST] The input terminals must be OFF.	9-214
The "Free run stop [MBS]" input terminal is ON.	[MBS] If the input terminal is ON, it will be in the free-run stop status and the operation command will not be accepted. [MBS] The input terminals must be OFF.	9-77
"Commercial switch [CS]" input terminal is ON.	[CS] If the terminal is ON, the commercial power supply is shut off and operation commands are not received. Check the commercial switching function.	9-82
"Operation enable [REN]" input terminal is assigned and OFF.	[REN] If the terminal function is OFF when using the input terminal, the operation command will not be accepted. Check the operation permission signal.	9-34
"Operation orientation limit selection [AA114]" is set.	Set [AA114] correctly.	9-33
"Reverse rotation prevention selection [HC114]" is set.	Set [HC114] correctly.	9-33
The short-circuit wire of the [ST1]/[ST2] terminal of the safety function is disconnected or in OFF status.	[ST1]/[ST2] The terminal is for functional safety. When this function is not used, a short-circuit wire must be provided.	14-1
Wrong or broken wiring, etc.	Check if there is any abnormality such as an output wire to the motor or a broken wire inside the motor.	-

S5: The motor speed does not increase.

Possible causal	Example of remedy	Reference
The stall prevention function or the overcurrent limit function is activated.	The stall prevention function or the overcurrent limit function limits the output current by stopping acceleration or lowering the output frequency when the output current exceeds the operating level. Increasing the operating level may improve the performance.	9-130 9-132
Frequency command is limited	If the frequency upper limiter and maximum frequency settings are low, they can be improved by raising the settings. To limit the frequency, use the upper limiter function rather than the highest frequency.	9-32
The frequency command value is overwritten by another frequency command method.	If a high-priority frequency command is input due to jogging, multi-speed command, etc., the actual frequency command may be low. Review of terminal function and frequency command destination is required.	9-6 9-10 9-13
Long acceleration time	If the acceleration time setting is long, it will accelerate slowly. Reduce the acceleration time.	9-22
Motor is constrained.	If the motor shaft is constrained by something that obstructs the brake or motor rotation (such as a jam), the cause must be removed.	-

S6: Motor rotates in reverse.

Possible causal	Example of remedy	Reference
The phase order of the wiring to the motor Is incorrect.	The rotation is reversed by replacing the two phases in the wiring to the motor.	-
For operation with RUN button on the control panel. The rotational direction setting is incorrect.	Check the setting of "RUN key Operation direction selection [AA-12]".	9-2
When using the 3-wire function, the input of the "3-wire forward/reverse [F/R]" input terminal is reversed.	[F/R] Check the input logic of the input terminals.	9-3 9-204
In the case of sensorless vector control, the motor reverses for a moment in the low-speed range,	Enable "Reverse rotation prevention selection [HC114]".	9-33

S7: Output-frequency becomes unstable

Possible causal	Example of remedy	Reference
Various parameters are not appropriate.	Check the basic setting parameters of the motor. This may be improved by adjusting the stabilization constant or by removing the output frequency slightly from the power supply frequency.	8-4 8-18 9-45
Load fluctuation is large.	It may be necessary to review the capacity of both the motor and the inverter.	-
The input power supply voltage fluctuates.	Option reactors (DC or AC) or input-side noise filters may be used to reduce power supply fluctuations.	5-9

S8: Torque is not generated

Possible causal	Example of remedy	Reference
The various parameters are not appropriate and the acceleration torque is not.	Adjust by setting the torque boost or switching to sensorless vector control.	9-40 9-41 9-46
The inverter is used for winding down.	When the torque is insufficient in regenerative operation, perform the following adjustment. - The deceleration time is increased. - Set "Overexcitation function selection (V/f) [bA146)" to "Always operation (01)". - Braking resistor or regenerative braking unit is used.	9-22 9-135 9-137
Too heavy load	It may be necessary to review the capacity of both the motor and the inverter.	-

S9: The parameter to be set is not displayed.

Possible causal	Example of remedy	Reference
Display restrictions are set	The display limit function may be activated. Review "Display selection [UA-10]". If [UA-10] cannot be changed, it may be protected by "View selection (UA-10) password [UA-01]". If this happens, cancel the password.	7-7 7-18
The display is fixed.	Operations on the operation panel are unavailable when the "Display Fixed [DISP]" of the input terminal function is ON. [DISP] OFF the INPUT terminal.	7-21

S10: The operation panel cannot be operated or the parameters cannot be set.

Possible causal	Example of remedy	Reference
The display is fixed.	Operations on the operation panel are unavailable when the "Display Fixed [DISP]" of the input terminal function is ON. [DISP] OFF the INPUT terminal.	7-21
The inverter is running.	Some parameters cannot be changed during operation. If it cannot be changed, stop the inverter once.	7-1
The soft lock function is activated.	Disable the soft lock function.	7-17
The parameter setting range, etc. has changed due to a change in the load specification setting.	The setting range of some parameters is changed by changing "Load-specification selection [Ub-03]", and some parameters are hidden. The load specification selection status of the inverter can be checked by "Inverter load specification selection status monitor [dC-01]". It is necessary to change the load specifications or review the setting within the settable range.	8-2 10-17

S11: Noise from motors and machines is noisy.

Possible causal	Example of remedy	Reference
Carrier frequency is set low	Increase "Carrier frequency [bb101]". However, noise generated from the inverter and leakage current may increase. Derating may also be required for the output current depending on the model.	9-152 17-11
The rotation frequency of the motor and the natural frequency of the machine are resonant.	Change the set frequency. If resonance occurs during acceleration/deceleration, avoid the resonance frequency with the frequency jump function ([AG101] to [AG106]).	9-6 9-156
The motor is over-excited.	Match the "IM base frequency [Hb104]" and "Motor rated voltage [Hb106]" with the motor rating. If this does not improve, slightly lower the "Output-voltage gain [Hb180]" or adjust the control method with free V/f response.	8-4 9-38 9-45 9-135

S12: Cannot operate/set via Modbus communication

Possible causal	Example of remedy	Reference
The communication parameter settings (station number, communication speed, and parity settings) are incorrect or changes have not been reflected.	Check the setting of Modbus (I/O) communications related parameter ([CF-01] to [CF-12]). If you change the setting, you must restart the communication by selecting "Communication restart selection [Ub-06]" or turn the power off and on again. For details, see "7.2.3 Restarting the communication settings".	11-1
Operation command selection is not "RS485 setting (03)".	Check if "Operation command selection [AA111]" is set to "RS485 setting (03)".	9-4
Main speed command selection is not "RS485 setting (08)"	Check if "Main speed command selection [AA101]" is set to "RS485 setting (08)".	9-14
Wrong wiring	Check that the communication cable is correctly wired.	11-3
The terminating resistor is connected incorrectly.	Termination resistors must be connected to both ends of the devices connected by RS485 communication. Connect the terminating resistor correctly. If the last stage is WJ-C1, turn ON the terminating resistor selector switch.	11-3
There is a lot of noise and there is a communication error.	Review the wiring, such as changing the wiring to a shielded cable, and review the grounding to the signal ground.	1-9

S13: Earth leakage breaker trips when operating

Possible causal	Example of remedy	Reference
Large leakage current of inverter	Decrease the carrier frequency [bb101].	9-152
	Increase the sensitivity current of the earth leakage breaker or consider replacing the earth leakage breaker with a one with high sensitivity current.	5-9

S14: DC braking does not work

Possible causal	Example of remedy	Reference
DC braking force, DC braking time, etc. are not set or are incorrect.	Check the setting of the DC braking-related parameter ([AF101] to [AF109]).	9-69 9-78
"External DC brake [DB]" is not assigned to the input terminal function or incorrect wiring.	When performing DC braking with signal-input, check with the above sets whether "External DC braking [DB]" is assigned. Also check the [DB] terminals.	9-78 9-204

S15: Noises may occur in devices near inverters, TV/radios etc.

Possible causal	Example of remedy	Reference
Conducted/radiated noise from the inverter	Keep the inverter as far away from nearby devices, TV/radio, etc. as possible.	1-9
	Insert a zero-phase noise filter into the power Input/Output of the inverter. Insert a radio noise filter (XY filter) into the power Input of the inverter.	5-9

S16: Cannot operate/set from optional communication board

Possible causal	Example of remedy	Reference
Operation command selection destination or main speed command selection destination is not "option"	"Option (09)" may not be set for "Main speed command selection [AA101]" and "Option (04)" may not be set for "Operation command selection [AA111]". [AA101], Check the [AA111] setting.	9-4 9-14

S17: Cannot connect to PC software

Possible causal	Example of remedy	Reference
The communication cable is disconnected or incorrect.	Check that there is no disconnection or contact failure at the communication cable or connection terminal, or that the cable specifications are not incorrect, etc.	12-1

Chapter 16 Maintenance and Inspection

16

This chapter describes how to perform maintenance and inspection on the product.
When performing each work, carefully read "Chapter 1 Safety Instructions/Risks" and the corresponding chapters and pay attention to safety.

DANGER

Electric Shock

DO

Prohibited

● **Risk of electric shock !**

- Before inspecting the inverter, be sure to turn off the power supply and wait for 10 minutes or more. (Confirm that the charge lamp on the inverter is turned off and the DC voltage between terminals [P/+] and [N/-] is DC45V or less.)
- 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 withstand voltage test.

Electric Shock Fire Injury

Prohibited

● **Risk of electric shock, fire and injury !**

- Never modify the unit.

16.1 Cautions for maintenance and inspection

16.1.1 Daily inspection

・Check that the following abnormalities are not observed during operation.

No.	Description	☑
1	Motor operation is not abnormal.	☐
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 multimeter, etc.

No.	Description	☑
1	There is no frequent occurrence of variation of power supply voltage.	☐
2	Three-phase AC voltage keeps a good balance.	☐

16.1.2 Cleaning

・Keep the inverter in a clean condition.

No.	Description	☑
1	When cleaning the inverter, use a soft cloth soaked in neutral detergent to gently wipe up the dirtied parts.	☐
2	Do not use solvents such as acetone, benzene, toluene, or alcohol as they may melt the surface or strip the coating of the inverter.	☐
3	Do not use detergents or alcoholic cleaners to clean the keypad displays.	☐

16.1.3 Periodic inspection

・Check sections that cannot be inspected unless operation is stopped and sections requiring periodic inspection.

No.	Description	☑
1	Check that there is no abnormality in the cooling system and clean the air filter, etc.	☐
2	Check the tightness and retighten if necessary. 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	☐

16.1.4 Periodic function test for safety function (STO)

・When handling the HF-620 as a functional safety certified product, be sure to perform the following items. For details, refer to the separate "Safety Function Guide (No. DM2503E)".

・A periodical STO functional test must be performed at least once in a year to maintain the intended safety performance level of the STO function. This periodical STO function test is one of the conditions for the STO function of HF-620 to meet PL e of ISO13849-1 and SIL 3 of IEC61800-5-2.

16.2 Daily inspection and periodic inspection

16.2.1 Inverter inspection list

Inspection part	Inspection items	Details of inspection	Inspection cycle			Inspection method	Criterion	Tester device
			Daily	Every 1 year	Every 2 year			
General	Surrounding environment	Check the ambient temperature, level of humidity, dust, ⋯ etc..	✓			Refer to "Chapter 4 Installation".	The ambient temperature and level of humidity are within the operating range. There are no freeze, condensation, dust, corrosive gas, explosive gas, flammable gas, grinding fluid mist, hydrogen sulfide and salt.	Thermo-meter, Hygro-meter, Data logger
	Whole inverter	Check that there are no abnormal vibrations or noises.	✓			Check visually and auditorily.	No abnormality.	-
	Power supply voltage	Check that the main circuit voltage is normal.	✓			Measure the line-to-line voltage of the inverter main circuit terminals [R/L1], [S/L2], and [T/L3].	Within the allowable AC voltage fluctuation.	Multimeter, Digital multimeter
Main circuit	General check	Check the resistance between the main circuit and the ground terminals. (between main circuit and ground terminals)		✓		Remove all wires from the main circuit terminal and control circuit terminal of the inverter. Then, shortcircuit all terminals of the main circuit terminal, and measure between this shortcircuited part and the ground terminal.	Resistance no less than 5MΩ.	DC500V class ohmmeter (megger)
		Check looseness in tightening parts.		✓		Check tighten.	No abnormality.	-
		Check for overheating traces.		✓		Check visually.	No abnormality.	-
	Conductors an cables	Check for straining in conductors.		✓		Check visually.	No abnormality.	-
		Check for cable coating damage.		✓				
	Terminal block	Check for any damage.		✓		Check visually.	No abnormality.	-
	Inverter and converter circuits (including resistors)	Check the resistance between all the terminals.			✓	Remove all wires from the main circuit terminal of the inverter. Then measure between main power supply terminals and DC bus voltage terminals [P/+]/[N/-], and between motor output terminals and DC bus voltage terminals [P/+]/[N/-] or [+]/[-] in the 1Ω range.	Refer to "16.2.4 Checking the Inverter and Converter Section". Reference for replacement of the inverter and converter Start/Stop:106 cycles [Note:3]	Analog multimeter
	Smoothing capacitor	Check for capacitor fluid leakage.	✓			Check visually.	No abnormality. [Note:1,3,4]	-
		Check that the relief valve does not swell or protude.		✓				
	Relay	No chatter sound while operating.		✓		Check auditorily.	No abnormality.	-
		Check contacts for damage.		✓		Check visually.	No abnormality.	-

Inspection part	Inspection items	Details of inspection	Inspection cycle: Daily	Every 1 year	Every 2 year	Inspection method	Criterion	Tester device
Control circuit Protection circuit	Operation check	While performing a unit operation of the inverter, check the balance of the output voltage among the individual phases.		✓		Measure the line voltages between the [U/T1], [V/T2], and [W/T3] terminals of the inverter main circuit.	Phase-to-phase voltage balance 200V class: within 4V 400V class: within 8V	Digital multimeter Ammeter, Voltmeter
		Carry out a sequential protection test, and check the protective and display circuits for any abnormality.		✓		Simulate a shortcircuit or open of the inverter output protection circuit.	An error must be detected according to the sequence.	-
Cooling system	Cooling fan	Check that there are no abnormal vibrations or noises.	○			Check auditorily and visually.	Smooth operation. No abnormality. Wind flows to the top. Approximate replacement period: 10 years Note:2,3,5	-
		Check for loose connections.		○		Check visually.		-
	Cooling fin	Check for obstrutions/clogging.		○		Check visually.	No clogging.	-
Display	Display	Check if the charge lamp and the keypad's LEDs light up.	○			Check visually.	Check the lighting.	-
		Display cleaning.		○		With cleaning rag.		-
	External meter	Check that Indicated values are normal.	○			Check the meters readings on the control panel.	Regulation and control value are satisfactory.	Voltmeter, Ammeter, etc.
Motor	General	Check that there are no abnormal vibrations or noises.	○			Check visually,auditorily, and by touch.	No abnormality.	-
		Check that there is no odour.	○			Check for abnormal superheating, damages and so on.	No abnormality.	-
	Insulation resistance	Check the resistance between the main circuit and the ground terminals.			Note:6	Remove the wiring from the main circuit terminals [U/T1], [V/T2] and [W/T3] of the inverter, shortcircuit the motor wire (for 3 phases), and measure with a megger between the motor wire andthe ground terminal.	No less than 5MΩ.	DC500V class ohmmeter (megger)

Note: 1. The life span of the smoothing capacitor is influenced by the ambient temperature. Refer to "16.2.5 Smoothing Capacitor Life Curve" for replacing measures.

2. The life span of the cooling fan is influenced by the ambient temperature, the dirt and the change in its environmental conditions. Check these circumstances on the usual inspection.

3. The estimated time before replacement (Number of years/cycle) and the "16.2.5 Smoothing Capacitor Life Curve" are based on the design lifespan, not guaranteed.

4. In case using an inverter with a long storage period, perform the following aging before use. (Aging is not required if the storage temperature is 5 to 35˚C and within 2 years.)

If the input voltage can be adjusted: Input about AC150V for 200V class and about AC300V for 400V class for about 10 minutes, then gradually input higher value and operate while checking the functions.

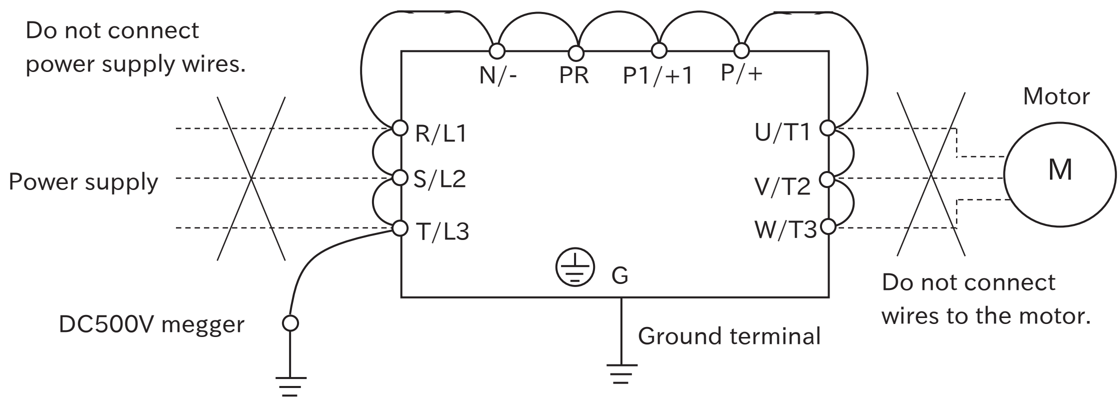
If the input voltage cannot be adjusted: Input the inverter rated voltage and run for about 30 minutes to check for any problems with the functions. Then, turn on the power again to perform full-scale operation.

5. If the cooling fan is locked due to dust, etc., it takes about 5 to 10 seconds to restart even if dust is removed.

6. Follow the instruction manual for the motor.

16.2.2 Megger test

- When testing an external circuit with a megger, disconnect all the external circuit cables from the inverter to prevent it from being exposed to the test voltage.
- In the control circuit carry out a conduction test, use a tester (with high resistance range), do not use a megger or buzzer/continuity tester.
- Use a DC500V megger for the megger test.
- For the megger test of the inverter main circuit, short-circuit the terminals with wires as shown in the figure below.
- As a result of the megger test, if the resistance value is 5MΩ or higher, it is normal.



16.2.3 Withstand voltage test

- Do not carry out a withstand voltage test for the inverter. The test may damage its internal parts, deteriorating the inverter.

16.2.4 Checking the inverter and converter section

Checking method of inverter and converter

・Using the analog multimeter, it can be checked if the inverter or converter unit are defective or non-defective.

1. Preparation

(1) Disconnect all the wires to the main circuit terminals (wires to [R/L1], [S/L2], [T/L3]), [U/T1], [V/T2], [W/T3], [P/+], [P1/+1] [N/-], [PR] terminals).

(2) Preparation the analog multimeter (The use range is 1Ω resistance measurement range.)

2. Checking method

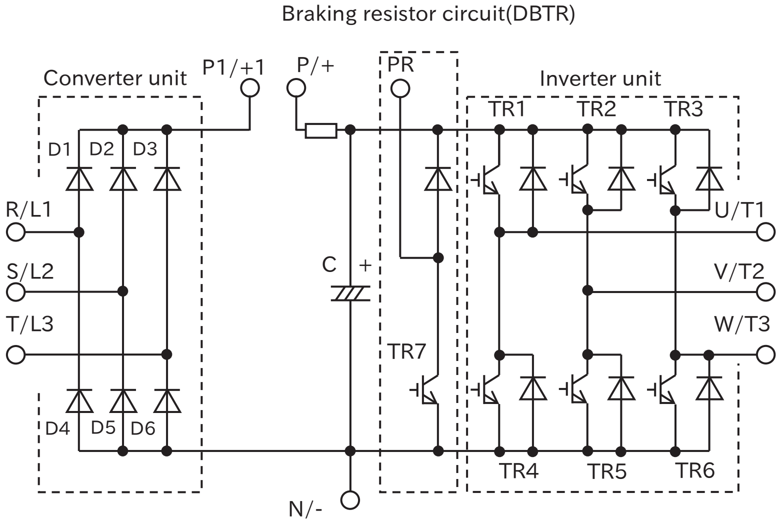
The good-or-bad condition of conduction status of terminals on the inverter main circuit terminal can be judged by alternately changing the polarity of tester for measurement.

・By measuring the DC bus voltage between terminal [P/+] and [N/-] in the DC voltage range, check that electricity is fully discharged from the smoothing capacitor before performing check.

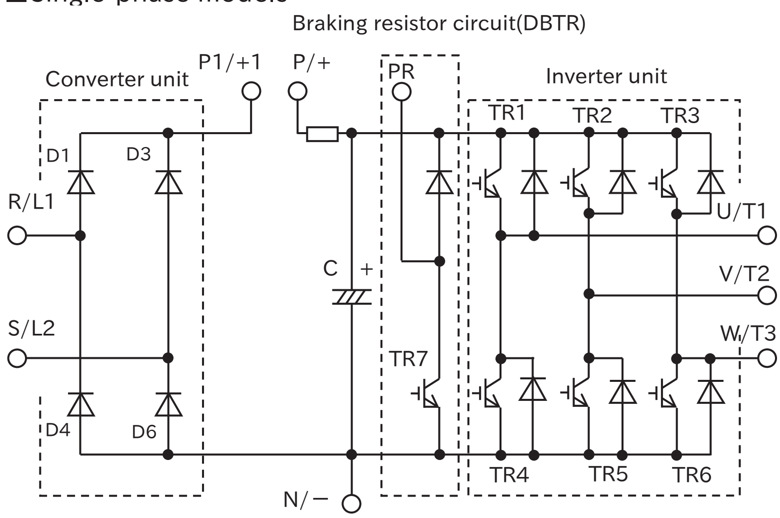
・When electricity is not conducted, the value is almost infinite. When conducting, it indicates several ohms to several tens of ohms. Due to effects of the smoothing capacitor, electricity may be conducted instantly and may not show infinity value. The measured values vary depending on the element type, tester type, etc., but it is acceptable if the values in each section are nearly equal. The measured value may be shifted by several ohms due to the current limiting resistance for preventing inrush current.

		Tester polarity		Measured value
		⊕(Red)	⊖(Black)	
Converter	D1	R/L1	P1/+	Non-conductive
		P1/+	R/L1	Conductive
	D2	S/L2	P1/+	Non-conductive
		P1/+	S/L2	Conductive
	D3	T/L3	P1/+	Non-conductive
		P1/+	T/L3	Conductive
	D4	R/L1	N/-	Conductive
		N/-	R/L1	Non-conductive
	D5	S/L2	N/-	Conductive
		N/-	S/L2	Non-conductive
	D6	T/L3	N/-	Conductive
		N/-	T/L3	Non-conductive
Inverter	TR1	U/T1	P/+	Non-conductive
		P/+	U/T1	Conductive
	TR2	V/T2	P/+	Non-conductive
		P/+	V/T2	Conductive
	TR3	W/T3	P/+	Non-conductive
		P/+	W/T3	Conductive
	TR4	U/T1	N/-	Conductive
		N/-	U/T1	Non-conductive
	TR5	V/T2	N/-	Conductive
		N/-	V/T2	Non-conductive
	TR6	W/T3	N/-	Conductive
		N/-	W/T3	Non-conductive
DBTR	TR7	PR	P/+	Non-conductive
		P/+	PR	Conductive
		PR	N/-	Uncertainly
		N/-	PR	Non-conductive

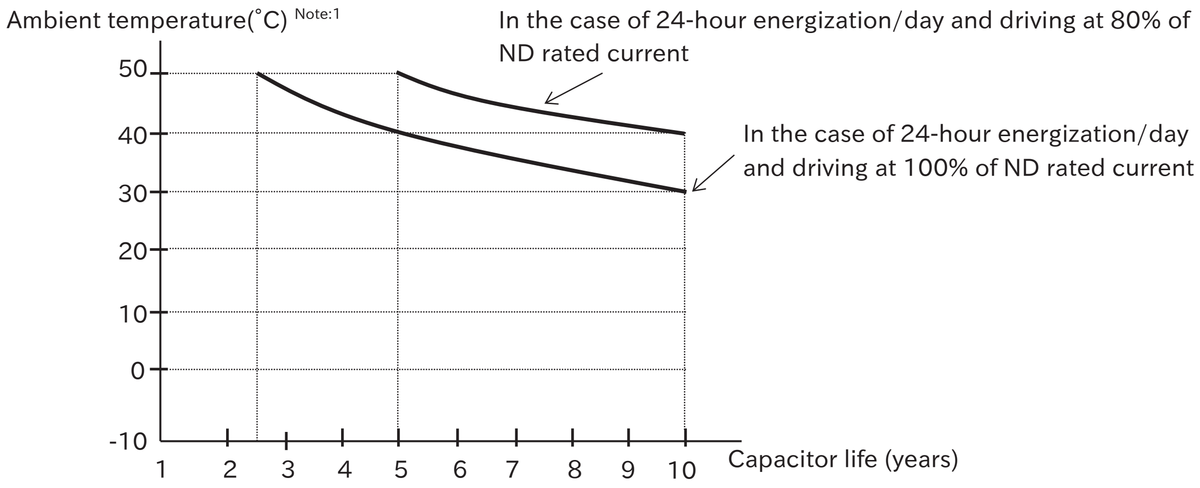
■Three-phase models



■Single-phase models



16.2.5 Smoothing capacitor life curve



Note: 1. The ambient temperature is a temperature measured at a position about 5cm from the bottom center of the inverter (atmospheric temperature). When the inverter is installed in the cabinet, it is the temperature inside the cabinet.

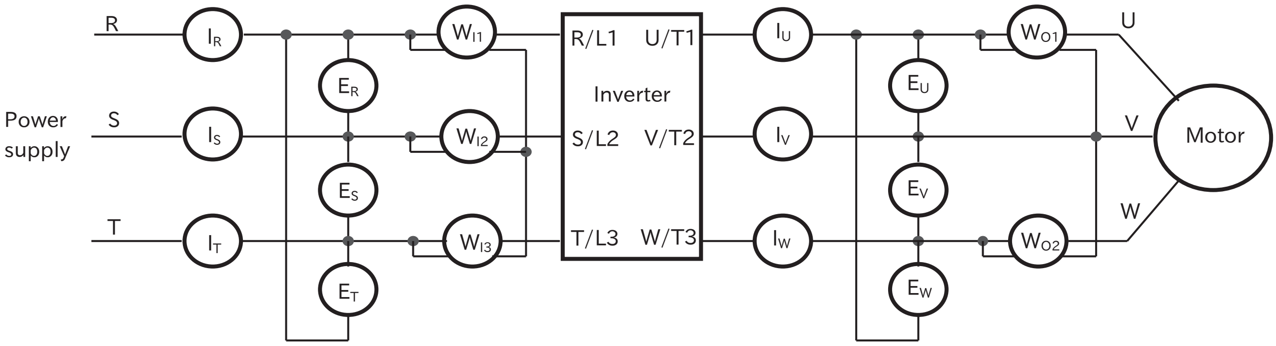
2. The smoothing capacitor is a finite life component which occurs chemical reaction inside, replacement is required after 10 years of use (It is a designed expected life, not a guaranteed value).
However, if the inverter is used in an environment at high temperature or in a heavy-load environment where its rated current is exceeded, the life is significantly shortened.

16.2.6 Life warning output

- By the self-diagnostic, it is possible to output an alarm in regards of the inverter own internal components lifespan when the lifespan is nearing to its end (the cooling fan, the circuit board electrolytic capacitor, the power module and the inrush current prevention circuit).
  If the life warning output of the cooling occurs, the cooling fan should be replaced. If other life warning output occurs, the inverter replacement is required.
- The life diagnosis of each life component can be checked using the output terminal functions "Capacitor life warning [WAC]", "Cooling-fan life warning [WAF]", "Power module life warning [WAP]", "Inrush circuit life warning [WAIC]", or "Life assessment monitor [dC-16]".
- The life diagnostics of the electrolytic capacitor on the board and the cooling fan can be checked with "Capacitor life warning [WAC] (39)" and "Cooling-fan life warning [WAF] (40)" output terminals or "Life assessment monitor [d022]".
- For details of each life diagnosis functions, refer to "9.11.9 Outputting a Warning for Capacitor Life on the Board", "9.11.10 Outputting a Warning for Cooling-Fan Life", "9.11.11 Outputting a Warning for Power Module", "10.3.3 Monitor the Results of Lifetime Diagnosis", respectively. Since these alarms are based on the design lifespan (not guaranteed values), problems may arise depending on the environment, the operation conditions, etc. It is recommended an early maintenance.

16.2.7 Measurement method of input/output voltage, current and power

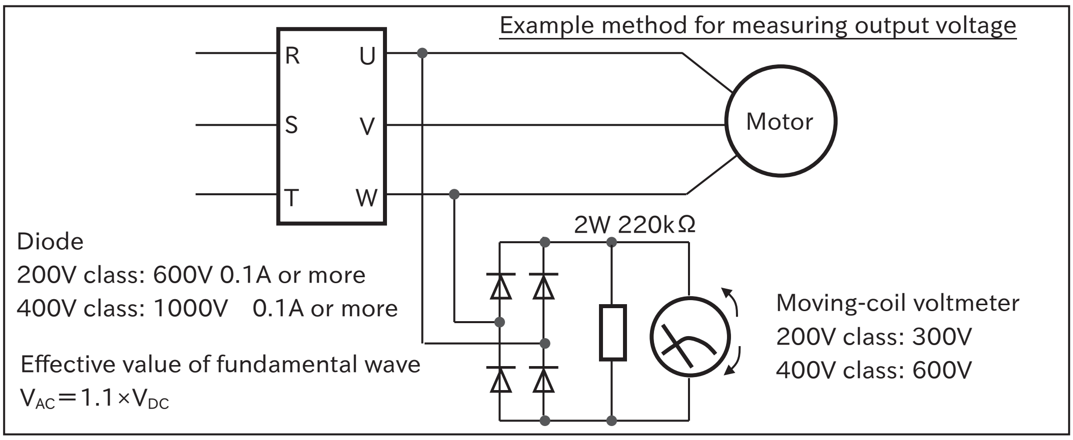
・Typical instruments for measuring input/output voltage, current and power are shown below.



Measurement data	Measurement point	Measuring instrument	Remarks	Standard reference values
Input voltage E_{IN}	R-S, S-T, T-R (E_R) (E_S) (E_T)	Moving-iron voltmeter or Rectifier-type voltmeter	Effective value of full waves	200V class: 200 to 240V, 50/60Hz 400V class: 380 to 480V, 50/60Hz
Input current I_{IN}	R, S, T current (I_R) (I_S) (I_T)	Moving-iron voltmeter		When there is unbalance in the input supply $I_{IN} = (I_R + I_S + I_T)/3$
Input power W_{IN}	R-S、S-T、T-R (W_{I1})+(W_{I2})+(W_{I3})	Electrodynamometer-type wattmeter Note:1		Three-wattmeter method
Power factor P_{fIN}	Calculated from the measured values of the input voltage (E_{IN}), power input current (I_{IN}), and input power (W_{IN}). $P_{fIN} = \frac{W_{IN}}{\sqrt{3} \times E_{IN} \times I_{IN}} \times 100$			-
Output voltage E_{OUT}	U-V, V-W, W-U (E_U) (E_V) (E_W)	See the figure below or Rectifier-type voltmeter Note:1,2	Effective value of fundamental wave	-
Output current I_{OUT}	U, V, W current (I_U) (I_V) (I_W)	Moving-iron ammeter Note:1,2	Effective value of full waves	
Output power W_{OUT}	U-V, V-W (W_{O1})+(W_{O2})	Electrodynamometer-type wattmeter Note:1,2		Two-wattmeter method (or three-wattmeter method)
Output power factor P_{fOUT}	Calculated from the measured values of the output voltage (E_{OUT}), output current (I_{OUT}), and output power (W_{OUT}). $P_{fOUT} = \frac{W_{OUT}}{\sqrt{3} \times F_{OUT} \times I_{OUT}} \times 100$			-

Note: 1. Use instruments that show the effective value of the fundamental wave for the output voltage and the effective value of full waves for the current and power.

2. Since the inverter output waveform is controlled by PWM, it has a large margin of error, especially at low frequencies. In many cases, general multimeters may be defective for the measurement, because of the adverse effects of the noise.



17

Chapter 17 Specifications

This chapter describes product specifications, external dimensions and current deratings.
The abbreviations used in the product specifications show the following meanings.

- Load rating: ND = Normal duty rating (Overload current rating 150%/60s)
  LD = Light duty rating (Overload current rating 120%/60s)
  (For details, refer to "8.1.2 Changing the Load Rating of the Inverter".)
- Motor type: IM = induction motor
  SM/PMM = synchronous motor/permanent magnet motor

17.1 Standard specifications

17.1.1 Single-phase 200V class

Model name				HF620S-A20	HF620S-A40	HF620S-A75	HF620S-1A5	HF620S-2A2
Applicable motor capacity (4 poles) (kW)			LD	0.4	0.55	1.1	2.2	3.0
			ND	0.2	0.4	0.75	1.5	2.2
Output	Rated output current (A) Note:1		LD	2.0	3.5	6.0	9.8	12.2
			ND	1.6	3.2	5.0	8.0	11.0
	Overload current rating		LD	120% / 60s				
			ND	150% / 60s				
	Rated output voltage			Three-phase 200 to 240V (Output above the incoming voltage is not possible.)				
	Rated power (kVA)	200V	LD	0.7	1.2	2.0	3.4	4.2
			ND	0.5	1.1	1.7	2.7	3.8
		240V	LD	0.8	1.4	2.4	4.0	5.0
			ND	0.6	1.3	2.0	3.3	4.5
Input	Rated input current (A) Note:2		LD	3.6	7.3	13.8	20.2	24.0
			ND	3.0	6.3	11.5	16.8	22.0
	Rated input AC voltage Note:3			Single-phase 200 to 240V (-15%/+10%), 50/60Hz ±5%				
	Power supply capacity (kVA) Note:4		LD	10.0	10.0	10.0	10.0	10.0
			ND	10.0	10.0	10.0	10.0	10.0
Carrier frequency variation Note:5			LD	2.0 to 10.0kHz				
			ND	2.0 to 15.0kHz				
Starting torque Note:6				200% / 0.5Hz				
Brake	Regenerative brake Note:7			Internal braking resistor operating circuit (connect the external braking resistor)				
	Minimum resistance value of connectable braking resistor (Ω)			100	100	50	50	35
Cooling method				Self-cooling (without Fan)			Forced air cooling (with Fan)	
Dimensions	H (height) (mm)			128	128	128	128	128
	W (width) (mm)			68	68	108	108	108
	D (depth) (mm) Note:8			109	122.5	170.5	170.5	170.5
Protective structure				IP20 / UL open type				
Approximate weight (kg)				1.0	1.1	1.6	1.8	1.8

Note:

1. Some models require current derating depending on the carrier frequency setting and ambient temperature. For details, refer to "17.3 Current Derating". (Please contact us for models not described.)
2. The rated input current is the value at the rated output current. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.). The input current on the specification label indicates the UL-certified current.
3. Compliance with the Low Voltage Directive (LVD) is as follows. -Pollution degree 2, -Overvoltage category 3
4. Power supply capacity is the value of the rated output current at 220V. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.).
5. The setting range of "Carrier Frequency setting [bb101]" is limited according to "Load type selection [Ub-03]". It is recommended to set the carrier frequency setting equal or greater than the (maximum output frequency×10) Hz.
6. The value is specified for the Sumitomo standard motor controlled by the sensorless vector control at ND rating. Torque characteristics may vary depending on the control mode and the motor used.
7. In case of shortage for braking torque using internal brake circuit, connect the external brake unit (option).
8. D dimension is without 3mm for dial projection. When the optional unit is connected, dimension D is increases. Refer to the option manuals.

