Instruction Manual

High Performance Inverter

IMO Jaguar VXT



⚠CAUTION

Thank you for purchasing our Jaguar VXT series of inverters.

- This product is designed to drive a three-phase induction motor. Read through this instruction manual and be familiar with the handling procedure for correct use.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- For how to use an optional device, refer to the instruction and installation manuals for that optional device.

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Preface

Thank you for purchasing our multifunction Jaguar VXT series of inverters. This product is designed to drive a three-phase induction motor or a three-phase permanent magnet synchronous motor under variable speed control.

This manual provides all the information on the Jaguar VXT series of inverters including its operating procedure and selection of peripheral equipment. Before use, carefully read this manual for proper use. Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.

The table below lists the other materials related to the use of the Jaguar VXT. Read them in conjunction with this manual if necessary.

Name	Description
Catalog	Product scope, features, specifications, external drawings, and options of the product
Jaguar VXT User's Manual	Product details control block diagrams, specifications, and external dimensions
RS-485 Communication User's Manual	Overview of functions implemented by using Jaguar VXT RS-485 communications facility, its communications specifications, Modbus RTU/IMO general-purpose inverter protocol, function codes and related data formats

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

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■ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Application

⚠WARNING

- The Jaguar VXT is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes.

  Fire or an accident could occur.

- The Jaguar VXT may not be used for a life-support system or other purposes directly related to the human safety.
- Though the Jaguar VXT is manufactured under strict quality control, install safety devices for applications where serious accidents or property damages are foreseen in relation to the failure of it.

  An accident could occur.

Installation

⚠WARNING

- Install the inverter on a base made of metal or other non-flammable material.

  Otherwise, a fire could occur.

- Do not place flammable object nearby.

  Doing so could cause fire.

- Inverters VXT-85 or above, whose protective structure is IP00, involve a possibility that a human body may touch the live conductors of the main circuit terminal block. Inverters to which an optional DC reactor is connected also involve the same. Install such inverters in an inaccessible place.

  Otherwise, electric shock or injuries could occur.

⚠CAUTION

- Do not support the inverter by its front cover during transportation.

  Doing so could cause a drop of the inverter and injuries.

- Prevent lint, paper fibres, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
- When changing the positions of the top and bottom mounting bases for external cooling, use only the specified screws.

  Otherwise, a fire or an accident might result.

- Do not install or operate an inverter that is damaged or lacking parts.

  Doing so could cause fire, an accident or injuries.

Wiring

⚠WARNING

- If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line, in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.

  Otherwise, a fire could occur.

- When wiring the inverter to the power source, insert a recommended moulded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Use wires in the specified size.
- Tighten terminals with specified torque.

  Otherwise, a fire could occur.

- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.
- Do not connect a surge arrestor to the inverter's output (secondary) circuit.

  Doing so could cause a fire.

- Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

  Otherwise, a fire could occur.

- Ground the inverter in compliance with the national or local electric code.
- Be sure to ground the inverter's grounding terminals ⏚G.

  Otherwise, an electric shock or a fire could occur.

- Qualified electricians should perform all wiring.
- Be sure to perform wiring after turning the power OFF.

  Otherwise, an electric shock could occur.

- Be sure to perform wiring after installing the inverter unit.

  Otherwise, an electric shock or injuries could occur.

- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.

  Otherwise, a fire or an accident could occur.

- Do not connect the power supply wires to output terminals (U, V, and W).
- When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals P(+) and DB.

  Doing so could cause fire or an accident.

- In general, sheaths of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the sheath might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

  Doing so could cause an accident or an electric shock.

⚠WARNING⚠

- Before changing the switches or touching the control circuit terminal symbol plate, **turn OFF the power and wait at least five minutes for inverters VXT-115A-2E / VXT-72-4**E **/ VXT-11A-7**E **or below, or at least ten minutes for inverters VXT-85A-4E or above.** Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multi-meter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

⚠CAUTION

- The inverter, motor and wiring generate electric noise. Be careful about malfunction of the nearby sensors and devices. To prevent them from malfunctioning, implement noise control measures.

  Otherwise an accident could occur.

Operation

⚠WARNING

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

  Otherwise, an electric shock could occur.

- Do not operate switches with wet hands.

  Doing so could cause electric shock.

- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting.

  Otherwise, an accident could occur.

- If the stall prevention function (current limiter), automatic deceleration (anti-regenerative control), or overload prevention control has been selected, the inverter may operate with acceleration/deceleration or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases.
- The STOP key on the keypad is effective only when the keypad operation is enabled with function code F02 (= 0, 2 or 3). When the keypad operation is disabled, prepare an emergency stop switch separately for safe operations.
  Switching the run command source from keypad (local) to external equipment (remote) by turning ON the "Enable communications link" command ***LE*** disables the STOP key. To enable the STOP key for an emergency stop, select the STOP key priority with function code H96 (= 1 or 3).
- If any of the protective functions have been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.

  Otherwise, an accident could occur.

- If you enable the "Restart mode after momentary power failure" (Function code F14 = 3 to 5), then the inverter automatically restarts running the motor when the power is recovered.

  Design the machinery or equipment so that human safety is ensured after restarting.

- If the user configures the function codes wrongly without completely understanding the User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- Starting auto-tuning involves motor rotation. Sufficiently check that motor rotation brings no danger beforehand.

  An accident or injuries could occur.

- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S, L3/T, L1/L and L2/N, voltage may be output to inverter output terminals U, V, and W.
- Even if the motor is stopped due to DC braking or preliminary excitation, voltage is output to inverter output terminals U, V, and W.

  An electric shock may occur.

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

  Otherwise, injuries could occur.

⚠CAUTION

- Do not touch the heat sink and braking resistor because they become very hot.

  Doing so could cause burns.

- The DC brake function of the inverter does not provide any holding mechanism.

  Injuries could occur.

- Ensure safety before modifying the function code settings.
  Run commands (e.g., "Run forward" ***FWD***), stop commands (e.g., "Coast to a stop" ***BX***), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***Hz2/Hz1***, ***Hz/PID***, ***IVS***, and ***LE***) may cause a sudden motor start or an abrupt change in speed.
- Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command ***CLC***. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.

  An accident or injuries could occur.

Maintenance and inspection, and parts replacement

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters VXT-115A-2E / VXT-72A-4E / VXT-11A-1E or below, or at least ten minutes for inverters VXT-85A-4E or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multi-meter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

- Always carry out the daily and periodic inspections described in the instruction/user's manual. Use of the inverter for long periods of time without carrying out regular inspections could result in malfunction or damage, and an accident or fire could occur.
- It is recommended that periodic inspections be carryout every one to two years, however, they should be carried out more frequently depending on the usage conditions.
- It is recommended that parts for periodic replacement be replaced in accordance with the standard replacement frequency indicated in the user's manual. Use of the product for long periods of time without replacement could result in malfunction or damage, and an accident or fire could occur.
- Contact outputs [30A/B/C] use relays, and may remain ON, OFF, or undetermined when their lifetime is reached. In the interests of safety, equip the inverter with an external protective function.

  Otherwise, an accident or fire could occur.

- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.

  Otherwise, an electric shock or injuries could occur.

- Never modify the inverter.

  Doing so could cause an electric shock or injuries.

Disposal

⚠CAUTION
• Treat the inverter as an industrial waste when disposing of it. **Otherwise injuries could occur.**

IMO Jaguar inverter 5 year warranty
. **Terms of IMO 5 year warranty.** • IMO Jaguar Inverters are covered by a 5 year warranty from date of despatch. • In the event of failure due to faulty components or inferior workmanship, the Inverter will be replaced or repaired free Warranty replacements and repaired units will be despatched free of charge, all costs related to faulty units being returned to IMO for inspection/repair are the responsibility of the sender. • In circumstances where it is viable for the Inverter to be repaired in situ due to size (>30kw), an Engineer from IMO or contracted to represent IMO can be supplied. Site visits are chargeable at IMO's current service rate, any warranty parts will be replaced free of charge. • All Inverters require a Returns Authorisation reference to be supplied with the Inverter upon returning the drive to IMO, this reference can be obtained from our website www.imopconline.com by registering and following the returns instructions. **Warranty restrictions.** • Incorrect, or unsafe installation. • Poor condition due to abuse, neglect or improper maintenance. • Modifications, repairs performed by anyone other than IMO or without prior written agreement. • Inverter used in incorrect application or used for function other than for which it is designed. • Any alterations, which may invalidate the Inverters CE declaration. • Non IMO options or ancillary devices used. **Liability.** • Regardless whether a breakdown occurs during or after the warranty period, IMO shall not be liable for any loss of opportunity, loss of profits, penalty clauses or damages arising from any special circumstances, secondary damages, accident compensation to another company, damages to any equipment, or personal injury.

GENERAL PRECAUTIONS
Drawings in this manual may be illustrated without covers or safety shields for explanation of detail parts. Restore the covers and shields in the original state and observe the description in the manual before starting operation.

Icons

The following icons are used throughout this manual.

Note This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

Tip This icon indicates information that can be useful when performing certain settings or operations.

This icon indicates a reference to more detailed information.

Chapter 1 BEFORE USE

1.1 Acceptance Inspection (Nameplates and Inverter Type)

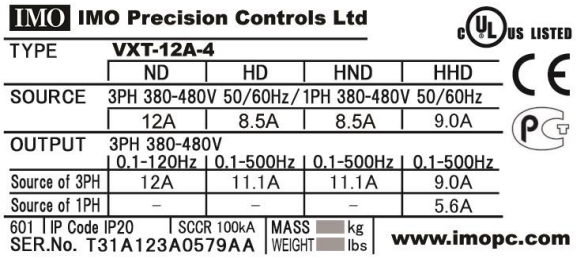
Unpack the package and check the following:

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

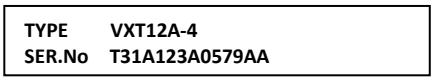
Accessories - DC reactor (for ND-mode inverters of VXT-139A-4 or above, HD/HND-mode inverters of VXT-168A-4 or above, and HHD-mode inverters of VXT-203A-4 or above)
- Keypad rear cover (with three screws for securing the keypad)
- Instruction manual

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

(3) The inverter is the model you ordered. You can check the model and specifications on the main nameplate. (The main and sub nameplates are attached to the inverter as shown on Figure 1.2-1.)



(a) Main Nameplate



(b) Sub Nameplate

Figure 1.1-1 Nameplates

The Jaguar VXT is available in four different drive modes--ND (Normal Duty), HD (Heavy Duty), HND (High, Normal Duty), and HHD (High, Heavy Duty). One of these modes should be selected to match the load property of your system. Specifications in each mode are printed on the main nameplate.

ND mode : Designed for general load applications.
Overload capability: 120% for 1 min.

HD mode : Designed for heavy duty load applications.
Overload capability: 150% for 1 min.

HND mode : Designed for general load applications.
Overload capability: 120% for 1 min.

HHD mode : Designed for heavy duty load applications.
Overload capability: 150% for 1 min. and 200% for 0.5 s.

SOURCE : Number of input phases (three-phase: 3PH), input voltage, input frequency, input current

OUTPUT : Number of output phases, rated output voltage, output frequency range, rated output capacity, rated output current, and overload capability

SCCR : Short-circuit capacity

MASS : Mass of the inverter in kilogram

SER. No. : Product number

400V / 3 Phase Models

VXT - 2A - 4 E

Drive	
series prefix	VXT

Max. Continuous Output Current (A)			
2Amp output current	2A		
4Amp output current	4A		
6Amp output current	6A		
7Amp output current	7A		
12Amp output current	12A	139A	139Amp output current
22Amp output current	22A	168A	168Amp output current
29Amp output current	29A	203A	203Amp output current
37Amp output current	37A	240A	240Amp output current
44Amp output current	44A	290A	290Amp output current
59Amp output current	59A	361A	361Amp output current
72Amp output current	72A	415A	415Amp output current
85Amp output current	85A	520A	520Amp output current
105Amp output current	105A	590A	590Amp output current

Filter	
	no filter
E	integrated EMC filter

Input Voltage (V) / Phase	
4	400V / 3 Phase

200V / 3 Phase Models

VXT - 4A - 2 E

Drive	
series prefix	VXT

Max. Continuous Output Current (A)			
4Amp output current	4A		
6Amp output current	6A		
10Amp output current	10A		
12Amp output current	12A		
20Amp output current	20A		
30Amp output current	30A	69A	69Amp output current
40Amp output current	40A	88A	88Amp output current
56Amp output current	56A	115A	115Amp output current

Filter	
	no filter
E	integrated EMC filter

Input Voltage (V) / Phase	
2	200V / 3 Phase

200V / 1 Phase Models

VXT - 8A - 1 E

Drive	
series prefix	VXT

Max. Continuous Output Current (A)	
3Amp output current	3A
5Amp output current	5A
8Amp output current	8A
11Amp output current	11A

Filter	
	no filter
E	integrated EMC filter

Input Voltage (V) / Phase	
1	200V / 1 Phase

CE : Compliance with European Standards (See Appendix G Section G-1)

c UL us LISTED : Compliance with UL Standards and Canadian Standards (cUL certification) (See Appendix G Section G-2)

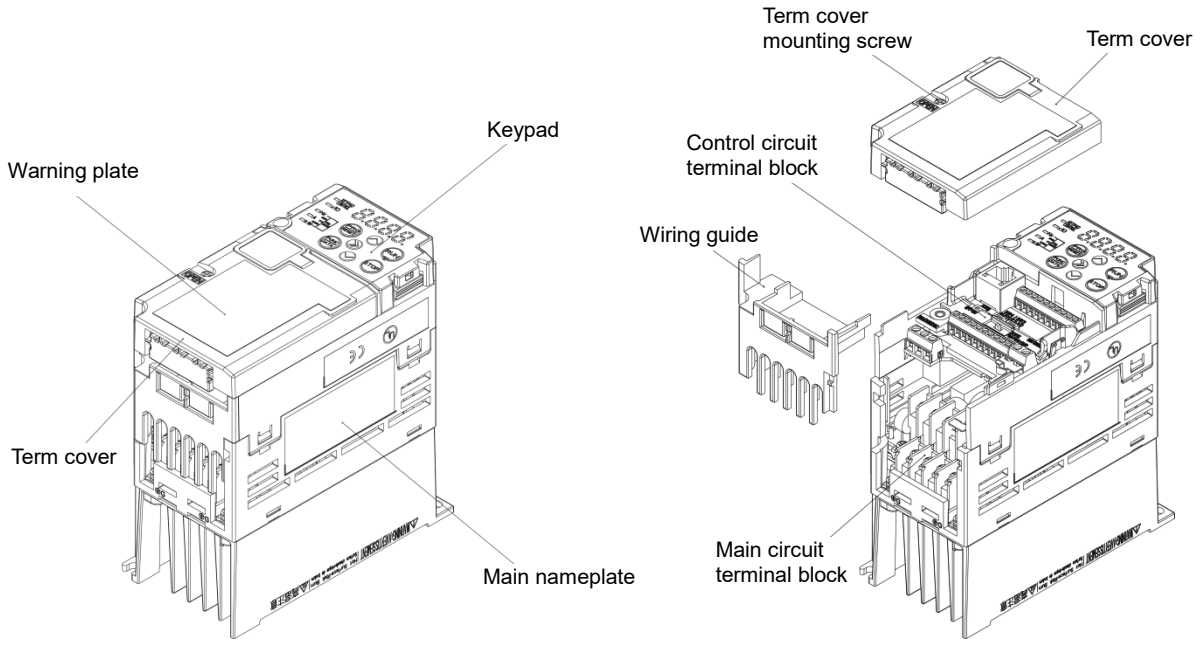
KC : Compliance with the Radio Waves Act (South Korea) (See Appendix G Section G-3)

EAC : Compliance with Russian Standards

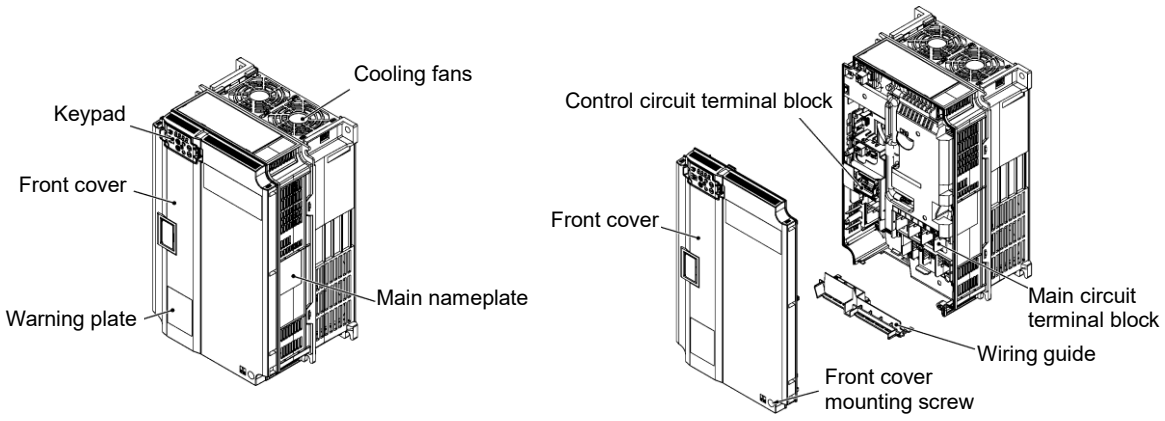
If you suspect the product is not working properly or if you have any questions about your product, contact IMO.

1.2 External View and Terminal Blocks

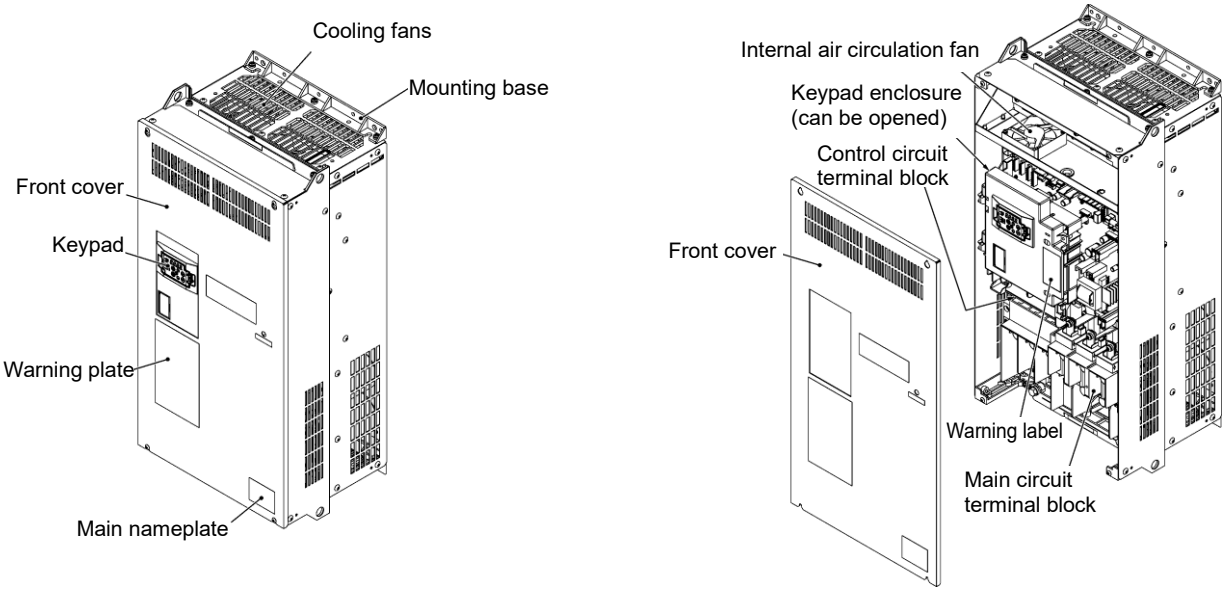
(1) Outside and inside views



(a) VXT-6A-2#



(b) VXT-72A-4



(c) VXT-590A-4

Figure 1.2-1 Outside and Inside Views of Inverters

(2) Warning plates and label







(a) VXT-6A-4 (b) VXT-203A-4

Figure 1.2-2 Warning Plates and Label

1.3 Precautions for Using Inverters

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

1.3.1 Usage environment

Install the inverter in an environment that satisfies the requirements listed in Table 1.3-1.