17.1.2 Three-phase 200V class

Model name			HF6202-A20	HF6202-A40	HF6202-A75	HF6202-1A5	HF6202-2A2	HF6202-3A7	HF6202-5A5	HF6202-7A5
Applicable motor capacity (4 poles) (kW)		LD	0.4	0.75	1.1	2.2	3.0	5.5	7.5	11
		ND	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Rated output current (A) Note:1	LD	2.0	3.5	6.0	9.8	12.2	19.6	30.0	45.0
		ND	1.6	3.2	5.0	8.0	11.0	17.5	25.0	33.5
	Overload current rating	LD	120% / 60s							
		ND	150% / 60s							
	Rated output voltage		Three-phase 200 to 240V (Output above the incoming voltage is not possible.)							
	Rated power (kVA) 200V	LD	0.7	1.2	2.0	3.4	4.2	6.7	10.3	15.6
		ND	0.5	1.1	1.7	2.7	3.8	6.0	8.6	11.6
	Rated power (kVA) 240V	LD	0.8	1.4	2.4	4.0	5.0	8.1	12.4	18.7
		ND	0.6	1.3	2.0	3.3	4.5	7.2	10.3	13.9
Input	Rated input current (A) Note:2	LD	2.0	3.9	7.2	10.8	13.9	23.2	37.0	48.0
		ND	1.6	3.3	6.0	9.0	12.7	20.5	30.8	39.6
	Rated input AC voltage Note:3		Three-phase 200 to 240V (-15%/+10%), 50/60Hz ±5%							
	Power supply capacity (kVA) Note:4	LD	10.0	10.0	10.0	10.0	10.0	20.0	30.0	50.0
		ND	10.0	10.0	10.0	10.0	10.0	20.0	20.0	30.0
Carrier frequency variation Note:5		LD	2.0 to 10.0kHz							
		ND	2.0 to 15.0kHz							
Starting torque Note:6			200% / 0.5Hz							
Brake	Regenerative brake Note:7		Internal braking resistor operating circuit (connect the external braking resistor)							
	Minimum resistance value of connectable braking resistor (Ω)		100	100	50	50	35	35	20	17
Cooling method			Self-cooling (without FAN)			Forced air cooling (with FAN)				
Dimensions	H (height) (mm)		128	128	128	128	128	128	260	260
	W (width) (mm) Note:8		68	68	68	108	108	140	140	140
	D (depth) (mm)		109	122.5	145.5	170.5	170.5	170.5	155	155
Degree of protection			IP20 / UL open type							
Approximate weight (kg)			1.0	1.1	1.2	1.6	1.8	2.0	3.5	3.5

Note:

1. Some models require current derating depending on the carrier frequency setting and ambient temperature. For details, refer to "17.3 Current Derating". (Please contact us for models not described.)
2. The rated input current is the value at the rated output current. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.). The input current on the specification label indicates the UL-certified current.
3. Compliance with the Low Voltage Directive (LVD) is as follows. -Pollution degree 2, -Overvoltage category 3
4. Power supply capacity is the value of the rated output current at 220V. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.).
5. The setting range of "Carrier Frequency setting [bb101]" is limited according to "Load type selection [Ub-03]". It is recommended to set the carrier frequency setting equal or greater than the (maximum output frequency×10) Hz.
6. The value is specified for the Sumitomo standard motor controlled by the sensorless vector control at ND rating. Torque characteristics may vary depending on the control mode and the motor used.
7. In case of shortage for braking torque using internal brake circuit, connect the external brake unit (option).
8. Dimension D is without 3mm for dial projection. When the optional unit is connected, dimension D is increases. Refer to the option manuals.

17.1.3 Three-phase 400V class

Model name				HF6204-						
				A40	A75	1A5	2A2	3A7	5A5	7A5
Applicable motor capacity (4 poles) (kW)			LD	0.75	1.5	2.2	3.0	5.5	7.5	11
			ND	0.4	0.75	1.5	2.2	4.0	5.5	7.5
Output	Rated output current (A) Note:1		LD	2.1	4.1	5.5	7.1	11.9	17.5	24.0
			ND	1.8	3.4	4.8	6.0	9.2	14.8	19.0
	Overload current rating		LD	120% / 60s						
			ND	150% / 60s						
	Rated output voltage			Three-phase 380 to 480V (Output above the incoming voltage is not possible.)						
	Rated power (kVA)	380V	LD	1.3	2.6	3.6	4.6	7.8	11.5	15.7
			ND	1.1	2.2	3.1	3.9	6.0	9.7	12.5
		480V	LD	1.7	3.4	4.5	5.9	9.8	14.5	19.9
			ND	1.4	2.8	3.9	4.9	7.6	12.3	15.7
Input	Rated input current (A) Note:2		LD	2.1	4.3	5.9	8.1	13.3	20.0	24.0
			ND	1.8	3.6	5.2	6.5	11.0	16.9	19.0
	Rated input AC voltage Note:3			Three-phase 380 to 480V (-15%/+10%), 50/60Hz ±5%						
	Power supply capacity (kVA) Note:4		LD	10.0	10.0	10.0	10.0	20.0	30.0	30.0
			ND	10.0	10.0	10.0	10.0	20.0	20.0	30.0
Carrier frequency variation Note:5			LD	2.0 to 10.0kHz						
			ND	2.0 to 15.0kHz						
Starting torque Note:6				200% / 0.5Hz						
Brake	Regenerative brake Note:7			Internal braking resistor operating circuit (connect the external braking resistor)						
	Minimum resistance value of connectable braking resistor (Ω)			180	180	180	100	100	70	70
Cooling method				Self-cooling (without FAN)	Forced air cooling (with FAN)					
Dimensions	H (height) (mm)			128	128	128	128	128	260	260
	W (width) (mm)			108	108	108	108	140	140	140
	D (depth) (mm) Note:8			143.5	170.5	170.5	170.5	170.5	155	155
Degree of protection				IP20 / UL open type						
Approximate weight (kg)				1.5	1.8	1.8	1.8	2.0	3.5	3.5

Note:
1. Some models require current derating depending on the carrier frequency setting and ambient temperature. For details, refer to "17.3 Current Derating". (Please contact us for models not described.)
2. The rated input current is the value at the rated output current. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.). The input current on the specification label indicates the UL-certified current.
3. Compliance with the Low Voltage Directive (LVD) is as follows. -Pollution degree 2, -Overvoltage category 3
4. Power supply capacity is the value of the rated output current at 440V. The value changes according to the impedance on the power supply side (wiring, breaker, input reactor option, etc.).
5. The setting range of "Carrier Frequency setting [bb101]" is limited according to "Load type selection [Ub-03]". It is recommended to set the carrier frequency setting equal or greater than the (maximum output frequency×10) Hz.
6. The value is specified for the Sumitomo standard motor controlled by the sensorless vector control at ND rating. Torque characteristics may vary depending on the control mode and the motor used.
7. In case of shortage for braking torque using internal brake circuit, connect the external brake unit (option).
8. Dimension D is without 3mm for dial projection. When the optional unit is connected, dimension D is increases. Refer to the option manuals.

17.1.4 Common Specifications

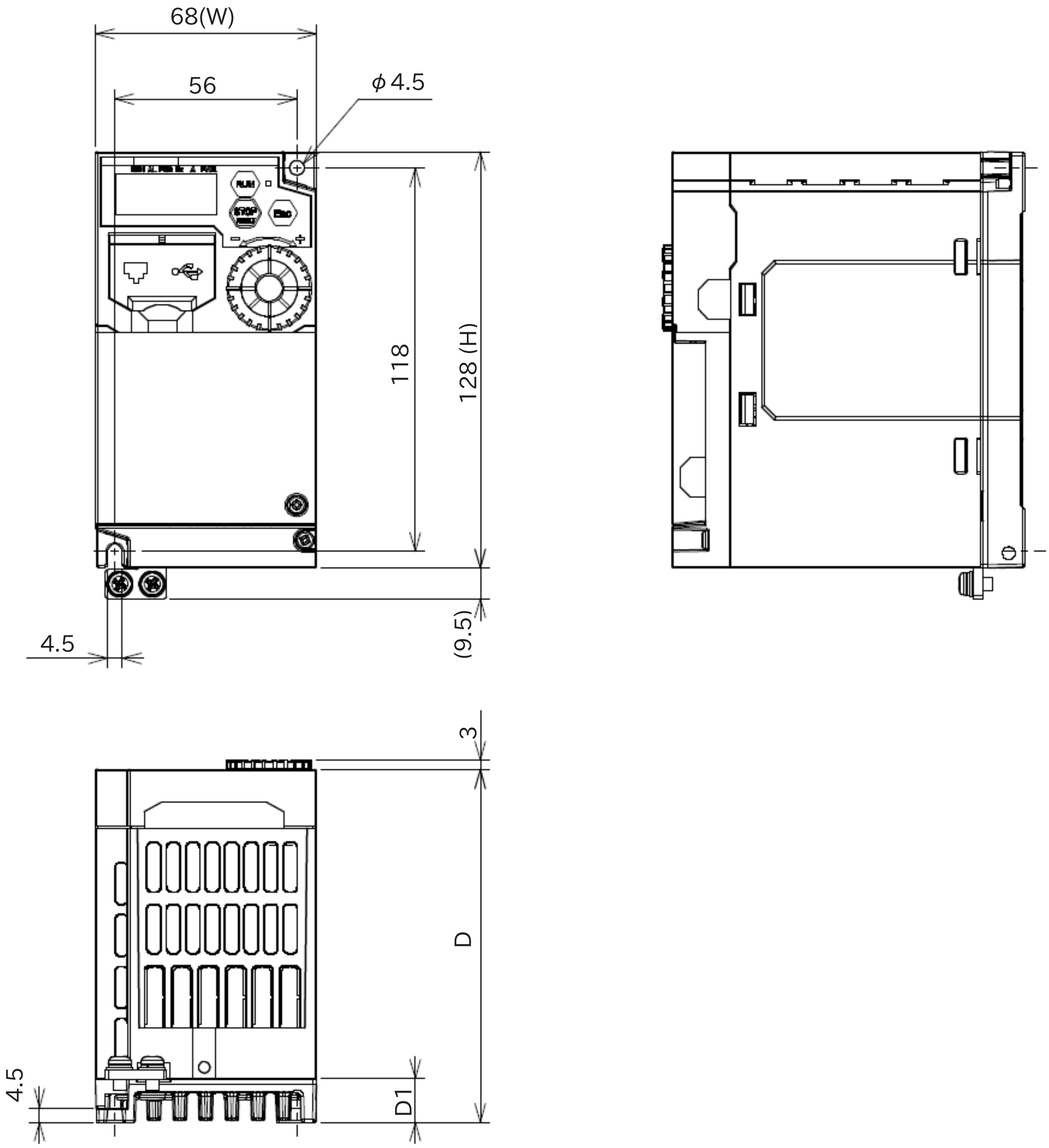
Item			Specifications	
Control method			PWM control (Switch between 3-phase modulation and 2-phase modulation)	
Output frequency range Note:1			0.01 to 590.00Hz	
Frequency accuracy			For the maximum frequency, digital ± 0.01%, analog ± 0.2% (25 ± 10°C)	
Frequency resolution			Digital: 0.01Hz, analog: maximum frequency/1000	
Control mode Note:2 (Voltage/frequency calculation)			IM	V/f control (Constant torque, Reduce torque, Free-V/f, Automatic torque boost) Sensorless vector control (With carrier frequency derating at low sepeed)
			SM/PMM	PM sensorless vector control Note:3
Acceleration/deceleration time			0.00 to 3600.00s (linear, S-curve, U-curve, inverted U-curve, EL-S-curve)	
Starting torque			200% / 0.5Hz (at IM sensorless vector control)	
Monitor function			Output frequency, Output current, Output torque Note:4, Trip history, Input/Output terminal status, Input power Note:5, Output power Note:5, etc. For details of monitor function, refer to "Chapter 10 Monitor Functions".	
Starting function			Starting after DC braking, Active frequency matching, Reduced voltage start, Trip retry restart	
Stop function			DC braking after deceleration stop or free run stop, DC braking by input terminal (Braking force, time, and operating speed are adjustable.)	
Stall prevention function			Stall prevention, Overcurrent suppression, Overvoltage suppression	
Protection function Note:6			Overcurrent error, Motor overload error, Braking resistor overload error, Overvoltage error, Memory error, Undervoltage error, Current detector error, CPU error, External trip, USP error, Ground fault, Input overvoltage error, Temperature detector error, Temperature error, CPU communication error, Input phase loss, Main circuit error, Analog input level over error, IGBT(Driver) error, Output phase loss, Thermistor error, Brake error, Overload error at low speed, Controller overload error, Operator keypad disconnection error, RTC error, Option related errors, Functional safety related errors, Encoder disconnection, Positioning range error, Speed deviation error, Excessive speed error, Contactor error, PID soft start error, Abnormal upper/lower detecting error For details of protection function, refer to "15.2 Troubleshooting for Protection Functions Related Error".	
Other functions			Free-V/f, Manual torque boost, Output voltage gain, AVR, Braking resistor circuit (DBTR), PID control, Motor constant selection, Auto-tuning, Stabilization control, Direction reversal protection, Position control, Torque control, Torque limit, Automatic carrier reduction, Energy saving operation, Brake control, Instantaneous power failure non-stop, Commercial power supply switching, Minimum frequency, Upper/lower frequency limit, Window comparator, Frequency jump, Acceleration/deceleration stop, Frequency calculation/addition, 2-stage acceleration/deceleration, External start/end, Multi-speed, Analog output adjustment, Stop selection, Input terminal response, Output signal delay, Soft-Lock, Operation direction limit, STOP/RESET key selection, Scaling function, Cooling-fan ON/OFF, Display restriction, Password function, Initial display selection, For details of each function, refer to chapter 7 to 10.	
Input	Frequency reference	Keypad	The parameters for the command value set by dial, Esc key and SET key on the keypad	
		External signal Note:7	Analog input (Terminal [VRF]/[IRF]) (Switch between voltage and current input by parameter setting.)	0 to 10V voltage input (Input impedance: 10kΩ)
				4 to 20mA current input (Input impedance: 100Ω)
			Multi-speed terminal (input terminal function used.)	Maximum 16 speeds
			Pulse input (Input terminal [RST]/[PLA])	Maximum 32kHz x 2
		External port	RS485 serial communication (Modbus-RTU), USB (PC Software), Remote operator, Communication option	
	Forward/ Reverse Run/Stop	Keypad	RUN and STOP/RESET key on the keypad (Forward/Reverse can be switched by parameter setting.)	
		External signal	"Forward [FR]"/"Reverse [RR]", 3-wire input (When input termnal functions are asigned)	
		External port	RS485 serial communication (Modbus-RTU), USB (PC Software), Remote operator, Communication option	
	Input terminal function		Input terminal function can be indivisually assiegned to input terminal [FR] to [PLA]. For details of types of input terminal function, refer to "9.15.1 Using External Input Signal Functions".	
	Analog input		2 terminals (Terminal [VRF]/[IRF]: 0 to 10V voltage input, 4 to 20mA current input) (Switch between voltage and current input by parameter setting.)	
	Backup power supply terminal		External +24V power supply can be input from [P24] terminal. (Installation of a reverse current prevention diode is mandatory.)	
	Safety function STO input terminal		2 terminals (Terminal [ST1]/[ST2])	
	Thermistor input terminal		1 terminal (PTC type thermistor can be connented to input terminal [AUT])	
	Pulse input terminal		Input terminal [PLA] (A-phase), [RST] (B-phase), [ES] (Z-phase [PLZ]), or amy input terminals assigned input terminal functions [PLA]/[PLB]. (Terminals differ depending on parameter settings and functions used. For details, refer to the related pages of following functions: Frequency reference, Pulse counter, PID feedback, PID target value, Control with encoder, and Position control functions)	

Item		Specifications
Output	Output terminal function	Output terminal function can be indivisually assigned to 2 open collector output terminals (Output terminal [UPF]/[DRV]) and a relay output terminal [ML]. For details of types of output terminal function, refer to "9.16.1 Using External Output Signal Functions".
	Functional safety EDM output	STO state monitor (Output terminal [UPF] is switched to [EDM] by slide switch)
	Monitor output Note:8	2 terminals Terminal [AMI]: 0 to 10V analog voltage output / 4 to 20mA analog current output Terminal [AMV]: Pulse output (max. 32kHz)/10V output) / 0 to 10V analog voltage output
EMC noise filter		Not built-in (optional external filter can be connected)
PC external access		USB Micro-B
Operating environment	Ambient temperature	ND (Normal duty): -10 to 50℃ / LD (Light duty): -10 to 40℃
	Storage Temperature Note:9	-20 to 65℃
	Humidity	20 to 90% RH (non-condensing)
	Vibration	10 to 57Hz: amplitude 0.075mm 57 to 150Hz: 9.8m/s^2 (1.0G)
	Installation place Note:10	Altitude: 1000m or less, indoors (free from corrosive gases, oil mist, and dust)
Components life span		The design life of the electrolytic capacitor on the board and the main circuit smoothing capacitor is 10 years.
		The design life of cooling fan is 10 years (models with cooling fan) with no dust.
		Non-volatile memory parts on control circuit board.
Conformity standards Note:11,12,13		CE: EN IEC 61800-3 (EMC-filter option required) EN 61800-5-1 UL: UL 61800-5-1, -Overvoltage Category 3, -Pollution Degree 2 Others: c-UL Functional safety: STO(Safe torque off) function / IEC 61508, EN 61800-5-2: SIL3、 EN ISO 13849-1: Cat.3 PLe IEC 60204-1: Stop Cat.0
Option board connector		One unit can be mounted
Other optional components		AC reactor, DC reactor, Noise filter, Radio noise filter(XY filter), Zero-phase reactor, Braking resistor, Brake unit, Remote operator (OS-44 ver.2.0 onwards), PC software, etc.

Note:
1. The output frequency range depends on the control mode and the motor used. Consult the motor manufacturer for the maximum allowable frequency of the motor when operating beyond 60Hz.
2. In case that the control mode is changed and the motor constant settings are not appropriate, the desired starting torque cannot be obtained and also exists the possibility of tripping.
3. Contact your supplier when driving SM/PMM.
4. Output torque monitor is reference value. They are not suitable for calculation of efficiency values, etc. To obtain an accurate value, use an external device.
5. Input power monitor and output power monitor are reference values. They are not suitable for calculation of efficiency values, etc. To obtain an accurate value, use an external device.
6. When "IGBT(Driver) error [E030]" occurs by the protective function, it may have happened by the short-circuit protection, but also can occur when the IGBT is damaged. Depending on the operating conditions of the inverter, "Overcurrent error [E001]" may occur instead of [E030].
7. At factory setting, the maximum output frequency for analog input [VRF] is adjusted to 9.8V for voltage input and [IRF] is adjusted to 19.8mA for current input. To change the characteristics, refer to the analog start/end function.
8. Analog monitor output is a reference output for analog meter or digital frequency meter connection. The maximum output value may deviate slightly due to variations in the connected meters and analog output circuits. To change the characteristics, use [AMI]/[AMV] adjust function.
9. The storage temperature is the temperature during transportation.
10. In case of installing at an altitude of 1000m or more, the atmospheric pressure decreases by approximately 1% for every 100m altitude increase. Apply 1% current derating from the rated current by increasing every 100m and conduct an evaluation test. When using at an altitude of 2500m, please contact your supplier.
11. Insulation distance conforms to UL and CE standards.
12. For details of standards of functional safety, refer to the separate "Safety Function Guide (No. DM2503E)".
13. The standards information on this document is as of June 2023.

17.2 External dimensions

Power supply	Model	W (mm)	H (mm)	D (mm)	D1 (mm)	Approx. weight (kg)
Single-phase 200V class	HF620S-A20			109	13.5	1.0
	HF620S-A40			122.5	27	1.1
Three-phase 200V class	HF6202-A20	68	128	109	13.5	1.0
	HF6202-A40			122.5	27	1.1
	HF6202-A75			145.5	50	1.2



<table>
<tr><th>Power supply</th><th>Model</th><th>W (mm)</th><th>H (mm)</th><th>D (mm)</th><th>D1 (mm)</th><th>Approx. weight (kg)</th></tr>
<tr><td rowspan="3">Single-phase 200V class</td><td>HF620S-A75</td><td rowspan="9">108</td><td rowspan="9">128</td><td rowspan="5">170.5</td><td rowspan="5">55.5</td><td>1.6</td></tr>
<tr><td>HF620S-1A5</td><td rowspan="2">1.8</td></tr>
<tr><td>HF620S-2A2</td></tr>
<tr><td rowspan="2">Three-phase 200V class</td><td>HF6202-1A5</td><td>1.6</td></tr>
<tr><td>HF6202-2A2</td><td>1.8</td></tr>
<tr><td rowspan="4">Three-phase 400V class</td><td>HF6204-A40</td><td>143.5</td><td>28.5</td><td>1.5</td></tr>
<tr><td>HF6204-A75</td><td rowspan="3">170.5</td><td rowspan="3">55.5</td><td rowspan="3">1.8</td></tr>
<tr><td>HF6204-1A5</td></tr>
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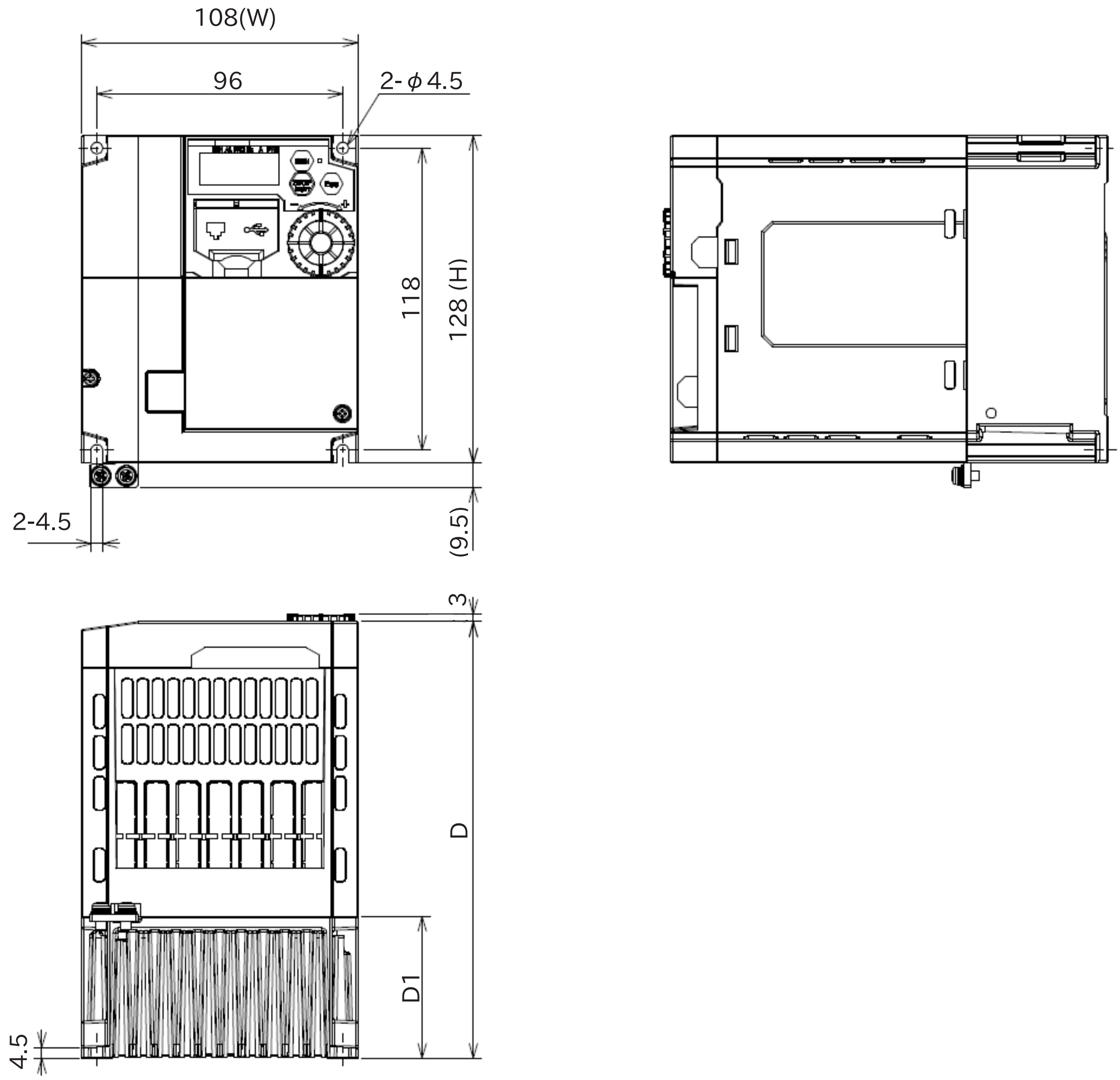
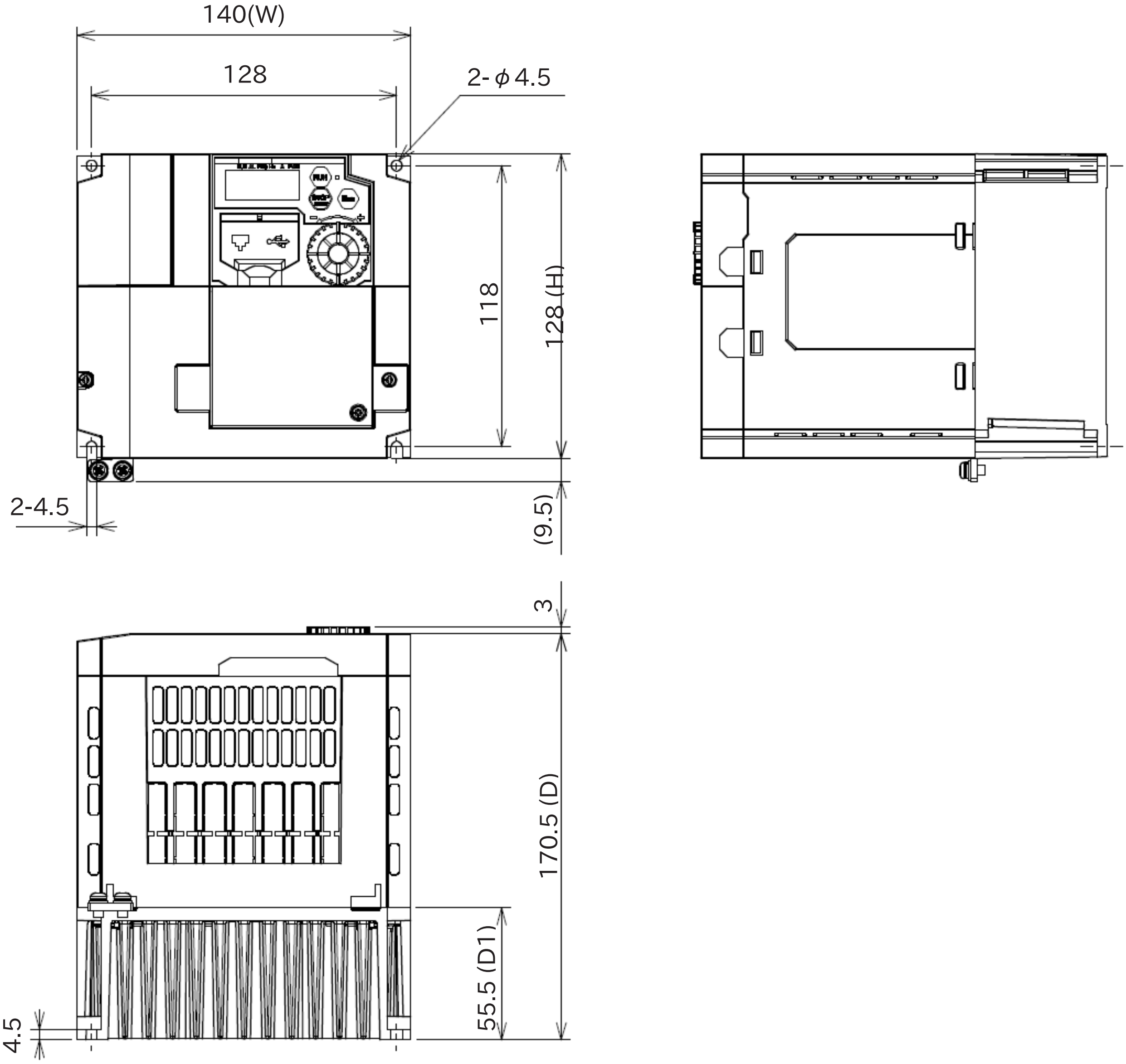
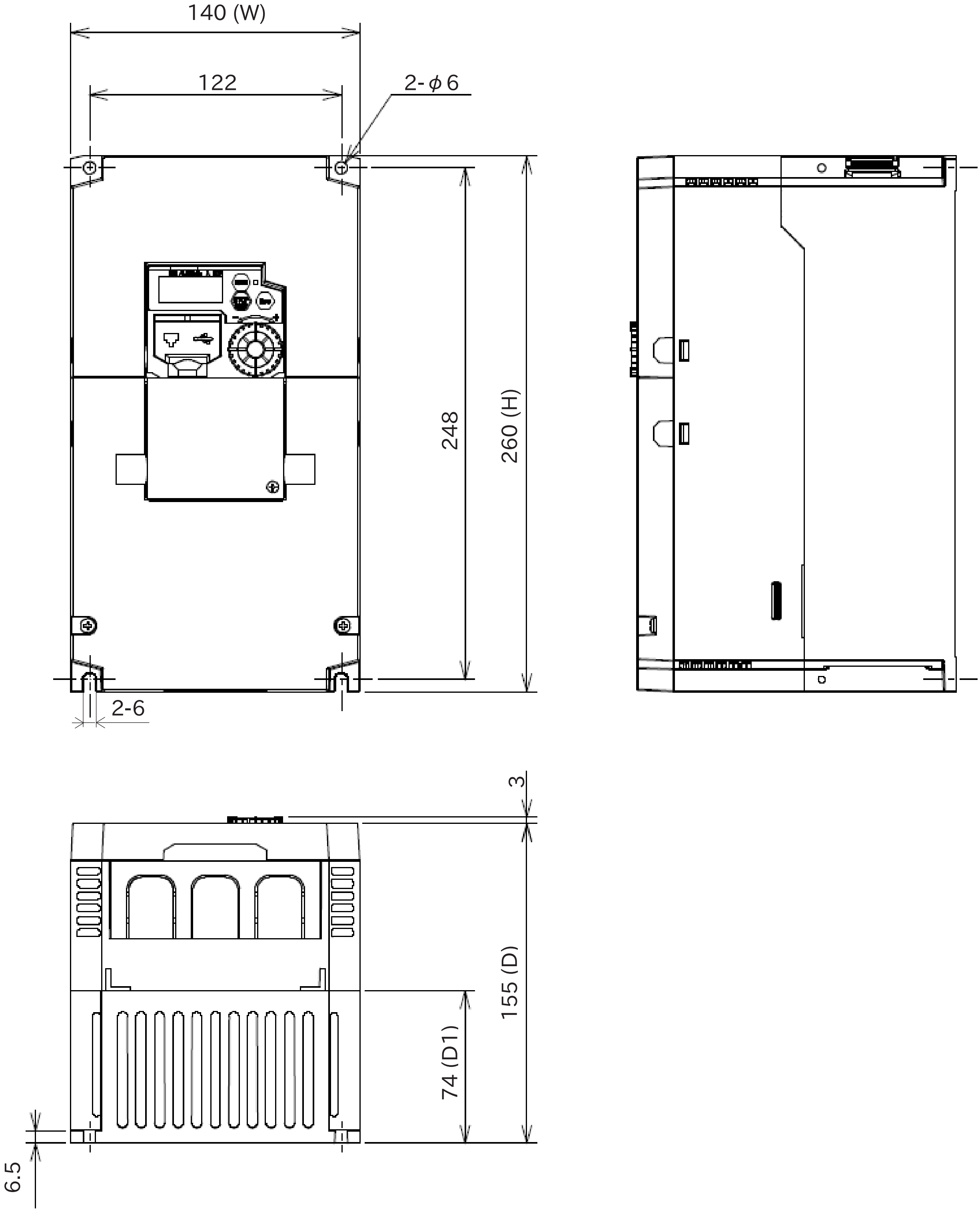


Power supply	Model	W (mm)	H (mm)	D (mm)	D1 (mm)	Approx. weight (kg)
Three-phase 200V class	HF6202-3A7	140	128	170.5	55.5	2.0
Three-phase 400V class	HF6204-3A7					



Power supply	Model	W (mm)	H (mm)	D (mm)	D1 (mm)	Approx. weight (kg)
Three-phase 200V class	HF6202-5A5	140	260	155	74	3.5
	HF6202-7A5					
Three-phase 400V class	HF6204-5A5					
	HF6204-7A5					



17.3 Current derating

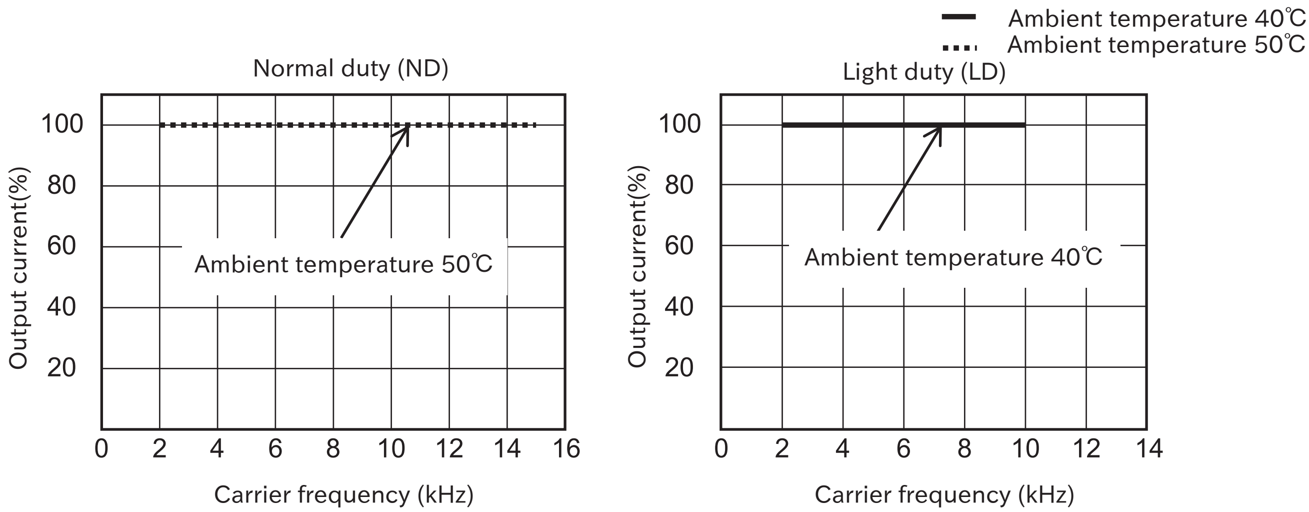
- When using a model that is checked with "○" in the "Required" column in the table below, perform current derating as shown in the graph below.
- Set the output current value to be derated in "Electronic thermal level setting [bC110]". For details, refer to "8.1.4 Setting Electronic Thermal for the Motor".
- When the product is used beyond the derating, it may cause damage to the inverter and shorten the product life.