Table 1.3-1 Usage Environment

<table>
<tr><th>Item</th><th colspan="3">Specifications</th></tr>
<tr><td>Site location</td><td colspan="3">Indoors</td></tr>
<tr><td>Ambient temperature</td><td colspan="3">Standard（Open Type）
-10 to +50°C (14 to 122°F) (HHD/HND spec.) (Note 1)
-10 to +40°C (14 to 104°F) (HD/ND spec.)
NEMA/UL Type1
-10 to +40°C (14 to 104°F) (HHD/HND spec.)
-10 to +30°C (14 to 86°F) (HD/ND spec.)</td></tr>
<tr><td>Relative humidity</td><td colspan="3">5 to 95% RH (No condensation)</td></tr>
<tr><td>Atmosphere</td><td colspan="3">The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops.
Pollution degree 2 (IEC60664-1) (Note 2)
The atmosphere can contain a small amount of salt (0.01 mg/cm^2 or less per year).
The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.</td></tr>
<tr><td>Altitude</td><td colspan="3">1,000 m (3,300 ft) max. (Note 3)</td></tr>
<tr><td>Atmospheric pressure</td><td colspan="3">86 to 106 kPa</td></tr>
<tr><td rowspan="2">Vibration</td><td>VXT-115A-2 or below
VXT-203A-4 or below
VXT-11A-1 or below</td><td colspan="2">VXT-240A-4# or above</td></tr>
<tr><td>3 mm (Max. amplitude)
2 to less than 9 Hz
9.8 m/s^2 9 to less than 20 Hz
2 m/s^2 20 to less than 55 Hz
1 m/s^2 55 to less than 200 Hz</td><td colspan="2">3 mm (Max. amplitude)
2 to less than 9 Hz
2 m/s^2 9 to less than 55 Hz
1 m/s^2 55 to less than 200 Hz</td></tr>
</table>

(Note 1) When inverters are mounted side-by-side without any clearance between them (VXT-11-1 / VXT-115A-2 / VXT-72-4 or below), the ambient temperature should be within the range from -10 to +40°C.

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

(Note 3) If you use the inverter in an altitude above 1,000 m (3,300 ft), you should apply an output current de-rating factor as listed in Table 1.3-2.

Table 1.3-2 Output Current De-rating Factor in Relation to Altitude

Altitude		Output current de-rating factor
1,000 m or lower	(3,300 ft or lower)	1.00
1,000 to 1500 m	(3,300 to 4,900 ft)	0.97
1,500 to 2,000 m	(4,900 to 6,600 ft)	0.95
2,000 to 2,500 m	(6,600 to 8,200 ft)	0.91
2,500 to 3,000 m	(8,200 to 9,800 ft)	0.88

IMO strongly recommends installing inverters in a panel for safety reasons, in particular, when installing the ones whose enclosure rating is IP00.
When installing the inverter in a place out of the specified environmental requirements, it is necessary to de-rate the inverter or consider the panel engineering design suitable for the special environment or the panel installation location. The special environments listed below require using the specially designed panel or considering the panel installation location.

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

1.3.2 Storage environment

The storage environment in which the inverter should be stored after purchase differs from the usage environment. Store the inverter in an environment that satisfies the requirements listed below.

[1] Temporary storage

Table 1.3-3 Storage and Transport Environments

Item	Specifications	
Storage temperature ***1**	During transport: -25 to +70°C (-13 to +158°F)	Places not subjected to abrupt temperature changes or condensation or freezing
	During storage: -25 to +65°C (-13 to +153°F)	
Relative humidity	5 to 95% RH ***2**	
Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive or flammable gases, oil mist, vapor, water drops or vibration. The atmosphere must contain only a low level of salt. (0.01 mg/cm^2 or less per year)	
Atmospheric pressure	86 to 106 kPa (during storage)	
	70 to 106 kPa (during transportation)	

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

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

Precautions for temporary storage

(1) Do not leave the inverter directly on the floor.

(2) If the environment does not satisfy the specified requirements listed in Table 1.3-3, wrap the inverter in an airtight vinyl sheet or the like for storage.

(3) If the inverter is to be stored in a high-humidity environment, put a drying agent (such as silica gel) in the airtight package described in (2) above.

[2] Long-term storage

The long-term storage method of the inverter varies largely according to the environment of the storage site. General storage methods are described below.

(1) The storage site must satisfy the requirements specified for temporary storage.

However, for storage exceeding three months, the surrounding temperature range should be within the range from -10 to +30°C (14 to 86°F). This is to prevent electrolytic capacitors in the inverter from deterioration.

(2) The package must be airtight to protect the inverter from moisture. Add a drying agent inside the package to maintain the relative humidity inside the package within 70%.

(3) If the inverter has been installed to the equipment or panel at construction sites where it may be subjected to humidity, dust or dirt, then temporarily remove the inverter and store it in the environment specified in Table 1.3-3.

Precautions for storage over 1 year

If the inverter has not been powered on for a long time, the property of the electrolytic capacitors may deteriorate. Power the inverters on once a year and keep the inverters powering on for 30 to 60 minutes. Do not connect the inverters to the load circuit (secondary side) or run the inverter.

Chapter 2 INSTALLATION AND WIRING

2.1 Installation

(1) Installation Environment

Please install Jaguar VXT in locations which meet the conditions specified in Chapter 1 “1.3.1 Usage environment”.

(2) Installation Surface

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

⚠WARNING
Install on non-combustible matter such as metals. **Risk of fire exists**

(3) Surrounding Space

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

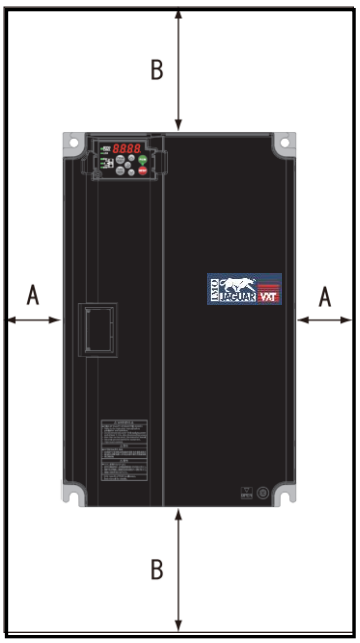


Figure 2.1-1 Installation Direction

■ **Installation of Multiple Inverters**

When installing 2 or more units in the same equipment or cabinet, generally mount them to the side of each other, not above each other. When the inverters are mounted above each other, attach partitioning boards to prevent that the heat dissipated from the lower inverter affects the upper inverter.

For types VXT-72A-4, VXT-115A-2, VXT-11A-1 or below and for ambient temperature below 40°C only, the units can be installed side by side without any spacing between them. (30°C or lower for ND and HD)

Table 2.1-1 Surrounding Space mm (inch)

Applicable Capacity	A	B	C
200 V class: VXT-4A to 115A-2 200 V class: VXT-3A to 11A-1 400 V class: VXT-2A to 72A-4	10 (0.39)	100 (3.9)	0 *1
400 V class: VXT-85 to 590A-4	50 (1.97)		100 (3.9)

*1 A clearance of 50 mm is required to use RJ45 connector.

C: Space in front of the inverter unit

■ **Installation with External Cooling**

The external cooling installation reduces the generated heat inside the panel by dissipating approximately 70% of the total heat generated (total heat loss) by mounting the cooling fins protruding outside the equipment or cabinet.

Installation with external cooling is possible for types VXT-30 to 115A-2 and VXT-22 to 72A-4 by adding attachments (optional) for external cooling, and for types VXT-85A-4 or above by moving the mounting bases.

(Please refer to the Jaguar VXT- User's Manual, Chapter 11 Item 11.15 for the external dimensions drawing of the external cooling attachment (optional)).

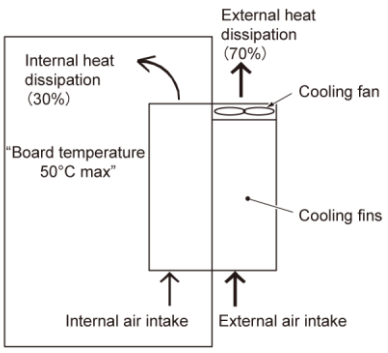


Figure 2.1-2 Installation with External Cooling

⚠CAUTION
Prevent lint, wastepaper, wood shavings, dust, metal scrap, and other foreign material from entering the inverter or from attaching to the cooling fins. **Risk of fire and risk of accidents exist**

To install the VXT-85A-4 inverter with external cooling, change the mounting position of the mounting bases

following the procedure in Figure 2.1-3.

As the type and number of screws differ by inverter type, please review Table 2.1-2.

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

Inverter type	Mounting base fixation screw	Case attachment screw	Tightening torque N•m (lb-in)
VXT-85A-4 to VXT-168A-4	M6×20 (5 screws on top, 3 screws on bottom)	M6×20 (2 screws on top only)	5.8 (51.3)
VXT-203A-4	M6×20 (3 screws on top and bottom each)	M6×12 (3 screws on top only)	5.8 (51.3)
VXT-240A-4 to VXT-290A-4	M5×12 (7 screws on top and bottom each)	M5×12 (7 screws on top only)	3.5 (31.0)
VXT-361A-4 to VXT-415A-4	M5×16 (7 screws on top and bottom each)	M5×16 (7 screws on top only)	3.5 (31.0)
VXT-520A-4 to VXT-590A-4	M5×16 (8 screws on top and bottom each)	M5×16 (8 screws on top only)	3.5 (31.0)

1) Remove all of the mounting base fixation screws and the case attachment screws on the top of the inverter.
2) Fix the mounting bases to the case attachment screw holes using the mounting base fixation screws. A few screws should remain after changing the position of the mounting bases.
3) Change the position of the mounting bases on the bottom side following the procedure in 1) and 2).

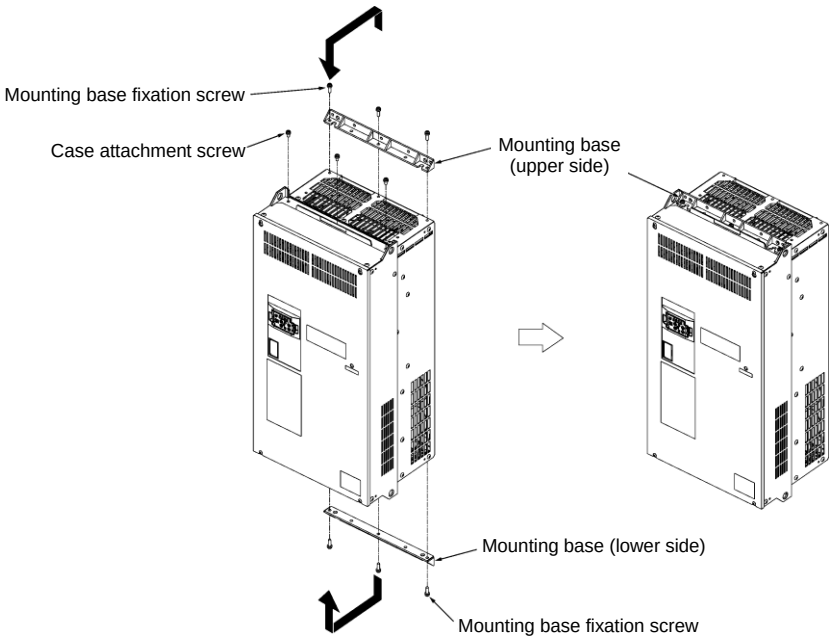


Figure 2.1-3 Method to Change the Mounting Base Positions

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

■ **Inverter unit installation screw size**

Select the bolt size, considering the thickness of the mounting feet and installation surface so that the bolt protrudes from the nut by 2 threads or more.

Inverter type	Inverter fixation screw	Tightening torque N•m (lb-in)
200V class : VXT-30/40A-2 400V class : VXT-22/29A-4	M5 (4 screws)	3.5 (31.0)
200V class : VXT-56/69A-2 400V class : VXT-37A-4 to VXT-203A-4	M8 (4 screws)	13.5 (119)
400V class : VXT-240A-4 to VXT-415A-4	M12 (4 screws)	48 (425)
400V class : VXT-520A-4 to VXT-590A-4	M12 (6 screws)	48 (425)

2.2 Wiring

2.2.1 Basic connection diagram

■ **Standard model with CANopen (single analogue output) FM1**

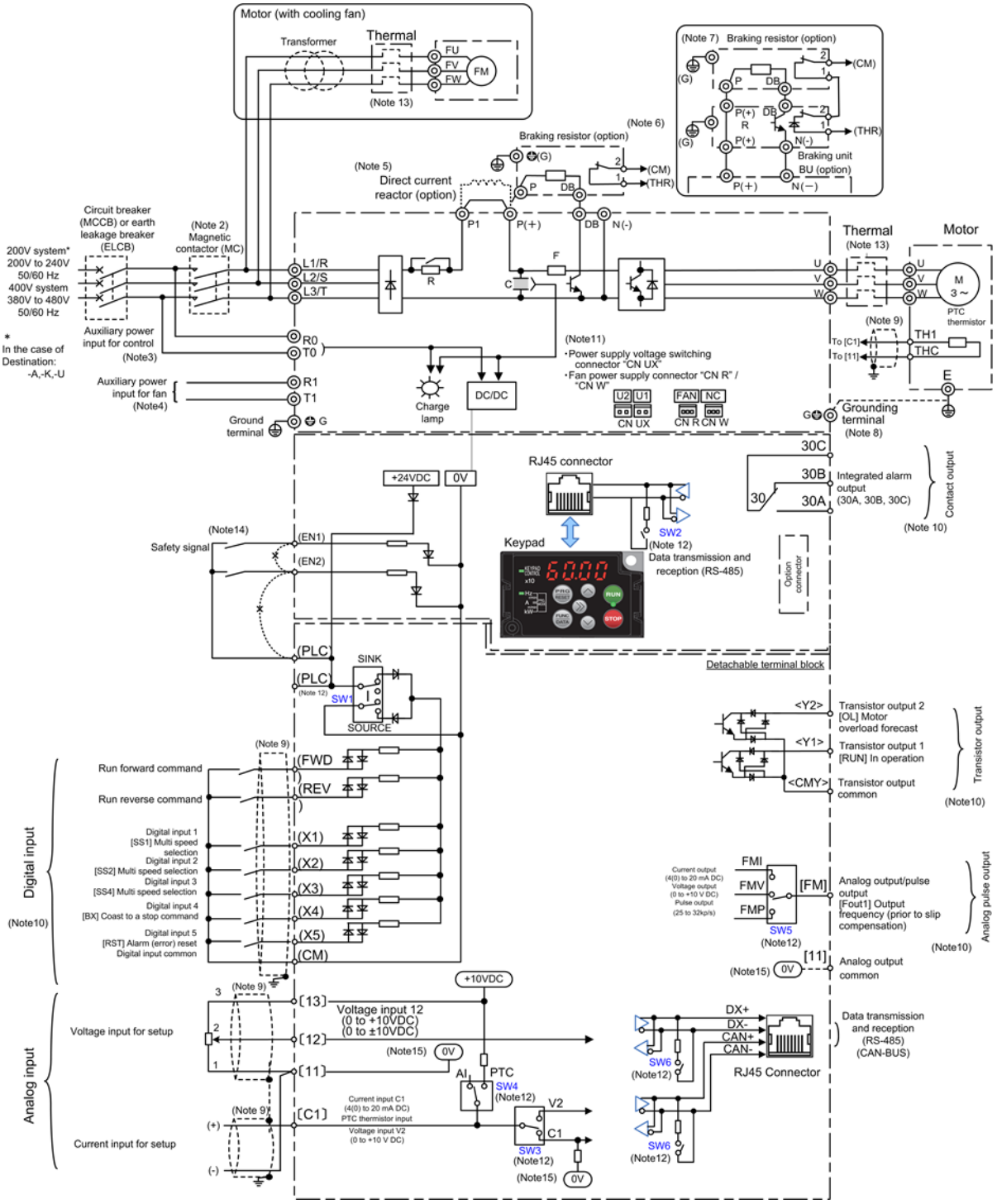


Figure 2.2-1 Standard model (with CAN)

■ Option model with 2 analogue outputs FM1 & FM2 (without CAN)

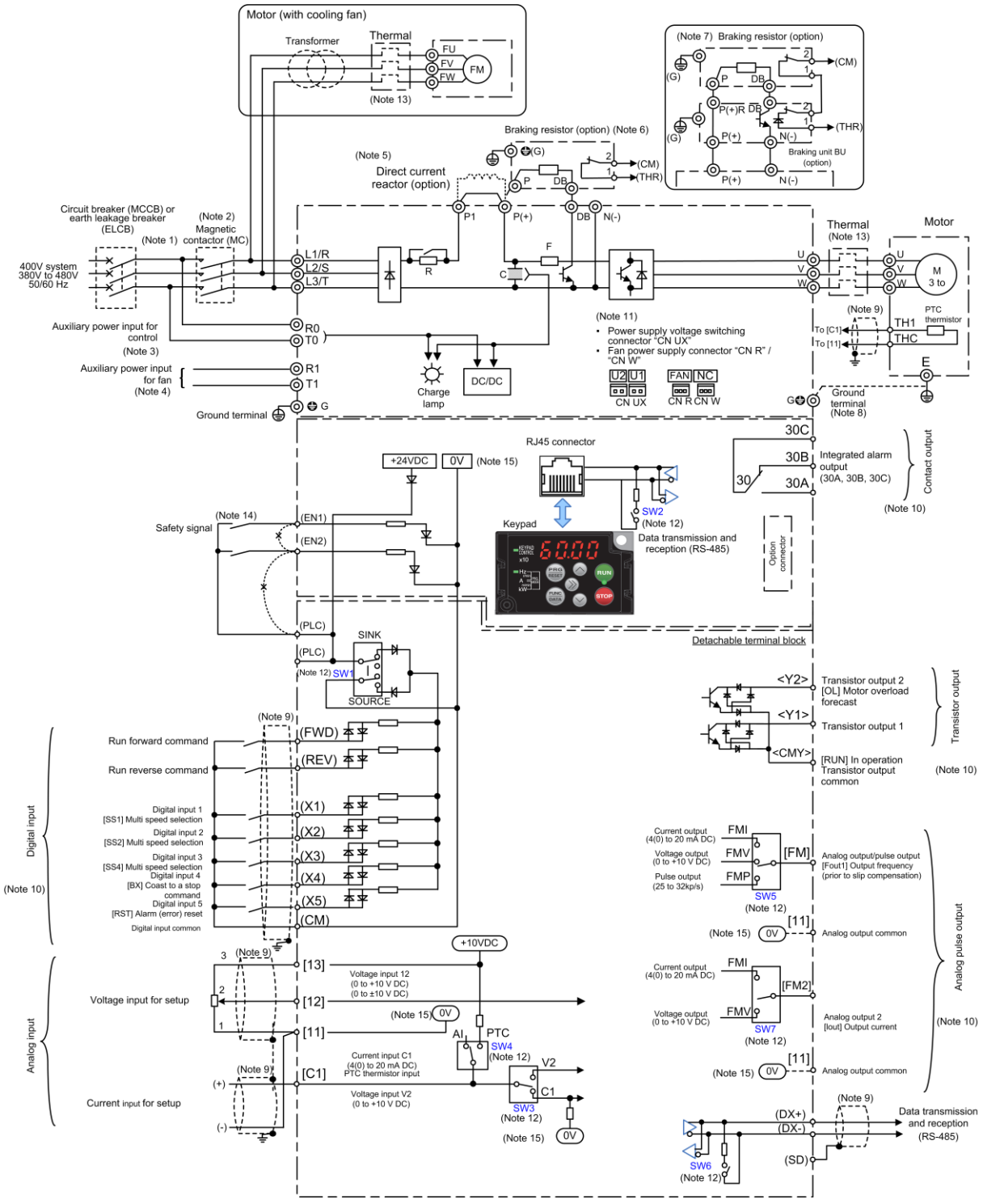


Figure 2.2-2 Option model (Without CAN)

(Note 1) Install recommended circuit breakers (MCCB) or residual-current-operated protective device (RCD)/ earth leakage breakers (ELCB) (with overcurrent protective function) on the inputs of each inverter (primary side) for wiring protection. Do not use breakers which exceed the recommended rated current.

(Note 2) Install recommended magnetic contactors (MC) as necessary on each inverter as these will be used to disconnect the inverter from the power supply separately from the MCCB or RCD / the ELCB. Additionally, when installing coils such as MC or solenoid close to the inverter, connect surge absorbers in parallel.

(Note 3) When it is desired to retain the alarm signal for the activation of the protective function even inverter main power supply is shut off, or when it is desired continuous display of the keypad, connect this terminal to the power supply. The inverter can be operated without connecting power to this terminal (applicable for types VXT-59A-4 / VXT-88A-2 or above)

(Note 4) The terminal does not need to be connected. Use this terminal when operating in combination with a high power factor regenerative PWM converter (RHC series). Applicable for types VXT-203A-4 or above)

(Note 5) Remove the shorting bar between the inverter main circuit terminals P1-P(+) before connecting the direct current reactor (DCR) (option).
It must be connected in the following cases:
ND mode: Types VXT-139A-4 or above, HD/ HND mode: Types VXT-168A-4 or above, HHD mode: Types VXT-203A-4 or above.
Use the direct current reactor (option) when the power supply transformer capacity is above 500 kVA and the transformer capacity is over 10 times the rated capacity of the inverter, or when “thyristor load exists” in the same power system.