■Derating necessity table

Single-phase 200 V	Required	Three-phase 200 V	Required	Three-phase 400 V	Required
HF620S-A20	-	HF6202-A20	○	HF6204-A40	○
HF620S-A40	○	HF6202-A40	-	HF6204-A75	○
HF620S-A75	○	HF6202-A75	-	HF6204-1A5	-
HF620S-1A5	-	HF6202-1A5	-	HF6204-2A2	-
HF620S-2A2	-	HF6202-2A2		HF6204-3A7	○
-	-	HF6202-3A7	○	HF6204-5A5	-
		HF6202-5A5	-	HF6204-7A5	-
		HF6202-7A5	-	-	-

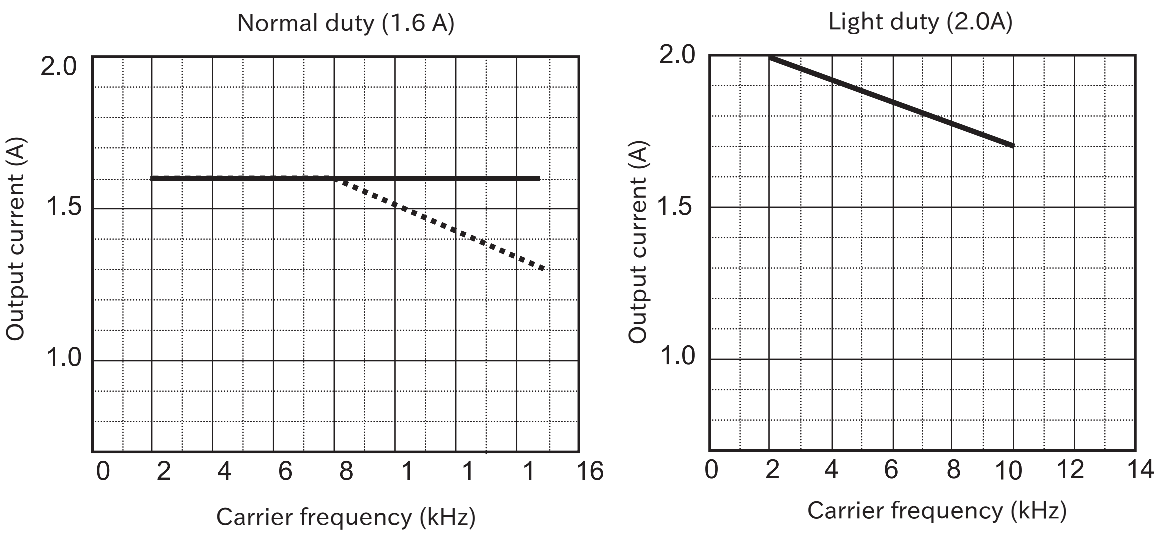
○: Derating required　- : Derating not required

Models that do not require current derating (common)



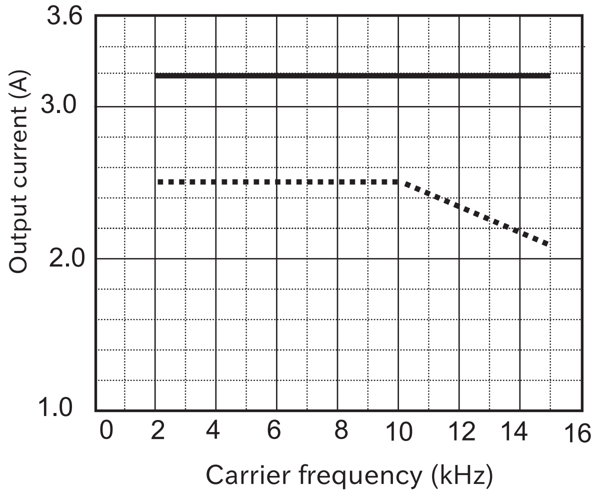
Models requiring current derating

■ HF6202-A20

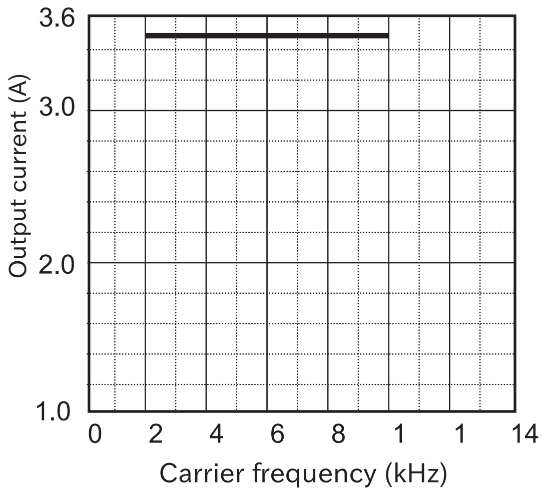


■ HF-620S-A40

Normal duty (3.2 A)

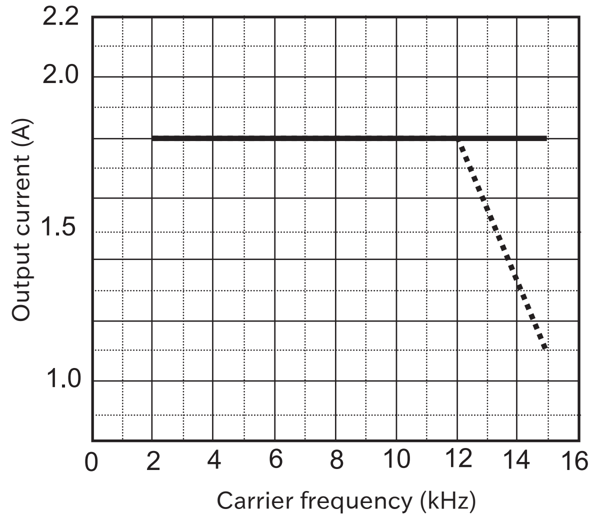


Light duty (3.5 A)

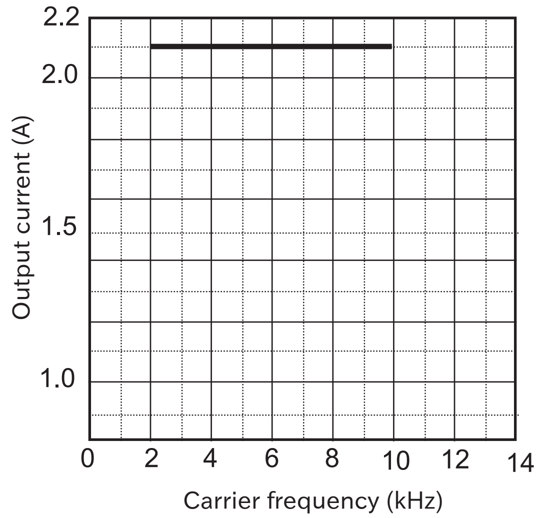


■ HF6204-A40

Normal duty (1.8 A)

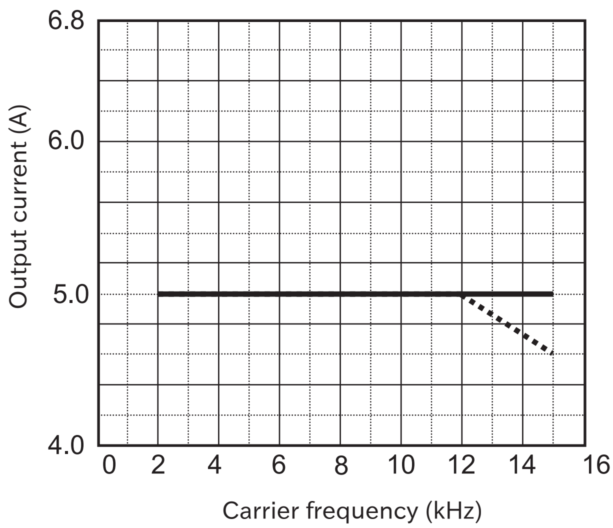


Light duty (2.1A)

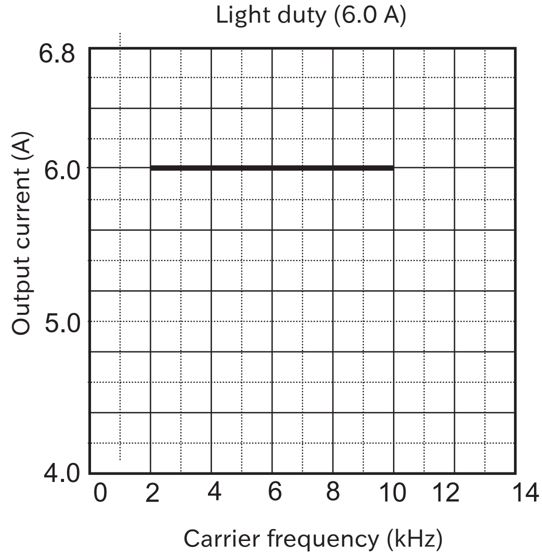


■ HF620S-A75

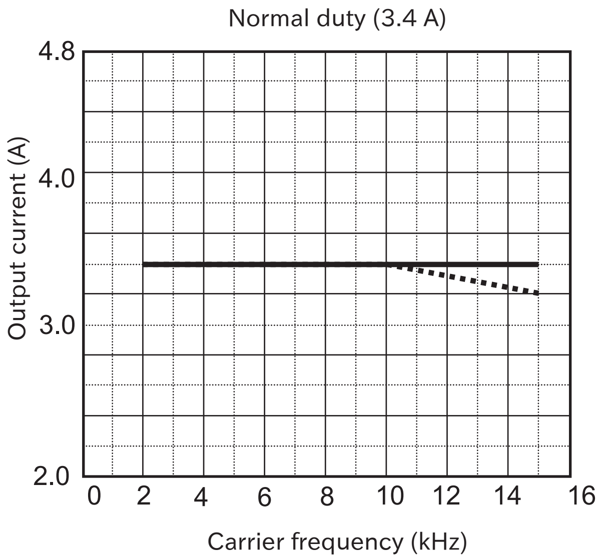
Normal duty (5.0 A)

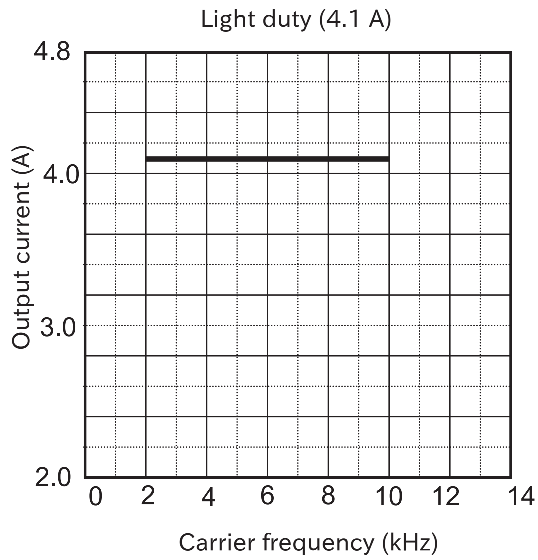


Light duty (6.0 A)

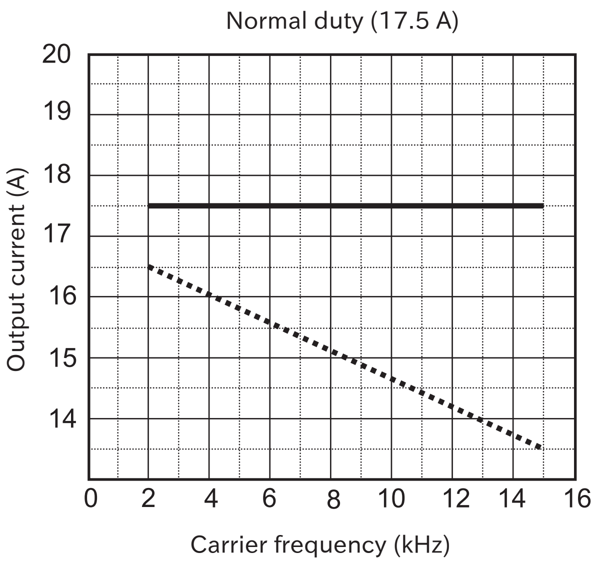


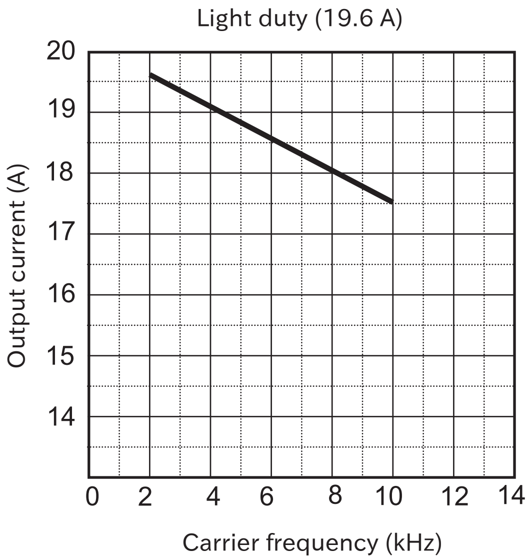
■ HF6204-A75



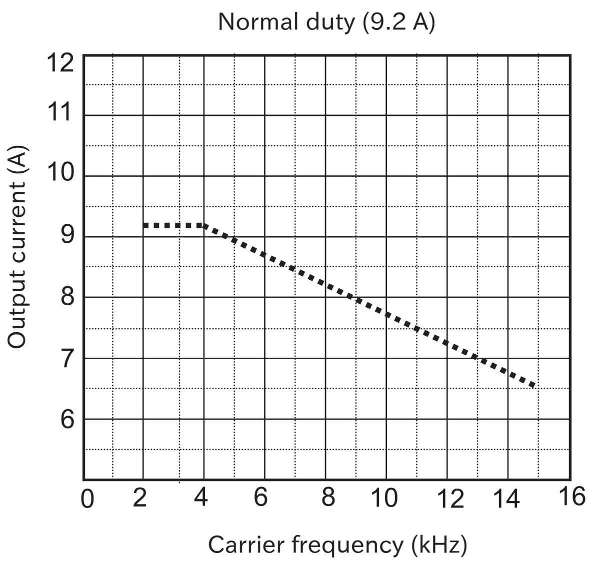


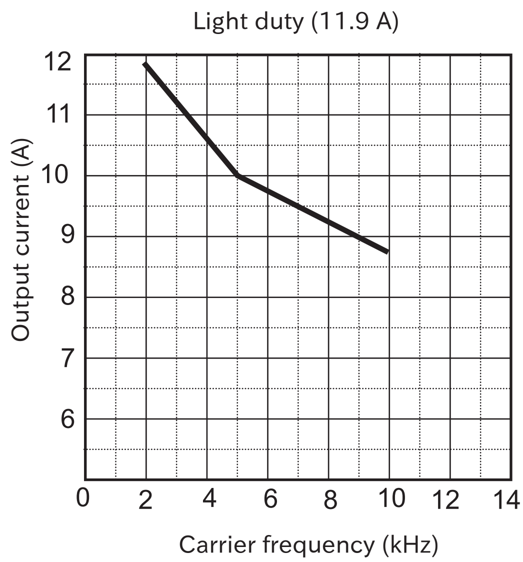
■ HF6202-3A7





■ HF6204-3A7





Chapter 18 Parameter

18

This chapter provides a list of monitor parameters, setting parameters, Modbus communication coils and register numbers. Monitor parameters and setting parameters accessible by Modbus communication are listed together with the holding register number.
Some parameters may not be displayed on the keypad due to display restrictions or the password function, or the settings may not be changed due to the soft lock function. In such a case, check "7.2 Functions Related to Keypad" or "15.4 How to Check When Something Is Wrong".

18.1 Modbus coil number/special resister numbers

18.1.1 List of Modbus coil numbers

Coil No.	Name	R/W	Setting
0000h	Reserved	-	-
0001h	RUN command	R/W	1: Run/ 0: Stop (Enable when [AA111]/[AA211]=RS485 (03))
0002h	Rotation direction command	R/W	1: Reverse/ 0: Forward (Enable when [AA111]/[AA211]=RS485 (03))
0003h	External trip [ES]	R/W	1: Trip / 0: No
0004h	Reset [RST]	R/W	1: Reset / 0: No
0005h	Multi-function input terminal [FR] Note	R/W	1: ON/ 0: OFF
0006h	Multi-function input terminal [RR] Note	R/W	1: ON/ 0: OFF
0007h	Multi-function input terminal [DFL] Note	R/W	1: ON/ 0: OFF
0008h	Multi-function input terminal [DFM] Note	R/W	1: ON/ 0: OFF
0009h	Multi-function input terminal [AUT] Note	R/W	1: ON/ 0: OFF
000Ah	Multi-function input terminal [RS] Note	R/W	1: ON/ 0: OFF
000Bh	Multi-function input terminal [RST] Note	R/W	1: ON/ 0: OFF
000Ch	Multi-function input terminal [PLA] Note	R/W	1: ON/ 0: OFF
000Dh to 0014h	Reserved	-	-
0015h	Operation status	R	1: Forward or Reverse/ 0: Stop or 0Hz output (Linked to [dA-03])
0016h	Rotation direction	R	1: Reverse/ 0: Forward (Linked to [dA-03])
0017h	Inverter ready	R	1: Ready/ 0: Not ready
0018h	Reserved	-	-
0019h	Multi-function output terminal [UPF]	R	1: ON/ 0: OFF
001Ah	Multi-function output terminal [DRV]	R	1: ON/ 0: OFF
001Bh to 001Eh	Reserved	-	-
001Fh	Multi-function output terminal [ML]	R	1: ON/ 0: OFF
0020h to 0048h	Reserved	-	-
0049h	Data writing in progress	R	1: Writing in progress/ 0: Normal state
004Ah	CRC error	R	1: With error/ 0: No error
004Bh	Overrun error	R	1: With error/ 0: No error
004Ch	Framing error	R	1: With error/ 0: No error
004Dh	Parity error	R	1: With error/ 0: No error
004Eh	Sum check error	R	1: With error/ 0: No error
004Fh to	Reserved	-	-

Note: The input terminal can be turned on/off by Modbus communication. The inverter recognizes that the input terminal is in the ON state if either the input terminal by communication or the input signal by control terminal is on. However, as "Intelligent Input terminal monitor [dA-51]" is a monitor of control terminal's input signal, input status via communication is not displayed.

18.1.2 Modbus list of Modbus special holding registers

・The following table lists Modbus register numbers that do not directly correspond to monitor parameters and setting parameters.
・For the number of the holding register corresponding to the monitor parameter/setting parameter that can be R/W from keypad, refer to "18.2 List of Parameters and Modbus Holding Registers".

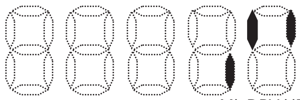
Resister No.	Name	R/W	Data range	Resolution
2328h	ENTER instruction (Write to Data Flash)	W	01: Write all parameters	-
232Ah	Single write mode	W	01: Enable	-
2332h	Motor constants re-calculation	W	01: Enable	-
2906h 2907h	RS485 speed reference (Signed) (For main/sub speed)	R/W	-59000 to 59000	0.01Hz
291Eh	RS485 torque reference	R/W	-5000 to 5000	0.1%
2922h	RS485 torque bias	R/W		
2926h	RS485 speed limit at torque control (at Forward rotation)	R/W	0 to 59000	0.01Hz
2927h	RS485 speed limit at torque control (at Reverse rotation)	R/W		
2932h 2933h	RS485 PID target value	R/W	-10000 to 10000	0.01%
293Ah 293Bh	RS485 PID feedback data	R/W		
2946h	RS485 torque limit	R/W	0 to 5000	0.1%
3EB5h	Output terminal function Option output [OPO]	R/W	0 to 0x7F	1
3EBCh	Coil data 0 (Coil No. 0000h to 000Fh)	R/W	0 to 0xFFFF	1
3EBDh	Coil data 1 (Coil No. 0010h to 001Fh)	R		
3EBEh	Coil data 2 (Coil No. 0020h to 002Fh)	R		
3EBFh	Coil data 3 (Coil No. 0030h to 003Fh)	R		
3EC0h	Coil data 4 (Coil No. 0040h to 004Fh)	R		

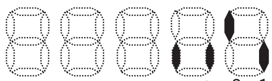
18.2 Parameter

- When the data range or initial value has a description regarding the rated current and is marked as rated output current, refer to the rated output current of the currently selected normal duty (ND) or light duty (LD). For those marked ND rated current, refer to the rated output current of the normal duty (ND), even if light duty (LD) is selected. The currently selected load type can be checked on the "Inverter load type status [dC-01].
- In the default condition, the data part (0.00Hz in the case of stopped state) of [dA-01] is always displayed after the power is turned on. To change the monitor at power-on, change the setting of "Initial display selection [UA-91]".
- If the parameter code cannot be displayed, or if the code and setting data can be displayed but cannot be changed, the display restrictions or Soft-Lock may be activated. For more information, refer to "7.2 Functions Related to Keypad" or "15.4.1 Troubleshooting Other Than Trip and Warning".
- The d parameter group can only be "Read", and the rest of the parameters can be R/W unless otherwise noted.
- In the table below, Modbus holding register numbers may be discontinuous, but do not access the holding registers that is not listed.

18.2.1 d parameter

Code	Name	Data range	Change during running	Modbus communication			Page
				Register No.	Data range	Resolution	
dA-01	Output frequency monitor	0.00 to 590.00 Hz	○	2711h	0 to 59000	0.01	10-1
dA-02	Output current monitor	0.00 to 655.35 A	-	2712h	0 to 65535	0.01	10-3
dA-03	Rotation direction monitor	o: Stop/ d: 0Hz output F: Forward/ r: Reverse	-	2713h	0 to 3	-	10-3
dA-04	Frequency reference monitor (after calculation) (signed)	-590.00 to 590.00 Hz	-	2714h 2715h	-59000 to 59000	0.01	10-1
dA-06	Output frequency scale conversion monitor	0.00 to 59000.00	○	2716h 2717h	0 to 5900000	0.01	10-1
dA-08	Detect speed monitor	-590.00 to 590.00 Hz	-	2718h 2719h	-59000 to 59000	0.01	10-4
dA-12	Output frequency monitor (signed)			271Ch 271Dh			10-2
dA-14	Frequency upper limit monitor	0.00 to 590.00 Hz	-	271Eh	0 to 59000	0.01	9-32
dA-15	Torque reference monitor (after calculation)	-1000.0 to 1000.0 %	-	271Fh	-10000 to 10000	0.1	10-5
dA-16	Torque limit monitor	0.0 to 500.0 %	-	2720h	0 to 59000	0.1	9-64 10-5
dA-17	Output torque monitor	-1000.0 to 1000.0 %	-	2721h	-10000 to 10000	0.1	10-5
dA-18	Output voltage monitor (RMS)	0.0 to 800.0 V	-	2722h	0 to 8000	0.1	10-6
dA-20	Current position monitor	Absolute position control : -268435455 to 268435455 pls High resolution absolute position control : -1073741823 to 1073741823 pls	-	2724h 2725h	Normal mode: -268435455 to 268435455 High resolution mode: -1073741823 to 1073741823	1	9-187 10-6
dA-28	Pulse count monitor	0 to 2147483647	-	272Ch 272Dh	0 to 2147483647	1	9-211
dA-30	Input power monitor	0.00 to 655.35 kW	-	272Eh	0 to 65535	0.01	10-7
dA-32	Accumulated input power monitor	0.0 to 1000000.0 kWh	-	2730h 2731h	0 to 10000000	0.1	10-7
dA-34	Output power monitor	0.00 to 655.35 kW	-	2732h	0 to 65535	0.01	10-8
dA-36	Accumulated output power monitor	0.0 to 1000000.0 kWh	-	2734h 2735h	0 to 10000000	0.1	10-8
dA-40	DC bus voltage monitor	DC0.0 to 1000.0 V	-	2738h	0 to 10000	0.1	10-9
dA-41	DBTR load factor monitor	0.00 to 100.00 %	-	2739h	0 to10000	0.01	9-137 10-9
dA-42	Electronic thermal load factor monitor (Motor)	0.00 to 100.00 %	–	273Ah	0 to 10000	0.01	9-163 10-10
dA-43	Electronic thermal load factor monitor (Inverter)	0.00 to 100.00 %	–	273Bh			9-164 10-10

Code	Name	Data range	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
dA-44	Safety STO terminal monitor	 STO/ON RUN enable/OFF 5 4 3 2 1 1: Terminal [ST1] (STO/ RUN enable) 2: Terminal [ST2] (STO/ RUN enable) 3: Terminal [EDM] (OFF/ ON) 4: [SFM1] signal (OFF/ ON) 5: [SFM2] signal (OFF/ ON)	-	273Ch	20 : Terminal [ST1] 21 : Terminal [ST2] 22 : Terminal [EDM] 23 : [SFM1] signal 24 : [SFM2] signal	-	14-5
dA-45	Safety STO monitor	00: No input 01: P-1A (-F20-) 02: P-2A (-F10-) 03: P-1b (-F02-) 04: P-2b (-F01-) 05: P-1C (-F22-) 06: P-2C (-F11-) 07: STO (--S--)	-	273Dh	0 to 7	1	14-5
dA-51	Input terminal monitor	 ON OFF PLA RST ES AUT DFM DFL RR FR (e.g.) FR, RR: ON	-	2743h	2^0 to: (terminal FR) 2^7 : (terminal PLA)	-	10-11
dA-54	Output terminal monitor	 ON OFF ML DRV UPF (e.g.) UPF, DRV: ON/ ML: OFF	-	2746h	2^0 : (UPF) 2^1 : (DRV) 2^2 : (AL)	-	10-11
dA-60	Analog input/output status monitor	 Voltage Current AMV AMI IRF VRF (e.g.) VRF: Analog current input IRF: Analog voltage input AMI: Analog current output AMV: Always voltage position	-	274Ch	00h to FFh	-	10-13
dA-61	Analog input [VRF]monitor	0.00 to 100.00 %	-	274Dh	0 to 10000	1	10-12
dA-62	Analog input [IRF] monitor			274Eh			
dA-70	Pulse input monitor	-100.00 to100.00 %	-	2756h	-10000 to 10000	0.01	10-12
dA-81	Option mounting status	00: (0x00) None 02: (0x02) Reserved 03: (0x03) Reserved 06: (0x06) Reserved 07: (0x07) CC-Link	-	2761h	0 to 7	1	13-1
db-30	PID1 feedback value 1 monitor	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	-	2792h 2793h	-10000 to 10000	Depends on AH-06	9-101 10-22
db-32	PID1 feedback value 2 monitor			2794h 2795h			
db-34	PID1 feedback value 3 monitor			2796h 2797h			
db-36	PID2 feedback value monitor	-100.00 to 100.00 % Data range depends on PID2 scale adjustment (AJ-04, 05, 06)	-	2798h 2799h		Depends on AJ-06	9-101 10-22
db-42	PID1 set-point monitor (after calculation)	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	-	279Eh 279Fh		Depend on AH-06	9-107 10-22
db-44	PID1 feedback value monitor (after calculation)			27A0h 27A1h			9-101 9-110 10-22
db-50	PID1 output monitor	-100.00 to 100.00 %	-	27A6h	-10000 to 10000	0.01	10-22
db-51	PID1 deviation monitor	-200.00 to 200.00 %	-	27A7h	-20000 to 20000	0.01	9-101 10-22
db-52	PID1 deviation 1 monitor			27A8h			10-22
db-53	PID1 deviation 2 monitor			27A9h			
db-54	PID1 deviation 3 monitor			27AAh			
db-55	PID2 output monitor	-100.00 to 100.00 %	-	27ABh	-10000 to 10000	0.01	
db-56	PID2 deviation monitor	-200.00 to 200.00 %	-	27ACh	-20000 to 20000	0.01	9-122 10-22

Code	Name	Data range	Change during running	Modbus communication			Page
				Register No.	Data range	Resolution	
db-61	Current PID P-Gain monitor	0.0 to 100.0	-	27B1h	0.0 to 1000	0.1	
db-62	Current PID I-Gain monitor	0.0 to 3600.0 s	-	27B2h	0 to 36000	0.1	10-22
db-63	Current PID D-Gain monitor	0.00 to 100.00 s	-	27B3h	0 to 10000	0.01	
db-64	PID feedforward monitor	0.00 to 100.00 %	-	27B4h			
dC-01	Inverter load type status	01: Light duty (LD) 02: Normal duty (ND)	-	27D9h	1 to 2	1	10-17
dC-02	Rated current monitor	0.0 to 6553.5 A	-	27DAh	0 to 65535	0.1	
dC-07	Main speed input source monitor	01: Terminal [VRF] 02: Terminal [IRF] 07: Multi-speed 0/ 09: Multi-speed 1 10: Multi-speed 2/ 11: Multi-speed 3 12: Multi-speed 4/ 13: Multi-speed 5 14: Multi-speed 6/ 15: Multi-speed 7 16: Multi-speed 8/ 17: Multi-speed 9 18: Multi-speed 10/ 19: Multi-speed 11 20: Multi-speed 12/ 21: Multi-speed 13 22: Multi-speed 14/ 23: Multi-speed 15 24: Jogging/ 25: RS485 26: Option/ 29: Pulse input 31: Reserved 32: PID function 34: AHD retention speed	-	27DFh	1 to 34	1	10-19
dC-08	Sub speed input source monitor	00: Disabled 01: Terminal [VRF] 02: Terminal [IRF] 08: Sub speed (Parameter setting) 25: RS485/26: Option 29: Pulse input/ 31: Reserved 32: PID function	-	27E0h	0 to 33	1	
dC-10	RUN command input source monitor	00: [FR]/[RR] terminal 01: 3-Wire 02: Keypad's RUN key 03: RS485 04: Option	-	27E2h	0 to 4	1	
dC-15	Cooling fin temperature monitor	-20.0 to 200.0 ℃	-	27E7h	-200 to 2000	0.1	9-166 10-16
dC-16	Life assessment monitor	 1: WAC (Capacitor life warning) 2: WAF (Cooling-fan life warning) 3: WAP (Power module life warning) 4: WAIC (Inrush circuit life warning)	-	27E8h	2^0 : WAC 2^1 : WAF 2^2 : WAP 2^3 : WAIC	1	9-167 9-168 9-169 10-16
dC-20	Accumulated number of starts monitor	1 to 65535	-	27ECh	1 to 65535	1	10-15
dC-21	Accumulated number of power-on times monitor			27EDh			
dC-22	Accumulated RUN time monitor	0 to 1000000 hr	-	27EEh 27EFh	0 to 1000000	1	9-170 10-15
dC-24	Accumulated power-on time monitor			27F0h 27F1h			
dC-26	Accumulated cooling-fan run time monitor			27F2h 27F3h			10-15
dC-30	Dual monitor	Monitor data selected by [UA-96], [UA-97]	-	27F6h	-	-	10-20
dC-31	Unsteady detection value monitor	-100.00 to 100.00 %	-	27F7h	-10000 to 10000	0.01	10-14
dC-32	Unsteady detection upper level monitor			27F8h			
dC-33	Unsteady detection lower level monitor			27F9h			
dC-37	Icon 2 LIM detail monitor	00: Motor RUN not restricted 01: OC suppress 02: OL restriction 03: OV suppress 04: Torque limit 05: Frequency limit 06: Minimum frequency	—	27FDh	0 to 6	1	10-20

Code	Name	Data range	Change during running	Modbus communication			Page
				Register No.	Data range	Resolution	
dC-38	Icon 2 ALT detail monitor	00: No warning notice 01: OL notice 02: Motor thermal notice 03: Controller thermal notice 04: Motor overheating notice	-	27FEh	0 to 4	1	10-20
dC-39	Icon 2 RETRY detail monitor	00: Not in retry status 01: Waiting for retry 02: Waiting for restart	-	27FFh	0 to 2	1	10-21
dC-40	Icon 2 NRDY detail monitor	00: Ready 01: Trip occurrence 02: Power supply error 03: Resetting 04: STO 05: Standby 06: Data warning, etc. 08: Free run 09: Forced stop	-	2800h	0 to 9	1	
dC-45	IM/SM monitor	00: IM selected 01: SM selected	-	2805h	0 to 1	1	10-17
dC-47	Auto-tuning monitor	00: -- 01: Auto-tuning completed 02: Auto-tuning failed	-	2807h	0 to 2	1	
dC-49	Emergency-force drive mode monitor	00: Disabled 01: EMF Active 02: BYP Active	-	2809h	0 to 2	1	9-90 10-18
dC-50	Firmware Ver. monitor (I/O)	00.00 to 99.99 (MM.mm) MM：Major, mm：Minor	-	280Ah	0000h to FFFFh Upper digits: Major Lower digits: Minor	0.01	-
dC-53	Firmware Gr. monitor	00: Standard	-	280Dh	0	1	
dC-87	Firmware Ver. monitor (Core)	00.00 to 99.99 (MM.mm) MM：Major, mm：Minor	-	282Fh	0000h to FFFFh Upper digits: Major Lower digits: Minor	0.01	