(Note 6) Types VXT-11A-1 / VXT-115A-2 / VXT-72A-4 or below have built-in braking transistors, allowing direct connection of braking resistors between P(+)-DB.

(Note 7) When connecting braking resistors to types VXT-85A-4 or above, always add the braking unit (option). Connect the braking unit (option) between P(+)-N(-). Auxiliary terminals [1] and [2] have polarity. Please connect as shown in the diagram.

(Note 8) This terminal is used for grounding the motor. Grounding the motor using this terminal is recommended in order to suppress inverter noise.

(Note 9) Use twisted lines or shielded lines for the control signals.
Generally, the shielded line requires grounding, but when the effect of externally induced noise is large, connecting to [CM] may suppress the effect of noise. Separate the line from the main circuit wiring and do not enclose in the same duct. (Separation distance of over 10 cm is recommended.) When crossing the main circuit wiring, make the intersection perpendicular.

(Note 10) The various functions listed for terminals[X1] to [X5] (digital inputs), terminals [Y1] to [Y2] (transistor output), and terminal [FM] (monitor output) show the functions assigned as factory default.

(Note 11) These are connectors for switching the main circuit. For details, refer to “2.2.7 Switching connector (types VXT-203A-4 or above)”.

(Note 12) The slide switches on the control printed circuit board define the settings for the inverter operation. For details, refer to “2.2.8 Operating slide switches”.

(Note 13) Make the circuit breakers (MCCB) or the magnetic contactors (MC) trip by the thermal relay auxiliary contacts (manual recovery).

(Note 14) Shorting bars are connected between the safety function terminals [EN1], [EN2], and [PLC] as factory default. Remove the shorting bars when using this function.

(Note 15) [0V] and (0V) are separated and insulated.

(Note 16) Charge lamp does not exist in the inverters VXT-69A-2 / VXT-44A-4 / VXT-11A-1 or below.

Route the wiring following the steps below. The descriptions assume that the inverter is already fixed to the cabinet.

2.2.2 Removal and attachment of the front cover/ terminal cover and wiring guide

⚠CAUTION
Always remove the RS-485 communication cable from the RJ-45 connector before removing the front cover. **Risk of fire and risk of accidents exist.**

(1) Types VXT-20A-2/ VXT-12A-4/ VXT-11A-1 or below

1) Loosen the screws of the terminal cover. To remove the terminal cover, put your finger in the dimple of the terminal cover and then pull it up toward you.
2) Pull out the wiring guide toward you.
3) After routing the wires, attach the wiring guide and the terminal cover reversing the steps above.

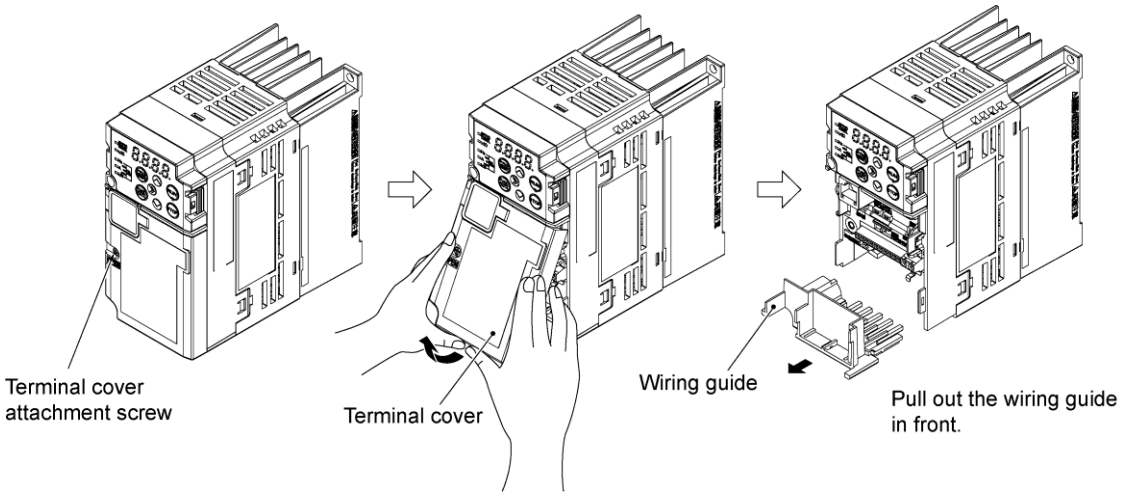


Figure 2.2-3 Removal of the Terminal Cover and the Wiring Guide (for VXT-6A-2)

(2) Types VXT-30A-2 to VXT-69A-2 and VXT-22A-4 to VXT-44A-4

1) Loosen the screws of the terminal cover. To remove the terminal cover, put your finger in the dimple of the terminal cover and then pull it up toward you.
2) Pull out the wiring guide toward you.
3) After routing the wires, attach the wiring guide and the terminal cover reversing the steps above.

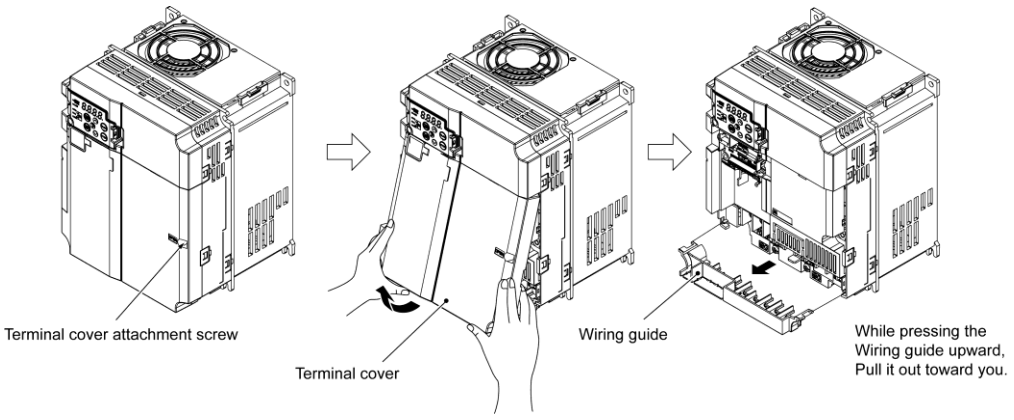


Figure 2.2-4 Removal of the Terminal Cover and the Wiring Guide (for VXT-69A-2)

(3) Types VXT-88A-2 / VXT-115A-2 / VXT-72A-4 / VXT-85A-4

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

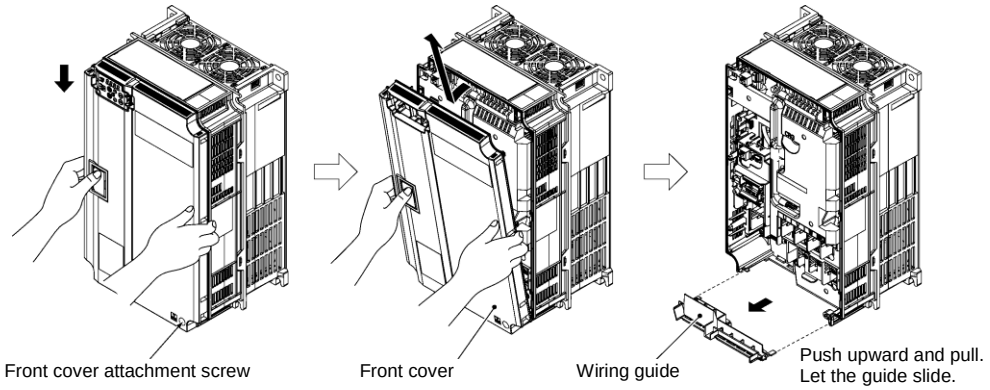
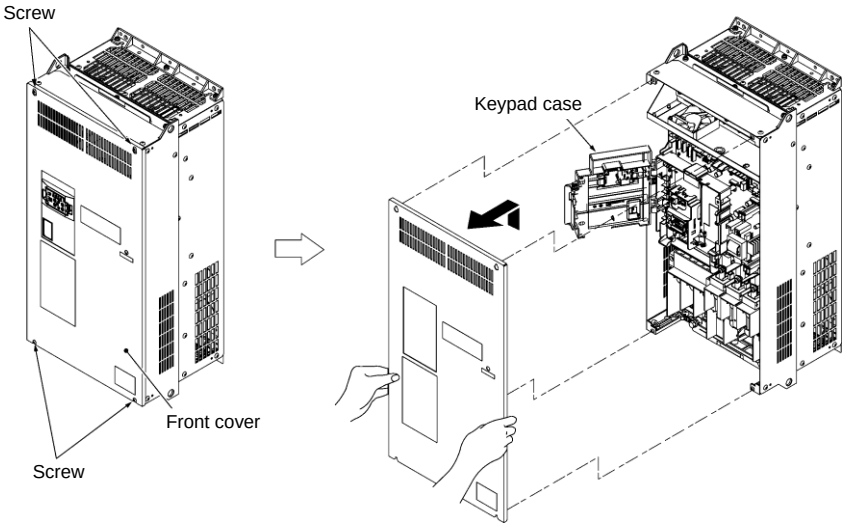


Figure 2.2-5 Removal of the Front Cover and the Wiring Guide (for VXT-72A-4)

(4) Types VXT-85A-4 or above

1) Loosen the screws of the front cover. Hold both sides of the front cover with the hands and slide it upward to remove.
2) After routing the wires, align the front cover top edge to the screw holes and attach the cover reversing the steps in Figure 2.2-6.

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



Tightening torque: 1.8 N·m (15.9 lb-in) (M4)
3.5 N·m (31.0 lb-in) (M5)

Figure 2.2-6 Removal of the front cover (for VXT-203A-4)

2.2.3 Precautions for wiring

Exercise caution for the following when wiring.

(1) Confirm that the supply voltage is within the input voltage range described on the rating plate.

(2) Always connect the power lines to the inverter main power input terminals L1/R, L2/S, L3/T (Three-phase). (The inverter will be damaged when power is applied if the power lines are connected to the wrong terminals.)

(3) Always route the ground line to prevent accidents such as electric shock and fire and to reduce noise.

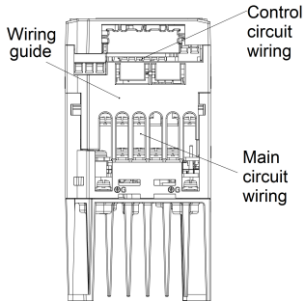
(4) For the lines connecting to the main circuit terminals, use crimped terminals with insulating sleeves or use crimped terminals in conjunction with insulating sleeves for high connection reliability.

(5) Separate the routing of the lines connected to the main circuit input side terminals (primary side) and the output side terminals (secondary side) and the lines connected to the control circuit terminals.
The control circuit terminal lines should be routed as far as possible from the main circuit routing. Malfunction may occur due to noise.

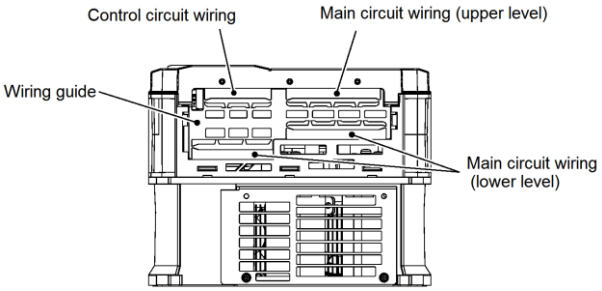
(6) To prevent direct contact with the main circuit live sections (such as the main circuit terminal block), route the control circuit wiring inside the inverter as bundles using cable ties.

(7) After removing a main circuit terminal screw, always restore the terminal screw in position and tighten even if lines are not connected.

(8) The wiring guide is used to separately route the main circuit wiring and the control circuit wiring. The main circuit wiring and the control circuit wiring can be separated. Exercise caution for the order of wiring.



Case of VXT-6A-2



Case of VXT-72A-4

■ **Handling the Wiring Guide**

For inverter types VXT-4 to 115A-2 and VXT-2 to 72A-4, the wiring space may become insufficient when routing the main circuit wires, depending on the wire material used. In these cases, the relevant cut-off sections (see Figure 2.2-7, Figure 2.2-8) can be removed using a pair of nippers to secure routing space. Be warned that removing the wiring guide to accommodate the enlarged main circuit wiring will result in non-conformance to IP20 requirements.

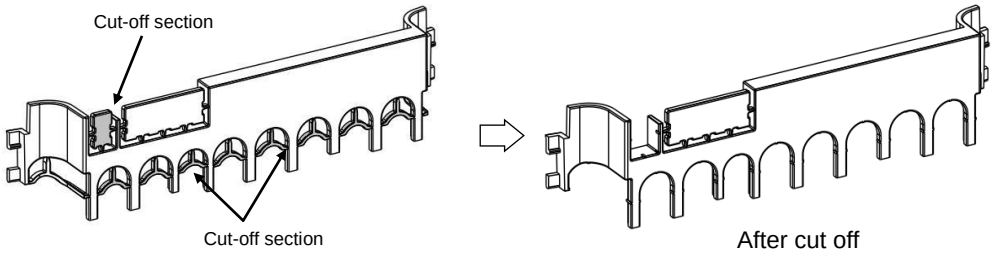


Figure 2.2-7 Wiring Guide (VXT-69A-2)

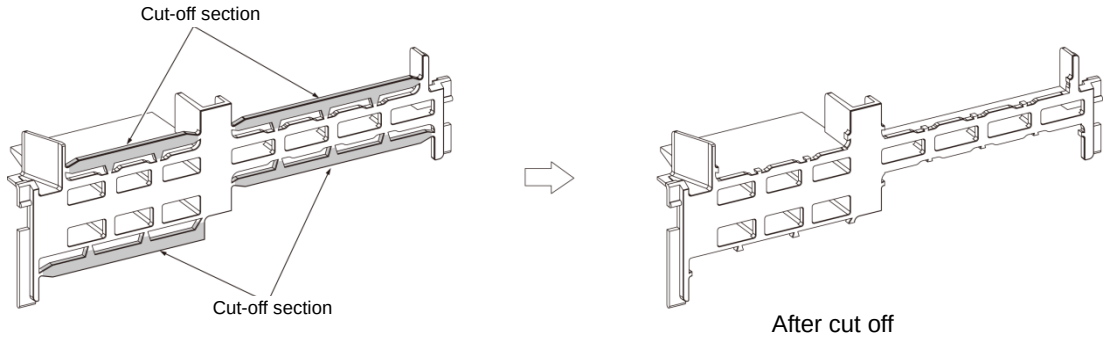
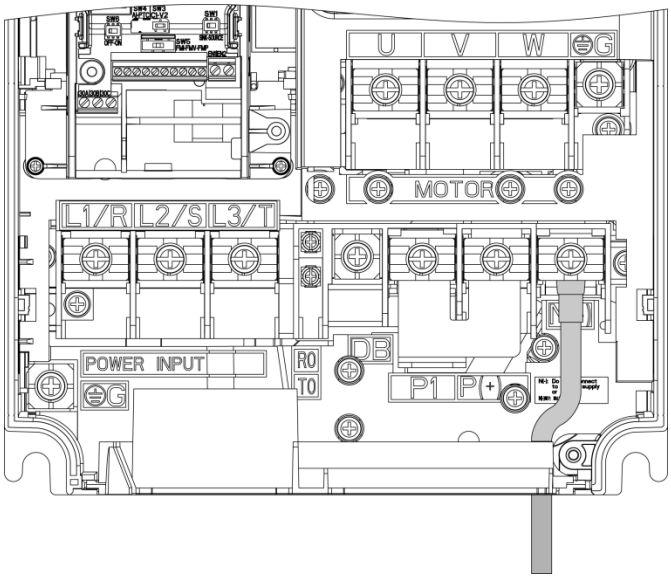


Figure 2.2-8 Wiring Guide (VXT-72A-4)

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



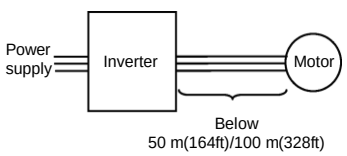
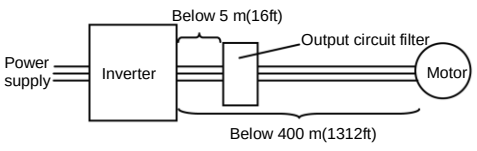
2.2.4 Precautions for long wiring (between inverter and motor)

(1) When multiple motors are connected to one inverter, the wiring length is the total of all wire lengths.

(2) Precautions shall be taken for high frequency leak current when the wiring length from the inverter to the motor is long, in this case the high frequency current may flow through the stray capacitance between the wires with various phases. The effect may cause the inverter to become overheated, or trip due to overcurrent. Leak current may increase and the accuracy of the displayed current may not be ensured. Depending on the conditions, excessive leak current may damage the inverter. To avoid the above problems when directly connecting an inverter to a motor, keep the wiring distance 50 m (164 ft) for inverters VXT-20A-2 / VXT-12A-4 / VXT-11A-1 or below, and below 100 m (328 ft) for inverters VXT-30A-2 / VXT-22A-4 or above.

To operate with longer wiring lengths than the ones above mentioned, reduce the carrier frequency or use an output circuit filter.

When multiple motors are operated in parallel connection configuration (group operation), and especially when shielded cables are used in the connections, the stray capacitance to ground is large. Reduce the carrier frequency or use output circuit filters.

Without output circuit filter	With output circuit filter
	

When the output circuit filter is used, the total wiring length should be below 400 m (1312ft) in case of using V/f control.
For motors with encoders, the wiring length between the inverter and motor should be below 100 m (328ft). The restriction comes from the encoder specifications. For distances beyond 100 m (328ft), insulation converters should be used. Please contact IMO when operating with wiring lengths beyond the upper limit.

(3) Precautions on the surge voltage when driving the inverter (especially for 400 V series motor)
When motors are driven by inverters using the PWM method, the surge voltage generated by the switching of the inverter elements is added to the output voltage and is applied onto the motor terminals. Especially when the motor wiring length is long, the surge voltage can cause insulation degradation in the motor. Please perform one of the countermeasures shown below.

- Use motor with insulation enhancement.
- Connect a surge suppression unit on the motor side.
- Connect an output circuit filter to the inverter output side (secondary side).
- Reduce the wiring length from the inverter to the motor to less than 10 to 20 meters (33 to 66ft).

(4) When output circuit filters are attached to the inverter or when the wiring length is long, the voltage applied to the motor will decrease due to the voltage drop caused by the filter or wiring. In these cases, current oscillation and lack of torque may occur due to insufficient voltage.

⚠WARNING ⚠

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

Risk of fire exists.

- Ground the inverter in compliance with the national or local electric code.
- Always connect the ground line to the inverter grounding terminal [ZG]

Risk of electric shock and risk of fire exist.

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

Risk of electric shock exists.

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

Risk of electric shock and risk of injury exist.

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

Risk of fire and risk of accidents exist.

2.2.5 Main circuit terminals

[1] Screw specifications

The specifications for the screws used in the main circuit wiring and the wire sizes are shown below. Exercise caution as the terminal position varies depending on inverter capacity. In the diagram in "[2] Terminal layout diagram (main circuit terminal)", the two ground terminals [ƶG] are not differentiated for the input side (primary side) and the output side (secondary side).

Also, use crimped terminals with insulating sleeves compatible for main circuit or terminals with insulating tubes. The recommended wire sizes are shown depending on cabinet temperature and wire type.