Code	Name	Data range	Change during running	Modbus communication			Page
				Register No.	Data range	Resolution	
dE-01	Trip counter	0 to 65535 times	-	03E8h	0 to 65535	1	10-23 15-2
dE-11	Trip monitor 1 Factor	E001 to E122	-	03E9h	0 to 122	1	
	Trip monitor 1 Output frequency (signed)	-590.00 to 590.00 Hz	-	03EAh 03EBh	-59000 to 59000	0.01	
	Trip monitor 1 Output current	0.00 to 655.35 A	-	03ECh	0 to 65535	0.01	
	Trip monitor 1 P-N DC voltage	0.0 to 1000.0 Vdc	-	03EDh	0 to 10000	0.1	
	Trip monitor 1 Inverter status	0 to 8	-	03EEh	0 to 8	1	
	Trip monitor 1 LAD status	0 to 5	-	03EFh	0 to 5	1	
	Trip monitor 1 INV control mode	0 to 11	-	03F0h	0 to 11	1	
	Trip monitor 1 Limit status	0 to 6	-	03F1h	0 to 6	1	
	Trip monitor 1 Special status			03F2h			
	Trip monitor 1 RUN time	0 to 1000000 hr	-	03F4h 03F5h	0 to 1000000	1	
	Trip monitor 1 Power-on time	1 to 1000000 hr	-	03F6h 03F7h			
	Trip monitor 1 Time Year/Month	YY/MM	-	03F8h	YY/MM	1	
	Trip monitor 1 Time Day/Day of week	DD/WW	-	03F9h	DD/WW	1	
	Trip monitor 1 Time Hour/Minute	HH/mm	-	03FAh	HH/mm	1	
dE-12	Trip monitor 2 Factor	E001 to E122	-	03FDh	0 to 122	1	
	Trip monitor 2 Output frequency (signed)	-590.00 to 590.00 Hz	-	03FEh 03FFh	-59000 to 59000	0.01	
	Trip monitor 2 Output current	0.00 to 655.35 A	-	0400h	0 to 65535	0.01	
	Trip monitor 2 P-N DC voltage	0.0 to 1000.0 Vdc	-	0401h	0 to 10000	0.1	
	Trip monitor 2 Inverter status	0 to 8	-	0402h	0 to 8	1	
	Trip monitor 2 LAD status	0 to 5	-	0403h	0 to 5	1	
	Trip monitor 2 INV control mode	0 to 11	-	0404h	0 to 11	1	
	Trip monitor 2 Limit status	0 to 6	-	0405h	0 to 6	1	
	Trip monitor 2 Special status			0406h			
	Trip monitor 2 RUN time	0 to 1000000 hr	-	0408h 0409h	0 to 1000000	1	
	Trip monitor 2 Power-on time	1 to 1000000 hr	-	040Ah 040Bh			
	Trip monitor 2 Time Year/Month	YY/MM	-	040Ch	YY/MM	1	
	Trip monitor 2 Time Day/Day of week	DD/WW	-	040Dh	DD/WW	1	
	Trip monitor 2 Time Hour/Minute	HH/mm	-	040Eh	HH/mm	1	
dE-13	Trip monitor 3 Factor	E001 to E122	-	0411h	0 to 122	1	
	Trip monitor 3 Output frequency (signed)	-590.00 to 590.00 Hz	-	0412h 0413h	-59000 to 59000	0.01	
	Trip monitor 3 Output current	0.00 to 655.35 A	-	0414h	0 to 65535	0.01	
	Trip monitor 3 P-N DC voltage	0.0 to 1000.0 Vdc	-	0415h	0 to 10000	0.1	
	Trip monitor 3 Inverter status	0 to 8	-	0416h	0 to 8	1	
	Trip monitor 3 LAD status	0 to 5	-	0417h	0 to 5	1	
	Trip monitor 3 INV control mode	0 to 11	-	0418h	0 to 11	1	
	Trip monitor 3 Limit status	0 to 6	-	0419h	0 to 6	1	
	Trip monitor 3 Special status			041Ah			
	Trip monitor 3 RUN time	0 to 1000000 hr	-	041Ch 041Dh	0 to 1000000	1	
	Trip monitor 3 Power-on time	1 to 1000000 hr		041Eh 041Fh	0 to 1000000	1	
	Trip monitor 3 Time Year/Month	YY/MM	-	0420h	YY/MM	1	
	Trip monitor 3 Time Day/Day of week	DD/WW	-	0421h	DD/WW	1	
	Trip monitor 3 Time Hour/Minute	HH/mm	-	0422h	HH/mm	1	
dE-14	Trip monitor 4 Factor	E001 to E122	-	0425h	0 to 122	1	
	Trip monitor 4 Output frequency (signed)	-590.00 to 590.00 Hz	-	0426h 0427h	-59000 to 59000	0.01	
	Trip monitor 4 Output current	0.00 to 655.35 A	-	0428h	0 to 65535	0.01	
	Trip monitor 4 P-N DC voltage	0.0 to 1000.0 Vdc	-	0429h	0 to 10000	0.1	
	Trip monitor 4 Inverter status	0 to 8	-	042Ah	0 to 8	1	
	Trip monitor 4 LAD status	0 to 5	-	042Bh	0 to 5	1	
	Trip monitor 4 INV control mode	0 to 11	-	042Ch	0 to 11	1	
	Trip monitor 4 Limit status	0 to 6	-	042Dh	0 to 6	1	
	Trip monitor 4 Special status			042Eh			
	Trip monitor 4 RUN time	0 to 1000000 hr	-	0430h 0431h	0 to 1000000	1	
	Trip monitor 4 Power-on time	1 to 1000000 hr	—	0432h 0433h	0 to 1000000	1	
	Trip monitor 4 Time Year/Month	YY/MM	-	0434h	YY/MM	1	
	Trip monitor 4 Time Day/Day of week	DD/WW	-	0435h	DD/WW	1	
	Trip monitor 4 Time Hour/Minute	HH/mm	-	0436h	HH/mm	1	

Code	Name	Data range	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
dE-15	Trip monitor 5 Factor	E001 to E122	-	0439h	0 to 122	1	10-23 15-2
	Trip monitor 5 Output frequency (signed)	-590.00 to 590.00 Hz	-	043Ah 043Bh	-59000 to 59000	0.01	
	Trip monitor 5 Output current	0.00 to 655.35 A	-	043Ch	0 to 65535	0.01	
	Trip monitor 5 P-N DC voltage	0.0 to 1000.0 Vdc	-	043Dh	0 to 10000	0.1	
	Trip monitor 5 Inverter status	0 to 8	-	043Eh	0 to 8	1	
	Trip monitor 5 LAD status	0 to 5	-	043Fh	0 to 5	1	
	Trip monitor 5 INV control mode	0 to 11	-	0440h	0 to 11	1	
	Trip monitor 5 Limit status	0 to 6	-	0441h	0 to 6	1	
	Trip monitor 5 Special status			0442h			
	Trip monitor 5 RUN time	0 to 1000000 hr	-	0444h 0445h	0 to 1000000	1	
	Trip monitor 5 Power-on time	1 to 1000000 hr	-	0446h 0447h			
	Trip monitor 5 Time Year/Month	YY/MM	-	0448h	YY/MM	1	
	Trip monitor 5 Time Day/Day of week	DD/WW	-	0449h	DD/WW	1	
	Trip monitor 5 Time Hour/Minute	HH/mm	-	044Ah	HH/mm	1	
dE-16	Trip monitor 6 Factor	E001 to E122	-	044Dh	0 to 122	1	
	Trip monitor 6 Output frequency (signed)	-590.00 to 590.00 Hz	-	044Eh 044Fh	-59000 to 59000	0.01	
	Trip monitor 6 Output current	0.00 to 655.35 A	-	0450h	0 to 65535	0.01	
	Trip monitor 6 P-N DC voltage	0.0 to 1000.0 Vdc	-	0451h	0 to 10000	0.1	
	Trip monitor 6 Inverter status	0 to 8	-	0452h	0 to 8	1	
	Trip monitor 6 LAD status	0 to 5	-	0453h	0 to 5	1	
	Trip monitor 6 INV control mode	0 to 11	-	0454h	0 to 11	1	
	Trip monitor 6 Limit status	0 to 6	-	0455h	0 to 6	1	
	Trip monitor 6 Special status			0456h			
	Trip monitor 6 RUN time	0 to 1000000 hr	-	0458h 0459h	0 to 1000000	1	
	Trip monitor 6 Power-on time	1 to 1000000 hr	-	045Ah 045Bh			
	Trip monitor 6 Time Year/Month	YY/MM	-	045Ch	YY/MM	1	
	Trip monitor 6 Time Day/Day of week	DD/WW	-	045Dh	DD/WW	1	
	Trip monitor 6 Time Hour/Minute	HH/mm	-	045Eh	HH/mm	1	
dE-17	Trip monitor 7 Factor	E001 to E122	-	0461h	0 to 122	1	
	Trip monitor 7 Output frequency (signed)	-590.00 to 590.00 Hz	-	0462h 0463h	-59000 to 59000	0.01	
	Trip monitor 7 Output current	0.00 to 655.35 A	-	0464h	0 to 65535	0.01	
	Trip monitor 7 P-N DC voltage	0.0 to 1000.0 Vdc	-	0465h	0 to 10000	0.1	
	Trip monitor 7 Inverter status	0 to 8	-	0466h	0 to 8	1	
	Trip monitor 7 LAD status	0 to 5	-	0467h	0 to 5	1	
	Trip monitor 7 INV control mode	0 to 11	-	0468h	0 to 11	1	
	Trip monitor 7 Limit status	0 to 6	-	0469h	0 to 6	1	
	Trip monitor 7 Special status	0 to 6		046Ah	0 to 6	1	
	Trip monitor 7 RUN time	0 to 1000000 hr	-	046Ch 046Dh	0 to 1000000	1	
	Trip monitor 7 Power-on time	1 to 1000000 hr	-	046Eh 046Fh	0 to 1000000	1	
	Trip monitor 7 Time Year/Month	YY/MM	-	0470h	YY/MM	1	
	Trip monitor 7 Time Day/Day of week	DD/WW	-	0471h	DD/WW	1	
	Trip monitor 7 Time Hour/Minute	HH/mm	-	0472h	HH/mm	1	
dE-18	Trip monitor 8 Factor	E001 to E122	-	0475h	0 to 122	1	
	Trip monitor 8 Output frequency (signed)	-590.00 to 590.00 Hz	-	0476h 0477h	-59000 to 59000	0.01	
	Trip monitor 8 Output current	0.00 to 655.35 A	-	0478h	0 to 65535	0.01	
	Trip monitor 8 P-N DC voltage	0.0 to 1000.0 Vdc	-	0479h	0 to 10000	0.1	
	Trip monitor 8 Inverter status	0 to 8	-	047Ah	0 to 8	1	
	Trip monitor 8 LAD status	0 to 5	-	047Bh	0 to 5	1	
	Trip monitor 8 INV control mode	0 to 11		047Ch	0 to 11	1	
	Trip monitor 8 Limit status	0 to 6	-	047Dh	0 to 6	1	
	Trip monitor 8 Special status			047Eh			
	Trip monitor 8 RUN time	0 to 1000000 hr	-	0480h 0481h	0 to 1000000	1	
	Trip monitor 8 Power-on time	1 to 1000000 hr	-	0482h 0483h	0 to 1000000	1	
	Trip monitor 8 Time Year/Month	YY/MM	-	0484h	YY/MM	1	
	Trip monitor 8 Time Day/Day of week	DD/WW	-	0485h	DD/WW	1	
	Trip monitor 8 Time Hour/Minute	HH/mm	-	0486h	HH/mm	1	

Code	Name	Data range	Change during running	Modbus communication			Page
				Register No.	Data range	Resolution	
dE-19	Trip monitor 9 Factor	E001 to E122	-	0489h	0 to 122	1	10-23 15-2
	Trip monitor 9 Output frequency (signed)	-590.00 to 590.00 Hz	-	048Ah 048Bh	-59000 to 59000	0.01	
	Trip monitor 9 Output current	0.00 to 655.35 A	-	048Ch	0 to 65535	0.01	
	Trip monitor 9 P-N DC voltage	0.0 to 1000.0 Vdc	-	048Dh	0 to 10000	0.1	
	Trip monitor 9 Inverter status	0 to 8	-	048Eh	0 to 8	1	
	Trip monitor 9 LAD status	0 to 5	-	048Fh	0 to 5	1	
	Trip monitor 9 INV control mode	0 to 11	-	0490h	0 to 11	1	
	Trip monitor 9 Limit status	0 to 6	-	0491h	0 to 6	1	
	Trip monitor 9 Special status			0492h			
	Trip monitor 9 RUN time	0 to 1000000 hr	-	0494h 0495h	0 to 1000000	1	
	Trip monitor 9 Power-on time	1 to 1000000 hr	-	0496h 0497h			
	Trip monitor 9 Time Year/Month	YY/MM	-	0498h	YY/MM	1	
	Trip monitor 9 Time Day/Day of week	DD/WW	-	0499h	DD/WW	1	
	Trip monitor 9 Time Hour/Minute	HH/mm	-	049Ah	HH/mm	1	
dE-20	Trip monitor 10 Factor	E001 to E122	-	049Dh	0 to 122	1	
	Trip monitor 10 Output frequency (signed)	-590.00 to 590.00 Hz	-	049Eh 049Fh	-59000 to 59000	0.01	
	Trip monitor 10 Output current	0.00 to 655.35 A	-	04A0h	0 to 65535	0.01	
	Trip monitor 10 P-N DC voltage	0.0 to 1000.0 Vdc	-	04A1h	0 to 10000	0.1	
	Trip monitor 10 Inverter status	0 to 8	-	04A2h	0 to 8	1	
	Trip monitor 10 LAD status	0 to 5	-	04A3h	0 to 5	1	
	Trip monitor 10 INV control mode	0 to 11	-	04A4h	0 to 11	1	
	Trip monitor 10 Limit status	0 to 6	-	04A5h	0 to 6	1	
	Trip monitor 10 Special status			04A6h			
	Trip monitor 10 RUN time	0 to 1000000 hr	-	04A8h 04A9h	0 to 1000000	1	
	Trip monitor 10 Power-on time	1 to 1000000 hr	-	04AAh 04ABh			
	Trip monitor 10 Time Year/Month	YY/MM	-	04ACh	YY/MM	1	
	Trip monitor 10 Time Day/Day of week	DD/WW	-	04ADh	DD/WW	1	
	Trip monitor 10 Time Hour/Minute	HH/mm	-	04AEh	HH/mm	1	
dE-31	Retry monitor 1 Factor	r001 to r009	-	04B1h	0 to 9	1	10-24 15-4
	Retry monitor 1 Output frequency (signed)	-590.00 to 590.00 Hz	-	04B2h 04B3h	-59000 to 59000	0.01	
	Retry monitor 1 Output current	0.00 to 655.35 A	-	04B4h	0 to 65535	0.01	
	Retry monitor 1 P-N DC voltage	0.0 to 1000.0 Vdc	-	04B5h	0 to 10000	0.1	
	Retry monitor 1 Inverter status	0 to 8	-	04B6h	0 to 8	1	
	Retry monitor 1 LAD status	0 to 5	-	04B7h	0 to 5	1	
	Retry monitor 1 INV control mode	0 to 11	-	04B8h	0 to 11	1	
	Retry monitor 1 Limit status	0 to 6	-	04B9h	0 to 6	1	
	Retry monitor 1 Special status			04BAh			
	Retry monitor 1 RUN time	0 to 1000000 hr	-	04BCh 04BDh	0 to 1000000	1	
	Retry monitor 1 Power-on time	1 to 1000000 hr	-	04BEh 04BFh	0 to 1000000	1	
	Retry monitor 1 Time Year/Month	YY/MM	-	04C0h	YY/MM	1	
	Retry monitor 1 Time Day/Day of week	DD/WW	-	04C1h	DD/WW	1	
	Retry monitor 1 Time Hour/Minute	HH/mm	-	04C2h	HH/mm	1	
dE-32	Retry monitor 2 Factor	r001 to r009	-	04C5h	0 to 122	1	
	Retry monitor 2 Output frequency (signed)	-590.00 to 590.00 Hz	-	04C6h 04C7h	-59000 to 59000	0.01	
	Retry monitor 2 Output current	0.00 to 655.35 A	-	04C8h	0 to 65535	0.01	
	Retry monitor 2 P-N DC voltage	0.0 to 1000.0 Vdc	-	04C9h	0 to 10000	0.1	
	Retry monitor 2 Inverter status	0 to 8	-	04CAh	0 to 8	1	
	Retry monitor 2 LAD status	0 to 5	-	04CBh	0 to 5	1	
	Retry monitor 2 INV control mode	0 to 11		04CCh	0 to 11	1	
	Retry monitor 2 Limit status	0 to 6	-	04CDh	0 to 6	1	
	Retry monitor 2 Special status			04CEh			
	Retry monitor 2 RUN time	0 to 1000000 hr	-	04D0h 04D1h	0 to 1000000	1	
	Retry monitor 2 Power-on time	1 to 1000000 hr	-	04D2h 04D3h	0 to 1000000	1	
	Retry monitor 2 Time Year/Month	YY/MM	-	04D4h	YY/MM	1	
	Retry monitor 2 Time Day/Day of week	DD/WW	-	04D5h	DD/WW	1	
	Retry monitor 2 Time Hour/Minute	HH/mm	-	04D6h	HH/mm	1	

Code	Name	Data range	Change during running	Modbus communication Register No.	Data range	Resolution	Page
dE-33	Retry monitor 3 Factor	r001 to r009	-	04D9h	0 to 122	1	10-24 15-4
	Retry monitor 3 Output frequency (signed)	-590.00 to 590.00 Hz	-	04DAh 04DBh	-59000 to 59000	0.01	
	Retry monitor 3 Output current	0.00 to 655.35 A	-	04DCh	0 to 65535	0.01	
	Retry monitor 3 P-N DC voltage	0.0 to 1000.0 Vdc	-	04DDh	0 to 10000	0.1	
	Retry monitor 3 Inverter status	0 to 8	-	04DEh	0 to 8	1	
	Retry monitor 3 LAD status	0 to 5	-	04EFh	0 to 5	1	
	Retry monitor 3 INV control mode	0 to 11	-	04E0h	0 to 11	1	
	Retry monitor 3 Limit status	0 to 6	-	04E1h	0 to 6	1	
	Retry monitor 3 Special status			04E2h			
	Retry monitor 4 RUN time	0 to 1000000 hr	-	04E4h 04E5h	0 to 1000000	1	
	Retry monitor 4 Power-on time	1 to 1000000 hr	-	04E6h 04E7h			
	Retry monitor 4 Time Year/Month	YY/MM	-	04E8h	YY/MM	1	
	Retry monitor 4 Time Day/Day of week	DD/WW	-	04E9h	DD/WW	1	
	Retry monitor 4 Time Hour/Minute	HH/mm	-	04EAh	HH/mm	1	
dE-34	Retry monitor 4 Factor	r001 to r009	-	04EDh	0 to 122	1	
	Retry monitor 4 Output frequency (signed)	-590.00 to 590.00 Hz	-	04EEh 04EFh	-59000 to 59000	0.01	
	Retry monitor 4 Output current	0.00 to 655.35 A	-	04F0h	0 to 65535	0.01	
	Retry monitor 4 P-N DC voltage	0.0 to 1000.0 Vdc	-	04F1h	0 to 10000	0.1	
	Retry monitor 4 Inverter status	0 to 8	-	04F2h	0 to 8	1	
	Retry monitor 4 LAD status	0 to 5	-	04F3h	0 to 5	1	
	Retry monitor 4 INV control mode	0 to 11	-	04F4h	0 to 11	1	
	Retry monitor 4 Limit status	0 to 6	-	04F5h	0 to 6	1	
	Retry monitor 4 Special status			04F6h			
	Retry monitor 4 RUN time	0 to 1000000 hr	-	04F8h 04F9h	0 to 1000000	1	
	Retry monitor 4 Power-on time	1 to 1000000 hr	-	04FAh 04FBh			
	Retry monitor 4 Time Year/Month	YY/MM	-	04FCh	YY/MM	1	
	Retry monitor 4 Time Day/Day of week	DD/WW	-	04FDh	DD/WW	1	
	Retry monitor 4 Time Hour/Minute	HH/mm	-	04FEh	HH/mm	1	
dE-35	Retry monitor 5 Factor	r001 to r009	-	0501h	0 to 9	1	
	Retry monitor 5 Output frequency (signed)	-590.00 to 590.00 Hz	-	0502h 0503h	-59000 to 59000	0.01	
	Retry monitor 5 Output current	0.00 to 655.35 A	-	0504h	0 to 65535	0.01	
	Retry monitor 5 P-N DC voltage	0.0 to 1000.0 Vdc	-	0505h	0 to 10000	0.1	
	Retry monitor 5 Inverter status	0 to 8	-	0506h	0 to 8	1	
	Retry monitor 5 LAD status	0 to 5	-	0507h	0 to 5	1	
	Retry monitor 5 INV control mode	0 to 11	-	0508h	0 to 11	1	
	Retry monitor 5 Limit status	0 to 6	-	0509h	0 to 6	1	
	Retry monitor 5 Special status			050Ah			
	Retry monitor 5 RUN time	0 to 1000000 hr	-	050Ch 050Dh	0 to 1000000	1	
	Retry monitor 5 Power-on time	1 to 1000000 hr	-	050Eh 050Fh	0 to 1000000	1	
	Retry monitor 5 Time Year/Month	YY/MM	-	0510h	YY/MM	1	
	Retry monitor 5 Time Day/Day of week	DD/WW	-	0511h	DD/WW	1	
	Retry monitor 5 Time Hour/Minute	HH/mm	-	0512h	HH/mm	1	
dE-36	Retry monitor 6 Factor	r001 to r009	-	0515h	0 to 122	1	
	Retry monitor 6 Output frequency (signed)	-590.00 to 590.00 Hz	-	0516h 0517h	-59000 to 59000	0.01	
	Retry monitor 6 Output current	0.00 to 655.35 A	-	0518h	0 to 65535	0.01	
	Retry monitor 6 P-N DC voltage	0.0 to 1000.0 Vdc	-	0519h	0 to 10000	0.1	
	Retry monitor 6 Inverter status	0 to 8	-	051Ah	0 to 8	1	
	Retry monitor 6 LAD status	0 to 5	-	051Bh	0 to 5	1	
	Retry monitor 6 INV control mode	0 to 11		051Ch	0 to 11	1	
	Retry monitor 6 Limit status	0 to 6	-	051Dh	0 to 6	1	
	Retry monitor 6 Special status			051Eh			
	Retry monitor 6 RUN time	0 to 1000000 hr	-	0520h 0521h	0 to 1000000	1	
	Retry monitor 6 Power-on time	1 to 1000000 hr	-	0522h 0523h	0 to 1000000	1	
	Retry monitor 6 Time Year/Month	YY/MM	-	0524h	YY/MM	1	
	Retry monitor 6 Time Day/Day of week	DD/WW	-	0525h	DD/WW	1	
	Retry monitor 6 Time Hour/Minute	HH/mm	-	0526h	HH/mm	1	

Code	Name	Data range	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
dE-37	Retry monitor 7 Factor	r001 to r009	-	0529h	0 to 122	1	10-24 15-4
	Retry monitor 7 Output frequency (signed)	-590.00 to 590.00 Hz	-	052Ah 052Bh	-59000 to 59000	0.01	
	Retry monitor 7 Output current	0.00 to 655.35 A	-	052Ch	0 to 65535	0.01	
	Retry monitor 7 P-N DC voltage	0.0 to 1000.0 Vdc	-	052Dh	0 to 10000	0.1	
	Retry monitor 7 Inverter status	0 to 8	-	052Eh	0 to 8	1	
	Retry monitor 7 LAD status	0 to 5	-	052Fh	0 to 5	1	
	Retry monitor 7 INV control mode	0 to 11	-	0530h	0 to 11	1	
	Retry monitor 7 Limit status	0 to 6	-	0531h	0 to 6	1	
	Retry monitor 7 Special status			0532h			
	Retry monitor 7 RUN time	0 to 1000000 hr	-	0534h 0535h	0 to 1000000	1	
	Retry monitor 7 Power-on time	1 to 1000000 hr	-	0536h 0537h			
	Retry monitor 7 Time Year/Month	YY/MM	-	0538h	YY/MM	1	
	Retry monitor 7 Time Day/Day of week	DD/WW	-	0539h	DD/WW	1	
	Retry monitor 7 Time Hour/Minute	HH/mm	-	053Ah	HH/mm	1	
dE-38	Retry monitor 8 Factor	r001 to r009	-	053Dh	0 to 122	1	
	Retry monitor 8 Output frequency (signed)	-590.00 to 590.00 Hz	-	053Eh 053Fh	-59000 to 59000	0.01	
	Retry monitor 8 Output current	0.00 to 655.35 A	-	0540h	0 to 65535	0.01	
	Retry monitor 8 P-N DC voltage	0.0 to 1000.0 Vdc	-	0541h	0 to 10000	0.1	
	Retry monitor 8 Inverter status	0 to 8	-	0542h	0 to 8	1	
	Retry monitor 8 LAD status	0 to 5	-	0543h	0 to 5	1	
	Retry monitor 8 INV control mode	0 to 11	-	0544h	0 to 11	1	
	Retry monitor 8 Limit status	0 to 6	-	0545h	0 to 6	1	
	Retry monitor 8 Special status			0546h			
	Retry monitor 8 RUN time	0 to 1000000 hr	-	0548h 0549h	0 to 1000000	1	
	Retry monitor 8 Power-on time	1 to 1000000 hr	-	054Ah 054Bh			
	Retry monitor 8 Time Year/Month	YY/MM	-	054Ch	YY/MM	1	
	Retry monitor 8 Time Day/Day of week	DD/WW	-	054Dh	DD/WW	1	
	Retry monitor 8 Time Hour/Minute	HH/mm	-	054Eh	HH/mm	1	
dE-39	Retry monitor 9 Factor	r001 to r009	-	0551h	0 to 9	1	
	Retry monitor 9 Output frequency (signed)	-590.00 to 590.00 Hz	-	0552h 0553h	-59000 to 59000	0.01	
	Retry monitor 9 Output current	0.00 to 655.35 A	-	0554h	0 to 65535	0.01	
	Retry monitor 9 P-N DC voltage	0.0 to 1000.0 Vdc	-	0555h	0 to 10000	0.1	
	Retry monitor 9 Inverter status	0 to 8	-	0556h	0 to 8	1	
	Retry monitor 9 LAD status	0 to 5	-	0557h	0 to 5	1	
	Retry monitor 9 INV control mode	0 to 11	-	0558h	0 to 11	1	
	Retry monitor 9 Limit status	0 to 6	-	0559h	0 to 6	1	
	Retry monitor 9 Special status			055Ah			
	Retry monitor 9 RUN time	0 to 1000000 hr	-	055Ch 055Dh	0 to 1000000	1	
	Retry monitor 9 Power-on time	1 to 1000000 hr	-	055Eh 055Fh	0 to 1000000	1	
	Retry monitor 9 Time Year/Month	YY/MM	-	0560h	YY/MM	1	
	Retry monitor 9 Time Day/Day of week	DD/WW	-	0561h	DD/WW	1	
	Retry monitor 9 Time Hour/Minute	HH/mm	-	0562h	HH/mm	1	
dE-40	Retry monitor 10 Factor	r001 to r009	-	0565h	0 to 122	1	
	Retry monitor 10 Output frequency (signed)	-590.00 to 590.00 Hz	-	0566h 0567h	-59000 to 59000	0.01	
	Retry monitor 10 Output current	0.00 to 655.35 A	-	0568h	0 to 65535	0.01	
	Retry monitor 10 P-N DC voltage	0.0 to 1000.0 Vdc	-	0569h	0 to 10000	0.1	
	Retry monitor 10 Inverter status	0 to 8	-	056Ah	0 to 8	1	
	Retry monitor 10 LAD status	0 to 5	-	056Bh	0 to 5	1	
	Retry monitor 10 INV control mode	0 to 11		056Ch	0 to 11	1	
	Retry monitor 10 Limit status	0 to 6	-	056Dh	0 to 6	1	
	Retry monitor 10 Special status			056Eh			
	Retry monitor 10 RUN time	0 to 1000000 hr	-	0570h 0571h	0 to 1000000	1	
	Retry monitor 10 Power-on time	1 to 1000000 hr	-	0572h 0573h	0 to 1000000	1	
	Retry monitor 10 Time Year/Month	YY/MM	-	0574h	YY/MM	1	
	Retry monitor 10 Time Day/Day of week	DD/WW	-	0575h	DD/WW	1	
	Retry monitor 10 Time Hour/Minute	HH/mm	-	0576h	HH/mm	1	
dE-50	Warning monitor	Warning code [Note]	–	05DCh	Waning code	-	

Note: Refer to "15.3.1 Warning display".

18.2.2 F parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
FA-01	Main speed reference setting (monitor)	0.00 to 590.00 Hz	10.00	○	2AF9h	0 to 59000	0.01	9-6 9-8 9-9 9-10
FA-02	Sub speed reference setting (monitor)		0.00	○	2AFAh 2AFBh			9-6 9-8
FA-10	Acceleration time setting (monitor)	0.00 to 3600.00 s	10.00	○	2B02h 2B03h	0 to 360000	0.01	9-23
FA-12	Deceleration time setting (monitor)				2B04h 2B05h			
FA-15	Torque reference setting (monitor)	-500.0 to 500.0 %	0.0	○	2B07h	-5000 to 5000	0.1	9-57
FA-16	Torque bias setting (monitor)				2B08h			9-64
FA-20	Position reference setting (monitor)	Absolute position control : -268435455 to 268435455 pls High resolution absolute position control : -1073741823 to 1073741823 pls	0	○	2B0Ch 2B0Dh	Normal mode: -268435455 to 268435455 High resolution mode: -1073741823 to 1073741823	1	9-187
FA-30	PID1 set-point 1 setting (monitor)	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	0.00	○	2B16h 2B17h	-10000 to 10000	Depends on AH-06	9-107
FA-32	PID1 set-point 2 setting (monitor)				2B18h 2B19h			
FA-34	PID1 set-point 3 setting (monitor)				2B1Ah 2B1Bh			
FA-36	PID2 set-point setting (monitor)	-100.00 to 100.00 % Data range depends on PID2 scale adjustment (AJ-04, 05, 06)	0.00	○	2B1Ch 2B1Dh	-10000 to 10000	Depends on AJ-06	9-122

18.2.3 A parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AA101	Main speed input source selection, 1st-motor	01: Terminal [VRF]/ 02: Terminal [IRF] 07: Parameter setting/ 08: RS485 09: Option/ 12: Pulse input 14: Reserved/ 15: PID function	07 [Note]	×	2EE1h	1 to 16	1	9-7
AA102	Sub speed input source selection, 1st-motor	00: Disabled/ 01: Terminal [VRF] 02: Terminal [IRF]/ 07: Parameter setting 08: RS485/ 09: Option 12: Pulse input/ 14: Reserved 15: PID function	00	×	2EE2h	0 to 16	1	
AA104	Sub speed setting, 1st-motor	0.00 to 590.00 Hz	0.00	○	2EE4h	0 to 59000	0.01	9-16
AA105	Speed reference calculation symbol selection, 1st-motor	00: Disable 01: Addiction [ADD] 02: Subtraction [SUB] 03: Multiplication [MUL]	00	○	2EE5h	0 to 3	1	
AA106	Add frequency setting, 1st-motor	-590.00 to 590.00 Hz	0.00	○	2EE6h 2EE7h	-59000 to 59000	0.01	9-18
AA111	RUN command input source selection, 1st-motor	00: [FR]/[RR] terminal 01: 3-wire 02: Keypad's RUN-key 03: RS485 04: Option	02	×	2EEBh	0 to 4	1	9-1
AA-12	RUN-key command rotation direction	00: Forward 01: Reverse	00	○	2EECh	0 to 1	1	9-2
AA-13	STOP-key enable	00: Disable 01: Enable 02: Enable at only trip reset	01	○	2EEDh	0 to 2	1	9-5
AA114	RUN direction restriction selection, 1st-motor	00: No restriction 01: Only Forward 02: Only Reverse	00	×	2EEEh	0 to 2	1	9-33
AA115	STOP mode selection, 1st-motor	00: Deceleration stop 01: Free-run stop	00	○	2EEFh	0 to 1	1	9-77
AA121	Control mode selection, 1st-motor	00: V/f control (Constant torque) (IM) 01: V/f control (Reduce torque) (IM) 02: V/f control (Free-V/f) (IM) 03: V/f control (Automatic torque boost) (IM) 08: Sensorless vector control (IM) 11: Sensorless vector control (SM/PMM)	00	×	2EF5h	0 to 11	1	9-35
AA123	Vector control mode selection, 1st-motor	00: Speed/Torque control mode 02: Absolute position control 03: High resolution absolute position control	00	×	2EF7h	0 to 3	1	9-43 9-187
AA124	Speed compensation with encoder selection, 1st-motor	00: Disable 01: Enable	00	×	2EF8h	0 to 1	1	9-43 9-48
AA201	Main speed input source selection, 2nd-motor	01: Terminal [VRF]/ 02: Terminal [IRF] 07: Parameter setting/08: RS485 09: Option/ 12: Pulse input 14: Reserved/ 15: PID function	07 [Note]	×	55F1h	1 to 16	1	9-7 9-95
AA202	Sub speed input source selection, 2nd-motor	00: Disable/ 01: Terminal [VRF] 02: Terminal [IRF]/ 07: Parameter setting 08: RS485/ 09: Option 12: Pulse input/ 14: Reserved 15: PID function	00	×	55F2h	0 to 16	1	
AA204	Sub speed setting, 2nd-motor	0.00 to 590.00 Hz	0.00	○	55F4h	0 to 59000	0.01	9-16 9-95
AA205	Speed reference calculation selection, 2nd-motor	00: Disable 01: Addiction [ADD] 02: Subtraction [SUB] 03: Multiplication [MUL]	00	○	55F5h	0 to 3	1	
AA206	Add frequency setting, 2nd-motor	-590.00 to 590.00 Hz	0.00	○	55F6h 55F7h	-59000 to 59000	0.01	9-18 9-95
AA211	RUN command input source selection, 2nd-motor	00: [FR]/[RR] terminal 01: 3-wire 02: Keypad's RUN-key 03: RS485 04: Option	02 [Note]	×	55FBh	0 to 4	1	9-1 9-95