Table 2.2-1 Screw Specifications (Three-phase 200V series, Basic type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Three-phase 200 V	VXT-4A-2	Fig. a	M3.5	0.8 (7.1)	M3.5	1.2 (10.6)	—	—	—	—
	VXT-6A-2									
	VXT-10A-2	Fig. b	M4	1.2 (10.6)	M4	1.8 (15.9)				
	VXT-12A-2									
	VXT-20A-2	Fig. c								
	VXT-30A-2	Fig. A	M5	3.0 (26.6)	M5	3.0 (26.6)				
	VXT-40A-2									
	VXT-56A-2	Fig. B	M6 (No.3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)				
	VXT-69A-2									
	VXT-88A-2	Fig. C	M6 (No.3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)	M3.5	1.2		
	VXT-115A-2									

Table 2.2-2 Screw Specifications (Three-phase 200V series, EMC filter built-in type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Three-phase 200 V	VXT-4A-2E	Fig. a	M3.5	0.8 (7.1)	M3.5	1.2 (10.6)	—	—	—	—
	VXT-6A-2E									
	VXT-10A-2E	Fig. h	M4	1.2 (10.6)	M4	1.8 (15.9)				
	VXT-12A-2E									
	VXT-20A-2E									
	VXT-30A-2E	Fig. i	Input: M4 Other: M5	Input: 1.8(15.9) Other: 3.0(26.6)	M5	3.0 (26.6)				
	VXT-40A-2E									
	VXT-56A-2E	Fig. j	M6 (No.3)	Input: 8.1(71.7) Other: 5.8(51.3)	M6 (No.3)	5.8 (51.3)				
	VXT-69A-2E									
	VXT-88A-2E	Fig. C	M6 (No.3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)	M3.5	1.2		
	VXT-115A-2E									

Table 2.2-3 Screw Specifications (Three-phase 400V series, Basic type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Three-phase 400 V	VXT-2A-4	Fig. b	M4	1.2 (10.6)	M4	1.8 (15.9)	-	-	-	-
	VXT-4A-4									
	VXT-6A-4									
	VXT-7A-4									
	VXT-12A-4	Fig. c								
	VXT-22A-4	Fig. A	M5	3.0 (26.6)	M5	3.0 (26.6)				
	VXT-29A-4									
	VXT-37A-4	Fig. B	M6 (No. 3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)				
	VXT-44A-4									
	VXT-59A-4	Fig. C	M6 (No. 3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)	M3.5	1.2 (10.6)		
	VXT-72A-4									
	VXT-85A-4	Fig. D	M8	13.5 (119)	M8	13.5 (119)				
	VXT-105A-4									
	VXT-139A-4									
	VXT-168A-4									
	VXT-203A-4	Fig. E	M10	27 (239)					M3.5	1.2 (10.6)
	VXT-240A-4	Fig. F								
	VXT-290A-4									
	VXT-361A-4	Fig. G	M12	48 (425)	M10	27 (239)				
	VXT-415A-4									
	VXT-520A-4	Fig. H								
	VXT-590A-4									

Table 2.2-4 Screw Specifications (Three-phase 400V series, EMC filter built-in type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Three-phase 400 V	VXT-2A-4E	Fig. g	M4	1.2 (10.6)	M4	1.8 (15.9)	-	-	-	-
	VXT-4A-4E									
	VXT-6A-4E	Fig. h								
	VXT-7A-4E									
	VXT-12A-4E									
	VXT-22A-4E	Fig. i	Input M4 Output M5	Input: 1.8(15.9) Other: 3.0(26.6)	M5	3.0 (26.6)				
	VXT-29A-4E									
	VXT-37A-4E	Fig. j	Input M4 Output M6	Input: 1.8(15.9) Other: 5.8(51.3)	M6 (No.3)	5.8 (51.3)				
	VXT-44A-4E									
	VXT-59A-4E	Fig. C	M6 (No. 3)	5.8 (51.3)	M6 (No.3)	5.8 (51.3)	M3.5	1.2 (10.6)		
	VXT-72A-4E									
	VXT-85A-4E	Fig. D	M8	13.5 (119)	M8	13.5 (119)				
	VXT-105A-4E									
	VXT-139A-4E									
	VXT-168A-4E									
	VXT-203A-4E	Fig. E	M10	27 (239)					M3.5	1.2 (10.6)
	VXT-240A-4E	Fig. F								
	VXT-290A-4E									
	VXT-361A-4E	Fig. G	M12	48 (425)	M10	27 (239)				
	VXT-415A-4E									
	VXT-520A-4E	Fig. H								
	VXT-590A-4E									

Table 2.2-5 Screw Specifications (Single-phase 200V series, Basic type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Single- phase 200 V	VXT-3A-1	Fig. k	M3.5	0.8 (7.1)	M3.5	1.2 (10.6)	-	-	-	-
	VXT-5A-1									
	VXT-8A-1	Fig. l	M4	1.2 (10.6)	M4	1.8 (15.9)				
	VXT-11A-1	Fig. m								

Table 2.2-6 Screw Specifications (Single-phase 200V series, EMC filter built-in type)

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size (driver size)	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)	Screw size	Tightening torque N•m (lb-in)
Single- phase 200 V	VXT-3A-1E	Fig. k	M3.5	0.8 (7.1)	M3.5	1.2 (10.6)	-	-	-	-
	VXT-5A-1E	Fig. n								
	VXT-8A-1E	Fig. h	M4	1.2 (10.6)	M4	1.8 (15.9)				
	VXT-11A-1E									

[2] Terminal layout diagram (main circuit terminal)

Figure A

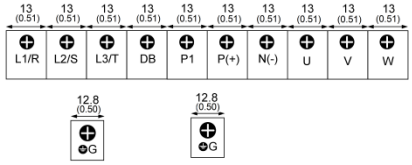


Figure B

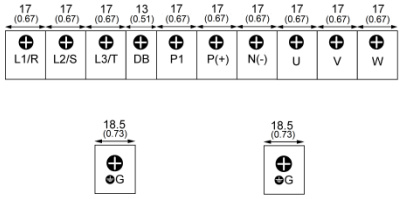


Figure C

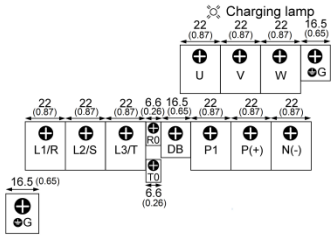


Figure D

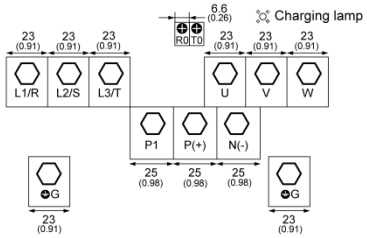


Figure E / Figure F

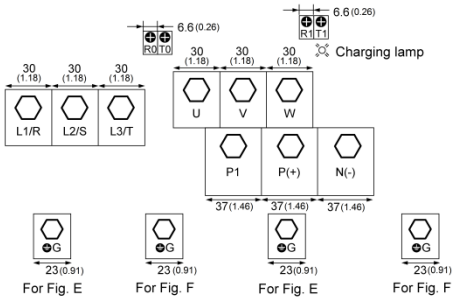
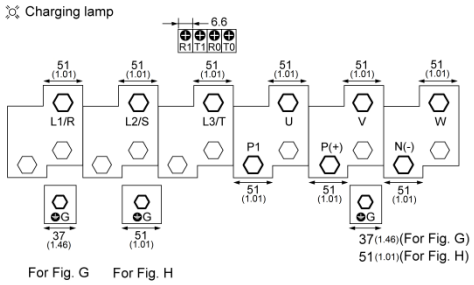


Figure G / Figure H



⚠WARNING⚠

The following terminals will have high voltage when power is ON.

Main circuit: L1/R, L2/S, L3/T, L1/L, L2/N, P1, P(+), N(-), DB, U, V, W, R0, T0, R1, T1

Insulation level

Main circuit - Casing : Basic insulation (overvoltage category III, degree of contamination 2)

Main circuit - Control circuit : Enhanced insulation (overvoltage category III, degree of contamination 2)

Risk of electric shock exists

Figure a

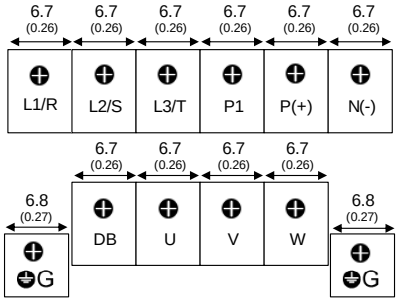


Figure b

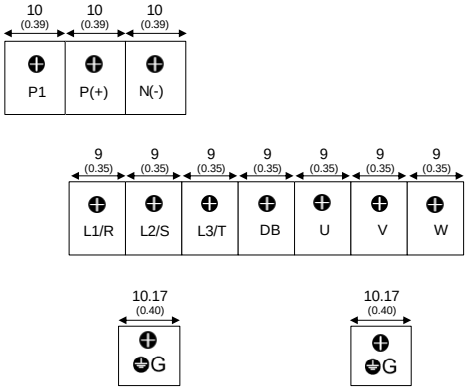


Figure c

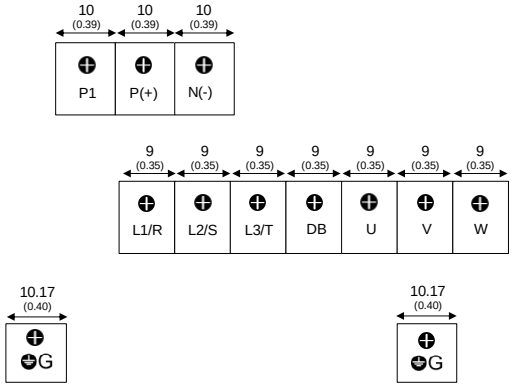


Figure i

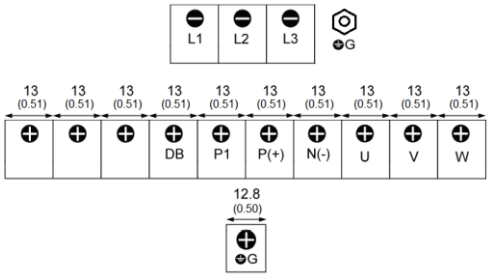


Figure j

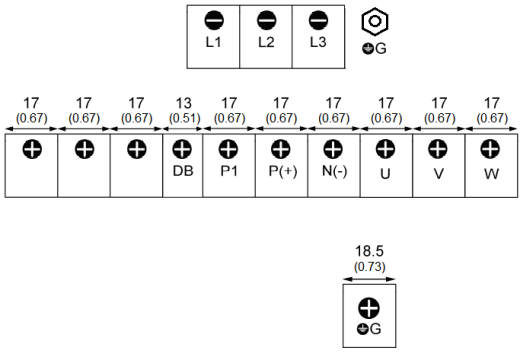


Figure k

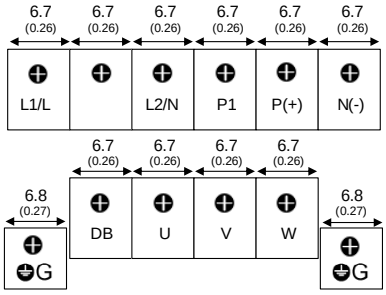


Figure l

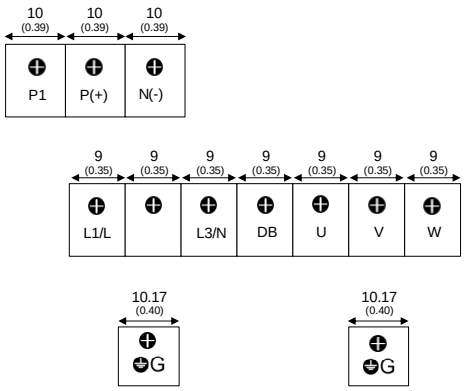
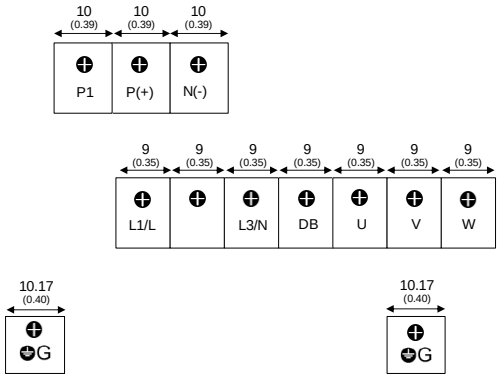


Figure m



For the figure g / h / n, please contact IMO.

[3] Recommended wire size (main circuit terminals)

The following wires are recommended unless special requirements exist.

■ 600 V vinyl insulation wire (IV wire)

This wire is used in circuits except the inverter control circuit. The wire is difficult to twist and is not recommended for inverter control circuit. The maximum allowable temperature for the insulated wire is 60°C.

■ 600 V type 2 vinyl insulation wire or 600 V polyethylene insulation wire (HIV wire)

In comparison to the IV wire, this wire is smaller, more flexible, and the maximum allowable temperature for the insulated wire is 75°C (higher), making it suitable for both the inverter main circuit and control circuit. However, the wiring distance should be short and the wire must be twisted for use in the inverter control circuit.

■ 600 V cross-linked polyethylene insulation wire (FSLC wire)

This wire is used mainly in the main circuit and the grounding circuits. The size is even smaller than the IV wire or the HIV wire and also more flexible. Due to these features, the wire is used to reduce the area occupied by wiring and to improve work efficiency in high temperature areas. The maximum allowable temperature for the insulated wire is 90°C. As a reference, Furukawa Electric Co., Ltd. produces Boardlex which satisfies these requirements.

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

This product is used in inverter control circuits. Use this wire with high shielding effect when risk of exposure to or effect of radiated noise and induced noise exists. Always use this wire when the wiring distance is long, even within the cabinet. Furukawa Electric's BEAMEX S shielded cables XEBV or XEWV satisfy these requirements.

Table 2.2-7 Recommended Wire Sizes (Common Terminals)

Common terminals	Recommended wire size (mm^2) [AWG]	Remarks
Auxiliary power input terminals for control circuit R0, T0	2.0 [14]	VXT-88A-2 or above VXT-59A-4 or above
Auxiliary power input terminals for fan R1, T1	2.0 [14]	VXT-203A-4 or above

Refer to Appendix G-3 to conform the wire sizes to the UL Standards and Canadian Standards (cUL Certification).

(1) Wire sizes conforming to low voltage directive in Europe

Table 2.2-8 Recommended Wire Sizes, conforming to low voltage directive in Europe

ND Mode, Conforming to low voltage directive in Europe

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
Three-phase 400 V	0.75	VXT-2A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	1.5	VXT-4A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	2.2	VXT-6A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	3.0	VXT-7A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	5.5	VXT-12A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	11	VXT-22A-4#	4	6	4	6	4	4	2.5
	15	VXT-29A-4#	6	10	6	10	6	6	2.5
	18.5	VXT-37A-4#	6	16	6	16	10	10	2.5
	22	VXT-44A-4#	10	16	10	16	10	16	2.5
	30	VXT-59A-4#	16	25	16	16	16	25	2.5
	37	VXT-72A-4#	25	35	16	16	25	25	2.5
	45	VXT-85A-4#	25	50	16	25	35	35	-
	55	VXT-105A-4#	35	70	16	35	50	50	-
	75	VXT-139A-4#	70	-	35	-	70	95	-
	90	VXT-168A-4#	95	-	50	-	95	120	-
	110	VXT-203A-4#	120	-	70	-	120	150	-
	132	VXT-240A-4#	150	-	95	-	150	95×2	-
	160	VXT-290A-4#	95×2	-	95	-	95×2	120×2	-
	200	VXT-361A-4#	300	-	150	-	300	150×2	-
	220	VXT-415A-4#	300	-	150	-	150×2	185×2	-
	280	VXT-520A-4#	185×2	-	185	-	240×2	300×2	-
	315	VXT-590A-4#	240×2	-	240	-	240×2	300×2	-

HD Mode, Conforming to low voltage directive in Europe

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
Three-phase 400 V	0.75	VXT-2A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	1.1	VXT-4A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	2.2	VXT-6A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	3.0	VXT-7A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	5.5	VXT-12A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	7.5	VXT-22A-4#	2.5	4	2.5	4	2.5	2.5	2.5
	11	VXT-29A-4#	4	6	4	6	4	4	2.5
	15	VXT-37A-4#	6	10	6	10	6	6	2.5
	18.5	VXT-44A-4#	6	16	6	16	10	10	2.5
	22	VXT-59A-4#	10	16	10	16	10	16	2.5
	30	VXT-72A-4#	16	25	16	16	16	25	2.5
	37	VXT-85A-4#	25	35	16	16	25	25	-
	45	VXT-105A-4#	25	50	16	25	35	35	-
	55	VXT-139A-4#	35	70	16	35	50	50	-
	75	VXT-168A-4#	70	-	35	-	70	95	-
	90	VXT-203A-4#	95	-	50	-	95	120	-
	110	VXT-240A-4#	120	-	70	-	120	150	-
	132	VXT-290A-4#	150	-	95	-	150	95×2	-
	160	VXT-361A-4#	185	-	95	-	240	300	-
	200	VXT-415A-4#	300	-	150	-	300	150×2	-
	220	VXT-520A-4#	300	-	150	-	150×2	185×2	-
	250	VXT-590A-4#	185×2	-	185	-	185×2	240×2	-

The recommended wire sizes for the main circuit terminals assume using 70°C 600 V PVC wire at 40°C ambient temperature.

Table 2.2-9 Recommended Wire Sizes, conforming to low voltage directive in Europe (continued)

HND Mode, Conforming to low voltage directive in Europe

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
Three-phase 400 V	0.75	VXT-2A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	1.1	VXT-4A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	2.2	VXT-6A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	3.0	VXT-7A-4#*10	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	5.5	VXT-12A-4#*10	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	7.5	VXT-22A-4#	2.5	4	2.5	4	2.5	2.5	2.5
	11	VXT-29A-4#	4	6	4	6	4	4	2.5
	15	VXT-37A-4#	6	10	6	16	6	6	2.5
	18.5	VXT-44A-4#	6	16	10	16	10	10	2.5
	22	VXT-59A-4#	10	16	10	16	10	16	2.5
	30	VXT-72A-4#	16	25	16	16	16	25	2.5
	37	VXT-85A-4#	25	35	16	16	25	25	-
	45	VXT-105A-4#	25	50	16	25	35	35	-
	55	VXT-139A-4#	35	70	16	35	50	50	-
	75	VXT-168A-4#	70	-	35	-	70	95	-
	90	VXT-203A-4#	95	-	50	-	95	120	-
	110	VXT-240A-4#	120	-	70	-	120	150	-
	132	VXT-290A-4#	150	-	95	-	150	95×2	-
	160	VXT-361A-4#	185	-	95	-	240	300	-
	200	VXT-415A-4#	300	-	150	-	300	150×2	-
	220	VXT-520A-4#	300	-	150	-	150×2	185×2	-
	280	VXT-590A-4#	185×2	-	185	-	240×2	300×2	-

HHD Mode, Conforming to low voltage directive in Europe

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
Three-phase 400 V	0.4	VXT-2A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	0.75	VXT-4A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	1.5	VXT-6A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	2.2	VXT-7A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	3.7	VXT-12A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	5.5	VXT-22A-4#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	7.5	VXT-29A-4#	2.5	4	2.5	4	2.5	2.5	2.5
	11	VXT-37A-4#	4	6	4	6	4	4	2.5
	15	VXT-44A-4#	6	10	6	10	6	6	2.5
	18.5	VXT-59A-4#	6	16	10	16	10	10	2.5
	22	VXT-72A-4#	10	16	10	16	10	16	2.5
	30	VXT-85A-4#	16	25	16	16	16	25	-
	37	VXT-105A-4#	25	35	16	16	25	25	-
	45	VXT-139A-4#	25	50	16	25	35	35	-
	55	VXT-168A-4#	35	70	16	35	50	50	-
	75	VXT-203A-4#	70	-	35	-	70	95	-
	90	VXT-240A-4#	95	-	50	-	95	120	-
	110	VXT-290A-4#	120	-	70	-	120	150	-
	132	VXT-361A-4#	150	-	95	-	150	185	-
	160	VXT-415A-4#	185	-	95	-	240	300	-
	200	VXT-520A-4#	300	-	150	-	300	150×2	-
	220	VXT-590A-4#	300	-	150	-	150×2	185×2	-
Single-phase 200 V	0.4	VXT-3A-1#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	0.75	VXT-5A-1#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	1.5	VXT-8A-1#	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	2.2	VXT-11A-1#	2.5	4	2.5	4	2.5	2.5	2.5

The recommended wire sizes for the main circuit terminals assume using 70°C 600 V PVC wire at 40°C ambient temperature.

*10 ND-spec.