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AA214	RUN direction restriction selection, 2nd-motor	00: No restriction 01: Only Forward 02: Only Reverse	00	×	55FEh	0 to 2	1	9-33 9-95
AA215	STOP mode selection, 2nd-motor	00: Deceleration stop 01: Free-run stop	00	○	55FFh	0 to 1	1	9-77 9-95
AA221	Control mode selection, 2nd-motor	00: V/f control (Constant torque) (IM) 01: V/f control (Reduce torque) (IM) 02: V/f control (Free-V/f) (IM) 03: V/f control (Automatic torque boost) (IM) 08: Sensorless vector control (IM) 11: Sensorless vector control (SM/PMM)	00	×	5605h	0 to 11	1	9-35 9-95
AA223	Vector control mode selection, 2nd-motor	00: Speed/Torque control mode 02: Absolute position control 03: High resolution absolute position control	00	×	5607h	0 to 3	1	9-43 9-95 9-187
AA224	Speed compensation with encoder selection, 2nd-motor	00: Disable 01: Enable	00	×	5608h	0 to 1	1	9-43 9-48 9-95
Ab-01	Frequency conversion gain	0.01 to 100.00	1.00	○	2F45h	1 to 10000	0.01	10-1
Ab-03	Multi-speed operation selection	00: Binary (16-speeds) 01: Bit (8-speeds)	00	×	2F47h	0 to 1	1	9-10 9-29
Ab110	Multi-speed 0 setting, 1st-motor	0.00 to Max. frequency, 1st motor Hz	10.00	○	2F4Eh	0 to 59000	0.01	9-10
Ab-11	Multi-speed 1 setting	0.00 to Max. frequency Hz	20.00		2F4Fh			
Ab-12	Multi-speed 2 setting		30.00		2F50h			
Ab-13	Multi-speed 3 setting		40.00		2F51h			
Ab-14	Multi-speed 4 setting		0.00		2F52h			
Ab-15	Multi-speed 5 setting				2F53h			
Ab-16	Multi-speed 6 setting				2F54h			
Ab-17	Multi-speed 7 setting				2F55h			
Ab-18	Multi-speed 8 setting				2F56h			
Ab-19	Multi-speed 9 setting				2F57h			
Ab-20	Multi-speed 10 setting				2F58h			
Ab-21	Multi-speed 11 setting				2F59h			
Ab-22	Multi-speed 12 setting				2F5Ah			
Ab-23	Multi-speed 13 setting				2F5Bh			
Ab-24	Multi-speed 14 setting				2F5Ch			
Ab-25	Multi-speed 15 setting				2F5Dh			
Ab210	Multi-speed 0 setting, 2nd-motor	0.00 to Max. frequency, 2nd motor Hz	10.00	○	565Eh	0 to 59000	0.01	9-10 9-95
AC-01	Reserved	-	-		-	-	-	-
AC-02	Acceleration/ Deceleration selection	00: Common setting 01: Multi-stage acceleration/deceleration	00	×	2FAAh	0 to 1	1	9-29
AC-03	Acceleration curve selection	00: Linear acceleration 01: S-curve acceleration 02: U-curve acceleration 03: Reverse U-curve acceleration 04: Elevator S-curve acceleration	01	×	2FABh	0 to 4	1	9-26
AC-04	Reserved	-	-	-	-	-	-	-
AC-05	Acceleration curve constant setting	1 to 10	2	○	2FADh	1 to 10	1	9-26
AC-06	Deceleration curve constant setting				2FAEh			
AC-08	EL-S-curve ratio at start of acceleration	0 to (100 - [AC-09]) %	10	×	2FB0h	0 to 100	1	
AC-09	EL-S-curve ratio at end of acceleration	0 to (100 - [AC-08]) %	10	×	2FB1h			

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
AC-10	EL-S-curve ratio at start of deceleration	0 to (100-[AC-11]) %	10	×	2FB2h	0 to 100	1	9-26
AC-11	EL-S-curve ratio at end of deceleration	0 to (100-[AC-10]) %			2FB3h			
AC115	Accel/Decel change trigger, 1st-motor	00: Switching by [AD2] terminal 01: Switching by setting 02: Switching only when rotation is reversed	00	×	2FB7h	0 to 2	1	9-24
AC116	Accel 1 to Accel 2 frequency transition point, 1st-motor	0.00 to 590.00 Hz	0.00	○	2FB8h	0 to 59000	0.01	
AC117	Decel 1 to Decel 2 frequency transition point, 1st-motor				2FB9h			
AC120	Acceleration time 1 1st-motor	0.00 to 3600.00 s	10.00	○	2FBCh 2FBDh	0 to 360000	0.01	9-23
AC122	Deceleration time 1 1st-motor				2FBEh 2FBFh			
AC124	Acceleration time 2 1st-motor				2FC0h 2FC1h			9-24
AC126	Deceleration time 2 1st-motor				2FC2h 2FC3h			
AC-30	Acceleration time for Multi-speed 1	0.00 to 3600.00 s	0.00	○	2FC6h 2FC7h	0 to 360000	0.01	9-29
AC-32	Deceleration time for Multi-speed 1				2FC8h 2FC9h			
AC-34	Acceleration time for Multi-speed 2				2FCAh 2FCBh			
AC-36	Deceleration time for Multi-speed 2				2FCCh 2FCDh			
AC-38	Acceleration time for Multi-speed 3				2FCEh 2FCFh			
AC-40	Deceleration time for Multi-speed 3				2FD0h 2FD1h			
AC-42	Acceleration time for Multi-speed 4				2FD2h 2FD3h			
AC-44	Deceleration time for Multi-speed 4				2FD4h 2FD5h			
AC-46	Acceleration time for Multi-speed 5				2FD6h 2FD7h			
AC-48	Deceleration time for Multi-speed 5				2FD8h 2FD9h			
AC-50	Acceleration time for Multi-speed 6				2FDAh 2FDBh			
AC-52	Deceleration time for Multi-speed 6				2FDCh 2FDDh			
AC-54	Acceleration time for Multi-speed 7				2FDEh 2FDFh			
AC-56	Deceleration time for Multi-speed 7				2FE0h 2FE1h			
AC-58	Acceleration time for Multi-speed 8				2FE2h 2FE3h			
AC-60	Deceleration time for Multi-speed 8				2FE4h 2FE5h			
AC-62	Acceleration time for Multi-speed 9				2FE6h 2FE7h			
AC-64	Deceleration time for Multi-speed 9				2FE8h 2FE9h			
AC-66	Acceleration time for Multi-speed 10				2FEAh 2FEBh			
AC-68	Deceleration time for Multi-speed 10				2FECh 2FEDh			
AC-70	Acceleration time for Multi-speed 11				2FEEh 2FEFh			
AC-72	Deceleration time for Multi-speed 11				2FF0h 2FF1h			
AC-74	Acceleration time for Multi-speed 12				2FF2h 2FF3h			
AC-76	Deceleration time for Multi-speed 12				2FF4h 2FF5h			

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Data range	Resolution	Page
AC-78	Acceleration time for Multi-speed 13	0.00 to 3600.00 s	0.00	○	2FF6h 2FF7h	0 to 360000	0.01	9-29
AC-80	Deceleration time for Multi-speed 13				2FF8h 2FF9h			
AC-82	Acceleration time for Multi-speed 14				2FFAh 2FFBh			
AC-84	Deceleration time for Multi-speed 14				2FFCh 2FFDh			
AC-86	Acceleration time for Multi-speed 15				2FFEh 2FFFh			
AC-88	Deceleration time for Multi-speed 15				3000h 3001h			
AC215	Accel/Decel change trigger, 2nd-motor	00: Switching by [AD2] terminal 01: Switching by setting 02: Switching only when rotation is reversed	00	×	56C7h	0 to 2	1	9-24 9-95
AC216	Accel1 to Accel2 frequency transition point 2nd-motor	0.00 to 590.00 Hz	0.00	○	56C8h	0 to 59000	1	
AC217	Decel1 to Decel2 frequency transition point 2nd-motor				56C9h			
AC220	Acceleration time 1 2nd-motor	0.00 to 3600.00 s	10.00	○	56CCh 56CDh	0 to 360000	0.01	
AC222	Deceleration time 1 2nd-motor				56CEh 56CFh			
AC224	Acceleration time 2 2nd-motor				56D0h 56D1h			
AC226	Deceleration time 2, 2nd-motor				56D2h 56D3h			
Ad-01	Torque reference input source selection	01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input 15: PID function	01	×	300Dh	1 to 15	1	9-57
Ad-02	Torque reference value setting	-500.0 to 500.0 (%)	0.0	○	300Eh	-5000 to 5000	0.1	
Ad-03	Torque reference polarity selection	00: According to sign 01: Depending on the operation direction	01	×	300Fh	0 to 1	1	
Ad-04	Switching time of speed control to torque control	0 to 1000 ms	100	×	3010h	0 to 1000	1	
Ad-11	Torque bias input source selection	00: Disable 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input 15: PID function	00	×	3017h	0 to 15	1	9-64
Ad-12	Torque bias value setting	-500.0 to 500.0 %	0.0	○	3018h	-5000 to 5000	0.1	
Ad-13	Torque bias polarity selection	00: According to sign 01: Depending on the operation direction	00	×	3019h	0 to 1	1	
Ad-14	Enable terminal [TBS]	00: Disabled 01: Enabled	00	×	301Ah	0 to 1	1	
Ad-40	Speed limit input source selection at torque control	01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	07	×	3034h	1 to 12	1	9-57
Ad-41	Speed limit at torque control (at Forward rotation)	0.00 to Max. frequency Hz	0.00	○	3035h	0 to 59000	0.01	
Ad-42	Speed limit at torque control (at Reverse rotation)			○	3036h			

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AE-04	Positioning completed range setting	0 to 10000 pls	50	○	3074h	0 to 10000	1	9-187
AE-05	Positioning completed delay time setting	0.00 to 10.00 s	0.00	○	3075h	0 to 1000	0.01	
AE-10	Stop position selection of home search function	00: Parameter setting 01: Option	00	×	307Ah	0 to 1	1	9-200
AE-11	Stop position of home search function	0 to 4095	0	○	307Bh	0 to 4095	1	
AE-12	Speed reference of home search function	0.00 to 120.00 Hz	5.00	○	307Ch	0 to 12000	0.01	
AE-13	Direction of home search function	00: Forward 01: Reverse	00	×	307Dh	0 to 1	1	
AE-14	DC braking control selection for simple positioning	00: Disable DB on simple positioning 01: Enable DB on simple positioning	00	×	307Eh	0 to 1	1	9-202
AE-15	Creep speed setting	[Hb*30] to 10.00 Hz	5.00	○	307Fh	[Hb*30] to 1000	0.01	9-52 9-187
AE-16	Position displacement at creep speed	0 to 16384 pls	2560	×	3080h	0 to 16384	1	9-187
AE-17	Positioning restart range	0 to 10000 pls	0	○	3081h	0 to 10000	1	9-193
AE-20	Position reference 0	Absolute position control : -268435455 to 268435455 pls High resolution absolute position control : -1073741823 to 1073741823 pls (Data range is limited [AE-54] to [AE-52] by parameter setting)	0	○	3084h 3085h	Normal mode: -268435455 to 268435455 High resolution mode: -1073741823 to 1073741823 ([AE-54] to [AE-52])	1	9-187
AE-22	Position reference 1				3086h 3087h			
AE-24	Position reference 2				3088h 3089h			
AE-26	Position reference 3				308Ah 308Bh			
AE-28	Position reference 4				308Ch 308Dh			
AE-30	Position reference 5				308Eh 308Fh			
AE-32	Position reference 6				3090h 3091h			
AE-34	Position reference 7				3092h 3093h			
AE-36	Position reference 8				3094h 3095h			
AE-38	Position reference 9				3096h 3097h			
AE-40	Position reference 10				3098h 3099h			
AE-42	Position reference 11				309Ah 309Bh			
AE-44	Position reference 12				309Ch 309Dh			
AE-46	Position reference 13				309Eh 309Fh			
AE-48	Position reference 14				30A0h 30A1h			
AE-50	Position reference 15				30A2h 30A3h			
AE-52	Position control range setting (forward)	Absolute position control : 0 to 268435455 pls High resolution absolute position control : 0 to 1073741823 pls	268435455	○	30A4h 30A5h	Normal mode: 0 to 268435455 High resolution mode: 0 to 1073741823	1	9-187 9-190 9-197
AE-54	Position control range setting (reverse)	Absolute position control : -268435455 to 0 pls High resolution absolute position control : -1073741823 to 0 pl)	-268435455	○	30A6h 30A7h	Normal mode: -268435455 to 0 High resolution mode: -1073741823 to 0	1	
AE-56	Position control mode selection	00: Limited 01: Not limited	00	×	30A8h	0 to 1	1	9-187

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
AE-60	Teach-in function target selection	00: X00 / 01: X01/ 02: X02 03: X03/ 04: X04 / 05: X05 06: X06 / 07: X07/ 08: X08 09: X09/ 10: X10 / 11: X11 12: X12 / 13: X13/ 14: X14 15: X15	00	○	30ACh	0 to 15	1	9-191
AE-61	Save current position at power off	00: Disable 01: Enable	00	○	30ADh	0 to 1	1	9-198
AE-62	Pre-set position data	Absolute position control : -268435455 to 268435455 pls High resolution absolute position control : -1073741823 to 1073741823 pls (Data range is limited [AE-54] to [AE-52] by parameter setting)	0	○	30AEh 30AFh	Normal mode: -268435455 to 268435455 High resolution mode: -1073741823 to 1073741823 ([AE-54] to [AE-52])	1	9-197
AE-64	Deceleration stop distance calculation gain	50.00 to 200.00 %	100.00	○	30B0h	5000 to 20000	0.01	9-188
AE-65	Deceleration stop distance calculation bias	0.00 to 655.35 %	0.00	○	30B1h	0 to 65535	0.01	
AE-70	Homing function selection	00: Low speed homing 01: High speed homing 1 02: High speed homing 2	00	○	30B6h	0 to 2	1	9-194
AE-71	Direction of homing function	00: Forward 01: Reverse	01	○	30B7h	0 to 1	1	
AE-72	Low-speed homing speed setting	0.00 to 10.00 Hz	5.00	○	30B8h	0 to 1000	0.01	
AE-73	High-speed homing speed setting	0.00 to Max. frequency Hz	5.00	○	30B9h	0 to 59000	0.01	
AE-74	ORG action selection	00: Without RUN command 01: With RUN command	01	○	30BAh	0 to 1	1	
AF101	DC braking selection 1st-motor	00: Disable 01: Enable 02: Enable (by frequency reference)	00	○	30D5h	0 to 2	1	9-69 9-78
AF103	DC braking frequency 1st-motor	0.00 to 590.00 Hz	0.50	○	30D7h	0 to 59000	0.01	9-78
AF104	DC braking delay time 1st-motor	0.00 to 5.00 s	0.00	○	30D8h	0 to 500	0.01	
AF105	DC braking force setting, 1st-motor	0 to 100 %	50	○	30D9h	0 to 100	1	
AF106	DC braking active time at stop, 1st-motor	0.00 to 60.00 s	0.50	○	30DAh	0 to 6000	0.01	
AF107	DC braking operation method selection 1st-motor	00: Edge 01: Level	01	○	30DBh	0 to 1	1	
AF108	DC braking force at start, 1st-motor	0 to 100 %	0	○	30DCh	0 to 100	1	9-69
AF109	DC braking active time at start, 1st-motor	0.00 to 60.00 s	0.00	○	30DDh	0 to 6000	0.01	
AF120	Contactor control enable, 1st-motor	00: Disable 01: Enable (Primary side) 02: Enable (Secondary side)	00	×	30E8h	0 to 2	1	9-86
AF121	Run delay time 1st-motor	0.00 to 2.00 s	0.20	○	30E9h	0 to 200	0.01	
AF122	Contactor off delay time, 1st-motor	0.00 to 2.00 s	0.10	○	30EAh			
AF123	Contactor response check time, 1st-motor	0.00 to 5.00 s	0.10	○	30EBh			
AF130	Brake control enable, 1st-motor	00: Disable 01: Brake control enable (Common) 02: Brake control enable (Separate for FWD/REV)	00	○	30F2h	0 to 2	1	9-84
AF131	Brake release wait time 1st-motor (Forward)	0.00 to 5.00 s	0.00	○	30F3h	0 to 500	0.01	
AF132	Brake wait time for accel.,1st-motor (Forward)				30F4h			

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AF133	Brake wait time for stopping 1st-motor (Forward)	0.00 to 5.00 s	0.00	○	30F5h	0 to 500		9-84
AF134	Brake confirmation signal wait time, 1st-motor (Forward)			○	30F6h			
AF135	Brake release frequency setting, 1st-motor (Forward)	0.00 to 590.00 Hz	0.00	○	30F7h	0 to 59000	0.01	
AF136	Brake release current setting 1st-motor (Forward)	(0.00 to 2.00)×Inverter rated output current A	1.00× Rated output current	○	30F8h	(0.20 to 2.00) ×Rated output current	0.1	
						2000 to 20000 Note	0.01	
AF137	Braking frequency, 1st-motor (Forward)	0.00 to 590.00 Hz	0.00	○	30F9h	0 to 59000	0.01	
AF138	Brake release wait time 1st-motor (Reverse)	0.00 to 5.00 s	0.00	○	30FAh	0 to 500	0.01	
AF139	Brake wait time for accel. 1st-motor (Reverse)			○	30FBh			
AF140	Brake wait time for stopping 1st-motor (Reverse)			○	30FCh			
AF141	Brake confirmation signal wait time, 1st-motor (Reverse)			○	30FDh			
AF142	Brake release frequency setting, 1st-motor (Reverse)	0.00 to 590.00 Hz	0.00	○	30FEh	0 to 59000	0.01	
AF143	Brake release current setting 1st-motor (Reverse)	(0.00 to 2.00)×Inverter rated output current A	1.00× Rated output current	○	30FFh	(0.20 to 2.00) ×Rated output current	0.1	
						2000 to 20000 Note	0.01	
AF144	Braking frequency, 1st-motor (Reverse)	0.00 to 590.00 Hz	0.00	○	3100h	0 to 59000	0.01	
AF201	DC braking selection 2nd-motor	00: Disable 01: Enable 02: Enable (by frequency reference)	00	○	57E5h	0 to 2	1	9-69 9-78 9-95
AF203	DC braking frequency 2nd-motor	0.00 to 590.00 Hz	0.50	○	57E7h	0 to 59000	0.01	9-78 9-95
AF204	DC braking delay time 2nd-motor	0.00 to 5.00 s	0.00	○	57E8h	0 to 500	0.01	
AF205	DC braking force setting 2nd-motor	0 to 100 %	50	○	57E9h	0 to 00	1	
AF206	DC braking active time at stop 2nd-motor	0.00 to 60.00 s	0.50	○	57EAh	0 to 6000	0.01	
AF207	DC braking operation method selection, 2nd-motor	00: Edge 01: Level	01	○	57EBh	0 to 1	1	
AF208	DC braking force at start 2nd-motor	0 to 100 %	0	○	57ECh	0 to 100	1	9-69 9-95
AF209	DC braking active time at start 2nd-motor	0.00 to 60.00 s	0.00	○	57EDh	0 to 6000	0.01	
AF220	Contactor control enable 2nd-motor	00: Disable 01: Enable (Primary side) 02: Enable (Secondary side)	00	×	57F8h	0 to 2	1	9-86 9-95
AF221	Run delay time, 2nd-motor	0.00 to 2.00 s	0.20	○	57F9h	0 to 200	0.01	
AF222	Contactor off delay time 2nd-motor	0.00 to 2.00 s	0.10	○	57FAh	0 to 200	0.01	
AF223	Contactor response check time 2nd-motor	0.00 to 5.00 s	0.10	○	57FBh	0 to 500	0.01	
AF230	Brake control enable 2nd-motor	00: Disable 01: Brake control enable (Common) 02: Brake control enable (Separate for FWD/REV)	00	○	5802h	0 to 2	1	9-84 9-95
AF231	Brake release wait time 2nd-motor (Forward)	0.00 to 5.00 s	0.00	○	5803h	0 to 500	0.01	
AF232	Brake wait time for accel. 2nd-motor (Forward)				5804h			
AF233	Brake wait time for stopping 2nd-motor (Forward)				5805h			

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
AF234	Brake confirmation signal wait time, 2nd-motor (Forward)	0.00 to 5.00 s	0.00	○	5806h	0 to 500	0.01	9-84 9-95
AF235	Brake release frequency setting, 2nd-motor (Forward)	0.00 to 590.00 Hz	0.00	○	5807h	0 to 59000	0.01	
AF236	Brake release current setting, 2nd-motor (Forward)	(0.00 to 2.00)×Inverter rated output current A	1.00× Rated output current	○	5808h	(0.20 to 2.00) ×Rated output current		
						2000 to 20000 Note	0.01	
AF237	Braking frequency 2nd-motor (Forward)	0.00 to 590.00 Hz	0.00	○	5809h	0 to 59000	0.01	
AF238	Brake release wait time 2nd-motor (Reverse)	0.00 to 5.00 s	0.00	○	580Ah	0 to 500	0.01	
AF239	Brake wait time for accel. 2nd-motor (Reverse)			○	580Bh			
AF240	Brake wait time for stopping 2nd-motor (Reverse)			○	580Ch			
AF241	Brake confirmation signal wait time, 2nd-motor (Reverse)			○	580Dh			
AF242	Brake release frequency setting, 2nd-motor (Reverse)	0.00 to 590.00 Hz	0.00	○	580Eh	0 to 59000	0.01	
AF243	Brake release current setting 2nd-motor (Reverse)	(0.00 to 2.00)×Inverter rated output current A	1.00× Rated output current	○	580Fh	(0.20 to 2.00) ×Rated output current	0.1	
						2000 to 20000 Note	0.01	
AF244	Braking frequency 2nd-motor (Reverse)	0.00 to 590.00 Hz	0.00	○	5810h	0 to 59000	0.01	
AG101	Jump frequency 1, 1st-motor	0.00 to 590.00 Hz	0.00	○	3139h	0 to 59000	0.01	9-156
AG102	Jump frequency width 1 1st-motor	0.00 to 10.00 Hz	0.50	○	313Ah	0 to 1000	0.01	
AG103	Jump frequency 2, 1st-motor	0.00 to 590.00 Hz	0.00	○	313Bh	0 to 59000	0.01	
AG104	Jump frequency width 2 1st-motor	0.00 to 10.00 Hz	0.50	○	313Ch	0 to 1000	0.01	
AG105	Jump frequency 3, 1st-motor	0.00 to 590.00 Hz	0.00	○	313Dh	0 to 59000	0.01	
AG106	Jump frequency width 3 1st-motor	0.00 to 10.00 Hz	0.50	○	313Eh	0 to 1000	0.01	
AG110	Acceleration stop frequency setting, 1st-motor	0.00 to 590.00 Hz	0.00	○	3142h	0 to 59000	0.01	9-25
AG111	Acceleration stop time setting, 1st-motor	0.0 to 60.0 s	0.0	○	3143h	0 to 600	0.1	
AG112	Deceleration stop frequency setting, 1st-motor	0.00 to 590.00 Hz	0.00	○	3144h	0 to 59000	0.01	
AG113	Deceleration stop time setting, 1st-motor	0.0 to 60.0 s	0.0	○	3145h	0 to 600	0.1	
AG-20	Jogging frequency	0.00 to 10.00 Hz	6.00	○	314Ch	0 to 1000	0.01	9-13
AG-21	Jogging stop mode selection	(Disable at RUN) 00: Free run at jogging stop 01: Deceleration stop at jogging stop 02: DC braking at jogging stop (Enable at RUN) 03: Free run at jogging stop 04: Deceleration stop at jogging stop 05: DC braking at jogging stop	04	○	314Dh	0 to 5	1	
AG201	Jump frequency 1, 2nd-motor	0.00 to 590.00 Hz	0.00	○	5849h	0 to 59000	0.01	9-156 9-95
AG202	Jump frequency width 1, 2nd-motor	0.00 to 10.00 Hz	0.50	○	584Ah	0 to 1000	0.01	
AG203	Jump frequency 2, 2nd-motor	0.00 to 590.00 Hz	0.00	○	584Bh	0 to 59000	0.01	
AG204	Jump frequency width 2, 2nd-motor	0.00 to 10.00 Hz	0.50	○	584Ch	0 to 1000	0.01	
AG205	Jump frequency 3, 2nd-motor	0.00 to 590.00 Hz	0.00	○	584Dh	0 to 59000	0.01	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
AG206	Jump frequency width 3, 2nd-motor	0.00 to 10.00 Hz	0.50	○	584Eh	0 to 1000	0.01	9-156 9-95
AG210	Acceleration stop frequency setting, 2nd-motor	0.00 to 590.00 Hz	0.00	○	5852h	0 to 59000	0.01	9-25 9-95
AG211	Acceleration stop time setting 2nd-motor	0.0 to 60.0 s	0.0	○	5853h	0 to 600	0.1	
AG212	Deceleration stop frequency setting, 2nd-motor	0.00 to 590.00 Hz	0.00	○	5854h	0 to 59000	0.01	
AG213	Deceleration stop time setting 2nd-motor	0.0 to 60.0 s	0.0	○	5855h	0 to 600	0.1	
AH-01	PID1 enable	00: Disable 01: Enable 02: Enable (with inverted output)	00	○	319Dh	0 to 2	1	9-100 9-102
AH-02	PID1 deviation inversion	00: Disable 01: Enable	00	○	319Eh	0 to 1	1	9-102
AH-03	PID1 unit selection	00: non/ 01: %/ 02: A/ 03: Hz 04: V/ 05: kW/ 06: W/ 07: hr 08: s/ 09 kHz/ 10: Ω/ 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 /30: m 31: cm/32: °F/ 33: l/s 34: l/min/ 35: l/h/ 36: m^3/s 37: m^3/min/ 38: m3/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	01	○	319Fh	0 to 58	1	9-129
AH-04	PID1 scale adjustment (0%)	-10000 to 10000	0	○	31A0h	-10000 to 10000	1	
AH-05	PID1 scale adjustment (100%)		10000	○	31A1h			
AH-06	PID1 scale adjustment (decimal point position)	0 to 4	2	○	31A2h	0 to 4	1	
AH-07	PID1 set-point 1 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	07	×	31A3h	0 to 12	1	9-102
AH-10	PID1 set-point 1 setting	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	0.00	○	31A6h 31A7h	-10000 to 10000	1	
AH-12	PID1 multistage set-point 1			○	31A8h 31A9h			
AH-14	PID1 multistage set-point 2			○	31AAh 31ABh			
AH-16	PID1 multistage set-point 3			○	31ACh 31ADh			
AH-18	PID1 multistage set-point 4			○	31AEh 31AFh			
AH-20	PID1 multistage set-point 5			○	31B0h 31B1h			
AH-22	PID1 multistage set-point 6			○	31B2h 31B3h			
AH-24	PID1 multistage set-point 7			○	31B4h 31B5h			
AH-26	PID1 multistage set-point 8			○	31B6h 31B7h			
AH-28	PID1 multistage set-point 9			○	31B8h 31B9h			
AH-30	PID1 multistage set-point 10			○	31BAh 31BBh			

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Data range	Resolution	Page
AH-32	PID1 multistage set-point 11	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	0.00	○	31BCh 31BDh	-10000 to 10000	1	9-102
AH-34	PID1 multistage set-point 12			○	31BEh 31BFh			
AH-36	PID1 multistage set-point 13			○	31C0h 31C1h			
AH-38	PID1 multistage set-point 14			○	31C2h 31C3h			
AH-40	PID1 multistage set-point 15			○	31C4h 31C5h			
AH-42	PID1 set-point 2 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	00	×	31C6h	0 to 12	1	
AH-44	PID1 set-point 2 setting	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	0.00	○	31C8h 31C9h	-10000 to 10000	1	
AH-46	PID1 set-point 3 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	00	×	31CAh	0 to 12	1	9-107
AH-48	PID1 set-point 3 setting	-100.00 to 100.00 % Data range depends on PID1 scale adjustment (AH-04, 05, 06)	0.00	○	31CCh 31CDh	-10000 to 10000	1	
AH-50	PID1 set-point calculation symbol selection	01: Addition 02: Subtraction 03: Multiplication 04: Division 05: Minimum deviation 06: Maximum deviation	01	○	31CEh	1 to 6	1	
AH-51	PID1 feedback 1 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 08: RS485 09: Option 12: Pulse input	02	○	31CFh	0 to 12	1	9-110
AH-52	PID1 feedback 2 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 08: RS485 09: Option 12: Pulse input	00	×	31D0h	0 to 12	1	
AH-53	PID1 feedback 3 input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 08: RS485 09: Option 12: Pulse input	00	×	31D1h	0 to 12	1	
AH-54	PID1 feedback calculation symbol selection	01: Addition 02: Subtraction 03: Multiplication 04: Division 05: Square root of FB1 06: Square root of FB2 07: Square root of FB1-FB2 08: Average of the three inputs 09: Minimum of the three inputs 10: Maximum of the three inputs	01	○	31D2h	1 to 10	1	

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AH-60	PID1 gain change method selection	00: Using gain-1 only 01: [PRO] terminal	00	×	31D8h	0 to 1	1	9-114
AH-61	PID1 proportional gain 1	0.0 to 100.0	1.0	○	31D9h	0 to 1000	0.1	
AH-62	PID1 integral time constant 1	0.0 to 3600.0 s	1.0	○	31DAh	0 to 36000	0.1	
AH-63	PID1 derivative gain 1	0.00 to 100.00 s	0.00	○	31DBh	0 to 10000	0.01	
AH-64	PID1 proportional gain 2	0.0 to 100.0	0.0	○	31DCh	0 to 1000	0.1	
AH-65	PID1 integral time constant 2	0.0 to 3600.0 s	0.0	○	31DDh	0 to 36000	0.1	
AH-66	PID1 derivative gain 2	0.00 to 100.00 s	0.00	○	31DEh	0 to 10000	0.01	
AH-67	PID1 gain change time	0 to 10000 ms	100	○	31DFh	0 to 10000	1	
AH-70	PID1 feed-forward input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF]	00	○	31E2h	0 to 2	1	9-111
AH-71	PID1 output range	0.00 to 100.00 %	0.00	○	31E3h	0 to 10000	0.01	9-112
AH-72	PID1 over deviation level	0.00 to 100.00 %	3.00	○	31E4h	0 to 10000	0.01	9-126
AH-73	Turn-off level for the PID1 feedback compare signal	0.00 to 100.00 %	100.00	○	31E5h	0 to 10000	0.01	9-127
AH-74	Turn-on level for the PID1 feedback compare signal	0.00 to 100.00 %	0.00	○	31E6h	0 to 10000	0.01	
AH-75	PID soft start function enable	00: Disable 01: Enable	00	×	31E7h	0 to 1	1	9-115
AH-76	PID soft start target level	0.00 to 100.00 %	100.00	○	31E8h	0 to 10000	0.01	
AH-78	Acceleration time setting for PID soft start function	0.00 to 3600.00 s	30.00	○	31EAh 31EBh	0 to 360000	0.01	
AH-80	PID soft start time	0.00 to 600.00 s	0.00	○	31ECh	0 to 60000	0.01	
AH-81	PID soft start error detection enable	00: Disable 01: Enable (Error) 02: Enable (Warning)	00	×	31EDh	0 to 2	1	9-116
AH-82	PID soft start error detection level	0.00 to 100.00 %	0.00	○	31EEh	0 to 10000	0.01	
AH-85	PID sleep trigger selection	00: Disable 01: Low output 02: [SLEP] terminal	00	×	31F1h	0 to 2	1	9-117
AH-86	PID sleep start level	0.00 to 590.00 Hz	0.00	○	31F2h	0 to 59000	0.01	
AH-87	PID sleep active time	0.00 to 100.00 s	0.00	○	31F3h	0 to 10000	0.01	
AH-88	Enable set-point boost before PID sleep	00: Disable 01: Enable	00	×	31F4h	0 to 1	1	9-119
AH-89	Set-point boost time before PID sleep	0.00 to 100.00 s	0.00	○	31F5h	0 to 10000	0.01	
AH-90	Set-point boost value before PID sleep	0.00 to 100.00 %	0.00	○	31F6h	0 to 10000	0.01	
AH-91	Minimum RUN time before PID sleep	0.00 to 100.00 s	0.00	○	31F7h	0 to 10000	0.01	9-120
AH-92	Minimum active time of PID sleep	0.00 to 100.00 s	0.00	○	31F8h	0 to 10000	0.01	
AH-93	PID wake trigger selection	01: Deviation value 02: Low feedback 03: [WAKE] terminal	01	×	31F9h	1 to 3	1	9-117
AH-94	PID wake start level	0.00 to 100.00 %	0.00	○	31FAh	0 to 10000	0.01	
AH-95	PID wake start time	0.00 to 100.00 s	0.00	○	31FBh	0 to 10000	0.01	
AH-96	PID wake start deviation value	0.00 to 100.00 %	0.00	○	31FCh	0 to 10000	0.01	
AJ-01	PID2 enable	00: Disable 01: Enable 02: Enable (with inverted output)	00	×	3201h	0 to 2	1	
AJ-02	PID2 deviation inversion	00: Disable 01: Enable	00	×	3202h	0 to 1	1	
AJ-03	PID2 unit selection	00 to 58 (Same as AH-03)	01	○	3203h	0 to 58	1	
AJ-04	PID2 scale adjustment (0%)	-10000 to 10000	0	○	3204h	-10000 to 10000	1	
AJ-05	PID2 scale adjustment (100%)	-10000 to 10000	10000	○	3205h	-10000 to 10000	1	
AJ-06	PID2 scale adjustment (decimal point position)	0 to 4	2	○	3206h	0 to 4	1	

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
AJ-07	PID2 set-point input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input 15: PID1 output	07	×	3207h	0 to 15	1	9-123
AJ-10	PID2 set-point setting	-100.00 to 100.00 % Data range depends on PID2 scale adjustment (AJ-04, 05, 06)	0.00	○	320Ah	-10000 to 10000	1	9-123
AJ-12	PID2 feedback input source selection	00: Not used 01: Terminal [VRF] 02: Terminal [IRF] 08: RS485 09: Option 12: Pulse input	02	×	320Ch	0 to 12	1	9-123
AJ-13	PID2 proportional gain	0.0 to 100.0	1.0	○	320Dh	0 to 1000	0.1	9-123 9-126
AJ-14	PID2 integral time constant	0.0 to 3600.0 s	1.0	○	320Eh	0 to 36000	0.1	
AJ-15	PID2 derivative gain	0.00 to 100.00 s	0.00	○	320Fh	0 to 10000	0.01	
AJ-16	PID2 output range	0.00 to 100.00 %	0.00	○	3210h	0 to 10000	0.01	9-125
AJ-17	PID2 over deviation level		3.00	○	3211h			9-126
AJ-18	Turn-off level for the PID2 feedback compare signal		100.00	○	3212h			9-127
AJ-19	Turn-on level for the PID2 feedback compare signal		0.00	○	3213h			