(2) Recommended Wire Sizes

1) Ambient temperature: Below 40°C, Wire type: 60°C wire

Table 2.2-10 Recommended wire size, Ambient temperature: Below 40°C, Wire type: 60°C wire

ND Mode, Ambient temperature: Below 40°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ɀG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	11	VXT-22A-4#	2	5.5	3.5	2	3.5	2
	15	VXT-29A-4#	3.5	8	5.5	3.5	5.5	2
	18.5	VXT-37A-4#	5.5	14	5.5	5.5	8	2
	22	VXT-44A-4#	8	14	5.5	8	14	2
	30	VXT-59A-4#	14	22	8*1	14	14	2
	37	VXT-72A-4#	14	38	8*1	14	22	2
	45	VXT-85A-4#	22	38	8	22	38	-
	55	VXT-105A-4#	38	60	14	38	38	-
	75	VXT-139A-4#	60	-	14	60	60	-
	90	VXT-168A-4#	60	-	14	60	100*2	-
	110	VXT-203A-4#	100	-	22	100	-	-
	132	VXT-240A-4#	100	-	22	100	-	-
	160	VXT-290A-4#	-	-	22	-	-	-
	200	VXT-361A-4#	-	-	38	-	-	-
	220	VXT-415A-4#	-	-	38	-	-	-
	280	VXT-520A-4#	-	-	38	-	-	-
	315	VXT-590A-4#	-	-	60	-	-	-

HD Mode, Ambient temperature: Below 40°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ɀG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	3.5	2	2	2	2
	11	VXT-29A-4#	2	5.5	3.5	3.5	3.5	2
	15	VXT-37A-4#	3.5	8	5.5	5.5	5.5	2
	18.5	VXT-44A-4#	5.5	14	5.5	5.5	8	2
	22	VXT-59A-4#	8*1	14	5.5	8*1	14	2
	30	VXT-72A-4#	14	22	8*1	14	14	2
	37	VXT-85A-4#	14	38	8	22	22	-
	45	VXT-105A-4#	22	38	8	22	38	-
	55	VXT-139A-4#	38	60	14	38	38	-
	75	VXT-168A-4#	60	-	14	60	60	-
	90	VXT-203A-4#	60	-	14	60	100	-
	110	VXT-240A-4#	100	-	22	100	-	-
	132	VXT-290A-4#	100	-	22	-	-	-
	160	VXT-361A-4#	-	-	22	-	-	-
	200	VXT-415A-4#	-	-	38	-	-	-
	220	VXT-520A-4#	-	-	38	-	-	-
	250	VXT-590A-4#	-	-	38	-	-	-

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*2 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-11 Recommended wire sizes, Ambient temperature : Below 40°C, Wire type: 60°C wire

HND Mode, Ambient temperature: Below 40°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.1	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	2	2	2	2	2
	5.5	VXT-20A-2# *10	2	5.5	3.5	2	3.5	2
	7.5	VXT-30A-2#	3.5	8	5.5	3.5	5.5	2
	11	VXT-40A-2#	8	14	5.5	5.5	14	2
	15	VXT-56A-2#	14	22	5.5	14	14	2
	18.5	VXT-69A-2#	14	38	8	14	22	2
	22	VXT-88A-2#	22	38*7	8	22	38*7	2
	30	VXT-115A-2#	38*7	60*8	14	38*7	60*8	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	3.5	2	2	2	2
	11	VXT-29A-4#	2	5.5	3.5	3.5	3.5	2
	15	VXT-37A-4#	3.5	8	3.5	5.5	5.5	2
	18.5	VXT-44A-4#	8	14	5.5	8	8	2
	22	VXT-59A-4#	8*1	14	5.5	8*1	14	2
	30	VXT-72A-4#	14	22	8*1	14	14	2
	37	VXT-85A-4#	14	38	8	22	22	-
	45	VXT-105A-4#	22	38	8	22	38	-
	55	VXT-139A-4#	38	60	14	38	38	-
	75	VXT-168A-4#	60	-	14	60	60	-
	90	VXT-203A-4#	60	-	14	60	100	-
	110	VXT-240A-4#	100	-	22	100	-	-
	132	VXT-290A-4#	100	-	22	-	-	-
	160	VXT-361A-4#	-	-	22	-	-	-
	200	VXT-415A-4#	-	-	38	-	-	-
	220	VXT-520A-4#	-	-	38	-	-	-
	280	VXT-590A-4#	-	-	38	-	-	-

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*2 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*8 For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

Table 2.2-12 Recommended wire sizes, Ambient temperature : Below 40°C, Wire type: 60°C wire (continued)

HHD Mode, Ambient temperature: Below 40°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2#	2	2	2	2	2	2
	3.7	VXT-20A-2#	2	3.5	2	2	2	2
	5.5	VXT-30A-2#	2	5.5	3.5	3.5	3.5	2
	7.5	VXT-40A-2#	3.5	8	5.5	5.5	5.5	2
	11	VXT-56A-2#	8	14	5.5	8	14	2
	15	VXT-69A-2#	14	22	5.5	14	14	2
	18.5	VXT-88A-2#	14	38*7	8	22	22	2
	22	VXT-115A-2#	22	38*7	8	22	38*7	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4# *10	2	2	2	2	2	2
	3.7	VXT-12A-4# *10	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	2	2	2	2	2
	7.5	VXT-29A-4#	2	3.5	2	2	2	2
	11	VXT-37A-4#	2	5.5	3.5	3.5	3.5	2
	15	VXT-44A-4#	3.5	8	5.5	3.5	5.5	2
	18.5	VXT-59A-4#	5.5	14	5.5	5.5	8*1	2
	22	VXT-72A-4#	8*1	14	5.5	8*1	14	2
	30	VXT-85A-4#	14	22	8	14	14	-
	37	VXT-105A-4#	14	38	8	22	22	-
	45	VXT-139A-4#	22	38	8	22	38	-
	55	VXT-168A-4#	38	60	14	38	38	-
	75	VXT-203A-4#	60	-	14	60	60	-
	90	VXT-240A-4#	60	-	14	60	100	-
	110	VXT-290A-4#	100	-	22	100	-	-
	132	VXT-361A-4#	100	-	22	-	-	-
	160	VXT-415A-4#	-	-	22	-	-	-
	200	VXT-520A-4#	-	-	38	-	-	-
	220	VXT-590A-4#	-	-	38	-	-	-
Single-phase	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	2	2	2	2	2
	2.2	VXT-11A-1#	2	3.5	2	2	2	2

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

2) Ambient temperature: Below 40°C, Wire type: 75°C wire

Table 2.2-13 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 75°C wire (continued)

ND Mode, Ambient temperature: Below 40°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	11	VXT-22A-4#	2	3.5	3.5	2	2	2
	15	VXT-29A-4#	2	5.5	5.5	2	3.5	2
	18.5	VXT-37A-4#	3.5	8	5.5	3.5	5.5	2
	22	VXT-44A-4#	5.5	8	5.5	5.5	5.5	2
	30	VXT-59A-4#	8*1	14	8*1	8*1	14	2
	37	VXT-72A-4#	14	14	8*1	14	14	2
	45	VXT-85A-4#	14	22	8	14	22	-
	55	VXT-105A-4#	22	38	14	22	38	-
	75	VXT-139A-4#	38	-	14	38	38	-
	90	VXT-168A-4#	38	-	14	38	60	-
	110	VXT-203A-4#	60	-	22	60	100	-
	132	VXT-240A-4#	100	-	22	100	100	-
	160	VXT-290A-4#	100	-	22	100	150*3	-
	200	VXT-361A-4#	150	-	38	150	200	-
	220	VXT-415A-4#	150	-	38	150	200	-
	280	VXT-520A-4#	200	-	38	250	325	-
	315	VXT-590A-4#	250	-	60	250	325	-

HD Mode, Ambient temperature: Below 40°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	2	2
	15	VXT-37A-4#	2	5.5	5.5	3.5	3.5	2
	18.5	VXT-44A-4#	3.5	8	5.5	3.5	5.5	2
	22	VXT-59A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-72A-4#	8*1	14	8*1	8*1	14	2
	37	VXT-85A-4#	14	14	8	14	14	-
	45	VXT-105A-4#	14	22	8	14	22	-
	55	VXT-139A-4#	22	38	14	22	38	-
	75	VXT-168A-4#	38	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	60	60	-
	110	VXT-240A-4#	60	-	22	60	100	-
	132	VXT-290A-4#	100	-	22	100	100	-
	160	VXT-361A-4#	100	-	22	100	150	-
	200	VXT-415A-4#	150	-	38	150	200	-
	220	VXT-520A-4#	150	-	38	150	200	-
	250	VXT-590A-4#	200	-	38	200	250	-

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model CB150-10 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-14 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 75°C wire (continued)

HND Mode, Ambient temperature: Below 40°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.5	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	2	2	2	2	2
	5.5	VXT-20A-2# *10	2	3.5	3.5	2	2	2
	7.5	VXT-30A-2#	2	5.5	5.5	3.5	3.5	2
	11	VXT-40A-2#	5.5	8	5.5	5.5	5.5	2
	15	VXT-56A-2#	8	14	5.5	8	14	2
	18.5	VXT-69A-2#	14	22	8	14	14	2
	22	VXT-88A-2#	14	22	8	14	22	2
	30	VXT-115A-2#	22	38*7	14	22	38*7	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	2	2
	15	VXT-37A-4#	2	5.5	3.5	3.5	3.5	2
	18.5	VXT-44A-4#	5.5	8	5.5	5.5	5.5	2
	22	VXT-59A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-72A-4#	8*1	14	8*1	8*1	14	2
	37	VXT-85A-4#	14	14	8	14	14	-
	45	VXT-105A-4#	14	22	8	14	22	-
	55	VXT-139A-4#	22	38	14	22	38	-
	75	VXT-168A-4#	38	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	60	60	-
	110	VXT-240A-4#	60	-	22	60	100	-
	132	VXT-290A-4#	100	-	22	100	100	-
	160	VXT-361A-4#	100	-	22	100	150	-
	200	VXT-415A-4#	150	-	38	150	200	-
	220	VXT-520A-4#	150	-	38	150	200	-
	280	VXT-590A-4#	200	-	38	250	325	-

The recommended wire sizes for the main circuit terminals assume using 75°C 600V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

Table 2.2-15 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 75°C wire (continued)

HHD Mode, Ambient temperature: Below 40°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2#	2	2	2	2	2	2
	3.7	VXT-20A-2#	2	2	2	2	2	2
	5.5	VXT-30A-2#	2	3.5	3.5	2	2	2
	7.5	VXT-40A-2#	2	5.5	5.5	3.5	3.5	2
	11	VXT-56A-2#	5.5	8	5.5	5.5	5.5	2
	15	VXT-69A-2#	8	14	5.5	8	14	2
	18.5	VXT-88A-2#	14	22	8	14	14	2
	22	VXT-115A-2#	14	22	8	14	22	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4#	2	2	2	2	2	2
	3.7	VXT-12A-4#	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	2	2	2	2	2
	7.5	VXT-29A-4#	2	2	2	2	2	2
	11	VXT-37A-4#	2	3.5	3.5	2	2	2
	15	VXT-44A-4#	2	5.5	5.5	3.5	3.5	2
	18.5	VXT-59A-4#	3.5*4	8*1	5.5	3.5*4	5.5	2
	22	VXT-72A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-85A-4#	8	14	8	8	14	-
	37	VXT-105A-4#	14	14	8	14	14	-
	45	VXT-139A-4#	14	22	8	14	22	-
	55	VXT-168A-4#	22	38	14	22	38	-
	75	VXT-203A-4#	38	-	14	38	38	-
	90	VXT-240A-4#	38	-	14	60	60	-
	110	VXT-290A-4#	60	-	22	60	100	-
	132	VXT-361A-4#	100	-	22	100	100	-
	160	VXT-415A-4#	100	-	22	100	150	-
	200	VXT-520A-4#	150	-	38	150	200	-
	220	VXT-590A-4#	150	-	38	150	200	-
Single-phase 200 V	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	2	2	2	2	2
	2.2	VXT-11A-1#	2	2	2	2	2	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

3) Ambient temperature: Below 40°C, Wire type: 90°C wire

Table 2.2-16 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 90°C wire

ND Mode, Ambient temperature: Below 40°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⅇG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	11	VXT-22A-4#	2	2	3.5	2	2	2
	15	VXT-29A-4#	2	3.5	5.5	2	3.5	2
	18.5	VXT-37A-4#	3.5	5.5	5.5	3.5	3.5	2
	22	VXT-44A-4#	3.5	5.5	5.5	3.5	5.5	2
	30	VXT-59A-4#	5.5	8*1	8*1	5.5	8*1	2
	37	VXT-72A-4#	8*1	14	8*1	8*1	14	2
	45	VXT-85A-4#	14	22	8	14	14	-
	55	VXT-105A-4#	14	22	14	14	22	-
	75	VXT-139A-4#	22	-	14	22	38	-
	90	VXT-168A-4#	38	-	14	38	38	-
	110	VXT-203A-4#	38	-	22	38	60	-
	132	VXT-240A-4#	60	-	22	60	100	-
	160	VXT-290A-4#	100	-	22	100	100	-
	200	VXT-361A-4#	100	-	38	100	150	-
	220	VXT-415A-4#	150	-	38	150	150	-
	280	VXT-520A-4#	150	-	38	200	250	-
	315	VXT-590A-4#	200	-	60	200	250	-

HD Mode, Ambient temperature: Below 40°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⅇG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	2	3.5	2	2	2
	15	VXT-37A-4#	2	3.5	5.5	2	3.5	2
	18.5	VXT-44A-4#	3.5	5.5	5.5	3.5	3.5	2
	22	VXT-59A-4#	3.5*4	5.5	5.5	3.5*4	5.5	2
	30	VXT-72A-4#	5.5	8*1	8*1	5.5	8*1	2
	37	VXT-85A-4#	8	14	8	8	14	-
	45	VXT-105A-4#	14	22	8	14	14	-
	55	VXT-139A-4#	14	22	14	14	22	-
	75	VXT-168A-4#	22	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	38	38	-
	110	VXT-240A-4#	38	-	22	60	60	-
	132	VXT-290A-4#	60	-	22	60	100	-
	160	VXT-361A-4#	100	-	22	100	100	-
	200	VXT-415A-4#	100	-	38	100	150	-
	220	VXT-520A-4#	150	-	38	150	150	-
	250	VXT-590A-4#	150	-	38	150	200	-

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-17 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 90°C wire (continued)

HND Mode, Ambient temperature: Below 40°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.1	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	2	2	2	2	2
	5.5	VXT-20A-2# *10	2	2	3.5	2	2	2
	7.5	VXT-30A-2#	2	3.5	5.5	2	3.5	2
	11	VXT-40A-2#	3.5	5.5	5.5	3.5	5.5	2
	15	VXT-56A-2#	5.5	14	5.5	5.5	8	2
	18.5	VXT-69A-2#	8	14	8	8	14	2
	22	VXT-88A-2#	14	14	8	14	14	2
	30	VXT-115A-2#	22	38*7	14	22	22	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	2	3.5	2	2	2
	15	VXT-37A-4#	2	3.5	3.5	3.5	3.5	2
	18.5	VXT-44A-4#	3.5	5.5	5.5	3.5	3.5	2
	22	VXT-59A-4#	3.5*4	5.5	5.5	3.5*4	5.5	2
	30	VXT-72A-4#	5.5	8*1	8*1	5.5	8*1	2
	37	VXT-85A-4#	8	14	8	8	14	-
	45	VXT-105A-4#	14	22	8	14	14	-
	55	VXT-139A-4#	14	22	14	14	22	-
	75	VXT-168A-4#	22	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	38	38	-
	110	VXT-240A-4#	38	-	22	60	60	-
	132	VXT-290A-4#	60	-	22	60	100	-
	160	VXT-361A-4#	100	-	22	100	100	-
	200	VXT-415A-4#	100	-	38	100	150	-
	220	VXT-520A-4#	150	-	38	150	150	-
	280	VXT-590A-4#	150	-	38	200	250	-

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

Table 2.2-18 Recommended Wire Sizes, Ambient temperature: Below 40°C, Wire type: 90°C wire (continued)

HHD Mode, Ambient temperature: Below 40°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2#	2	2	2	2	2	2
	3.7	VXT-20A-2#	2	2	2	2	2	2
	5.5	VXT-30A-2#	2	2	3.5	2	2	2
	7.5	VXT-40A-2#	2	3.5	5.5	2	3.5	2
	11	VXT-56A-2#	3.5	5.5	5.5	3.5	5.5	2
	15	VXT-69A-2#	5.5	14	5.5	5.5	8	2
	18.5	VXT-88A-2#	8	14	8	8	14	2
	22	VXT-115A-2#	14	14	8	14	14	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4#	2	2	2	2	2	2
	3.7	VXT-12A-4#	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	2	2	2	2	2
	7.5	VXT-29A-4#	2	2	2	2	2	2
	11	VXT-37A-4#	2	2	3.5	2	2	2
	15	VXT-44A-4#	2	3.5	5.5	2	3.5	2
	18.5	VXT-59A-4#	3.5*4	5.5	5.5	3.5*4	3.5*4	2
	22	VXT-72A-4#	3.5*4	5.5	5.5	3.5*4	5.5	2
	30	VXT-85A-4#	5.5	8	8	5.5	8	-
	37	VXT-105A-4#	8	14	8	8	14	-
	45	VXT-139A-4#	14	22	8	14	14	-
	55	VXT-168A-4#	14	22	14	14	22	-
	75	VXT-203A-4#	22	-	14	38	38	-
	90	VXT-240A-4#	38	-	14	38	38	-
	110	VXT-290A-4#	38	-	22	60	60	-
	132	VXT-361A-4#	60	-	22	60	100	-
	160	VXT-415A-4#	100	-	22	100	100	-
	200	VXT-520A-4#	100	-	38	100	150	-
	220	VXT-590A-4#	150	-	38	150	150	-
Single-phase 200 V	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	2	2	2	2	2
	2.2	VXT-11A-1#	2	2	2	2	2	2

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

4) Ambient temperature: Below 50°C, Wire type: 60°C wire

Table 2.2-19 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 60°C wire

ND Mode, Ambient temperature: Below 50°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [zG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	3.5	2	2	2	2
	11	VXT-22A-4#	3.5	5.5	3.5	3.5	3.5	2
	15	VXT-29A-4#	5.5	14	5.5	5.5	5.5	2
	18.5	VXT-37A-4#	8	14	5.5	8	5.5	2
	22	VXT-44A-4#	8	14	5.5	14	8	2
	30	VXT-59A-4#	14	22	8*1	14	22	2
	37	VXT-72A-4#	22	38	8*1	22	38	2
	45	VXT-85A-4#	38	38	8	38	38	-
	55	VXT-105A-4#	38	60	14	38	60	-
	75	VXT-139A-4#	60	-	14	60	100*2	-
	90	VXT-168A-4#	100*2	-	14	100*2	100*2	-
	110	VXT-203A-4#	100	-	22	100	-	-
	132	VXT-240A-4#	-	-	22	-	-	-
	160	VXT-290A-4#	-	-	22	-	-	-
	200	VXT-361A-4#	-	-	38	-	-	-
	220	VXT-415A-4#	-	-	38	-	-	-
	280	VXT-520A-4#	-	-	38	-	-	-
	315	VXT-590A-4#	-	-	60	-	-	-

HD Mode, Ambient temperature: Below 50°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [zG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) *[P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	3.5	2	2	2	2
	7.5	VXT-22A-4#	2	3.5	2	2	2	2
	11	VXT-29A-4#	3.5	5.5	3.5	3.5	3.5	2
	15	VXT-37A-4#	5.5	14	5.5	5.5	5.5	2
	18.5	VXT-44A-4#	8	14	5.5	8	5.5	2
	22	VXT-59A-4#	8*1	14	5.5	14	14	2
	30	VXT-72A-4#	14	22	8*1	14	22	2
	37	VXT-85A-4#	22	38	8	22	38	-
	45	VXT-105A-4#	38	38	8	38	38	-
	55	VXT-139A-4#	38	60	14	38	60	-
	75	VXT-168A-4#	60	-	14	60	100*2	-
	90	VXT-203A-4#	100	-	14	100	100	-
	110	VXT-240A-4#	100	-	22	100	-	-
	132	VXT-290A-4#	-	-	22	-	-	-
	160	VXT-361A-4#	-	-	22	-	-	-
	200	VXT-415A-4#	-	-	38	-	-	-
	220	VXT-520A-4#	-	-	38	-	-	-
	250	VXT-590A-4#	-	-	38	-	-	-

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*2 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-20 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 60°C wire (continued)

HND Mode, Ambient temperature: Below 50°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.1	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	3.5	2	2	2	2
	5.5	VXT-20A-2# *10	3.5	8	3.5	3.5	5.5	2
	7.5	VXT-30A-2#	8	14	5.5	8	14	2
	11	VXT-40A-2#	14	22*3	5.5	14	22*3	2
	15	VXT-56A-2#	22	38*4	5.5	22	38*4	2
	18.5	VXT-69A-2#	38*4	60*5	8	38*4	38*4	2
	22	VXT-88A-2#	38*7	60*8	8	38*7	60*8	2
	30	VXT-115A-2#	60*8	100*9	14	60*8	100*9	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	3.5	2	2	2	2
	7.5	VXT-22A-4#	2	5.5	2	3.5	3.5	2
	11	VXT-29A-4#	5.5	8	3.5	5.5	5.5	2
	15	VXT-37A-4#	8	14	3.5	8	14	2
	18.5	VXT-44A-4#	14	22	5.5	14	14	2
	22	VXT-59A-4#	14	22	5.5	14	22	2
	30	VXT-72A-4#	22	38	8*1	22	38	2
	37	VXT-85A-4#	38	60	8	38	38	-
	45	VXT-105A-4#	38	60	8	38	60	-
	55	VXT-139A-4#	60	100*2	14	60	60	-
	75	VXT-168A-4#	100*2	-	14	100*2	100*2	-
	90	VXT-203A-4#	100	-	14	-	-	-
	110	VXT-240A-4#	-	-	22	-	-	-
	132	VXT-290A-4#	-	-	22	-	-	-
	160	VXT-361A-4#	-	-	22	-	-	-
	200	VXT-415A-4#	-	-	38	-	-	-
	220	VXT-520A-4#	-	-	38	-	-	-
	280	VXT-590A-4#	-	-	38	-	-	-

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*2 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model 22-S5 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model 38-S6 by JST Mfg. Co., Ltd. or equivalent.