18.2.4 b parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
bA101	Upper frequency limit source selection, 1st-motor	00: Disable 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	00	×	32C9h	0 to 12	1	9-32
bA102	Upper frequency limit 1st-motor	0.00 to Max. frequency, 1st motor (Hz)	0.00	○	32CAh	0 to 59000	0.01	
bA103	Lower frequency limit 1st-motor	0.00 to Upper frequency limit, 1st motor (Hz)	0.00	○	32CBh			
bA110	Torque limit selection 1st-motor	00: Disable 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option	07	○	32D2h	0 to 9	1	9-59
bA111	Torque limiting parameters mode selection, 1st-motor	00: 4 quadrants 01: Switched by [TRQ1][TRQ2] terminals	00	×	32D3h	0 to 1	1	
bA112	Torque limit 1 (Forward drive), 1st-motor	0.0 to 500.0 %	200.0	○	32D4h	0 to 5000	0.1	
bA113	Torque limit 2 (Reverse regenerative), 1st-motor				32D5h			
bA114	Torque limit 3 (Reverse drive), 1st-motor				32D6h			
bA115	Torque limit 4 (Forward regenerative), 1st-motor				32D7h			
bA116	Torque limit LADSTOP selection, 1st-motor	00: Disable 01: Enable	00	○	32D8h	0 to 1	1	9-61
bA120	Overcurrent suppression enable, 1st-motor	00: Disable 01: Enable 02: Enable (with voltage reduction)	00	○	32DCh	0 to 2	1	9-132
bA121	Overcurrent suppression level, 1st-motor	(0.30 to 1.80)×Inverter rated output current	1.80× Rated output current	×	32DDh	(0.30 to 1.80) ×Rated output current 3000 to 18000[Note]	0.1 0.01	
bA122	Overload restriction 1 mode selection, 1st-motor	00: Disable 01: Enable during accel. and constant speed 02: Constant speed only 03: Enable during accel. and constant speed (Accel. during regeneration)	01	○	32DEh	0 to 3	1	9-130
bA123	Overload restriction 1 active level, 1st-motor	0.20 to 2.00)×Inverter rated output current	1.50× Rated output current	○	32DFh	(0.20 to 2.00) ×Rated output current 2000 to 20000 [Note]	0.1 0.01	
bA124	Overload restriction 1 action time, 1st-motor	0.10 to 3600.00 s	1.00	○	32E0h 32E1h	10 to 360000	0.01	
bA126	Overload restriction 2 mode selection, 1st-motor	00: Disable 01: Enable during accel. and constant speed 02: Constant speed only 03: Enable during accel. And constant speed (Accel. during regeneration)	01	○	32E2h	0 to 3	1	9-131
bA127	Overload restriction 2 active level, 1st-motor	0.20 to 2.00)×Inverter rated output current	1.50× Rated output current	○	32E3h	(0.20 to 2.00) ×Rated output current 2000 to 20000 [Note]	0.1 0.01	
bA128	Overload restriction 2 action time, 1st-motor	0.10 to 3600.00 s	1.00	○	32E4h 32E5h	10 to 360000	0.01	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
bA-30	Instantaneous power failure non-stop function, mode selection	00: Disable 01: Deceleration stop 02: Deceleration stop at power failure (without resume) 03: Deceleration stop at power failure (with resume)	00	×	32E6h	0 to 3	1	9-149
bA-31	Instantaneous power failure non-stop function, start voltage level	200V class: DC0.0 to 400.0 V 400V class: DC0.0 to 800.0 V	220.0 440.0	○	32E7h	200V class:0 to 4000 400V class: 0 to 8000 0 to 20000 Note	0.1 0.01	
bA-32	Instantaneous power failure non-stop function, target voltage level		360.0 720.0	○	32E8h	200V class: 0 to 4000 400V class: 0 to 8000 0 to 20000 Note	0.1 0.01	
bA-34	Instantaneous power failure non-stop function, deceleration time	0.01 to 3600.00 s	1.00	○	32EAh 32EBh	1 to 360000	0.01	
bA-36	Instantaneous power failure non-stop function, start frequency decrement	0.00 to 10.00 Hz	0.00	○	32ECh	0 to 1000	0.01	
bA-37	Instantaneous power failure non-stop function, DC bus voltage control P gain	0.00 to 5.00	0.20	○	32EDh	0 to 500	0.01	
bA-38	Instantaneous power failure non-stop function, DC bus voltage control I gain	0.00 to 150.00 s	1.00	○	32EEh	0 to 15000	0.01	
bA140	Overvoltage suppression enable setting, 1st-motor	00: Disable 01: Constant DC bus voltage control (deceleration stop) 02: Enable acceleration (at deceleration) 03: Enable acceleration (at constant speed and deceleration)	00	○	32F0h	0 to 3	1	9-133
bA141	Overvoltage suppression active level, 1st-motor	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	380.0 760.0	○	32F1h	200V class: 3300 to 4000 400V class: 6600 to 8000 16500 to 20000 Note	0.1 0.01	
bA142	Overvoltage suppression active time, 1st-motor	0.00 to 3600.00 s	1.00	○	32F2h 32F3h	0 to 360000	0.01	
bA144	Constant DC bus voltage control P gain, 1st-motor	0.00 to 5.00	0.20	○	32F4h	0 to 500	0.01	
bA145	Constant DC bus voltage control I gain, 1st-motor	0.00 to 150.00 s	1.00	○	32F5h	0 to 15000	0.01	
bA146	Overexcitation function selection, 1st-motor	00: Disable 01: Always enable 02: At deceleration only 03: Operation at setting level 04: Operation at setting level at deceleration stop	00	○	32F6h	0 to 4	1	9-135
bA147	Overexcitation function output filter time constant, 1st-motor	0.000 to 10.000 s	0.300	○	32F7h	0 to 10000	0.001	
bA148	Overexcitation function voltage gain, 1st-motor	50 to 400 %	100	○	32F8h	50 to 400	1	
bA149	Overexcitation function level setting, 1st-motor	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	360.0 720.0	○	32F9h	200V class: 3300 to 4000 400V class: 6600 to 8000 16500 to 20000 Note	0.1 0.01	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
bA-60	Dynamic brake use ratio	0.0 to 10.0×([bA-63]/ Min. resistance)2 %	10.0	○	3304h	0 to 10000	0.1	9-137
bA-61	Dynamic brake activation selection	00: Disable 01: Only while running 02: Enable during stop	00	○	3305h	0 to 2	1	
bA-62	Dynamic brake activation level	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	360.0 720.0	○	3306h	200V class: 3300 to 4000 400V class: 6600 to 8000 16500 to 20000 Note	0.1 0.01	
bA-63	Dynamic brake resistor value	Min. resistance to 600.0 Ω	Min. resistance	○	3307h	Min. resistance to 6000	0.1	
bA-70	Cooling fan control method selection	00: Always ON 01: While inverter operates 02: Depends on temperature	01	○	330Eh	0 to 2	1	9-156
bA-71	Clear accumulated cooling fan run time monitor	00: Disabled 01: Clear	00	○	330Fh	0 to 1	1	9-168
bA-72	Ambient temperature	-10 to 50 ℃	40	○	3310h	-10 to 50	1	
bA201	Upper frequency limit source selection, 2nd-motor	00: Disable 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input	00	×	59D9h	0 to 12	1	9-32 9-95
bA202	Upper frequency limit, 2nd-motor	0.00 to Max. frequency, 2nd motor (Hz)	0.00	○	59DAh	0 to 59000	0.01	
bA203	Lower frequency limit, 2nd-motor	0.00 to Upper frequency limit, 2nd motor (Hz)	0.00	○	59DBh			
bA210	Torque limit selection, 2nd-motor	00: Disable 01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option	07	○	59E2h	0 to 9	1	
bA211	Torque limiting parameters mode selection, 2nd-motor	00: 4 quadrants 01: Switched by [TRQ1][TRQ2] terminals	00	×	59E3h	0 to 1	1	
bA212	Torque limit 1 (Forward drive), 2nd-motor	0.0 to 500.0 %	200.0	○	59E4h	0 to 5000	0.1	9-59 9-95
bA213	Torque limit 2 (Reverse regenerative), 2nd-motor			○	59E5h			
bA214	Torque limit 3 (Reverse drive), 2nd-motor			○	59E6h			
bA215	Torque limit 4 (Forward regenerative), 2nd-motor			○	59E7h			
bA216	Torque limit LADSTOP selection, 2nd-motor	00: Disable 01: Enable	00	○	59E8h	0 to 1	1	9-61 9-95
bA220	Overcurrent suppression enable, 2nd-motor	00: Disable 01: Enable 02: Enable (with voltage reduction)	00	○	59ECh	0 to 2	1	9-132 9-95
bA221	Overcurrent suppression level, 2nd-motor	(0.30 to 1.80)×Inverter rated output current	1.80× Rated output current	×	59EDh	(0.30 to 1.80) ×Rated output current 3000 to 18000 Note	0.1 0.01	
bA222	Overload restriction 1 mode selection, 2nd-motor	0: Disabled 01: Enable during accel. and constant speed 02: Constant speed only 03: Enable during accel. and constant speed (Accel. during regeneration)	01	○	59EEh	0 to 3	1	9-130 9-95
bA223	Overload restriction 1 active level, 2nd-motor	(0.20 to 2.00)×Inverter rated output current	1.50× Rated output current	○	59EFh	(0.20 to 2.00) ×Rated output current 2000 to 20000 Note	0.1 0.01	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
bA224	Overload restriction 1 action time, 2nd-motor	0.10 to 3600.00 s	1.00	○	59F0h 59F1h	10 to 360000	0.01	9-130 9-95
bA226	Overload restriction 2 mode selection, 2nd-motor	00: Disable 01: Enable during accel. and constant speed 02: Constant speed only 03: Enable during accel. and constant speed (Accel. during regeneration)	01	○	59F2h	0 to 3	1	9-131 9-95
bA227	Overload restriction 2 active level, 2nd-motor	(0.20 to 2.00)×Inverter rated output current	1.50× Rated output current	○	59F3h	(0.20 to 2.00) ×Rated output current 2000 to 20000 Note	0.1 0.01	
bA228	Overload restriction 2 action time, 2nd-motor	0.10 to 3600.00 s	1.00	○	59F4h 59F5h	10 to 360000	0.01	
bA240	Overvoltage suppression enable, 2nd-motor	00: Disable 01: Constant DC bus voltage control (deceleration stop) 02: Enable acceleration (at deceleration) 03: Enable acceleration (at constant speed and deceleration)	00	○	5A00h	0 to 3	1	9-133 9-95
bA241	Overvoltage suppression active level, 2nd-motor	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	380.0 760.0	○	5A01h	200V class: 3300 to 4000 400V class: 6600 to 8000 16500 to 20000 Note	0.1 0.01	
bA242	Overvoltage suppression active time, 2nd-motor	0.00 to 3600.00 s	1.00	○	5A02h 5A03h	0 to 360000	0.01	
bA244	Constant DC bus voltage control P gain, 2nd-motor	0.00 to 5.00	0.20	○	5A04h	0 to 500	0.01	
bA245	Constant DC bus voltage control I gain, 2nd-motor	0.00 to 150.00 s	1.00	○	5A05h	0 to 15000	0.01	
bA246	Overexcitation function selection, 2nd-motor	00: Disable 01: Always enable 02: At deceleration only 03: Operation at setting level 04: Operation at setting level at deceleration stop	00	○	5A06h	0 to 4	1	9-135 9-95
bA247	Overexcitation function output filter time constant, 2nd-motor	0.000 to 10.000 s	0.300	○	5A07h	0 to 10000	0.001	
bA248	Overexcitation function voltage gain, 2nd-motor	50 to 400 %	100	○	5A08h	50 to 400	1	
bA249	Overexcitation function level setting, 2nd-motor	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	360.0 720.0	○	5A09h	200V class: 3300 to 4000 400V class: 6600 to 8000 16500 to 20000 Note	0.1 0.01	
bb101	Carrier frequency setting, 1st-motor	ND: 2.0 to 15.0 kHz LD: 2.0 to 10.0 kHz	2.0	○	332Dh	ND: 20 to 150 LD: 20 to 100	0.1	9-152
bb102	Sprinkle carrier pattern selection, 1st-motor	00: Disable 01: Enable (Pattern-1)	00	×	332Eh	0 to 1	1	9-154
bb103	Automatic carrier reduction selection, 1st-motor	00: Disable 01: Enable (Current) 02: Enable (Temperature)	01	○	332Fh	0 to 2	1	9-153
bb-10	Automatic error reset selection	00: Disable 01: If RUN command is OFF 02: After set time	00	×	3336h	0 to 2	1	9-92 9-216
bb-11	Alarm signal selection at automatic error reset	00: Enable 01: Disable	00	×	3337h	0 to 1	1	
bb-12	Automatic error reset wait time	0 to 600 s	2	○	3338h	0 to 600	1	
bb-13	Automatic error reset number	0 to 10	3	×	3339h	0 to 10	1	

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Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
bb-21	Number of retries after under voltage	0 (Trip) to 16/ 255 (Unlimited)	0	○	3341h	0 to 16 /255	1	9-139
bb-22	Number of retries after overcurrent	0 to 5	0	○	3342h	0 to 5	1	9-143
bb-23	Number of retries after over voltage			○	3343h			9-146
bb-24	Restart mode selection after instantaneous power failure/under-voltage error	00: Restart at 0 Hz 01: Restart with frequency matching 02: Restart with active frequency matching 03: Detect speed 04: Trip after deceleration stop with frequency matching	01	○	3344h	0 to 4	1	9-139
bb-25	Instantaneous power failure allowed time	0.3 to 25.0 s	1.0	○	3345h	3 to 250	0.1	
bb-26	Retry wait time after instantaneous power failure/under-voltage error	0.3 to 100.0 s	0.3	○	3346h	3 to 1000	0.1	9-75 9-139
bb-27	Enable instantaneous power failure/under-voltage error while in stop status	00: Disable 01: Enable 02: Disable at stop and deceleration	00	○	3347h	0 to 2	1	9-139
bb-28	Restart mode selection after an overcurrent error	00: Restart at 0 Hz 01: Restart with frequency matching 02: Restart with active frequency matching 03: Detect speed 04: Trip after deceleration stop with frequency matching	01	○	3348h	0 to 4	1	9-143
bb-29	Retry wait time after an overcurrent error	0.3 to 100.0 s	0.3	○	3349h	3 to 1000	0.1	
bb-30	Restart mode selection after an overvoltage error	00: Restart at 0 Hz 01: Restart with frequency matching 02: Restart with active frequency matching 03: Detect speed 04: Trip after deceleration stop with frequency matching	01	○	334Ah	0 to 4	1	9-146
bb-31	Retry wait time after an overvoltage error	0.3 to 100.0 s	0.3	○	334Bh	3 to 1000	0.1	
bb-40	Restart mode after FRS release	00: Restart at 0 Hz 01: Restart with frequency matching 02: Restart with active frequency matching 03: Detect speed	00	○	3354h	0 to 3	1	9-77
bb-41	Restart mode after RS release	00: Restart at 0 Hz 01: Restart with frequency matching 02: Restart with active frequency matching 03: Detect speed	00	○	3355h	0 to 3	1	9-75 9-92
bb-42	Frequency matching minimum restart frequency	0.00 to 590.00 Hz	0.00	○	3356h	0 to 59000	0.01	9-71
bb-43	Active frequency matching restart level	(0.20 to 2.00)×Inverter rated output current	1.00× Rated output current	○	3357h	(0.20 to 2.00) ×Rated output current	0.1	
						0 to 20000 Note	0.01	
bb-44	Restart constant (speed) of Active frequency matching	0.10 to 30.00 s	0.50	○	3358h	10 to 3000	0.01	
bb-45	Active frequency matching restart constant (voltage)		1.20	○	3359h			

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Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
bb-46	OC-suppress level at active frequency matching	(0.30 to 1.80)×Inverter rated output current	1.80× Rated output current	○	335Ah	(0.30 to 1.80) ×Rated output current 3000 to 18000 Note	0.1 0.01	9-71
bb-47	Active frequency matching restart speed selection	00: Output frequency at shut down 01: Maximum frequency 02: Setting frequency	00	○	335Bh	0 to 2	1	
bb160	Overcurrent detection level, 1st-motor	(0.30 to 2.20)×Inverter rated output current	2.20× Rated output current	×	3368h	(0.30 to 2.20) ×Rated output Current 3000 to 22000 Note	0.1 0.01	15-6
bb-61	Power supply overvoltage selection	00: Warning 01: Error	00	○	3369h	0 to 1	1	9-165
bb-62	Power supply overvoltage level setting	200V class: DC330.0 to 400.0 V 400V class: DC660.0 to 800.0 V	390.0 780.0	○	336Ah	200V class: 3300 to 4000 400V class: 6600 to 8000 15000 to 20000 Note	0.1 0.01	
bb-64	Detect ground fault selection	00: Disable 01: Enable	00	×	336Ch	0 to 1	1	9-158
bb-65	Input phase loss detection enable	00: Disable 01: Enable	00	○	336Dh	0 to 1	1	
bb-66	Output phase loss detection enable	00: Disable 01: Enable	00	○	336Eh	0 to 1	1	
bb-67	Output phase loss detection sensitivity	1 to 100 %	10	○	336Fh	1 to 100	1	
bb-70	Thermistor error level	0 to 10000 Ω	3000	○	3372h	0 to 10000	1	9-157
bb-77	Input phase loss detection level	0 to 200	50	○	3379h	0 to 200	1	9-158
bb-80	Over-speed detection level	0.0 to 150.0 %	115.0	○	337Ch	0 to 1500	0.1	9-52
bb-81	Over-speed detection time	0.0 to 5.0 s	0.5	○	337Dh	0 to 50	0.1	
bb-82	Speed deviation error mode selection	00: Warning 01: Error	00	×	337Eh	0 to 1	1	
bb-83	Speed deviation error detection level	0.00 to 100.00 %	15.00	○	337Fh	0 to 10000	0.01	
bb-84	Speed deviation error detection time	0.0 to 5.0 s	0.5	×	3380h	0 to 50	0.1	
bb201	Carrier frequency setting 2nd-motor	ND: 2.0 to 15.0 kHz LD: 2.0 to 10.0 kHz	2.0	○	5A3Dh	ND: 20 to 150 LD: 20 to 100	0.1	9-152 9-95
bb202	Sprinkle carrier pattern selection, 2nd-motor	00: Disable 01: Enable (Pattern-1)	00	×	5A3Eh	0 to 1	1	9-154 9-95
bb203	Automatic carrier reduction selection, 2nd-motor	00: Disable 01: Enable (Current) 02: Enable (Temperature)	01	○	5A3Fh	0 to 2	1	9-153 9-95
bb260	Overcurrent detection level, 2nd-motor	(0.30 to 2.20)×Inverter rated output current	2.20× Rated output current	×	5A78h	(0.30 to 2.20) ×Rated output current 3000 to 22000 Note	0.1 0.01	15-6 9-95
bC110	Electronic thermal level setting, 1st-motor	(0.00 to 3.00)×Inverter rated output current	1.00× Rated output current	○	339Ah	(0.00 to 3.00) ×Rated output current 0 to 33000 Note	0.1 0.01	8-6
bC111	Electronic thermal characteristic selection, 1st-motor	00: Reduce torque (VT) 01: Constant torque (CT) 02: Free setting (FREE)	01	○	339Bh	0 to 2	1	8-7
bC112	Electronic thermal decrease function enable, 1st-motor	00: Disable 01: Enable (Linear decrement) 02: Enable (Time constant decrement)	01	○	339Ch	0 to 2	1	8-9
bC113	Electronic thermal decreasing time, 1st-motor	1 to 65535 s	600	○	339Dh	1 to 65535	1	
bC-14	Electronic thermal counter memory selection at Power-off	00: Disable 01: Enable	01	○	339Eh	0 to 1	1	8-10

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
bC115	Electronic thermal accumulation gain 1st-motor	1.0 to 200.0 %	100.0	○	339Fh	10 to 2000	0.1	8-6 8-9
bC120	Free electronic thermal frequency-1, 1st-motor	0.00 to [bC122] Hz	0.00	○	33A4h	0 to 59000	0.01	8-8
bC121	Free electronic thermal current-1, 1st-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	33A5h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bC122	Free electronic thermal frequency-2, 1st-motor	[bC120] to [bC124] Hz	0.00	○	33A6h	0 to 59000	0.01	
bC123	Free electronic thermal current-2, 1st-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	33A7h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bC124	Free electronic thermal frequency-3, 1st-motor	[bC122] to 590.00 Hz	0.00	○	33A8h	0 to 59000	0.01	
bC125	Free electronic thermal current-3, 1st-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	33A9h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bC210	Electronic thermal level setting, 2nd-motor	(0.00 to 3.00)×Inverter rated output current	1.00× Rated output current	○	5AAAh	(0.00 to 3.00) ×Rated output current	0.1	8-6 9-95
						0 to 33000 Note	0.01	
bC211	Electronic thermal characteristic selection 2nd-motor	00: Reduce torque (VT) 01: Constant torque (CT) 02: Free setting (FREE)	00	○	5AABh	0 to 2	1	8-7 9-95
bC212	Electronic thermal decrease function selection, 2nd-motor	00: Disable 01: Enable (Linear decrement) 02: Enable (Time constant decrement)	01	○	5AACh	0 to 2	1	8--9 9-95
bC213	Electronic thermal decreasing time 2nd-motor	1 to 65535 s	600	○	5AADh	1 to 65535	1	
bC215	Electronic thermal accumulation gain 2nd-motor	1.0 to200.0 %	100.0	○	5AAFh	10 to 2000	0.1	
bC220	Free electronic thermal frequency-1, 2nd-motor	0.00 to [bC222] Hz	0.00	○	5AB4h	0 to 59000	0.01	8-8 9-95
bC221	Free electronic thermal current-1, 2nd-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	5AB5h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bC222	Free electronic thermal frequency-2, 2nd-motor	[bC220] to [bC224] Hz	0.00	○	5AB6h	0 to 59000	0.01	
bC223	Free electronic thermal current-2, 2nd-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	5AB7h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bC224	Free electronic thermal frequency-3, 2nd-motor	[bC222] to 590.00 Hz	0.00	○	5AB8h	0 to 59000	0.01	
bC225	Free electronic thermal current-3, 2nd-motor	(0.00 to 3.00)×Inverter rated output current	0.00	○	5AB9h	(0.00 to 3.00) ×Rated output current	0.1	
						0 to 33000 Note	0.01	
bd-01	STO input display selection	00: Warning (display) 01: Warning (without display) 02: Trip	01	○	33F5h	0 to 2	1	14-5
bd-02	STO input change time (release)	0.00: Disable, 0.01 to 60.00 s	0.01	○	33F6h	0 to 6000	0.01	
bd-03	Display selection during STO input change time	00: Warning (display) 01: Warning (without display)	01	○	33F7h	0 to 1	1	
bd-04	Action selection after STO input change time	00: Maintain current status 01: Disable 02: Trip	01	○	33F8h	0 to 2	1	14-6

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
bd-05	STO input change time (shutoff)	0.00: Disable, 0.01 to 60.00 s	0.01	○	33F9h	0 to 6000	0.01	14-6
bd-06	Warning release mode selection	00: Keep warning display 01: Release warning display	00 Note	○	33FAh	0 to 1	1	
bd-07	Warning re-display time	1 to 30 (s)	30	○	33FBh	1 to 30	1	
bE-01	Unsteady detection enable	00: Disable 01: Enable (Frequency mode) 02: Enable (Time mode)	00	×	3459h	0 to 2	1	9-177
bE-02	Unsteady detection target	dA-**, db-**, dC-**, FA-**	dA-01	×	345Ah	0 to 65535 (Register No.)	-	
bE-03	Unsteady detection auto tuning selection	00: Disable 01: Enable	00	×	345Bh	0 to 1	1	
bE-04	Unsteady detection tuning tolerance	0.00 to 100.00 %	0.10	○	345Ch	0 to 10000	1	
bE-05	Unsteady upper level detecting action	01: Warning 02: Trip 03: Trip after deceleration stop	01	×	345Dh	1 to 3	1	
bE-06	Unsteady upper level detecting time	0.00 to 600.00 s	0.00	○	345Eh	0 to 60000	0.01	
bE-07	Unsteady lower level detecting action	01: Warning 02: Trip 03: Trip after deceleration stop	01	×	345Fh	1 to 3	1	
bE-08	Unsteady lower level detecting time	0.00 to 600.00 s	0.00	○	3460h	0 to 60000	0.01	
bE-10	Unsteady detection minimum frequency	0.00 to Max. frequency Hz	0.00	○	3462h 3463h	0 to 59000	0.01	
bE-12	Unsteady detection intermediate frequency 1			○	3464h 3465h			
bE-14	Unsteady detection intermediate frequency 2			○	3466h 3467h			
bE-16	Unsteady detection intermediate frequency 3			○	3468h 3469h			
bE-18	Unsteady detection maximum frequency			○	346Ah 346Bh			
bE-21	Upper limit at minimum frequency	-100.00 to 100.00 %	0.00	○	346Dh	-10000 to 10000	0.01	
bE-22	Upper limit at intermediate frequency 1			○	346Eh			
bE-23	Upper limit at intermediate frequency 2			○	346Fh			
bE-24	Upper limit at intermediate frequency 3			○	3470h			
bE-25	Upper limit at maximum frequency			○	3471h			
bE-26	Lower limit at minimum frequency			○	3472h			
bE-27	Lower limit at intermediate frequency 1			○	3473h			
bE-28	Lower limit at intermediate frequency 2			○	3474h			
bE-29	Lower limit at intermediate frequency 3			○	3475h			
bE-30	Lower limit at maximum frequency			○	3476h			
bE-31	Unsteady time detection operating time 1	0.00 to [bE-32] s	0.00	○	3477h	0 to 60000	0.01	
bE-32	Unsteady time detection operating time 2	[bE-31] to [bE-33] s	0.00	○	3478h			
bE-33	Unsteady time detection operating time 3	[bE-32] to [bE-34] s	0.00	○	3479h			
bE-34	Unsteady time detection operating time 4	[bE-33] to [bE-35] s	0.00	○	347Ah			
bE-35	Unsteady time detection operating time 5	[bE-34] to [bE-36] s	0.00	○	347Bh			
bE-36	Unsteady time detection operating time 6	[bE-35] to [bE-37] s	0.00	○	347Ch			
bE-37	Unsteady time detection operating time 7	[bE-36] to [bE-38] s	0.00	○	347Dh			

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
bE-38	Unsteady time detection operating time 8	[bE-37] to [bE-39] s	0.00	○	347Eh	0 to 60000	0.01	9-177
bE-39	Unsteady time detection operating time 9	[bE-38] to [bE-40] s	0.00	○	347Fh			
bE-40	Unsteady time detection operating time 10	[bE-39] to 600.00 s	0.00	○	3480h			
bE-41	Unsteady time detection upper level 1	-100.00 to 100.00 %	0.00	○	3481h	-10000 to 10000	0.01	9-178
bE-42	Unsteady time detection upper level 2			○	3482h			
bE-43	Unsteady time detection upper level 3			○	3483h			
bE-44	Unsteady time detection upper level 4			○	3484h			
bE-45	Unsteady time detection upper level 5			○	3485h			
bE-46	Unsteady time detection upper level 6			○	3486h			
bE-47	Unsteady time detection upper level 7			○	3487h			
bE-48	Unsteady time detection upper level 8			○	3488h			
bE-49	Unsteady time detection upper level 9			○	3489h			
bE-50	Unsteady time detection upper level 10			○	348Ah			
bE-51	Unsteady time detection lower level 1			○	348Bh			
bE-52	Unsteady time detection lower level 2			○	348Ch			
bE-53	Unsteady time detection lower level 3			○	348Dh			
bE-54	Unsteady time detection lower level 4			○	348Eh			
bE-55	Unsteady time detection lower level 5			○	348Fh			
bE-56	Unsteady time detection lower level 6			○	3490h			
bE-57	Unsteady time detection lower level 7			○	3491h			
bE-58	Unsteady time detection lower level 8			○	3492h			
bE-59	Unsteady time detection lower level 9			○	3493h			
bE-60	Unsteady time detection lower level 10			○	3494h			

18.2.5 C parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
CA-01	Input terminal [FR] function	Refer to "18.2.6 List of Intelligent Input Terminal Functions"	001/FR	○	36B1h	0(no)/ 1 to 110	1	9-204
CA-02	Input terminal [RR] function		002/RR		36B2h			
CA-03	Input terminal [DFL] function		003/DFL		36B3h			
CA-04	Input terminal [DFM] function		004/DFM		36B4h			
CA-05	Input terminal [AUT] function		015/AUT		36B5h			
CA-06	Input terminal [ES] function		033/ES		36B6h			
CA-07	Input terminal [RST] function		028/RST		36B7h			
CA-08	Input terminal [PLA] function		103/PLA		36B8h			
CA-21	Input terminal [FR] active state	00: Normally Open (NO) 01: Normally Closed (NC)	00	○	36C5h	0 to 1	1	
CA-22	Input terminal [RR] active state				36C6h			
CA-23	Input terminal [DFL] active state				36C7h			
CA-24	Input terminal [DFM] active state				36C8h			
CA-25	Input terminal [AUT] active state				36C9h			
CA-26	Input terminal [ES] active state				36CAh			
CA-27	Input terminal [RST] active state				36CBh			
CA-28	Input terminal [PLA] active state				36CCh			
CA-41	Input terminal [FR] response time	0 to 400 ms	2	○	36D9h	0 to 400	1	9-206
CA-42	Input terminal [RR] response time				36DAh			
CA-43	Input terminal [DFL] response time				36DBh			
CA-44	Input terminal [DFM] response time				36DCh			
CA-45	Input terminal [AUT] response time				36DDh			
CA-46	Input terminal [ES] response time				36DEh			
CA-47	Input terminal [RST] response time				36DFh			
CA-48	Input terminal [PLA] response time				36E0h			
CA-55	Multistage input determination time	0 to 2000 ms	0	○	36E7h	0 to 2000	1	9-10 9-108 9-190
CA-60	UP/DWN overwrite target selection	00: Speed reference 01: PID1 Set-point 1	00	○	36ECh	0 to 1	1	9-19 9-115
CA-61	UP/DWN data save enable	00: Not save 01: Save	00	○	36EDh	0 to 1	1	
CA-62	UP/DWN/UDC selection	00: 0Hz 01: Saved data	00	○	36EEh	0 to 1	1	
CA-64	Acceleration time setting for UP/DWN function	0.00 to 3600.00 s	10.00	○	36F0h 36F1h	000 to 360000	0.01	
CA-66	Deceleration time setting for UP/DWN function			○	36F2h 36F3h			
CA-70	Speed reference source selection when [F-OP] is active	01: Terminal [VRF] 02: Terminal [IRF] 07: Parameter setting 08: RS485 09: Option 12: Pulse input 14: Reserved 15: PID function	01	○	36F6h	1 to 15	1	9-21
CA-71	RUN command source selection when [F-OP] is active	00: [FR]/[RR] terminal 01: 3-wire 02: Keypad's RUN-key 03: RS485 04: Option	00	○	36F7h	0 to 4	1	9-4
CA-72	Reset mode selection	00: Always enabled (Trip release at turn-on) 01: Always enabled (Trip release at turn-off) 02: Only enabled in trip status (Trip release at turn-on) 03: Only enabled in trip status (Trip release at turn-off)	00	○	36F8h	0 to 3	1	9-214
CA-73	[USP] active selection	00: Disabled 01: Enabled	00	○	36F9h	0 to 1	1	9-155

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
CA-81	Encoder constant setting	1 to 65535 pls	512	×	3701h	1 to 65535	1	9-48 10-4
CA-82	Encoder phase sequence selection	00: Phase-A Lead 01: Phase-B Lead	00	×	3702h	0 to 1	1	9-48
CA-83	Motor gear ratio numerator	1 to 10000	1	×	3703h	1 to 10000	1	
CA-84	Motor gear ratio denominator			×	3704h			
CA-85	Encoder disconnection time	0.0 to 10.0 s	1.0	○	3705h	0 to 100	0.1	9-52
CA-86	Speed feedback filter	0 to 1000 ms	20	○	3706h	0 to 1000	1	9-48 10-4
CA-90	Pulse input target function selection	00: Disable 01: Frequency reference 02: Speed feedback 03: Pulse count	01	×	370Ah	0 to 3	1	9-15 9-43 9-48 10-4
CA-91	Pulse input mode selection	00: 90 degrees shift pulse input 01: Forward/Reverse pulse input and direction signal 03: Single phase pulse input	03	×	370Bh	0 to 3	1	9-43 9-48
CA-92	Pulse input frequency scale	0.05 to 32.00 kHz	25.00[Note]	○	370Ch	0.05 to 32.00	0.01	9-15
CA-93	Pulse input frequency filter time constant	0.01 to 2.00 s	0.10	○	370Dh	01 to 200	0.01	
CA-94	Pulse input frequency bias value	-100.0 to 100.0 %	0.0	○	370Eh	-1000 to 1000	0.1	
CA-95	Pulse input upper frequency detection level	0.0 to 100.0 %	100.0	○	370Fh	0 to 1000	0.1	
CA-96	Pulse input lower frequency detection level		1.0	○	3710h			
CA-97	Pulse counter compare match output ON value	0 to 65535	0	○	3711h	0 to 65535	1	9-211
CA-98	Pulse counter compare match output OFF value		0	○	3712h			
CA-99	Pulse counter compare match maximum value		65535	○	3713h			
Cb-01	[VRF] Filter time constant	1 to 500 ms	500	○	3715h	1 to 500	1	9-207
Cb-03	[VRF] Start value	0.00 to 100.00 %	0.00	○	3717h	0.00 to 100.00	0.01	
Cb-04	[VRF] End value		100.00	○	3718h			
Cb-05	[VRF] Start rate	0.0 to [Cb-06] %	0.0	○	3719h	0.0 to 100.0	0.1	
Cb-06	[VRF] End rate	[Cb-05] to 100.0 %	100.0	○	371Ah			
Cb-07	[VRF] Start value selection	00: Start value [Cb-03] 01: 0 %	01	○	371Bh	0 to 1	1	
Cb-08	[VRF] Input selection	01: Voltage 02: Current	01	○	371Ch	1 to 2	1	
Cb-11	[IRF] Filter time constant	1 to 500 ms	500	○	371Fh	1 to 500	1	9-208
Cb-13	[IRF] Start value	0.00 to 100.00 %	0.00	○	3721h	0.00 to 100.00	0.01	
Cb-14	[IRF] End value		100.00	○	3722h			
Cb-15	[IRF] Start rate	0.0 to [Cb-16] %	20.0	○	3723h	0 to 1000	0.1	
Cb-16	[IRF] End rate	[Cb-15] to 100.0 %	100.0	○	3724h			
Cb-17	[IRF] Start value selection	00: Start value [Cb-13] 01: 0%	01	○	3725h	0 to 1	-	
Cb-18	[IRF] Input selection	01: Voltage 02: Current	02	○	3726h	1 to 2	-	
Cb-30	[VRF] Voltage/Current bias adjustment	-100.00 to 100.00 %	0.00	○	3732h	-1000 to 1000	0.01	9-207
Cb-31	[VRF] Voltage/Current gain adjustment	0.00 to 200.00 %	100.00	○	3733h	0 to 20000	0.01	
Cb-32	[IRF] Voltage/Current bias adjustment	-100.00 to 100.00 %	0.00	○	3734h	-1000 to 1000	0.01	9-208
Cb-33	[IRF] Voltage/Current gain adjustment	0.00 to 200.00 %	100.00	○	3735h	0 to 20000	0.01	
Cb-40	Thermistor type selection	00: Disabled 01: PTC	00		373Ch	0 to 1	1	9-157
Cb-41	Thermistor gain adjustment	0.0 to 1000.0	100.0	○	373Dh	0 to 10000	0.1	