*5 For compatible crimped terminals, please use model CB60-S6 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*8 For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

*9 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

Table 2.2-21 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 60°C wire (continued)

HHD Mode, Ambient temperature: Below 50°C, Wire type: 60°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2#	2	2	2	2	2	2
	3.7	VXT-20A-2#	2	5.5	2	3.5	3.5	2
	5.5	VXT-30A-2#	5.5	8	3.5	5.5	5.5	2
	7.5	VXT-40A-2#	8	14	5.5	8	14	2
	11	VXT-56A-2#	14	22	5.5	14	22	2
	15	VXT-69A-2#	22	38	5.5	22	38	2
	18.5	VXT-88A-2#	38[*7]	60[*8]	8	38[*7]	38[*7]	2
	22	VXT-115A-2#	38[*7]	60[*8]	8	38[*7]	60[*8]	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4#	2	2	2	2	2	2
	3.7	VXT-12A-4#	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	3.5	2	2	2	2
	7.5	VXT-29A-4#	2	5.5	2	3.5	3.5	2
	11	VXT-37A-4#	5.5	8	3.5	5.5	5.5	2
	15	VXT-44A-4#	8	14	5.5	8	14	2
	18.5	VXT-59A-4#	14	22	5.5	14	14	2
	22	VXT-72A-4#	14	22	5.5	14	22	2
	30	VXT-85A-4#	22	38	8	22	38	-
	37	VXT-105A-4#	38	60	8	38	38	-
	45	VXT-139A-4#	38	60	8	38	60	-
	55	VXT-168A-4#	60	100[*2]	14	60	60	-
	75	VXT-203A-4#	100	-	14	100	100	-
	90	VXT-240A-4#	100	-	14	-	-	-
	110	VXT-290A-4#	-	-	22	-	-	-
	132	VXT-361A-4#	-	-	22	-	-	-
	160	VXT-415A-4#	-	-	22	-	-	-
	200	VXT-520A-4#	-	-	38	-	-	-
	220	VXT-590A-4#	-	-	38	-	-	-
Single-phase 200 V	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	3.5	2	2	2	2
	2.2	VXT-11A-1#	3.5	5.5	2	2	3.5	2

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*2 For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model 22-S5 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model 38-S6 by JST Mfg. Co., Ltd. or equivalent.

*5 For compatible crimped terminals, please use model CB60-S6 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*8 For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

5) Ambient temperature: Below 50°C, Wire type: 75°C wire

Table 2.2-22 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 75°C wire

ND Mode, Ambient temperature: Below 50°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [zG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	11	VXT-22A-4#	2	3.5	3.5	2	2	2
	15	VXT-29A-4#	2	5.5	5.5	2	2	2
	18.5	VXT-37A-4#	3.5	5.5	5.5	3.5	3.5	2
	22	VXT-44A-4#	5.5	8	5.5	5.5	5.5	2
	30	VXT-59A-4#	8*1	14	8*1	8*1	14	2
	37	VXT-72A-4#	8*1	14	8*1	14	14	2
	45	VXT-85A-4#	14	22	8	14	22	-
	55	VXT-105A-4#	22	38	14	22	22	-
	75	VXT-139A-4#	38	-	14	38	38	-
	90	VXT-168A-4#	38	-	14	38	60	-
	110	VXT-203A-4#	60	-	22	60	60	-
	132	VXT-240A-4#	60	-	22	60	100	-
	160	VXT-290A-4#	100	-	22	100	150*3	-
	200	VXT-361A-4#	150	-	38	150	150	-
	220	VXT-415A-4#	150	-	38	150	200	-
	280	VXT-520A-4#	200	-	38	200	250	-
	315	VXT-590A-4#	250	-	60	250	325	-

HD Mode, Ambient temperature: Below 50°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [zG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	2	2
	15	VXT-37A-4#	2	5.5	5.5	3.5	2	2
	18.5	VXT-44A-4#	3.5	5.5	5.5	3.5	3.5	2
	22	VXT-59A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-72A-4#	8*1	14	8*1	8*1	14	2
	37	VXT-85A-4#	8	14	8	14	14	-
	45	VXT-105A-4#	14	22	8	14	22	-
	55	VXT-139A-4#	22	38	14	22	22	-
	75	VXT-168A-4#	38	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	38	60	-
	110	VXT-240A-4#	60	-	22	60	60	-
	132	VXT-290A-4#	60	-	22	100	100	-
	160	VXT-361A-4#	100	-	22	100	150	-
	200	VXT-415A-4#	150	-	38	150	150	-
	220	VXT-520A-4#	150	-	38	150	200	-
	250	VXT-590A-4#	150	-	38	200	250	-

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model CB150-10 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-23 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 75°C wire (continued)

HND Mode, Ambient temperature: Below 50°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.1	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	2	2	2	2	2
	5.5	VXT-20A-2# *10	2	3.5	3.5	2	3.5	2
	7.5	VXT-30A-2#	3.5	5.5	5.5	3.5	5.5	2
	11	VXT-40A-2#	5.5	14	5.5	5.5	8	2
	15	VXT-56A-2#	14	14	5.5	14	14	2
	18.5	VXT-69A-2#	14	22	8	14	22	2
	22	VXT-88A-2#	22	38*7	8	22	22	2
	30	VXT-115A-2#	38*7	60*8	14	38*7	38*7	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	3.5	2
	15	VXT-37A-4#	3.5	5.5	3.5	5.5	5.5	2
	18.5	VXT-44A-4#	5.5	8	5.5	5.5	5.5	2
	22	VXT-59A-4#	5.5	14	5.5	8*1	8*1	2
	30	VXT-72A-4#	14	14	8*1	14	14	2
	37	VXT-85A-4#	14	22	8	14	22	-
	45	VXT-105A-4#	22	38	8	22	22	-
	55	VXT-139A-4#	22	38	14	38	38	-
	75	VXT-168A-4#	38	-	14	60	60	-
	90	VXT-203A-4#	60	-	14	60	100	-
	110	VXT-240A-4#	100	-	22	100	100	-
	132	VXT-290A-4#	100	-	22	100	150*3	-
	160	VXT-361A-4#	150	-	22	150	150	-
	200	VXT-415A-4#	150	-	38	200	250	-
	220	VXT-520A-4#	200	-	38	200	250	-
	280	VXT-590A-4#	250	-	38	325	200×2	-

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model CB150-10 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*8 For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec.

Table 2.2-24 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 75°C wire (continued)

HHD Mode, Ambient temperature: Below 50°C, Wire type: 75°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2#	2	2	2	2	2	2
	3.7	VXT-20A-2#	2	2	2	2	2	2
	5.5	VXT-30A-2#	2	3.5	3.5	3.5	3.5	2
	7.5	VXT-40A-2#	3.5	5.5	5.5	3.5	5.5	2
	11	VXT-56A-2#	5.5	14	5.5	8	8	2
	15	VXT-69A-2#	14	14	5.5	14	14	2
	18.5	VXT-88A-2#	14	22	8	14	22	2
	22	VXT-115A-2#	22	38[*7]	8	22	22	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4#	2	2	2	2	2	2
	3.7	VXT-12A-4#	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	2	2	2	2	2
	7.5	VXT-29A-4#	2	2	2	2	2	2
	11	VXT-37A-4#	2	3.5	3.5	2	3.5	2
	15	VXT-44A-4#	3.5	5.5	5.5	3.5	5.5	2
	18.5	VXT-59A-4#	5.5	8[*1]	5.5	5.5	5.5	2
	22	VXT-72A-4#	5.5	14	5.5	8[*1]	8[*1]	2
	30	VXT-85A-4#	14	14	8	14	14	-
	37	VXT-105A-4#	14	22	8	14	22	-
	45	VXT-139A-4#	22	38	8	22	22	-
	55	VXT-168A-4#	22	38	14	38	38	-
	75	VXT-203A-4#	38	-	14	60	60	-
	90	VXT-240A-4#	60	-	14	60	100	-
	110	VXT-290A-4#	100	-	22	100	100	-
	132	VXT-361A-4#	100	-	22	100	150	-
	160	VXT-415A-4#	150	-	22	150	150	-
	200	VXT-520A-4#	150	-	38	200	250	-
	220	VXT-590A-4#	200	-	38	200	250	-
Single-phase 200 V	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	2	2	2	2	2
	2.2	VXT-11A-1#	2	3.5	2	2	2	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*3 For compatible crimped terminals, please use model CB150-10 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

6) Ambient temperature: Below 50°C, Wire type: 90°C wire

Table 2.2-25 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 90°C wire

ND Mode, Ambient temperature: Below 50°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [ⅎG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.5	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	11	VXT-22A-4#	2	3.5	3.5	2	2	2
	15	VXT-29A-4#	2	5.5	5.5	2	3.5	2
	18.5	VXT-37A-4#	3.5	5.5	5.5	3.5	5.5	2
	22	VXT-44A-4#	5.5	8	5.5	5.5	5.5	2
	30	VXT-59A-4#	5.5	8*1	8*1	5.5	5.5	2
	37	VXT-72A-4#	5.5	14	8*1	8*1	8*1	2
	45	VXT-85A-4#	8	14	8	8	14	-
	55	VXT-105A-4#	14	22	14	14	14	-
	75	VXT-139A-4#	22	-	14	22	38	-
	90	VXT-168A-4#	22	-	14	38	38	-
	110	VXT-203A-4#	38	-	22	38	60	-
	132	VXT-240A-4#	60	-	22	60	60	-
	160	VXT-290A-4#	60	-	22	60	100	-
	200	VXT-361A-4#	100	-	38	100	150	-
	220	VXT-415A-4#	100	-	38	100	150	-
	280	VXT-520A-4#	150	-	38	150	200	-
	315	VXT-590A-4#	150	-	60	200	250	-

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

HD Mode, Ambient temperature: Below 50°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [ⅎG]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4#	2	2	2	2	2	2
	5.5	VXT-12A-4#	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	2	2
	15	VXT-37A-4#	2	5.5	5.5	2	3.5	2
	18.5	VXT-44A-4#	3.5	5.5	5.5	3.5	5.5	2
	22	VXT-59A-4#	3.5*4	5.5	5.5	3.5*4	3.5*4	2
	30	VXT-72A-4#	5.5	8*1	8*1	5.5	5.5	2
	37	VXT-85A-4#	5.5	14	8	8	8	-
	45	VXT-105A-4#	8	14	8	14	14	-
	55	VXT-139A-4#	14	22	14	14	14	-
	75	VXT-168A-4#	22	-	14	22	38	-
	90	VXT-203A-4#	22	-	14	38	38	-
	110	VXT-240A-4#	38	-	22	38	60	-
	132	VXT-290A-4#	60	-	22	60	60	-
	160	VXT-361A-4#	60	-	22	60	100	-
	200	VXT-415A-4#	100	-	38	100	150	-
	220	VXT-520A-4#	100	-	38	100	150	-
	250	VXT-590A-4#	150	-	38	150	150	-

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

Table 2.2-26 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 90°C wire (continued)

HND Mode, Ambient temperature: Below 50°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [ⱿG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.75	VXT-4A-2#	2	2	2	2	2	2
	1.1	VXT-6A-2#	2	2	2	2	2	2
	2.2	VXT-10A-2#	2	2	2	2	2	2
	3.0	VXT-12A-2# *10	2	2	2	2	2	2
	5.5	VXT-20A-2# *10	2	3.5	3.5	2	2	2
	7.5	VXT-30A-2#	2	5.5	5.5	2	3.5	2
	11	VXT-40A-2#	5.5	8	5.5	3.5	5.5	2
	15	VXT-56A-2#	8	14	5.5	5.5	14	2
	18.5	VXT-69A-2#	14	14	8	8	14	2
	22	VXT-88A-2#	14	22	8	14	22	2
	30	VXT-115A-2#	22	38*7	14	22	38*7	2
Three-phase 400 V	0.75	VXT-2A-4#	2	2	2	2	2	2
	1.1	VXT-4A-4#	2	2	2	2	2	2
	2.2	VXT-6A-4#	2	2	2	2	2	2
	3.0	VXT-7A-4# *10	2	2	2	2	2	2
	5.5	VXT-12A-4# *10	2	2	2	2	2	2
	7.5	VXT-22A-4#	2	2	2	2	2	2
	11	VXT-29A-4#	2	3.5	3.5	2	2	2
	15	VXT-37A-4#	2	5.5	3.5	3.5	3.5	2
	18.5	VXT-44A-4#	3.5	5.5	5.5	3.5	5.5	2
	22	VXT-59A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-72A-4#	8*1	14	8*1	8*1	8*1	2
	37	VXT-85A-4#	8	14	8	14	14	-
	45	VXT-105A-4#	14	22	8	14	22	-
	55	VXT-139A-4#	22	38	14	22	22	-
	75	VXT-168A-4#	38	-	14	38	38	-
	90	VXT-203A-4#	38	-	14	38	60	-
	110	VXT-240A-4#	60	-	22	60	60	-
	132	VXT-290A-4#	60	-	22	100	100	-
	160	VXT-361A-4#	100	-	22	100	150	-
	200	VXT-415A-4#	150	-	38	150	150	-
	220	VXT-520A-4#	150	-	38	150	200	-
	280	VXT-590A-4#	200	-	38	200	250	-

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

*7 For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

*10 ND-spec

Table 2.2-27 Recommended Wire Sizes, Ambient temperature: Below 50°C, Wire type: 90°C wire (continued)

HHD Mode, Ambient temperature: Below 50°C, Wire type: 90°C wire

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [zG]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
Three-phase 200 V	0.4	VXT-4A-2#	2	2	2	2	2	2
	0.75	VXT-6A-2#	2	2	2	2	2	2
	1.5	VXT-10A-2#	2	2	2	2	2	2
	2.2	VXT-12A-2# *10	2	2	2	2	2	2
	3.7	VXT-20A-2# *10	2	2	2	2	2	2
	5.5	VXT-30A-2#	2	3.5	3.5	2	2	2
	7.5	VXT-40A-2#	2	5.5	5.5	3.5	3.5	2
	11	VXT-56A-2#	5.5	8	5.5	5.5	5.5	2
	15	VXT-69A-2#	8	14	5.5	8	14	2
	18.5	VXT-88A-2#	14	14	8	14	14	2
	22	VXT-115A-2#	14	22	8	14	22	2
Three-phase 400 V	0.4	VXT-2A-4#	2	2	2	2	2	2
	0.75	VXT-4A-4#	2	2	2	2	2	2
	1.5	VXT-6A-4#	2	2	2	2	2	2
	2.2	VXT-7A-4#	2	2	2	2	2	2
	3.7	VXT-12A-4#	2	2	2	2	2	2
	5.5	VXT-22A-4#	2	2	2	2	2	2
	7.5	VXT-29A-4#	2	2	2	2	2	2
	11	VXT-37A-4#	2	3.5	3.5	2	2	2
	15	VXT-44A-4#	2	5.5	5.5	2	3.5	2
	18.5	VXT-59A-4#	3.5*4	5.5	5.5	3.5*4	5.5	2
	22	VXT-72A-4#	5.5	8*1	5.5	5.5	5.5	2
	30	VXT-85A-4#	8	14	8	8	8	-
	37	VXT-105A-4#	8	14	8	14	14	-
	45	VXT-139A-4#	14	22	8	14	22	-
	55	VXT-168A-4#	22	38	14	22	22	-
	75	VXT-203A-4#	38	-	14	38	38	-
	90	VXT-240A-4#	38	-	14	38	60	-
	110	VXT-290A-4#	60	-	22	60	60	-
	132	VXT-361A-4#	60	-	22	100	100	-
	160	VXT-415A-4#	100	-	22	100	150	-
	200	VXT-520A-4#	150	-	38	150	150	-
	220	VXT-590A-4#	150	-	38	150	200	-
Single-phase 200 V	0.4	VXT-3A-1#	2	2	2	2	2	2
	0.75	VXT-5A-1#	2	2	2	2	2	2
	1.5	VXT-8A-1#	2	2	2	2	2	2
	2.2	VXT-11A-1#	2	2	2	2	2	2

The recommended wire sizes for the main circuit terminals assume using 90°C 600 V FSLC wire.

*1 For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

*4 For compatible crimped terminals, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

[4] Description of terminal functions (main circuit terminal)

Classification	Terminal symbol	Terminal name	Specification
Main circuit	L1/R, L2/S, L3/T	Main power input	Terminals to connect Three-phase power source.
	L1/L, L2/N	Main power input	Terminals to connect Single-phase power source.
	U, V, W	Inverter output	Terminals to connect Three-phase motors.
	P (+), P1	For direct current reactor connection	Terminals to connect DC reactor (DCR) for power factor enhancement. It must be connected in the following cases: ND mode: Types VXT-139A-4 or above. HD/HND mode: Types VXT-168A-4 or above. HHD mode: Types VXT-203A-4 or above.
	P (+), N (-)	For direct current bus connection	Terminals to connect direct current intermediate circuit of other inverters and PWM converters.
	P (+), DB	For braking resistor connection	Terminals to connect a braking resistor (optional). Wiring length: Below 5 meters. (Types VXT-115A-2 / VXT-72A-4 / VXT-11A-1 or below)
	zG	For inverter chassis (case) grounding	Grounding terminal for inverter chassis (case).
	R0, T0	Auxiliary power input for control circuit	When it is desired to retain the alarm signal for the activation of the protective function even inverter main power supply shut off or when continuous display of the keypad is desired, connect this terminal to the power supply. (Types VXT-88A-4 / VXT-59A-4 or above)
	R1, T1	Auxiliary power input for fan	Ordinarily, these terminals do not need to be connected. Connect these terminals to AC power supply when operating with direct current power input (such as in combination with PWM converters). (Types VXT-203A-4 or above)

Follow the sequence below when wiring.

(1) Inverter ground terminal (zG)
(2) Inverter output terminals (U, V, W), motor ground terminal (zG)
(3) Direct current reactor connection terminals (P1, P(+))*
(4) Braking resistor connection terminals (P(+), DB)*
(5) Direct current bus connection terminals(P(+), N(-))*
(6) Main power supply input terminals (L1/R, L2/S, L3/T) or (L1/L, L2/N)
(7) Auxiliary power input for control circuit (R0,T0) *
*: Connect if necessary.
Connect in the order (1), (2), (6), (3), (4), (5), (7) for the following models.
VXT-10 to 20A-2#, VXT-2 to 12A-4#, VXT-8 to 11A-1#

(1) Main power source input terminals L1/R, L2/S, L3/T (Three-phase input) or L1/L, L2/N (Single-phase input)

Connect the Three-phase power source for Three-phase input model.Connect the Single-phase power source for Single-phase input model.

1) For safety, confirm that the circuit breaker (MCCB) or the magnetic contactor (MC) is OFF prior to wiring the power lines.
2) Connect the power lines (L1/R, L2/S, L3/T) or (L1/L, L2/N) to MCCB or residual-current-operated protective device (RCD)/ the earth leakage breaker (ELCB)*, or connect via MC if necessary. The phase sequence of the power lines and the inverter do not need to be matched.
   *: With overcurrent protection

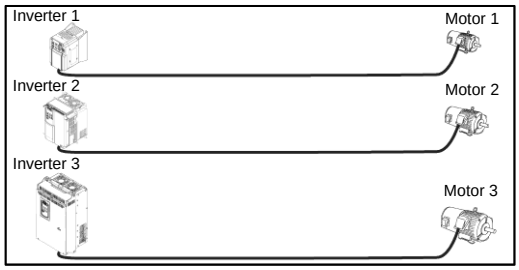
Tip In emergencies such as when the inverter protective function is activated, disconnecting the inverter from the power source to prevent magnification of failure or accident may be desired. Installation of an MC

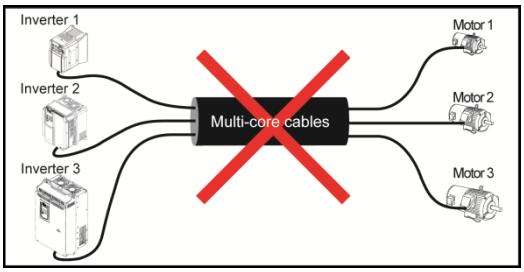
which allows manual disconnection of the power source is recommended.