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
CC-01	Output terminal [UPF] function	Refer to "18.2.7 List of Intelligent Output Terminal Functions"	002 (UPF1)	○	3779h	0 to 98	1	9-218
CC-02	Output terminal [DRV] function		001 (DRV)	○	377Ah			
CC-07	Output terminal [ML] function		017(AL)	○	377Fh			
CC-11	Output terminal [UPF] active state	00: Normally Open (NO) 01: Normally Closed(NC)	00	○	3783h	0 to 1	1	
CC-12	Output terminal [DRV] active state		00	○	3784h			
CC-17	Output terminal [ML] active state		00	○	3789h			
CC-20	Output terminal [UPF] on-delay time	0.00 to 100.00 s	0.00	○	378Ch	0 to 10000	0.01	9-221
CC-21	Output terminal [UPF] off-delay time				378Dh			
CC-22	Output terminal [DRV] on-delay time				378Eh			
CC-23	Output terminal [DRV] off-delay time				378Fh			
CC-32	Output terminal [ML] on-delay time				3798h			
CC-33	Output terminal [ML] off-delay time				3799h			
CC-40	LOG1 operand-1 selection	Same as [CC-01] to [CC-07] (Except [LOG1] to [LOG3])	000	○	37A0h	0 to 98	1	9-185
CC-41	LOG1 operand-2 selection		000	○	37A1h			
CC-42	LOG1 logical calculation selection	00: AND 01: OR 02: XOR	00	○	37A2h	0 to 2		
CC-43	LOG2 operand-1 selection	Same as [CC-01] to [CC-07] (Except [LOG1] to [LOG3])	000	○	37A3h	0 to 98		
CC-44	LOG2 operand-2 selection		000	○	37A4h			
CC-45	LOG2 logical calculation selection	00: AND 01: OR 02: XOR	00	○	37A5h	0 to 2		
CC-46	LOG3 operand-1 selection	Same as [CC-01] to [CC-07] (Except [LOG1] to [LOG3])	000	○	37A6h	0 to 98		
CC-47	LOG3 operand-2 selection		000	○	37A7h			
CC-48	LOG3 logical calculation selection	00: AND 01: OR 02: XOR	00	○	37A8h	0 to 2		
Cd-01	[FRQ] Output wave form selection	00 : PWM 01 : Frequency	01	○	37DDh	0 to 1	1	9-224
Cd-02	[FRQ] Output base frequency (at frequency output)	0 to 32000 Hz	1440	○	37DEh	0 to 32000	1	
Cd-03	[FRQ] Output monitor selection	Monitor parameters (Refer to "9.16.3 Selecting a Monitor Data for Analog/Pulse Output ")	dA-01	○	37DFh	0 to 65535 Register No.	1	
Cd-04	[AMI] Output monitor selection			○	37E0h			9-231
Cd-05	[AMV] Output monitor selection			○	37E1h			9-232
Cd-06	Analog adjust gain basis selection	00: Bias value based full scale 01: Fixed full scale	00	○	37E2h	0 to 1	-	9-224 9-232
Cd-10	Analog monitor adjustment mode enable	00: Disable 01: Enable	00	○	37E6h	0 to 1	-	9-224 9-229
Cd-11	[FRQ] Output filter time constant	1 to 500 (ms)	10	○	37E7h	1 to 500	1	9-224
Cd-12	[FRQ] Data type selection	00: Absolute value 01: Signed value	00	○	37E8h	0 to 1	-	9-224 9-229
Cd-13	[FRQ] Bias adjustment	-100.0 to 100.0 %	0.0	○	37E9h	-1000 to 1000	0.1	9-224
Cd-14	[FRQ] Gain adjustment	-1000.0 to 1000.0 %	100.0	○	37EAh	-10000 to 10000	0.1	
Cd-15	Adjustment mode [FRQ] output level	-100.0 to 100.0 %	100.0	○	37EBh	-1000 to 1000	0.1	9-229
Cd-16	Pulse input/output scale conversion gain	0.01 to 100.00	1.00	○	37ECh	1 to 10000	0.01	9-230
Cd-21	[AMI] Output filter time constant	1 to 500 ms	10	○	37F1h	1 to 500	1	9-236
Cd-22	[AMI] Data type selection	00: Absolute value 01: Signed value	00	○	37F2h	0 to 1	-	9-231 9-232

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
Cd-23	[AMI] Bias adjustment (Voltage/Current)	-100.0 to 100.0 %	20.0	○	37F3h	-1000 to 1000	0.1	9-231
Cd-24	[AMI] Gain adjustment (Voltage/Current)	-1000.0 to 1000.0 %	80.0	○	37F4h	-10000 to 10000	0.1	
Cd-25	Adjustment mode [AMI] output level	-100.0 to 100.0 %	100.0	○	37F5h	-1000 to 1000	0.1	
Cd-26	[AMI] Output type selection	01: Voltage 02: Current	02	○	37F6h	0 to 1	1	
Cd-31	[AMV] Output filter time constant	1 to 500 ms	100	○	37FBh	1 to500	1	9-236
Cd-32	[AMV] Data type selection	00: Absolute value 01: Signed value	00	○	37FCh	00 to 01	-	9-232 9-235
Cd-33	[AMV] Bias adjustment (Voltage)	-100.0 to 100.0 %	0.0	○	37FDh	-1000 to 1000	0.1	9-232
Cd-34	[AMV] Gain adjustment (Voltage)	-1000.0 to 1000.0 %	100.0	○	37FEh	-10000 to 10000	0.1	
Cd-35	Adjustment mode [AMV] output level	-100.0 to 100.0 %	100.0	○	37FFh	-1000 to 1000	0.1	9-235
Cd-36	[AMV] Output type selection	00: Voltage 01: Current	01	○	3800h	1 to 3	1	9-224 9-229
CE101	Low current signal output mode selection, 1st motor	00: During accel./decel. and constant speed 01: During constant speed only	01	○	3841h	0 to 1	1	9-162
CE102	Low current detection level 1, 1st motor	(0.00 to 2.00)×Inverter output current A	1.00× Rated output current	○	3842h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 Note	0.01	
CE103	Low current detection level 2, 1st motor			○	3843h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 Note	0.01	
CE105	Overload signal output mode selection, 1st motor	00: During accel./decel. and constant speed 01: During constant speed only	00	○	3845h	0 to 1	1	9-161
CE106	Overload warning level 1, 1st motor	(0.00 to 2.00)×Inverter output current A	1.15× Rated output current	○	3846h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 Note	0.01	
CE107	Overload warning level 2, 1st motor			○	3847h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 Note	0.01	
CE-10	Arrival frequency 1 value setting during acceleration	0.00 to 590.00 Hz	0.00	○	384Ah	0 to 59000	0.01	9-182
CE-11	Arrival frequency 1 value setting during deceleration			○	384Bh			
CE-12	Arrival frequency 2 value setting during acceleration			○	384Ch			
CE-13	Arrival frequency 2 value setting during deceleration			○	384Dh			
CE120	Over-torque level (Forward drive), 1st motor	0.0 to 500.0 %	100.0	○	3854h	0 to 5000	0.1	9-59
CE121	Over-torque level (Reverse regenerative), 1st motor			○	3855h			
CE122	Over-torque level (Reverse drive), 1st motor			○	3856h			
CE123	Over-torque level (Forward regenerative), 1st motor			○	3857h			
CE124	Over/Under torque output signal mode, 1st-motor	00: During accel./decel. and constant speed 01: During constant speed only	01	○	3858h	0 to 1	-	
CE125	Over/Under torque selection, 1st-motor	00: Over torque 01: Under torque	00	○	3859h	0 to 1	-	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication: Register No.	Modbus communication: Data range	Modbus communication: Resolution	Page
CE-30	Electronic thermal warning level (Motor)	0.00 to 100.00 %	85.00	○	385Eh	0 to 10000	0.01	9-163
CE-31	Electronic thermal warning level (Inverter)			○	385Fh			9-164
CE-33	Zero speed detection level	0.00 to 100.00 Hz	0.00	○	3861h	0 to 10000	0.01	9-184
CE-34	Cooling fin overheat warning level	0 to 200 ℃	100	○	3862h	0 to 200	1	9-166
CE-36	Accum. RUN time (RNT) / Accum. Power-on time (ONT) setting	0 to100000 hr	0	○	3864h 3865h	0 to 100000	1	9-170
CE-40	[VRF] Window comparator higher limit	0 to 100 % Min. : ([CE-41]+[CE-42])×2	100	○	3868h	0 to 100	1	9-172
CE-41	[VRF] Window comparator lower limit	0 to 100 % Max. : ([CE-40]-[CE-42])×2	0	○	3869h	0 to 100	1	
CE-42	[VRF] Window comparator hysteresis width	0 to 10 % Max. : ([CE-40]-[CE-41])/2	0	○	386Ah	0 to 10	1	
CE-43	[IRF] Window comparator higher limit	0 to 100 % Min. : ([CE-44]+[CE-45])×2	100	○	386Bh	0 to 100	1	
CE-44	[IRF] Window comparator lower limit	0 to 100 (%) Max. : ([CE-43]-[CE-45])×2	0	○	386Ch	0 to 100	1	
CE-45	[IRF] Window comparator hysteresis width	0 to 10 (%) Max. : ([CE-43]-[CE-44])/2	0	○	386Dh	0 to 10	1	
CE-50	[VRF] Operation set level at disconnection or compare event	0 to 100 %	0	○	3872h	0 to 100	1	
CE-51	[VRF] Operation set level implement timing	00: Disable 01:Enable (at WCVRF active) 02:Enable(at WCVRF de-active)	00	○	3873h	0 to 2	1	
CE-52	[IRF] Operation set level at disconnection or compare event	0 to 100 %	0	○	3874h	0 to 100	1	
CE-53	[IRF] Operation set level implement timing	00: Disable 01: Enable (at WCIRF active) 02: Enable (at WCIRF de-active)	00	○	3875h	0 to 2	1	
CE-60	Output frequency related filter for terminal function	0 to 2000 ms	20	○	387Ch	0 to 2000	1	9-184
CE-61	Output current related filter f or terminal function		300	○	387Dh			9-161 9-162
CE-62	Output torque related filter for terminal function		100	○	387Eh			9-59
CE201	Low current signal output mode selection, 2nd-motor	00: During accel./decel. and constant speed 01: During constant speed only	01	○	5F51h	0 to 1	1	9-95 9-162
CE202	Low current detection level 1, 2nd-motor	(0.00 to 2.00)×Inverter output current A	1.00× Rated output current	○	5F52h	(0.00 to 2.00)× Rated output current	0.1	9-95 9-162
						0 to 20000 [Note]	0.01	
CE203	Low current detection level 2, 2nd-motor			○	5F53h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 [Note]	0.01	
CE205	Overload signal output mode selection, 2nd-motor	00: During accel./decel. and constant speed 01: During constant speed only	00	○	5F55h	0 to 1	0	9-95 9-161
CE206	Overload warning level 1, 2nd-motor	(0.00 to 2.00)×Inverter output current A	1.15× Rated output current	○	5F56h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 [Note]	0.01	
CE207	Overload warning level 2, 2nd-motor			○	5F57h	(0.00 to 2.00)× Rated output current	0.1	
						0 to 20000 [Note]	0.01	
CE220	Over-torque level (Forward drive), 2nd-motor	0.0 to 500.0 %	100.0	○	5F64h	0 to 5000	0.1	9-59 9-95
CE221	Over-torque level (Reverse regenerative), 2nd-motor			○	5F65h			
CE222	Over-torque level (Reverse drive), 2nd-motor			○	5F66h			

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
CE223	Over-torque level (Forward regenerative), 2nd motor	0.0 to 500.0 %	100.0	○	5F64h	0 to 5000	0.1	9-59 9-95
CE224	Over/Under torque output signal mode, 2nd-motor	00: During accel./decel. And constant speed 01: During constant speed only	01	○	5F68h	0 to 1	1	
CE225	Over/Under torque selection, 2nd-motor	00: Over torque 01: Under torque	00	○	5F69h			
CF-01	RS485 communication baudrate selection	03: 2400bps 04: 4800bps 05: 9600bps 06: 19.2kbps 07: 38.4kbps 08: 57.6kbps 09: 76.8kbps 10: 115.2kbps	05	○	38A5h	3 to 10	1	11-1
CF-02	RS485 communication node address	1 to 247	1	○	38A6h	1 to 247	1	
CF-03	RS485 communication parity selection	00: no parity 01: Even parity 02: Odd parity	00	○	38A7h	0 to 2	1	11-2
CF-04	RS485 communication stop bit selection	01: 1-bit 02: 2-bit	01	○	38A8h	1 to 2	1	
CF-05	RS485 communication error selection	00: Error 01: Trip after deceleration stop 02: Ignore 03: Free run stop 04: Deceleration stop	02	○	38A9h	0 to 4	1	
CF-06	RS485 communication timeout setting	0.00 to 100.00 s	2.00	○	38AAh	0 to 10000	0.01	
CF-07	RS485 communication wait time setting	0 to 1000 m	5	○	38ABh	0 to 1000	1	
CF-08	RS485 communication mode selection	01: Modbus-RTU 02: Communication between inverters (EzCOM) 03: Communication between inverters (EzCOM Administrator)	01	○	38ACh	1 to 3	1	
CF-11	Register data AV<=>% conversion function	00: A, V 01: %	00	×	38AFh	0 to 1	1	
CF-12	RS485 endianness selection	00: Big endian 01: Little endian 02: Special endian	00	○	38B0h	0 to 2	–	
CF-20	EzCOM start node No.	1 to 8	1	×	38B8h	1 to 8	1	11-25
CF-21	EzCOM end node No.			×	38B9h			
CF-22	EzCOM start method selection	00: [ECOM] terminal 01: Usually communication	00	×	38BAh	0 to 1	–	
CF-23	EzCOM data size	1 to 5	5	○	38BBh	1 to 5	1	
CF-24	EzCOM destination address 1	1 to 247	1	○	38BCh	1 to 247	1	
CF-25	EzCOM destination register 1	0000h to FFFFh	0000h	○	38BDh	0000h to FFFFh	1	
CF-26	EzCOM source register 1			○	38BEh			
CF-27	EzCOM destination address 2	1 to 247	2	○	38BFh	1 to 247	1	
CF-28	EzCOM destination register 2	0000h to FFFFh	0000h	○	38C0h	0000h to FFFFh	1	
CF-29	EzCOM source register 2			○	38C1h		1	
CF-30	EzCOM destination address 3	1 to 247	3	○	38C2h	1 to 247	1	
CF-31	EzCOM destination register 3	0000h to FFFFh	0000h	○	38C3h	0000h to FFFFh	1	
CF-32	EzCOM source register 3			○	38C4h		1	
CF-33	EzCOM destination address 4	1 to 247	4	○	38C5h	1 to 247	1	
CF-34	EzCOM destination register 4	0000h to FFFFh	0000h	○	38C6h	0000h to FFFFh	1	
CF-35	EzCOM source register 4			○	38C7h		1	
CF-36	EzCOM destination address 5	1 to 247	5	○	38C8h	1 to 247	1	
CF-37	EzCOM destination register 5	0000h to FFFFh	0000h	○	38C9h	0000h to FFFFh	1	
CF-38	EzCOM source register 5			○	38CAh		1	

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
CF-50	USB communication node address	1 to 247	1	×	38D6h	1 to 247	1	-
CF-61	Output current monitor filter	0 to 1000 ms	300	○	38E1h	0 to 1000	1	10-3
CF-62	Output torque monitor filter		100	○	38E2h			10-5
CF-63	Output voltage monitor filter		100	○	38E3h			10-6
CF-64	Input/Output power filter		400	○	38E4h			10-7 10-8
CG-01	Register mapping function selection	00: Disable 01: Enable	00	○	3909h	0 to 1	1	11-21
CG-11	External register 1	0000h to FFFFh	0000h	○	3913h	0000h to FFFFh	1	
CG-12	External register 2			○	3914h			
CG-13	External register 3			○	3915h			
CG-14	External register 4			○	3916h			
CG-15	External register 5			○	3917h			
CG-16	External register 6			○	3918h			
CG-17	External register 7			○	3919h			
CG-18	External register 8			○	391Ah			
CG-19	External register 9			○	391Bh			
CG-20	External register 10			○	391Ch			
CG-31	External register 1 format	00: Unsigned word 01: Signed word	00	○	3927h	0 to 1	1	
CG-32	External register 2 format			○	3928h			
CG-33	External register 3 format			○	3929h			
CG-34	External register 4 format			○	392Ah			
CG-35	External register 5 format			○	392Bh			
CG-36	External register 6 format			○	392Ch			
CG-37	External register 7 format			○	392Dh			
CG-38	External register 8 format			○	392Eh			
CG-39	External register 9 format			○	392Fh			
CG-40	External register 10 format			○	3930h			
CG-51	External register 1 scaling	0.001 to 65.535	1.000	○	393Bh	1 to 65535	0.001	
CG-52	External register 2 scaling			○	393Ch			
CG-53	External register 3 scaling			○	393Dh			
CG-54	External register 4 scaling			○	393Eh			
CG-55	External register 5 scaling			○	393Fh			
CG-56	External register 6 scaling			○	3940h			
CG-57	External register 7 scaling			○	3941h			
CG-58	External register 8 scaling			○	3942h			
CG-59	External register 9 scaling			○	3943h			
CG-60	External register 10 scaling			○	3944h			
CG-71	Internal register 1	0000h to FFFFh	0000h	○	394Fh	0000h to FFFFh	1	
CG-72	Internal register 2			○	3950h			
CG-73	Internal register 3			○	3951h			
CG-74	Internal register 4			○	3952h			
CG-75	Internal register 5			○	3953h			
CG-76	Internal register 6			○	3954h			
CG-77	Internal register 7			○	3955h			
CG-78	Internal register 8			○	3956h			
CG-79	Internal register 9			○	3957h			
CG-80	Internal register 10			○	3958h			
CH-01	Sync input terminal function selection 1	Refer to "18.2.6 List of Multi-function Input Terminal Functions"	000	○	396Dh	00 to 110	1	9-237
CH-02	Sync input terminal function selection 2			○	396Eh			
CH-03	Sync input terminal function selection 3			○	396Fh			
CH-04	Sync input terminal function selection 4			○	3970h			
CH-05	Sync input terminal function selection 5			○	3971h			
CH-06	Sync input terminal function selection 6			○	3972h			

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
CH-11	Sync output terminal function selection 1	Refer to "18.2.7 List of Muti-function Output Terminal Functions"	00	○	3977h	00 to 98	1	9-237
CH-12	Sync output terminal function selection 2			○	3978h			
CH-13	Sync output terminal function selection 3			○	3979h			
CH-14	Sync output terminal function selection 4			○	397Ah			
CH-15	Sync output terminal function selection 5			○	397Bh			
CH-16	Sync output terminal function selection 6			○	397Ch			
CH-21	Sync terminal logic selection 1	00: Normally Open (NO) 01: Normally Closed (NC)	00	○	3981h	0 to 1	1	9-237
CH-22	Sync terminal logic selection 2			○	3982h			
CH-23	Sync terminal logic selection 3			○	3983h			
CH-24	Sync terminal logic selection 4			○	3984h			
CH-25	Sync terminal logic selection 5			○	3985h			
CH-26	Sync terminal logic selection 6			○	3986h			
CH-30	Sync terminal on-delay time 1	0.00 to 100.00 s	0.00	○	398Ah	0 to 10000	0.01	9-237 9-238
CH-31	Sync terminal off-delay time 1			○	398Bh			
CH-32	Sync terminal on-delay time 2			○	398Ch			
CH-33	Sync terminal off-delay time 2			○	398Dh			
CH-34	Sync terminal on-delay time 3			○	398Eh			
CH-35	Sync terminal off-delay time 3			○	398Fh			
CH-36	Sync terminal on-delay time 4			○	3990h			
CH-37	Sync terminal off-delay time 4			○	3991h			
CH-38	Sync terminal on-delay time 5			○	3992h			
CH-39	Sync terminal off-delay time 5			○	3993h			
CH-40	Sync terminal on-delay time 6			○	3994h			
CH-41	Sync terminal off-delay time 6			○	3995h			

18.2.6 List of multi-function input terminal functions

Function Code	Symbol	Name	Page
000	no	Not use	-
001	FR	Forward rotation	9-2
002	RR	Reverse rotation	
003	DFL	Multi speed selection 1	9-11 9-30
004	DFM	Multi speed selection 2	
005	DFH	Multi speed selection 3	
006	DHH	Multi speed selection 4	
007	SF1	Multi speed Bit-1	9-12 9-30
008	SF2	Multi speed Bit-2	
009	SF3	Multi speed Bit-3	
010	SF4	Multi speed Bit-4	
011	SF5	Multi speed Bit-5	
012	SF6	Multi speed Bit-6	
013	SF7	Multi speed Bit-7	
014	ADD	Trigger for frequency addition	9-18
015	AUT	Main/Sub speed reference change	9-16
016	STA	3-wire start	9-3
017	STP	3-wire stop	
018	F/R	3-wire forward/reverse	
019	AHD	Analog command holding	9-20
020	UP	Remote control Speed-Up function	9-19
021	DWN	Remote control Speed-Down function	
022	UDC	Remote control Speed data clearing	
023	F-OP	Force operation	9-8 9-21
024	SET	2nd-motor control	9-95
028	RST	Reset	9-214
029	JOG	Jogging	9-13
030	DB	External DC braking	9-78
031	AD2	2-stage Acceleration/Deceleration	9-24
032	MBS	Free run stop	9-77
033	ES	External fault	9-154
034	USP	Unattended start protection	9-155
035	CS	Commercial power supply change	9-82
036	SFT	Soft-Lock	7-17
037	BOK	Answer back from Brake	9-84
038	OLR	Overload restriction selection	9-131
039	KHC	Accumulated input power clearance	10-7
040	OKHC	Accumulated output power clearance	10-8
041	PID	Disable PID1	9-112
042	PIDC	PID1 integration reset	
043	PID2	Disable PID2	9-125
044	PIDC2	PID2 integration reset	
051	SVC1	Multi set-point selection 1	9-108
052	SVC2	Multi set-point selection 2	
053	SVC3	Multi set-point selection 3	
054	SVC4	Multi set-point selection 4	

Function Code	Symbol	Name	Page
055	PRO	PID gain change	9-114
056	PIO1	PID output switching 1	9-124
058	SLEP	SLEEP condition activation	9-117
059	WAKE	WAKE condition activation	9-8-20
060	TL	Torque limit enable	9-59
061	TRQ1	Torque limit selection bit 1	9-60
062	TRQ2	Torque limit selection bit 2	
063	PPI	P/PI control mode selection	9-65 9-67
064	CAS	Control gain change	
067	ATR	Permission of torque control	9-55
068	TBS	Torque Bias enable	9-64
069	ORT	Home search function	9-200
071	LAC	Acceleration/Deceleration cancellation	9-23
072	PCLR	Clearance of position deviation	9-197
076	CP1	Multistage position settings selection 1	9-190
077	CP2	Multistage position settings selection 2	
078	CP3	Multistage position settings selection 3	
079	CP4	Multistage position settings selection 4	
080	ORL	Limit signal of Homing function	9-194
081	ORG	Start signal of Homing function	9-194
082	FOT	Forward Over Travel	9-198
083	ROT	Reserve Over Travel	
084	SPD	Speed/Position switching	9-201
085	PSET	Position data presetting	9-197
086	-	Reserved	-
087			
088			
089			
090			
091			
092			
093			
097	PCC	Pulse counter clearing	9-211
098	ECOM	EzCOM activation	11-25
099	-	Reserved	-
100	HLD	Acceleration/Deceleration disable	9-25
101	REN	RUN enable	9-34
102	DISP	Display lock	7-21
103	PLA	Pulse input A	9-211
104	PLB	Pulse input B	
105	EMF	Emergency-Force Drive activation	9-90
107	COK	Contactor check signal	9-86
108	DTR	Data trace start	12-3
109	PLZ	Pulse input Z	9-194 9-200
110	TCH	Teach-in signal	9-191

18.2.7 List of multi-function output terminal functions

Function Code	Symbol	Name	Page
000	no	Not use	-
001	DRV	Running	9-179
002	UPF1	Constant-frequency reached	9-181
003	UPF2	Set frequency overreached	9-182
004	UPF3	Set frequency reached	9-183
005	UPF4	Set frequency overreached 2	9-182
006	UPF5	Set frequency reached 2	9-183
007	IRDY	Inverter ready	9-180
008	FRR	Forward rotation	9-179
009	RRR	Reverse rotation	
010	FREF	Frequency reference=Keypad is selected	9-8
011	REF	Run command=Keypad is selected	9-2
012	SETM	2nd control is selected	9-95
016	OPO	Option output [Note]	-
017	AL	Alarm	9-159
018	MJA	Major failure	9-160
019	OTQ	Over-torque	9-59
021	UV	Undervoltage	9-139
022	TRQ	Torque limited	9-58
023	IPS	IP nonstop function is active	9-149
024	RNT	Accumulated operation time over	9-170
025	ONT	Accumulated power-on time over	9-170
026	THM	Electronic thermal alarm (Motor)	9-163
027	THC	Electronic thermal alarm (Inverter)	9-164
029	WAC	Capacitor life warning	9-167
030	WAF	Cooling-fan life warning	9-168
031	FS	RUN command active	9-180
032	OHF	Heat sink overheat warning	9-166
033	LOC	Low-current indication	9-162
034	LOC2	Low-current indication 2	
035	OL	Overload warning notice	9-161
036	OL2	Overload warning notice 2	
037	BRK	Brake release	9-84 9-202
038	BER	Brake error	
039	CON	Contactor control	9-86

Note: Option output [OPO]」is not available in preparation.

Function Code	Symbol	Name	Page
040	ZS	Zero speed detection	9-184
041	DSE	Speed over deviation	9-52
043	POK	Positioning completed	9-187
044	PCMP	Pulse count compare match output	9-213
045	OD	Over deviation for PID control	9-126
046	FBV	PID feedback comparison	9-127
047	OD2	Over deviation for PID2 control	9-126
048	FBV2	PID2 feedback comparison	9-127
049	NDc	Communication line disconnection	11-1
050	VRFDc	Analog VRF disconnection detection	9-172
051	IRFDc	Analog IRF disconnection detection	
056	WCVRF	Window comparator VRF	9-172
057	WCIRF	Window comparator IRF	
062	LOG1	Logical operation result 1	9-185
063	LOG2	Logical operation result 2	
064	LOG3	Logical operation result 3	
069	-	Reserved	-
070			
071			
076	EMFC	Emergency-Force Drive indicator	9-93
077	EMBP	Bypass mode indicator	
078	WFT	Trace function waiting for trigger	12-3
079	TRA	Trace function data logging	
080	LBK	Low-battery of keypad	7-22
081	OVS	Over-Voltage power supply	9-165
082	ABU	Abnormal exceeded Upper limit	9-178
083	ABL	Abnormal fall below Lower limit	
088	FSC	STO input discrepancy	14-6
093	SSE	PID soft start error	9-116
094	SFM1	ST1 feedback monitor	14-6
095	SFM2	ST2 feedback monitor	
096	EDM	STO state monitor	14-4
097	WAP	Power module life warning	9-169
098	WAIC	Inrush circuit life warning	

18.2.8 H parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
HA-01	Auto-tuning selection	00: Disabled 01: No-rotation 02: Rotation	00	×	3A99h	0 to 2	1	8-19
HA-02	Auto-tuning RUN command source selection	00: Keypad's RUN-key 01: Setting by [AA111]/[AA211]	00	×	3A9Ah	0 to 1	1	8-19
HA110	Stabilization constant, 1st-motor	0 to 1000 %	100	○	3AA2h	0 to 1000	1	9-45
HA112	Stabilization ramp function end ratio, 1st-motor	0 to 100 %	30	×	3AA4h	0 to 100	1	
HA113	Stabilization ramp function start ratio, 1st-motor		10	×	3AA5h			
HA115	Speed response, 1st-motor	0 to 1000 %	100	○	3AA7h	0 to 1000	1	9-46
HA120	ASR gain switching mode selection, 1st-motor	00: [CAS] terminal 01: Parameter setting	00	○	3AACh	0 to 1	1	9-67
HA121	ASR gain switching time setting, 1st-motor	0 to 10000 ms	100	○	3AADh	0 to 10000	1	
HA122	ASR gain mapping intermediate speed 1, 1st-motor	0.00 to 590.00 Hz	0.00	○	3AAEh	0 to 59000	0.01	
HA123	ASR gain mapping intermediate speed 2, 1st-motor				3AAFh			
HA124	ASR gain mapping maximum speed, 1st-motor				3AB0h			
HA125	ASR gain mapping P-gain 1, 1st-motor	0.0 to 1000.0 %	100.0	○	3AB1h	0 to 10000	0.1	
HA126	ASR gain mapping I-gain 1, 1st-motor				3AB2h			
HA127	ASR gain mapping P control P-gain 1, 1st-motor				3AB3h			
HA128	ASR gain mapping P-gain 2, 1st-motor				3AB4h			
HA129	ASR gain mapping I-gain 2, 1st-motor				3AB5h			
HA130	ASR gain mapping P control P-gain 2, 1st-motor				3AB6h			
HA131	ASR gain mapping P-gain 3, 1st-motor				3AB7h			
HA132	ASR gain mapping I-gain 3, 1st-motor				3AB8h			
HA133	ASR gain mapping P-gain 4, 1st-motor				3AB9h			
HA134	ASR gain mapping I-gain 4, 1st-motor				3ABAh			
HA181	Reserved	Do not change parameter.	10	×	-	-	-	-
HA210	Stabilization constant, 2nd-motor	0 to 1000 %	100	○	61B2h	0 to 1000	1	9-43 9-95
HA212	Stabilization ramp function end ratio, 2nd-motor	0 to 100	30	×	61B4h	0 to 100	1	
HA213	Stabilization ramp function start ratio, 2nd-motor	0 to 100	10	×	61B5h	0 to 100	1	
HA215	Speed response, 2nd-motor	0 to 1000 %	100	○	61B7h	0 to 1000	1	9-46 9-95
HA220	ASR gain switching mode selection, 2nd-motor	00: [CAS] terminal 01: Parameter setting	00	○	61BCh	0 to 1	1	9-67 9-95
HA221	ASR gain switching time setting, 2nd-motor	0 to 10000 ms	100	○	61BDh	0 to 10000	1	
HA222	ASR gain mapping intermediate speed 1, 2nd-motor	0.00 to 590.00 Hz	0.00	○	61BEh	0 to 59000	0.01	
HA223	ASR gain mapping intermediate speed 2, 2nd-motor				61BFh			
HA224	ASR gain mapping maximum speed, 2nd-motor				61C0h			

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
HA225	ASR gain mapping P-gain 1, 2nd-motor	0.0 to 1000.0 %	100.0	○	61C1h	0 to 10000	0.1	9-67 9-95
HA226	ASR gain mapping I-gain 1, 2nd-motor				61C2h			
HA227	ASR gain mapping P control P-gain 1, 2nd-motor				61C3h			
HA228	ASR gain mapping P-gain 2, 2nd-motor				61C4h			
HA229	ASR gain mapping I-gain 2, 2nd-motor				61C5h			
HA230	ASR gain mapping P control P-gain 2, 2nd-motor				61C6h			
HA231	ASR gain mapping P-gain 3, 2nd-motor				61C7h			
HA232	ASR gain mapping I-gain 3, 2nd-motor				61C8h			
HA233	ASR gain mapping P-gain 4, 2nd-motor				61C9h			
HA234	ASR gain mapping I-gain 4, 2nd-motor				61CAh			
HA281	Reserved	Do not change parameter	10	-	-	-	-	-
Hb101	Async. Motor type selection ,1st-motor	00: Reserved 01: Sumitomo AF motor 02: Sumitomo d2G4 motor 03: SumitomoIE3 motor	03	×	3AFDh	0 to 3	1	8-4
Hb102	Async. Motor capacity setting, 1st-motor	0.01 to 11.00 kW	Same as Inverter capacity	×	3AFEh	1 to 1100	0.01	
Hb103	Async. Motor number of poles setting, 1st-motor	00: 2P/01: 4P/02: 6P 03: 8P/04: 10P/05: 12P 06: 14P/07: 16P 08: 18P/09: 20P 10: 22P/11: 24P 12: 26P/13: 28P 14: 30P/15: 32P 16: 34P/17: 36P 18: 38P/19: 40P 20: 42P/21: 44P 22: 46P/23: 48P	01	×	3AFFh	0 to 23	1	
Hb104	Async. Motor base frequency setting, 1st-motor	30.00 to [Hb105] Hz	60.00 Note	×	3B00h	3000 to 59000	0.01	
Hb105	Async. Motor maximum frequency setting, 1st-motor	[Hb104] to 590.00 Hz			3B01h			
Hb106	Async. Motor rated voltage, 1st-motor	1 to 1000 V	200/400 Note	×	3B02h	1 to 1000	1	
Hb108	Async. Motor rated current, 1st-motor	0.01 to 10000.00 A	Depends on Hb101 to Hb104	×	3B04h 3B05h	1 to 1000000	0.01	
Hb110	Async. Motor constant R1, 1st-motor	0.000001 to 1000.000000 Ω			3B06h 3B07h	1 to 1000000000	0.000001	8-11
Hb112	Async. Motor constant R2, 1st-motor				3B08h 3B09h			
Hb114	Async. Motor constant L, 1st-motor	0.000001 to 1000.000000 mH			3B0Ah 3B0Bh			
Hb116	Async. Motor constant I0, 1st-motor	0.01 to 10000.00 A			3B0Ch 3B0Dh	1 to 1000000	0.01	
Hb118	Async. Motor constant J, 1st-motor	0.00001 to 10000.00000 kgm^2			3B0Eh 3B0Fh	1 to 1000000000	0.00001	
Hb130	Minimum frequency adjustment, 1st-motor	0.01 to 10.00 Hz	0.50	○	3B1Ah	0 to 1000	0.01	9-68
Hb131	Reduced voltage start time setting, 1st-motor	0 to 2000 ms	12	○	3B1Bh	0 to 2000	1	
Hb140	Manual torque boost operation mode selection, 1st-motor	00: Disabled 01: Always enable 02: Enable at Forward rotation 03: Enable at Reverse rotation	01	×	3B24h	0 to 3	-	9-41