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

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

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





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

Connect the direct current reactor (DCR) for power factor enhancement.

1) Remove the shorting bar from terminals P1-P(+).
(Types VXT-203A-4 or above will not have the shorting bar connected.)
2) Connect the P1, P(+) terminals to the direct current reactor (option).

Note
- Keep the wiring length below 10 meters.
- Do not remove the shorting bar if the direct current reactor is not used.
- When the capacity of the motor to be used is above 75 kW, always connect the direct current reactor.
- Direct current reactors do not have to be connected when connecting PWM converters.

⚠WARNING
Always connect the direct current reactor (option) when the power supply transformer capacity is above 500 kVA and is over 10 times the rated capacity of the inverter. **Risk of fire exists.**

(4) Braking resistor connection terminals P(+) DB
(Types VXT-115A-2 / VXT-72A-4 / VXT-11A-1 or below)

1) Connect terminals P(+), DB of the inverter to braking resistor terminals (option).
2) Mount the inverter main body and the braking resistor such that the wiring length will be less than 5m (16ft) and route the two wires twisted or in contact with each other (parallel).

⚠WARNING
Do not connect to terminals other than P(+)-DB when connecting braking resistors. **Risk of fire exists.**

(5) Direct current bus terminals P(+), N(-)

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

Inverter type	Braking transistor	Additional instruments for connection (option)	Instruments connected/connection terminals
Types VXT-85A-4 or below	Not equipped	Braking unit	Inverter (P(+), N(-)) - Braking unit (P(+), N(-))
		Braking resistor	Braking unit (P(+) R, DB) - Braking resistor (P, DB)

Braking units are necessary when using braking resistors for types VXT-85A-4 or above.

Connect terminals P(+), N(-) of the braking unit to the inverter terminals P(+), N(-). Mount the equipment such that the wiring length is below 5m (16ft) and route the two wires twisted or in contact with each other (parallel).

Connect the terminals P(+) R, DB of the braking unit to terminals P(+), DB of the braking resistor. Mount the equipment such that the wiring length is below 10m (33ft) and route the two wires twisted or in contact with each other (parallel).

For details such as other wirings, refer to the user's manual for the braking unit.

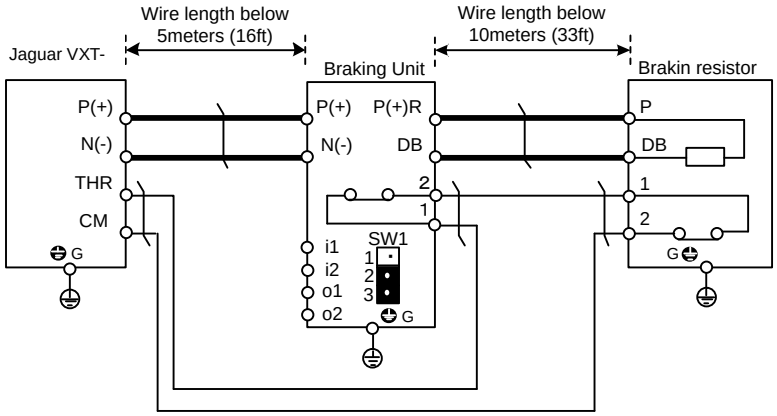


Figure 2.2-9

2) Connection of other instruments

The direct current intermediate circuit of other inverters and PWM converters can be connected.

(For connection with the PWM converter consult IMO.

(6) Inverter ground terminal ⏚G

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

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

1) Ground the inverter in compliance with the national or local electric code.
2) The grounding wire size should be as described before in this chapter, with large surface area, and as short as possible.

(7) Auxiliary power input terminals for control circuit R0, T0 (Types VXT-88A-2 / VXT-59A-4 or above)

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

When it is desired to retain the alarm signal for the activation of the protective function even inverter main power supply shut off, or when continuous display of the keypad is desired, connect these terminals to the power supply. When the inverter input side has a magnetic contactor (MC), wire from the input side (primary side) of the magnetic contactor (MC).

Terminal rating: AC 200 to 240 V, 50/60 Hz, maximum current 1.0 A (200 V series)
AC 380 to 480 V, 50/60 Hz, maximum current 0.5 A (400 V series)

Note When using the earth leakage breaker, connect terminals R0, T0 to the output side of the earth leakage breaker.

When connections are made to the input side of the earth leakage breaker, the earth leakage breaker will malfunction because the inverter input is three-phase and the terminals R0, T0 are single phase. When connecting to terminals R0, T0 to the input side of the earth leakage breaker, make sure that the connection is done through an insulating transformer or, alternatively, through the auxiliary B contacts of the magnetic contactor as shown in the figure below.

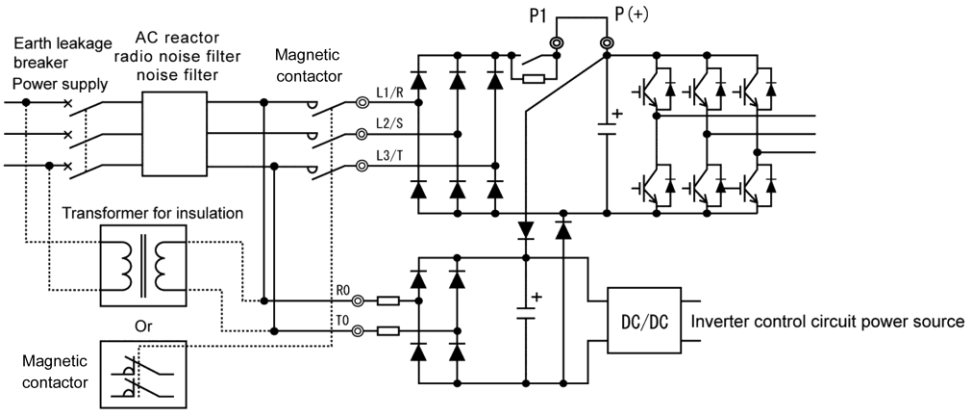


Figure 2.2-10 Connection of the Earth Leakage Breaker

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

On connection examples for the PWM converter side consult IMO.

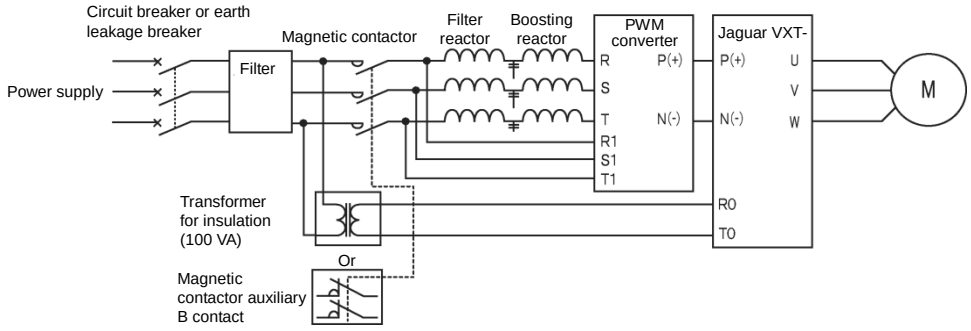


Figure 2.2-11 Example of connection of R0, T0 terminals in combination with PWM converter

(8) Auxiliary power input terminals for fan R1, T1 (Types VXT-203-4 or above)

These terminals are equipped on types VXT-203A-4# or below, but are not used ordinarily.

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

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

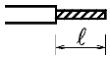
Terminal rating: AC 380 to 440 V/50 Hz, 380 to 480 V/60 Hz, maximum current 1.0 A (400 V series)

2.2.6 Control circuit terminals (common to all models)

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

The screw specifications and wire sizes to be used for control circuit wiring are shown below.
The control circuit terminal board differs depending on the destination.

Table 2.2-28 Screw Specifications and Recommended Wire Sizes

Terminal symbol	Screw specification		Allowable wire sizes	Driver (shape of tip)	Removal size of wire cover 	Gauge size to insert wire
	Size	Tightening torque				
30A, 30B, 30C EN1, EN2	M3	0.5 N·m (4.43 lb-in)	0.14 to 1.5 mm^2 (AWG26 to 16)	Minus (0.6mm×3.5mm)	6 mm (0.24 in)	A1[*1]
Others	M2	0.19 N·m (1.68 lb-in)	0.25 to 1 mm^2 (AWG24 to 18)	Minus (0.4mm×2.5mm)	5 mm (0.20 in)	φ1.6

* Recommended rod terminal: Phoenix Contact Refer to Table 2.2-29 for details.

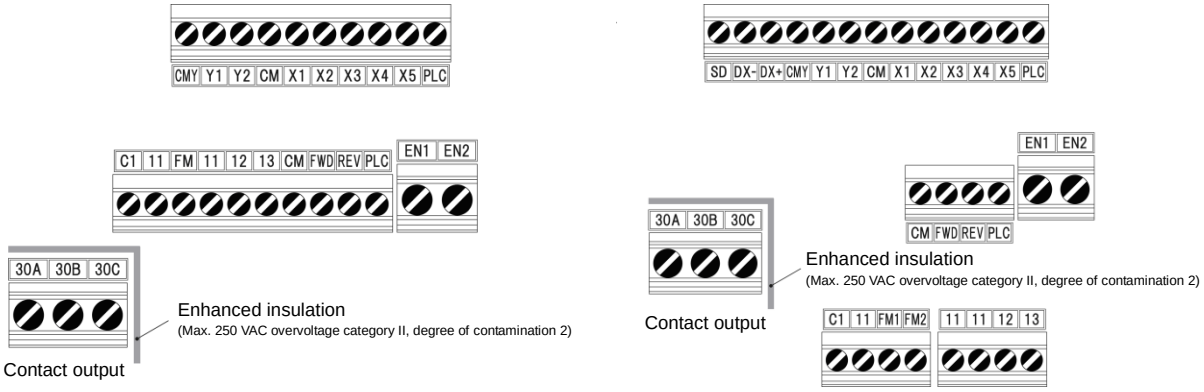
*1 Defined according to IEC/EN 60947-1.

Table 2.2-29 Recommended Rod Terminals

Screw size		Wire size	Type	
			With insulating collar	Without insulating collar
M3	M2	0.25 mm^2 (AWG24)	AI 0.25-6 BU	A 0.25-7
		0.34 mm^2 (AWG22)	AI 0.34-6 TQ	A 0.34-7
		0. 5 mm^2 (AWG20)	AI 0.5-6 WH	A 0.5-6
		0.75 mm^2 (AWG18)	AI 0.75-6 GY	A 0.75-6
		1 mm^2 (AWG18)	AI 1-6 RD	A 1-6
		1.5 mm^2 (AWG16)	AI 1.5-6 BK	A 1.5-7

Note) When sizes exceeding the recommended wire sizes are used, the front cover may be pushed outward depending on the number of wires, causing erroneous operation of the keypad.

[2] Terminal layout diagram (control circuit terminal)



Model: -GA Model: -GB/-C

⚠WARNING⚠

The following terminals may have high voltage when the power is ON.
Control terminals: AUX-contact (30A, 30B, 30C)
Insulation level
Contact output – control circuit : Enhanced insulation (overvoltage category II, degree of contamination 2)

Risk of electric shock exists

[3] Description of terminal functions (control circuit terminal)

⚠WARNING⚠

Generally, the insulation for control signal lines is not enhanced. When the control signal lines come into direct contact with the main circuit live section, the insulation cover may be damaged. High voltage of the main circuit may be applied on the control signal lines, so exercise caution such that the main circuit live sections do not contact the control signal lines.

Risk of accidents and risk of electric shock exist.

⚠CAUTION

Noise is generated by the inverter, motor, and wiring.

Exercise caution to prevent malfunction of peripheral sensors and instruments.

Risk of accidents exists.

Table 2.2-30 shows the functional explanations for the control circuit terminals. The connection method of the control circuit terminals differs depending on the functional code setting matching the purpose of inverter operation.

Properly wire such that the impact of noise generated by the main circuit wiring is reduced.

Table 2.2-30 Functional Description of Control Circuit Terminals

Classification	Terminal symbol	Terminal name	Functional description
Analog input	[13]	Power supply for the potentiometer	The terminal is used for the power supply (DC+10 V 10 mA Max) for the external frequency command potentiometer (variable resistor: 1 to 5 kΩ). Connect variable resistors larger than 1/2 W.
	[12]	Analog setup voltage input	(1) Frequency is set up according to the external analog voltage input command value. Normal operation • DC0 to +10 V/0 to 100(%) (DC0 to +5 V/0 to 100%) • DC0 to ±10 V/0 to ±100(%) (DC0 to ±5 V/0 to ±100%) Reverse operation • DC+10 to 0V/0 to 100(%) (DC+5 to 0 V/0 to 100%) • DC±10 to 0V/0 to ±100(%) (DC±5 to 0V/0 to ±100%) (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 22 (kΩ) * Up to DC±15 V can be input. However, input exceeding DC±10 V will be recognized as DC±10 V.
	[C1]	Analog setup current input (C1 function)	(1) Frequency is set up according to the external analog current input command value. Normal operation • DC4 to 20 mA/0 to 100(%)/-100% to 0 to 100% • DC0 to 20 mA/0 to 100(%)/-100% to 0 to 100% Reverse operation • DC20 to 4 mA/0 to 100(%)/-100% to 0 to 100% • DC20 to 0 mA/0 to 100(%)/-100% to 0 to 100% (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 250 (Ω) * Up to DC 30 mA can be input. However, input exceeding DC 20 mA will be recognized as DC 20 mA.

Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

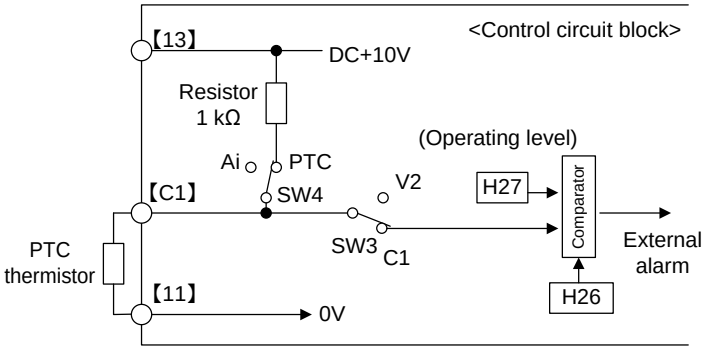
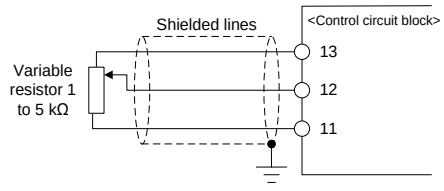
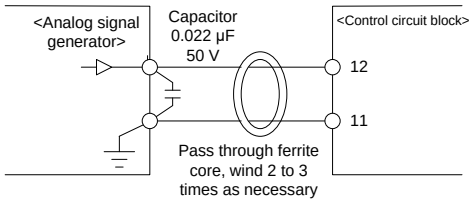
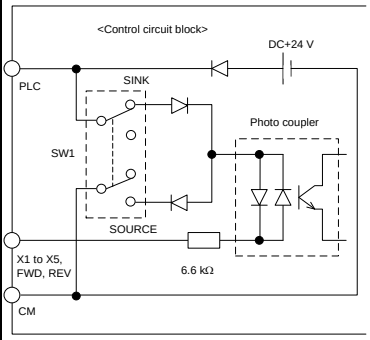
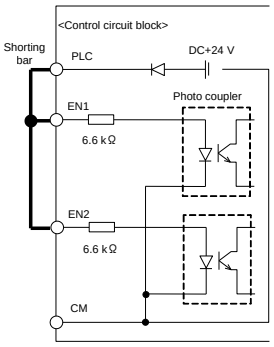
Classification	Terminal symbol	Terminal name	Functional description
Analog input	[C1]	Analog setup voltage input (V2 function)	(1) Frequency is set up according to the external analog voltage input command value. SW3 (refer to "2.2.8 Operating slide switches") must be switched on the printed circuit board. Normal operation • DC0 to +10 V/0 to 100(%) (DC0 to +5 V/0 to 100%) • DC0 to +10 V/-100 to 0 to 100(%) (DC0 to +5 V/-100 to 0 to 100%) Reverse operation • DC+10 to 0 V/0 to 100(%) (DC+5 V to 0 V/0 to 100%) • DC+10 to 0 V/-100 to 0 to 100(%) (DC+5 to 0 V/-100 to 0 to 100%) (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 22(kΩ) * Up to DC+15 V can be input. However, input exceeding DC+10 V will be recognized as DC+10 V.
		PTC thermistor input (PTC function)	(1) PTC (Positive Temperature Coefficient) thermistor for motor protection can be connected. SW3 (C1/V2 Switch) and SW4 (PTC /AI Switch) (refer to "2.2.8 Operating slide switches") must be switched on the printed circuit board. Figure 2.2-12 shows the internal circuit when SW3 and SW4 are set for PTC thermistor input. For details on SW3 and SW4, refer to "2.2.8 Operating slide switches". When SW3 and SW4 are switched to the PTC side, function codes H26 and H27 also needs to be changed.  Figure 2.2-12 Internal circuit when SW4 is switched to PTC side
		Analog input monitor (AI function)	(1) The analog input monitor can be used to monitor the status of peripheral instruments using communication by inputting the analog signals of various sensors such as temperature sensors. Data can be converted to physical property values such as temperature and pressure by using display factors and shown on the keypad display.
	[11]	Analog input common	The terminal is the common terminal for analog input signals (terminals [12], [13], [C1]). The terminal is insulated from terminals [CM], [CMY].
	Note		• Use shielded lines and keep the wiring to the minimum as possible (below 20 meters) for control signals which are susceptible to external noise. Grounding the shielded lines is generally recommended, but if external induction noise is large, connecting to terminal 11 may reduce the noise. The shielded line increases the blocking effect. Always ground one end as shown in Figure 2.2-13. • When inserting a relay contact at analog input signal lines, use the twin contacts relay for small signals. Also, do not insert a relay to terminal 11. • When external analog signal generators are connected, the analog signal generator circuit may malfunction due to the noise created by the inverter. In these cases, connect ferrite core (toroidal shape or equivalent) to the output terminals of the analog signal generator or connect high frequency capacitors between the control signal lines, as shown in Figure 2.2-14.   Figure 2.2-13 Connection Diagram for Shielded Lines Figure 2.2-14 Example of Noise Countermeasures

Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="8">Digital input</td><td>[X1]</td><td>Digital input 1</td><td rowspan="7">(1) Various signals (coast to a stop command, external alarm, multi-speed selection, etc) set up by function codes E01 to E05, E98 & E99 can be set up.
For details, refer to Chapter 5 “FUNCTION CODES”.
(2) Input mode, sink/source can be switched using SW1.
(Refer to “2.2.8 Operating slide switches”)
(3) The operating mode of the various digital input terminals when connected with terminal CM (sink mode) / PLC (source mode) can be switched to “ON when shorted with CM/PLC (active ON)” or “OFF when shorted with CM/PLC (active OFF)”
(4) Digital input terminal [X5] can be set up as a pulse train input terminal by changing the function code
Maximum wiring length 20 meters
Maximum input pulse
30 kHz: When connected to open collector output pulse generator
100 kHz: When connected to complementary output pulse generator
For function code settings, refer to Chapter 5 “FUNCTION CODES.

<Digital input circuit specification>


<table>
<tr><th colspan="2">Item</th><th>Minimum</th><th>Maximum</th></tr>
<tr><td rowspan="2">Operating voltage (SINK)</td><td>ON level</td><td>0 V</td><td>2 V</td></tr>
<tr><td>OFF level</td><td>22 V</td><td>27 V</td></tr>
<tr><td rowspan="2">Operating voltage (SOURCE)</td><td>ON level</td><td>22 V</td><td>27 V</td></tr>
<tr><td>OFF level</td><td>0 V</td><td>2 V</td></tr>
<tr><td colspan="2">Operating current at ON (at input voltage 0 V) (for [X5] input terminal)</td><td>2.5 mA (9.7 mA)</td><td>5 mA (16 mA)</td></tr>
<tr><td colspan="2">Allowable leak current at OFF</td><td>-</td><td>0.5 mA</td></tr>
</table>
Figure 2.2-15 Digital Input Circuit</td></tr>
<tr><td>[FWD]</td><td>Run forward command</td></tr>
<tr><td>[REV]</td><td>Run reverse command</td></tr>
<tr><td>[EN1]
[EN2]</td><td>Enable input</td><td>(1) When terminals [EN1]-[PLC] or terminals [EN2]-[PLC] are OFF, the inverter output transistors stop switching (safe torque off: STO).
Be sure to operate terminals [EN1] and [EN2] simultaneously; otherwise an ecf alarm is issued and the operation of the inverter will be disabled.
To enable the Enable function, remove the short bar.
(2) The input mode for terminals [EN1] and [EN2] is fixed to source. The mode cannot be switched to sink.
(3) Short terminals [EN1]-[PLC] and [EN2] – [PLC] using shorting bars when the enable input function is not used (Keep the shorting bar connected).