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
Hb141	Manual torque boost value, 1st-motor	0.0 to 20.0 %	1.0	○	3B25h	0 to 200	0.1	9-41
Hb142	Manual torque boost peak speed, 1st-motor	0.0 to 50.0 %	0.8	○	3B26h	0 to 500	0.1	
Hb145	Eco drive enable, 1st-motor	00: Disable 01: Enable	00	×	3B29h	0 to 1	1	9-42
Hb146	Eco drive response adjustment, 1st-motor	0 to 100 %	50	○	3B2Ah	0 to100	1	
Hb150	Free-V/f frequency 1 setting, 1st-motor	0.00 to [Hb152] Hz	0.00	×	3B2Eh	0 to 59000	0.01	9-38
Hb151	Free-V/f voltage 1 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B2Fh	0 to 10000	0.1	
Hb152	Free-V/f frequency 2 setting, 1st-motor	[Hb150] to [Hb154] Hz	0.00	×	3B30h	0 to 59000	0.01	
Hb153	Free-V/f voltage 2 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B31h	0 to 10000	0.1	
Hb154	Free-V/f frequency 3 setting, 1st-motor	[Hb152] to [Hb156] Hz	0.00	×	3B32h	0 to 59000	0.01	
Hb155	Free-V/f voltage 3 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B33h	0 to 10000	0.1	
Hb156	Free-V/f frequency 4 setting, 1st-motor	[Hb154] to [Hb158] Hz	0.00	×	3B34h	0 to 59000	0.01	
Hb157	Free-V/f voltage 4 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B35h	0 to 10000	0.1	
Hb158	Free-V/f frequency 5 setting, 1st-motor	[Hb156] to [Hb160] Hz	0.00	×	3B36h	0 to 59000	0.01	
Hb159	Free-V/f voltage 5 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B37h	0 to 10000	0.1	
Hb160	Free-V/f frequency 6 setting, 1st-motor	[Hb158] to [Hb162] Hz	0.00	×	3B38h	0 to 59000	0.01	
Hb161	Free-V/f voltage 6 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B39h	0 to 10000	0.1	
Hb162	Free-V/f frequency 7 setting, 1st-motor	[Hb160] to [Hb164] Hz	0.00	×	3B3Ah	0 to 59000	0.01	
Hb163	Free-V/f voltage 7 setting, 1st-motor	0.0 to 1000.0 V	0.0	×	3B3Bh	0 to 10000	0.1	
Hb170	Slip compensation P-gain with encoder, 1st-motor	0 to 1000 %	100	○	3B42h	0 to 1000	1	9-43
Hb171	Slip compensation I-gain with encoder, 1st-motor			○	3B43h			
Hb180	Output voltage gain, 1st-motor	0 to 255 %	100	○	3B4Ch	0 to 255	1	9-45
Hb201	Async. Motor type selection ,2nd-motor	00: Reserved 01: Sumitomo AF motor 02: Sumitomo d2G4 motor 03: SumitomoIE3 motor	03	×	620Dh	0 to 3	1	8-4 9-95
Hb202	Async. Motor capacity setting, 2nd-motor	0.01 to 11.00 kW	Same as Inverter capacity	×	620Eh	1 to 1100	0.01	
Hb203	Async. Motor number of poles setting, 2nd-motor	00: 2P/01: 4P/02: 6P 03: 8P/04: 10P/05: 12P 06: 14P/07: 16P/08: 18P 09: 20P/10: 22P/11: 24P 12: 26P/13: 28P/14: 30P 15: 32P/16: 34P/17: 36P 18: 38P/19: 40P/20: 42P 21: 44P/22: 46P/23: 48P	01	×	620Fh	0 to 23	1	
Hb204	Async. Motor base frequency setting, 2nd-motor	30.00 to [Hb205] Hz	60.00 Note	×	6210h	3000 to 59000	0.01	
Hb205	Async. Motor maximum frequency setting, 2nd-motor	[Hb204] to 590.00 Hz		×	6211h			
Hb206	Async. Motor rated voltage, 2nd-motor	1 to 1000 V	200/400 Note	×	6212h	1 to 1000	1	
Hb208	Async. Motor rated current, 2nd-motor	0.01 to 10000.00 A	Depends on Hb201 to Hb204	×	6214h 6215h	1 to 1000000	0.01	

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
Hb210	Async. Motor constant R1, 2nd-motor	0.000001 to 1000.000000 Ω	Depends on Hb201 to Hb204	×	6216h 6217h	1 to 1000000000	0.000001	8-4 9-95
Hb212	Async. Motor constant R2, 2nd-motor			×	6218h 6219h			
Hb214	Async. Motor constant L, 2nd-motor	0.000001 to 1000.000000 mH		×	621Ah 621Bh			
Hb216	Async. Motor constant I0, 2nd-motor	0.01 to 10000.00 A		×	621Ch 621Dh	1 to 1000000	0.01	
Hb218	Async. Motor constant J, 2nd-motor	0.00001 to 10000.00000 kgm^2		×	621Eh 621Fh	1 to 1000000000	0.00001	
Hb230	Minimum frequency adjustment, 2nd-motor	0.00 to 10.00 Hz	0.50	○	622Ah	0 to 1000	0.01	9-68 9-95
Hb231	Reduced voltage start time setting, 2nd-motor	0 to 2000 ms	12	○	622Bh	0 to 2000	1	
Hb240	Manual torque boost operation mode selection, 2nd-motor	00: Disable 01: Always enable 02: Enable at Forward rotation 03: Enable at Reverse rotation	01	×	6234h	0 to 3	1	9-41 9-95
Hb241	Manual torque boost value, 2nd motor	0.0 to 20.0 %	1.0	○	6235h	0 to 200	0.1	
Hb242	Manual torque boost peak speed, 2nd-motor	0.0 to 50.0 %	0.8	○	6236h	0 to 500	0.1	
Hb245	Eco drive enable, 2nd-motor	00: Disable 01: Enable	00	×	6239h	0 to 1	1	9-42 9-95
Hb246	Eco drive response adjustment, 2nd-motor	0 to 100 %	50	○	623Ah	0 to 100	1	
Hb250	Free-V/f frequency 1 setting, 2nd-motor	0.00 to [Hb252] Hz	0.00	×	623Eh	0 to 59000	0.01	9-38 9-95
Hb251	Free-V/f voltage 1 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	623Fh	0 to 10000	0.1	
Hb252	Free-V/f frequency 2 setting, 2nd-motor	[Hb250] to [Hb254] Hz	0.00	×	6240h	0 to 59000	0.01	
Hb253	Free-V/f voltage 2 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	6241h	0 to 10000	0.1	
Hb254	Free-V/f frequency 3 setting, 2nd-motor	[Hb252] to [Hb256] Hz	0.00	×	6242h	0 to 59000	0.01	
Hb255	Free-V/f voltage 3 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	6243h	0 to 10000	0.1	
Hb256	Free-V/f frequency 4 setting, 2nd-motor	[Hb254] to [Hb258] Hz	0.00	×	6244h	0 to 59000	0.01	
Hb257	Free-V/f voltage 4 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	6245h	0 to 10000	0.1	
Hb258	Free-V/f frequency 5 setting, 2nd-motor	[Hb256] to [Hb260] Hz	0.00	×	6246h	0 to 59000	0.01	
Hb259	Free-V/f voltage 5 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	6247h	0 to 10000	0.1	
Hb260	Free-V/f frequency 6 setting, 2nd-motor	[Hb258] to [Hb262] Hz	0.00	×	6248h	0 to 59000	0.01	
Hb261	Free-V/f voltage 6 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	6249h	0 to 10000	0.1	
Hb262	Free-V/f frequency 7 setting, 2nd-motor	[Hb260] to [Hb264] Hz	0.00	×	624Ah	0 to 59000	0.01	
Hb263	Free-V/f voltage 7 setting, 2nd-motor	0.0 to 1000.0 V	0.0	×	624Bh	0 to 10000	0.1	
Hb270	Slip compensation P-gain with encoder, 2nd-motor	0 to 1000 %	100	○	6252h	0 to 1000	1	9-43 9-95
Hb271	Slip compensation I-gain with encoder, 2nd-motor				6253h			
Hb280	Output voltage gain, 2nd-motor	0 to 255 %	100	○	625Ch	0 to 255	1	9-45 9-95
HC101	Automatic torque boost voltage compensation gain, 1st-motor			○	3B61h			9-40
HC102	Automatic torque boost slip compensation gain, 1st-motor				3B62h			
HC111	Boost value at start, 1st-motor (IM-SLV)	0 to 50 %	0	○	3B6Bh	0 to 50	1	9-46
HC114	Direction reversal protection, 1st-motor	00: Disabled 01: Enabled	01 Note	○	3B6Eh	0 to 1	1	9-33
HC115	Torque conversion method selection, 1st-motor	00: Torque 01: Current	01	○	3B6Fh	0 to 1	1	9-57

Note: The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
HC120	Torque current reference filter time constant, 1st-motor	0 to 100 ms	2	○	3B74h	0 to 100	1	9-46
HC121	Speed feedforward compensation gain, 1st-motor	0 to 1000 %	0	○	3B75h	0 to 1000	1	
HC137	Flux settling level, 1st-motor	0.0 to 100.0 %	80.0	×	3B85h	0 to1000	0.1	
HC141	Modulation threshold 1, 1st-motor	0 to 133 %	115	○	3B89h	0 to 133	1	
HC142	Modulation threshold 2, 1st-motor			○	3B8Ah			
HC201	Automatic torque boost voltage compensation gain, 2nd-motor	0 to 255 %	100	○	6271h	0 to 255	1	9-40 9-95
HC202	Automatic torque boost slip compensation gain, 2nd-motor			○	6272h			
HC211	Boost value at start, 2nd-motor (IM-SLV)	0 to 0 %	0	○	627Bh	0 to 50	1	9-46 9-95
HC214	Direction reversal protection, 2nd-motor	00: Disable 01: Enable	01 Note:1	○	627Eh	0 to 1	1	9-33 9-95
HC215	Torque conversion method selection, 2nd-motor	00: Torque 01: Current	01	○	627Fh	0 to 1	1	9-57 9-95
HC220	Torque current reference filter time constant, 2nd-motor	0 to 100 ms	2	○	6284h	0 to 100	1	9-46 9-95
HC221	Speed feedforward compensation gain, 2nd-motor	0 to 1000 %	0	○	6285h	0 to 1000	1	
HC237	Flux settling level, 2nd-motor	0.0 to 100.0	80.0	×	6295h	0 to 1000	0.1	
HC241	Modulation threshold 1, 2nd-motor	0 to 133	115	○	6299h	0 to 133	1	
HC242	Modulation threshold 2, 2nd-motor				629Ah			
Hd102	Sync. Motor capacity setting, 1st-motor	0.01 to 11.00 kW	Same as Inverter capacity	×	3BC6h	1 to 1100	0.01	Note:2
Hd103	Sync. Motor number of poles setting, 1st-motor	00: 2P/01: 4P/02: 6P 03: 8P/04: 10P/05: 12P 06: 14P/07: 16P/08: 18P 09: 20P/10: 22P/11: 24P 12: 26P/13: 28P/14: 30P 15: 32P/16: 34P/17: 36P 18: 38P/19: 40P/20: 42P 21: 44P/22: 46P/23: 48P	Depends on Hd102	×	3BC7h	0 to 23	1	
Hd104	Sync. Motor base frequency setting, 1st-motor	30.00 to [Hd105] Hz		×	3BC8h	3000 to 59000	0.01	
Hd105	Sync. Motor maximum frequency setting, 1st-motor	[Hd104] to 590.00 Hz		×	3BC9h			
Hd106	Sync. Motor rated voltage, 1st-motor	1 to 1000 V		×	3BCAh	1 to 1000	1	
Hd108	Sync. Motor rated current, 1st-motor	0.01 to 10000.00 A		×	3BCCh 3BCDh	1 to 1000000	0.01	
Hd110	Sync. Motor constant R, 1st-motor	0.000001 to 1000.000000 Ω		×	3BCEh 3BCFh	1 to 1000000000	0.000001	
Hd112	Sync. Motor constant Ld, 1st-motor	0.000001 to 1000.000000 mH		×	3BD0h 3BD1h			
Hd114	Sync. Motor constant Lq, 1st-motor				3BD2h 3BD3h			
Hd116	Sync. Motor constant Ke, 1st-motor	0.1 to 100000.0 (mVs/rad)		×	3BD4h 3BD5h	1 to 1000000	0.1	
Hd118	Sync. Motor constant J, 1st-motor	0.00001 to 10000.00000 kgm^2		×	3BD6h 3BD7h	1 to 1000000000	0.00001	
Hd130	Sync. Motor minimum frequency adjustment, 1st-motor	0 to 50 %	8	○	3BE2h	0 to 50	1	
Hd131	Sync. Motor No-Load current, 1st-motor	0 to 100 %	10	○	3BE3h	0 to 100	1	
Hd132	Sync. Motor starting method, 1st-motor	00: IMPE Disable 01: IMPE Enable	00	×	3BE4h	0 to 1	1	
Hd133	Sync. Motor IMPE 0V wait number, 1st-motor	0 to 255	10	×	3BE5h	0 to 255	1	
Hd134	Sync. Motor IMPE detect wait number, 1st-motor			×	3BE6h			

Note: 1. The default settings when initialize by setting 00 to "Initialize data selection [Ub-02]".
2. These parameters are SM/PMM related functions. For details, contact your supplier.

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
Hd135	Sync. Motor IMPE detect number, 1st-motor	0 to 255	30	×	3BE7h	0 to 255	1	Note
Hd136	Sync. Motor IMPE voltage gain, 1st-motor	0 to 200 %	100	×	3BE8h	0 to 200	1	
Hd137	Sync. Motor IMPE Mg-pole position offset, 1st-motor	0 to 359 deg	0	×	3BE9h	0 to 359	1	
Hd202	Sync. Motor capacity setting, 2nd-motor	0.01 to 11.00 kW	Same as Inverter capacity	×	62D6h	1 to1100	0.01	
Hd203	Sync. Motor number of poles setting, 2nd-motor	00: 2P/01: 4P/02: 6P 03: 8P/04: 10P/05: 12P/06: 14P/07: 16P/08: 18P 09: 20P/10: 22P/11: 24P 12: 26P/13: 28P/14: 30P 15: 32P/16: 34P/17: 36P 18: 38P/19: 40P/20: 42P 21: 44P/22: 46P/23: 48P	Depends on Hd202	×	62D7h	0 to 23	1	
Hd204	Sync. Motor base frequency setting, 2nd-motor	30.00 to [Hd205] Hz		×	62D8h	3000 to 59000	0.01	
Hd205	Sync. Motor maximum frequency setting, 2nd-motor	[Hd204] to 590.00 Hz		×	62D9h			
Hd206	Sync. Motor rated voltage, 2nd-motor	1 to 1000 V		×	62DAh	1 to 1000	1	
Hd208	Sync. Motor rated current, 2nd-motor	0.01 to 10000.00 A		×	62DCh 62DDh	1 to 1000000	0.01	
Hd210	Sync. Motor constant R, 2nd-motor	0.000001 to 1000.000000 Ω		×	62DEh 62DFh	1 to 1000000000	0.000001	
Hd212	Sync. Motor constant Ld, 2nd-motor	0.000001 to 1000.000000 mH		×	62E0h 62E1h			
Hd214	Sync. Motor constant Lq, 2nd-motor			×	62E2h 62E3h			
Hd216	Sync. Motor constant Ke, 2nd-motor	0.1 to 100000.0 (mVs/rad)		×	62E4h 62E5h	1 to 1000000	0.1	
Hd218	Sync. Motor constant J, 2nd-motor	0.00001 to 10000.00000 kgm^2		×	62E6h 62E7h	1 to 1000000000	0.00001	
Hd230	Sync. Motor minimum frequency adjustment, 2nd-motor	0 to 50 %	8	○	62F2h	0 to 50	1	
Hd231	Sync. Motor No-Load current, 2nd-motor	0 to 100 %	10	○	62F3h	0 to 100	1	
Hd232	Sync. Motor starting method, 2nd-motor	00: IMPE Disable 01: IMPE Enable	00	×	62F4h	0 to 1	1	
Hd233	Sync. Motor IMPE 0V wait number, 2nd-motor	0 to 255	10	×	62F5h	0 to 255	1	
Hd234	Sync. Motor IMPE detect wait number, 2nd-motor		10	×	62F6h			
Hd235	Sync. Motor IMPE detect number, 2nd-motor		30	×	62F7h			
Hd236	Sync. Motor IMPE voltage gain, 2nd-motor	0 to 200 %	100	×	62F8h	0 to 200	1	
Hd237	Sync. Motor IMPE Mg-pole position offset, 2nd-motor	0 to 359 deg	0	×	62F9h	0 to 359	1	

Note: These parameters are SM/PMM related functions. For details, contact your supplier.

18.2.9 O parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Modbus communication Data range	Modbus communication Resolution	Page
oA-10	Operation selection at an option error	00: Error 01: Ignore error (keep running)	00	○	3E8Ah	0 to 1	1	Note
oA-11	Communication Watch Dog Timer	0.00 to 100.00	1.00	×	3E8Bh	0 to 10000	1	
oA-12	Action selection at a communication error	00: Error 01: Trip after deceleration stop 02: Ignore 03: Free run stop 04: Deceleration stop	01	×	3E8Ch	0 to 4	1	
oA-13	RUN command selection at start up	00: Disable 01: Enable	00	×	3E8Dh	0 to 1	1	
oJ-01	Writing register 1, Gr. A	0000h to FFFFh	0000h	○	41A1h	0000h to FFFFh	1	
oJ-02	Writing register 2, Gr. A				41A2h			
oJ-03	Writing register 3, Gr. A				41A3h			
oJ-04	Writing register 4, Gr. A				41A4h			
oJ-05	Writing register 5, Gr. A				41A5h			
oJ-06	Writing register 6, Gr. A				41A6h			
oJ-07	Writing register 7, Gr. A				41A7h			
oJ-08	Writing register 8, Gr. A				41A8h			
oJ-09	Writing register 9, Gr. A				41A9h			
oJ-10	Writing register 10, Gr. A				41AAh			
oJ-11	Reading register 1, Gr. A				41ABh			
oJ-12	Reading register 2. Gr. A				41ACh			
oJ-13	Reading register 3. Gr. A				41ADh			
oJ-14	Reading register 4. Gr. A				41AEh			
oJ-15	Reading register 5. Gr. A				41AFh			
oJ-16	Reading register 6. Gr. A				41B0h			
oJ-17	Reading register 7. Gr. A				41B1h			
oJ-18	Reading register 8. Gr. A				41B2h			
oJ-19	Reading register 9. Gr. A				41B3h			
oJ-20	Reading register 10. Gr. A				41B4h			

Note: Communication options for HF-620 are under development.

18.2.10 P Parameter

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Name</th><th rowspan="2">Data range</th><th rowspan="2">Initial value</th><th rowspan="2">Change during running</th><th colspan="3">Modbus communication</th><th rowspan="2">Page</th></tr>
<tr><th>Register No.</th><th>Data range</th><th>Resolution</th></tr>
<tr><td>PA-01</td><td>Enable Emergency-force drive mode</td><td>00: Disable
01: Enable</td><td>00</td><td>×</td><td>4269h</td><td>0 to 1</td><td>1</td><td rowspan="3">9-91</td></tr>
<tr><td>PA-02</td><td>Emergency-force drive frequency reference</td><td>0.00 to 590.00 Hz</td><td>0.00</td><td>×</td><td>426Ah</td><td>0 to 59000</td><td>0.01</td></tr>
<tr><td>PA-03</td><td>Emergency-force drive direction command</td><td>00: Forward rotation
01: Reverse rotation</td><td>00</td><td>×</td><td>426Bh</td><td>0 to 1</td><td>1</td></tr>
<tr><td>PA-04</td><td>Commercial power supply bypass function selection</td><td>00: Disable
01: Enable</td><td>00</td><td>×</td><td>426Ch</td><td>0 to 1</td><td>1</td><td rowspan="2">9-93</td></tr>
<tr><td>PA-05</td><td>Commercial power supply bypass function delay time</td><td>0.0 to 1000.0 s</td><td>5.0</td><td>×</td><td>426Dh</td><td>0 to 10000</td><td>0.1</td></tr>
<tr><td>PA-20</td><td>Simulation mode enable</td><td>00: Disable
01: Enable</td><td>00</td><td>×</td><td>427Ch</td><td>0 to 1</td><td>1</td><td rowspan="16">8-13</td></tr>
<tr><td>PA-21</td><td>Error code selection for alarm test</td><td>0 to 255 (Error code)</td><td>0</td><td>○</td><td>427Dh</td><td>0 to 255</td><td>1</td></tr>
<tr><td>PA-22</td><td>Simulation mode:
Optional output selection for the output current monitor</td><td>00: Disable
01: Parameter [PA-23]
02: Setting by Terminal [VRF]
03: Setting by Terminal [IRF]</td><td>01</td><td>○</td><td>427Eh</td><td>0 to 3</td><td>1</td></tr>
<tr><td rowspan="2">PA-23</td><td rowspan="2">Optional output value setting for the output current monitor</td><td rowspan="2">(0.00 to 3.00)×Inverter output current A</td><td rowspan="2">0.00</td><td rowspan="2">○</td><td rowspan="2">427Fh</td><td>(0.00 to 3.00)× Rated output current</td><td>0.1</td></tr>
<tr><td>0 to 30000 Note</td><td>0.01</td></tr>
<tr><td>PA-24</td><td>Simulation mode:
Optional output selection for the DC bus voltage monitor</td><td>00: Disable
01: Parameter [PA-25]
02: Setting by Terminal [VRF]
03: Setting by Terminal [IRF]</td><td>01</td><td>○</td><td>4280h</td><td>0 to 3</td><td>1</td></tr>
<tr><td rowspan="2">PA-25</td><td rowspan="2">Optional output value setting for the DC bus voltage monitor</td><td rowspan="2">200V class: DC0.0 to 450.0 V
400V class: DC0.0 to 900.0 V</td><td rowspan="2">270.0
540.0</td><td rowspan="2">○</td><td rowspan="2">4281h</td><td>200V: 0 to 4500
400V: 0 to 9000</td><td>0.1</td></tr>
<tr><td>0 to 22500</td><td>0.01</td></tr>
<tr><td>PA-26</td><td>Simulation mode:
Optional output selection for the output voltage monitor</td><td>00: Disable
01: Parameter [PA-27]
02: Setting by Terminal [VRF]
03: Setting by Terminal [IRF]</td><td>01</td><td>○</td><td>4282h</td><td>0 to 3</td><td>1</td></tr>
<tr><td rowspan="2">PA-27</td><td rowspan="2">Optional output value setting for the output voltage monitor</td><td rowspan="2">200V class: 0.0 to 300.0 V
400V class: 0.0 to 600.0 V</td><td rowspan="2">0.0</td><td rowspan="2">○</td><td rowspan="2">4283h</td><td>200V: 0 to 3000
400V: 0 to 6000</td><td>0.1</td></tr>
<tr><td>0 to 15000</td><td>0.01</td></tr>
<tr><td>PA-28</td><td>Simulation mode:
Optional output selection for the output torque monitor</td><td>00: Disable
01: Parameter [PA-29]
02: Setting by Terminal [VRF]
03: Setting by Terminal [IRF]</td><td>01</td><td>○</td><td>4284h</td><td>0 to 3</td><td>1</td></tr>
<tr><td>PA-29</td><td>Optional output value setting for the output torque monitor</td><td>-500.0 to 500.0 %</td><td>0.0</td><td>○</td><td>4285h</td><td>-5000 to 5000</td><td>0.1</td></tr>
<tr><td>PA-30</td><td>Simulation mode:
Optional frequency matching start enable setting</td><td>00: Disable
01: Parameter [PA-31]
02: Setting by Terminal [VRF]
03: Setting by Terminal [IRF]</td><td>01</td><td>○</td><td>4286h</td><td>0 to 3</td><td>1</td></tr>
<tr><td>PA-31</td><td>Optional frequency matching start setting value</td><td>0.00 to 590.00 Hz</td><td>0.00</td><td>○</td><td>4287h</td><td>0 to 59000</td><td>0.01</td></tr>
</table>

Note: When the "Register data AV<=>% conversion function [CF-11]" is set to "A, V(00)", the upper row is the data range for Modbus communication, and when set to "%(01)", the lower row is the data range for Modbus communication.

18.2.11 U parameter

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
UA-01	Password for display	0000h to FFFFh	0000h	×	4651h	0000h to FFFFh	1	7-18
UA-02	Password for soft lock				4652h			
UA-10	Display restriction selection	00: Full display 01:Function-specific display 02: User setting display 03: Data compare display 04: Monitor only	00	○	465Ah	0 to 4	1	7-7
UA-12	Accumulated input power monitor clear	00: Disable 01: Clear	00	○	465Ch	0 to 1	1	10-7
UA-13	Display gain for the accumulated input power monitor	1 to 1000	1	○	465Dh	1 to 1000	1	
UA-14	Accumulated output power monitor clear	00: Disable 01: Clear	00	○	465Eh	0 to 1	1	10-8
UA-15	Display gain for the accumulated output power monitor	1 to 1000	1	○	465Fh	1 to 1000	1	
UA-16	Soft-Lock selection	00: [SFT] terminal 01: Always enable	00	○	4660h	0 to 1	1	7-17
UA-17	Soft-Lock target selection	00: All data 01: All data, except frequency related parameters	00	○	4661h	0 to 1	1	
UA-18	Data R/W selection	00: Enabled 01: Disabled R/W by remote operator	00	○	4662h	0 to 1	1	7-23
UA-19	Low battery warning enable	00: Disable 01: Warning 02: Error	00	×	4663h	0 to 2	1	7-22
UA-20	Action selection at keypad disconnection	00: Error 01: Trip after deceleration stop 02: Ignore 03: Free run stop 04: Deceleration stop	02	○	4664h	0 to 4	1	7-22
UA-21	2nd-motor parameter display selection	00: Hidden 01: Display	00	×	4665h	0 to 1	1	7-7
UA-22	Option parameter display selection	00: Hidden 01: Display	00	×	4666h	0 to 1	1	
UA-30	User-parameter auto setting function enable	00: Disable 01: Enable	00	○	466Eh	0 to 1	1	7-20
UA-31	User-parameter 1 selection	no / dA-01 to (Except [UA-31] to [UA-62])	no	○	466Fh	0 to 65535/ no: FFFFh (Register No.)	1	7-7 7-20
UA-32	User-parameter 2 selection				4670h			
UA-33	User-parameter 3 selection				4671h			
UA-34	User-parameter 4 selection				4672h			
UA-35	User-parameter 5 selection				4673h			
UA-36	User-parameter 6 selection				4674h			
UA-37	User-parameter 7 selection				4675h			
UA-38	User-parameter 8 selection				4676h			
UA-39	User-parameter 9 selection				4677h			
UA-40	User-parameter 10 selection				4678h			
UA-41	User-parameter 11 selection				4679h			
UA-42	User-parameter 12 selection				467Ah			
UA-43	User-parameter 13 selection				467Bh			
UA-44	User-parameter 14 selection				467Ch			
UA-45	User-parameter 15 selection				467Dh			
UA-46	User-parameter 16 selection				467Eh			
UA-47	User-parameter 17 selection				467Fh			
UA-48	User-parameter 18 selection				4680h			
UA-49	User-parameter 19 selection				4681h			
UA-50	User-parameter 20 selection				4682h			
UA-51	User-parameter 21 selection				4683h			
UA-52	User-parameter 22 selection				4684h			
UA-53	User-parameter 23 selection				4685h			
UA-54	User-parameter 24 selection				4686h			
UA-55	User-parameter 25 selection				4687h			

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
UA-56	User-parameter 26 selection	no / dA-01 to (Except [UA-31] to [UA-62])	no	○	4688h	0 to 65535/ no: FFFFh (Register No.)	1	7-7 7-20
UA-57	User-parameter 27 selection				4689h			
UA-58	User-parameter 28 selection				468Ah			
UA-59	User-parameter 29 selection				468Bh			
UA-60	User-parameter 30 selection				468Ch			
UA-61	User-parameter 31 selection				468Dh			
UA-62	User-parameter 32 selection				468Eh			
UA-76	Dial sensitivity	1 to 24	1	○	469Ch	1 to 24	1	7-6
UA-77	dial carry sensitivity	1 to 100	20	○	469Dh	1 to 100	1	
UA-90	Reserved	-	-	-	-	-	-	-
UA-91	Waiting time for turning off the display	0 to 60 min.	dA-01	○	46ABh	-	-	7-20
UA-92	Initial display selection	no / dA-01 to (Except [UA-31] to [UA-62])	00	○	46ACh	0 to 1	1	7-20
UA-93	Enable auto-return to the Initial display	00: Disable 01: Enable	00	○	46ADh	0 to 1	1	10-2
UA-94	Enable frequency changes through monitor display	00: Disable 01: Enable	00	×	46AEh	0 to 1	1	
UA-95	Display while external operator connected	dA-**, db-**, dC-**, FA-**	dA-01	○	46AFh	00 to 65535 (Register No.)	-	7-23
UA-96	Dual monitor target 1 selection	dA-**, db-**, dC-**, FA-** (except [dC-30])	dA-01	○	46B0h			10-20
UA-97	Dual monitor target 2 selection	dA-**, db-**, dC-**, FA-** (except [dC-30])	dA-02	○	46B1h			
Ub-01	Initialize mode selection	00: Disable 01: Error history clear 02: Data initialize 03: Error history clear and data initialize 05: All data except terminal configuration 06: All data except communication configuration 07: All data except terminal and communication configuration 10: User parameters 11: All data except user parameters	00	×	46B5h	0 to 11	1	7-7
Ub-02	Initialize data selection	00: Mode 0 (JP/USA) 01: Mode 1 (EU) 03: Mode 3 (CN)	00	×	46B6h	0 to 3	1	7-13
Ub-03	Load type selection	01: Light duty (LD) 02: Normal duty(ND)	02	×	46B7h	1 to 2	1	8-2
Ub-05	Enable initialization	00: Disable 01: Execute initialization	00	×	46B9h	0 to 1	1	7-13
Ub-06	Restart communication	00: Disable 01: Execute communication restart	00	×	46BAh	0 to 1	1	7-15
UC-01	Debug mode selection	(Do not change from initial value)	00	○	4719h	Do not change from initial value	-	-
Ud-01	Trace function enable	00: Disable 01: Enable	00	○	477Dh	0 to 1	1	12-3
Ud-02	Trace start	00: Stop 01: Start	00	○	477Eh	0 to 1	1	
Ud-03	Number of trace data setting	0 to 8	1	○	477Fh	0 to 8	1	
Ud-04	Number of trace signals setting			○	4780h			
Ud-10	Trace data 0 selection	Monitor parameters (Refer to "12.3.2 Trace Function Related Parameters")	dA-01	○	4786h	0 to 65535/ no: FFFFh (Register No.)	1	
Ud-11	Trace data 1 selection				4787h			
Ud-12	Trace data 2 selection				4788h			
Ud-13	Trace data 3 selection				4789h			
Ud-14	Trace data 4 selection				478Ah			
Ud-15	Trace data 5 selection				478Bh			
Ud-16	Trace data 6 selection				478Ch			
Ud-17	Trace data 7 selection				478Dh			

Code	Name	Data range	Initial value	Change during running	Modbus communication Register No.	Data range	Resolution	Page
Ud-20	Trace signal 0 input/output selection	00: Input [Ud-21] 01: Output [Ud-22]	00	○	4790h	0 to 1	1	12-3
Ud-21	Trace signal 0 input terminal selection	Same as [CA-01] to [CA-08]	001	○	4791h	0 to 110	1	
Ud-22	Trace signal 0 output terminal selection	Same as [CC-01] to [CC-07]	001	○	4792h	0 to 98	1	
Ud-23	Trace signal 1 input/output selection	00: Input [Ud-24] 01: Output [Ud-25]	00	○	4793h	0 to 1	1	
Ud-24	Trace signal 1 input terminal selection	Same as [CA-01] to [CA-08]	001	○	4794h	0 to 110	1	
Ud-25	Trace signal 1 output terminal selection	Same as [CC-01] to [CC-07]	001	○	4795h	0 to 98	1	
Ud-26	Trace signal 2 input/output selection	00: Input [Ud-27] 01: Output [Ud-28]	00	○	4796h	0 to 1	1	
Ud-27	Trace signal 2 input terminal selection	Same as [CA-01] to [CA-08]	001	○	4797h	0 to 110	1	
Ud-28	Trace signal 2 output terminal selection	Same as [CC-01] to [CC-07]	001	○	4798h	0 to 98	1	
Ud-29	Trace signal 3 input/output selection	00: Input [Ud-30] 01: Output [Ud-31]	00	○	4799h	0 to 1	1	
Ud-30	Trace signal 3 input terminal selection	Same as [CA-01] to [CA-08]	001	○	479Ah	0 to 110	1	
Ud-31	Trace signal 3 output terminal selection	Same as [CC-01] to [CC-07]	001	○	479Bh	0 to 98	1	
Ud-32	Trace signal 4 input/output selection	00: Input [Ud-33] 01: Output [Ud-34]	00	○	479Ch	0 to 1	1	
Ud-33	Trace signal 4 input terminal selection	Same as [CA-01] to [CA-08]	001	○	479Dh	0 to 110	1	
Ud-34	Trace signal 4 output terminal selection	Same as [CC-01] to [CC-07]	001	○	479Eh	0 to 98	1	
Ud-35	Trace signal 5 input/output selection	00: Input [Ud-36] 01: Output [Ud-37]	00	○	479Fh	0 to 1	1	
Ud-36	Trace signal 5 input terminal selection	Same as [CA-01] to [CA-08]	001	○	47A0h	0 to 110	1	
Ud-37	Trace signal 5 output terminal selection	Same as [CC-01] to [CC-07]	001	○	47A1h	0 to 98	1	
Ud-38	Trace signal 6 input/output selection	00: Input [Ud-39] 01: Output [Ud-40]	00	○	47A2h	0 to 1	1	
Ud-39	Trace signal 6 input terminal selection	Same as [CA-01] to [CA-08]	001	○	47A3h	0 to 110	1	
Ud-40	Trace signal 6 output terminal selection	Same as [CC-01] to [CC-07]	001	○	47A4h	0 to 98	1	
Ud-41	Trace signal 7 input/output selection	00: Input [Ud-42] 01: Output [Ud-43]	00	○	47A5h	0 to 1	1	
Ud-42	Trace signal 7 input terminal selection	Same as [CA-01] to [CA-08]	001	○	47A6h	0 to 110	1	
Ud-43	Trace signal 7 output terminal selection	Same as [CC-01] to [CC-07]	001	○	47A7h	0 to 98	1	
UD-50	Trace trigger 1 selection	00: Trip 01: Trace data 0 02: Trace data 1 03: Trace data 2 04: Trace data 3 05: Trace 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	○	47AEh	0 to 16	1	
Ud-51	Trigger 1 activation selection at trace data trigger	00: Action at rising above the trigger level 01: Action at falling below the trigger level	00	○	47AFh	0 to 1		
Ud-52	Trigger 1 level setting at trace data trigger	0 to 100 %	0	○	47B0h	0 to 100		
Ud-53	Trigger 1 activation selection at trace signal trigger	00: Action by signal ON 01: Action by signal OFF	00	○	47B1h	0 to 1		

Code	Name	Data range	Initial value	Change during running	Modbus communication			Page
					Register No.	Data range	Resolution	
Ud-54	Trace trigger 2 selection	00: Trip 01: Trace data 0 02: Trace data 1 03: Trace data 2 04: Trace data 3 05: Trace 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	○	47B2h	0 to 16	1	12-3
Ud-55	Trigger 2 activation selection at trace data trigger	00: Action at rising above the trigger level 01: Action at falling below the trigger level	00	○	47B3h	0 to 1	1	
Ud-56	Trigger 2 level setting at trace data trigger	0 to 100 %	0	○	47B4h	0 to 100	1	
Ud-57	Trigger 2 activation selection at trace signal trigger	00: Action by signal ON 01: Action by signal OFF	00	○	47B5h	0 to 1	1	
Ud-58	Trigger condition selection	00: At trace trigger 1 activation 01: At trace trigger 2 activation 02: Trigger-1 OR Trigger-2 activation 03: Trigger-1 AND Trigger-2 activation	00	○	47B6h	0 to 3	1	
Ud-59	Trigger point setting	0 to 100 %	0	○	47B7h	0 to 100	1	
Ud-60	Sampling time setting	02: 0.5ms 03: 1ms 04: 2ms 05: 5ms 06: 10ms 07: 50ms 08: 100ms 09: 500ms 10: 1000ms	03	○	47B8h	2 to 10	1	

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 following cost: 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	Notwithstanding 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 customer´s 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 bearing. 9. Any other problems with or damage to the product that are not attributable to the seller.

To inverter users:

The inverter described in this user´s manual is used for variable-speed operation of 3-phase induction motors for general industry use.

⚠ CAUTION

- ▼ The inverter described in this user´s 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 manual and this user´s 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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