<EN terminal circuit spec>


<table>
<tr><th colspan="2">Item</th><th>Min</th><th>Max</th></tr>
<tr><td rowspan="2">Operating voltage (SOURCE)</td><td>ON level</td><td>22 V</td><td>27 V</td></tr>
<tr><td>OFF level</td><td>0 V</td><td>2 V</td></tr>
<tr><td colspan="2">Operating current at ON (at input voltage 24 V)</td><td>-</td><td>4.5 mA</td></tr>
<tr><td colspan="2">Allowable leak current at OFF</td><td>-</td><td>0.5 mA</td></tr>
</table></td></tr>
<tr><td>[PLC]</td><td>Programmable controller signal power source</td><td>(1) The terminal is used for connecting the output signal power source of the programmable controller (rated voltage DC +24 V (power supply voltage fluctuation range: DC +22 to +27 V) maximum 100 mA).
(2) The terminal can also be used for the power source for the load connected to the transistor outputs. For details, refer to the page on “Transistor outputs”.</td></tr>
</table>

Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

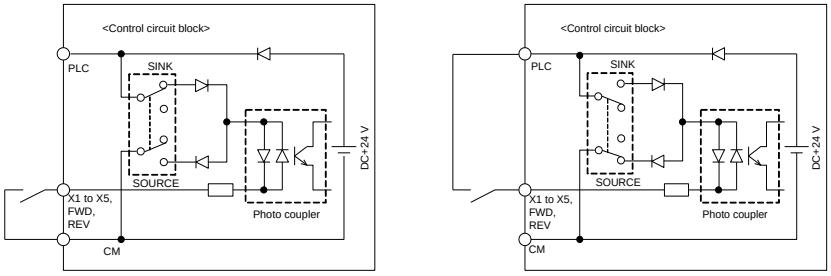
Classification	Terminal symbol	Terminal name	Functional description
Digital Input	[CM]	Digital common	This terminal is the common terminal for digital input signals. This terminal is insulated from terminals [11] and [CMY].

Tip

■ **When turning terminals [FWD], [REV], [X1] to [X5] ON and OFF using relay contacts**

Figure 2.2-16 shows an example of the circuit configuration using relay contact. Circuit (a) in Figure 2.2-16 shows the circuit configuration when the switch (SW1) is on the sink side and circuit (b) shows the circuit configuration when the switch is on the source side.

Caution: Use a relay which will not have contact failures (high contact reliability).



(a) Switch on sink side (b) Switch on source side

Figure 2.2-16 Circuit Configuration Example Using Relay Contact

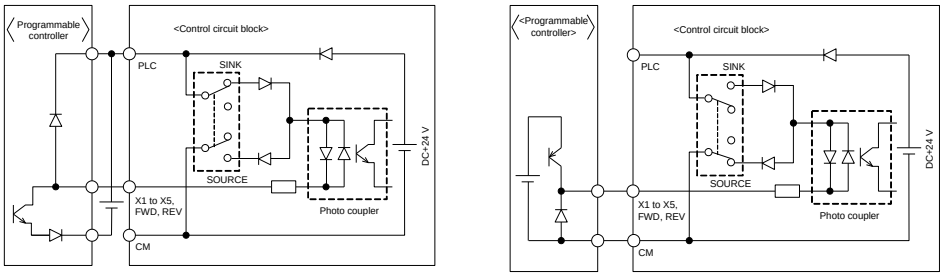
Tip

■ **When turning terminals [FWD], [REV], [X1] to [X5] ON and OFF using the programmable controller**

Figure 2.2-17 shows an example of the circuit configuration using programmable controller. Circuit (a) in Figure 2.2-17 shows the circuit configuration when the switch (SW1) is on the sink side and circuit (b) shows the circuit configuration when the switch is on the source side.

In circuit (a), terminals [FWD], [REV], [X1] to [X5] can be turned ON/OFF by shorting/opening the open collector transistor output of the programmable controller using the external power supply. Follow the instructions below when using this type of circuit.

- Connect the + side of the external power supply which is insulated from the programmable controller power supply to terminal [PLC].
- Do not connect the inverter's [CM] terminal and the common terminal of the programmable controller.

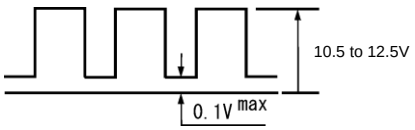


(a) Switch on the sink side (b) Switch on the source side

Figure 2.2-17 Circuit Configuration Example Using Programmable Controller

Refer to "2.2.8 Operating slide switches" for more information on the switches.

Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="4">Analog output/pulse output</td><td>[FM]</td><td>Analog monitor
FMV function
FMI function</td><td>This terminal outputs analog direct current voltage DC0 to 10 V or analog direct current DC4 to 20 mA / DC0 to 20mA monitor signal. The output form (FMV/FMI) can be switched using SW5 on the printed circuit board and function code F29. Refer to “Table 2.2-31 Functional Description of Slide switches”.
The signal content can be chosen in the function code F31 data setting among the following items.
• Output frequency 1 (before slip compensation)
• Output frequency 2 (after slip compensation)
• Output current
• Output voltage
• Output torque
• Load factor
• Input power
• PID feedback value
• Actual speed/estimated speed
• DC link bus voltage
• Universal AO
• Motor output
• Calibration (+)
• PID command (SV)
• PID output (MV)
• Position error in master-follower operation
• Inverter heat sink temperature
• PG feedback value
• Customizable logic ouput signal 1 to 10
* Allowable impedance for connection: Min 5 kΩ (at DC to 10 V output) (up to 2 analog volt meters (DC0 to 10 V, input impedance 10 kΩ) can be connected.)
* Allowable impedance for connection: Max 500 Ω (at DC4 to 20 mA/DC0 to 20 mA)
* Gain adjustable range: 0 to 300%</td></tr>
<tr><td>Pulse monitor
FMP function</td><td>The terminal outputs pulse signal. Signal content can be chosen same as for the FMV function by function code F31 setting. The output form (FMP) can be switched using SW5 on the printed circuit board and function code F29. Refer to “Table 2.2-31 Functional Description of Slide switches”.
* Allowable impedance for connection: Min. 5 kΩ (at DC to 10 V output) (up to 2 analog volt meters (DC0 to 10 V, input impedance 10 kΩ) can be connected.)
* Pulse duty: Approximately 50%, pulse rate: 25 to 32000 p/s (at full scale)
• Pulse output waveform


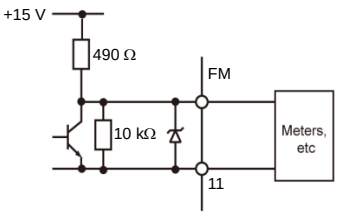
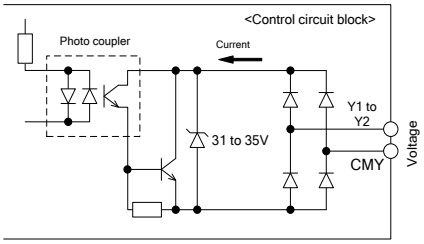
• FMP output circuit

</td></tr>
<tr><td>[FM2]</td><td>Analog monitor
FMV2 function
FMI2 function</td><td>This terminal outputs analog direct current voltage DC0 to 10 V or analog direct current DC4 to 20 mA (DC0 to 20mA) monitor signal. The output form (FMV2/FMI2) can be switched using SW7 on the printed circuit board and function code F32. Refer to “Table 2.2-13 Functional Description of Slide switches”.
The signal content can be chosen in the function code F35 data setting among the same items with [FM] (F31).
* This terminal is used on the models with the destination codes -GB/-C.
* Allowable impedance for connection: Min 5 kΩ (at DC to 10 V output) (up to 2 analog volt meters (DC0 to 10 V, input impedance 10 kΩ) can be connected.)
* Allowable impedance for connection: Max 500 Ω (at DC4 to 20 mA/DC0 to 20 mA)
* Gain adjustable range: 0 to 300%</td></tr>
<tr><td>[11]</td><td>Analog output common terminal</td><td>This terminal is the common terminal for analog input and analog/pulse output signals. The terminal is insulated from terminals [CM] and [CMY]. Do not use [CM] and [CMY] as common terminals for [FM], [FM2].</td></tr>
</table>

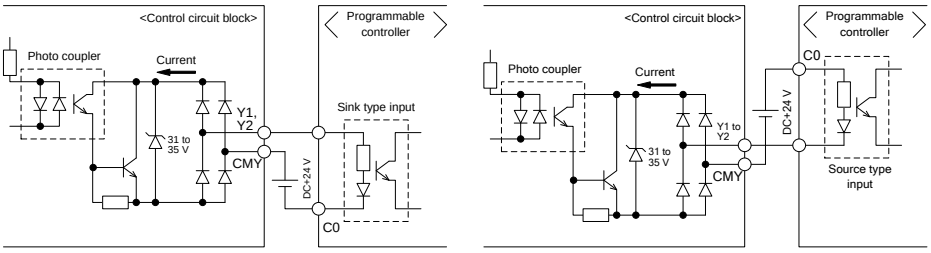
Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="3">Transistor outputs</td><td>[Y1]
[Y2]</td><td>Transistor output 1
Transistor output 2</td><td>(1) Various signals (running signal, frequency reached signal, overload forecast signal, etc) set up by function code E20, E21 can be output. For details, refer to Chapter 5 “FUNCTION CODES”. (2) The operating mode of the transistor output terminals [Y1], [Y2] can be switched to “ON (active ON) at signal output” or “OFF (active OFF) at signal output”.

<Transistor output circuit specification>


<table>
<tr><th colspan="2">Item</th><th>Maximum</th></tr>
<tr><td rowspan="2">Operating voltage</td><td>ON level</td><td>3 V</td></tr>
<tr><td>OFF level</td><td>27 V</td></tr>
<tr><td colspan="2">Max load current at ON</td><td>50 mA</td></tr>
<tr><td colspan="2">Leak current at OFF</td><td>0.1 mA</td></tr>
</table>
Figure 2.2-18 Transistor Output Circuit

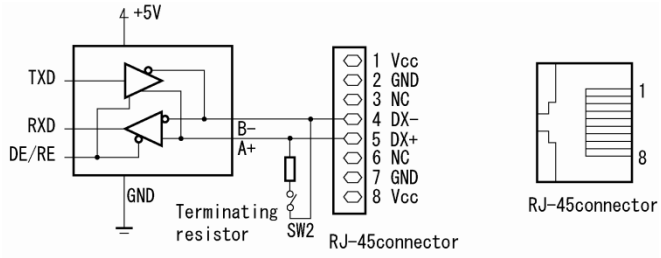
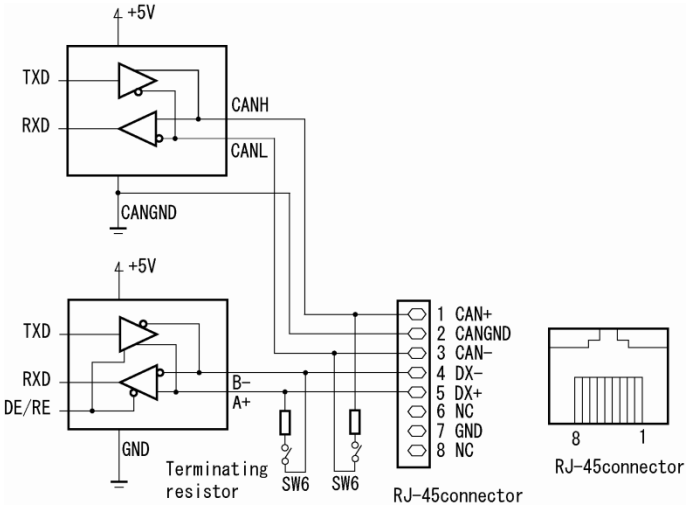
Note
• Connect a surge absorbing diode between the terminals the excitation coil when connecting control relays.
• When a power source is needed for the circuit to be connected, terminal PLC can be used as a power source terminal. Rated voltage: DC+24 V (power supply voltage fluctuation range: DC+22 to +27 V), maximum 50 mA). In this case, terminal [CMY] must be shorted to terminal [CM].</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>This terminal is the common terminal for transistor output signals.
This terminal is insulated from terminals [CM] and [11].</td></tr>
<tr><td colspan="3">Tip
■ When connecting the programmable controller to terminals [Y1], [Y2].
The circuit configuration example for connecting the inverter transistor output to the programmable controller is shown in Figure 2.2-19. Circuit (a) in Figure 2.2-19 shows the programmable controller input circuit as sink input and circuit (b) shows as the source input case.



(a) Connection diagram for sink input type programmable controller
(b) Connection diagram for source input type programmable controller

Figure 2.2-19 Example of Connection Circuit Configuration with Programmable Controller</td></tr>
<tr><td>Contact output</td><td>[30A/B/C]</td><td>Integrated alarm output</td><td>(1) When the inverter stops with an alarm, output is generated on the relay contact (1C). Contact rating: AC250 V 0.3 A cosϕ = 0.3, DC48 V 0.5 A
(2) Terminals can be switched to “Terminals [30A to 30C] shorted (excitation: active ON) at ON signal output” or “Terminals [30A to 30C] open (non-excitation: active OFF) at ON signal output”</td></tr>
</table>

Table 2.2-30 Functional Description of Control Circuit Terminals (continued)

Classification	Terminal symbol	Terminal name	Functional description
Communication	RJ-45 connector for keypad connection	RJ-45 connector for keypad connection RS-485 communication port 1	(1) Used to connect the keypad. The power to the keypad will be supplied from the inverter through this connector. (2) Also can be used to connect a computer, programmable controller, etc by RS-485 communication, after removing the keypad. (On terminating resistor, refer to “2.2.8 Operating slide switches”).  Figure 2.2-20 RJ-45 Connector Pin-layout • Pins 1, 2, 7, and 8 are assigned as power supply source for the keypad. When connecting this RJ-45 connector to other devices, do not use these pins.
	RJ-45 connector for RS-485 /CANopen communic a-tion	RS-485 communication port 2 CANopen communication port	(1) Can be used to connect a computer, programmable controller, etc by RS-485 communication. (On terminating resistor, refer to “2.2.8 Operating slide switches”). (2) Also can be used to connect a computer, programmable controller, etc by CANopen communication. (On terminating resistor, refer to “2.2.8 Operating slide switches”).  Figure 2.2-21 RJ-45 Connector Pin-layout * This terminal is used on the models with the destination codes -RJ * SW6 is shared between RS-485 communications and CAN bus communications. If both communications are used at the same time and the necessity of the terminating resistor for each communication network is different (for example in the CAN bus is located at either end of the network, but in the RS-485 network is located in the middle), turn SW6 “OFF” and use an external terminating resistor where needed.

■ **Wiring for control circuit terminals**

For VXT-361A-4 to VXT-590A-4

(1) As shown in Figure 2.2-22, route the control circuit wires along the left side panel to the outside of the inverter.

(2) Secure those wires to the wiring support, using a cable tie with 3.8 mm (0.15inch) or less in width and 1.5 mm or less in thickness.

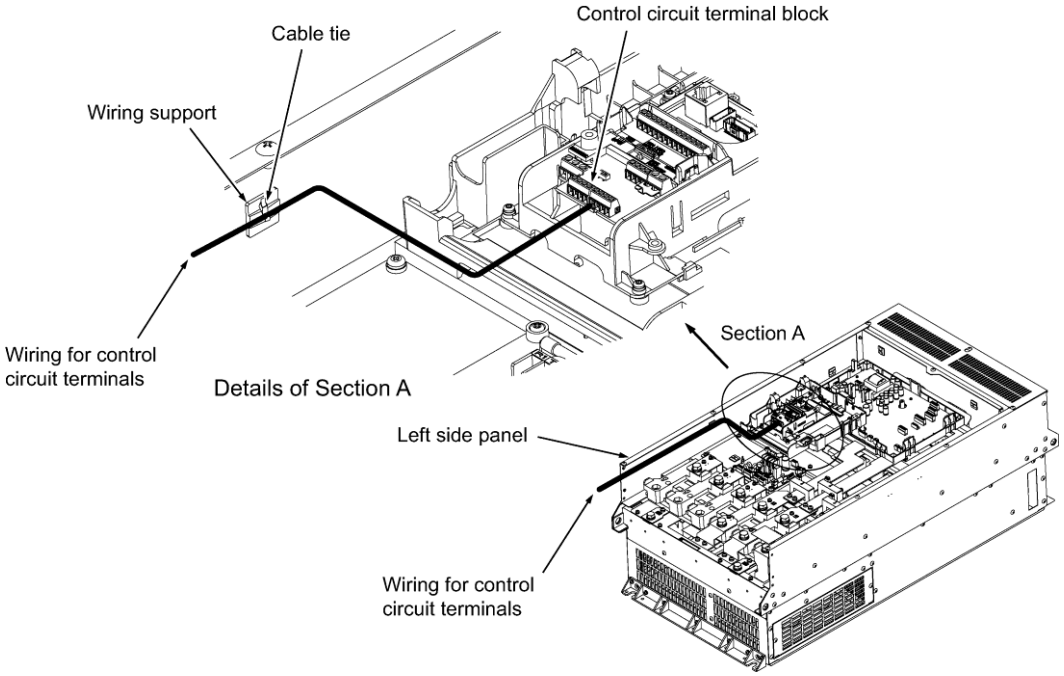


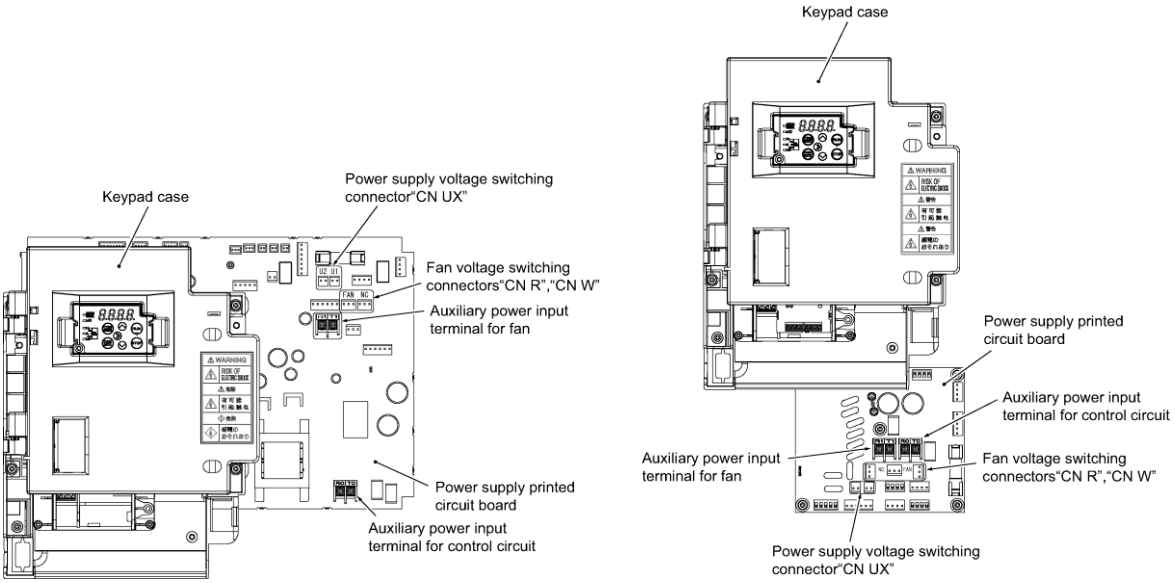
Figure 2.2-22 Wiring Route and Fixing Position for the Control Circuit Wires

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

2.2.7 Switching connector (types VXT-203A-4 or above)

■ **Position of each connector**

The individual switching connectors are located on the power supply printed circuit board as shown in Figure 2.2-23.



(a) VXT-203A-4 to VXT-290A-4 (b) VXT-361A-4 to VXT-590A-4

Figure 2.2-23 Switching Connector Positions

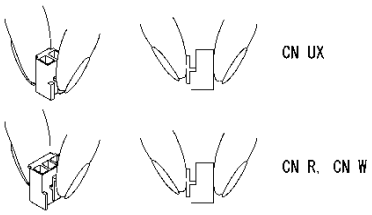


Figure 2.2-24 Attachment and Removal of the Switching Connector

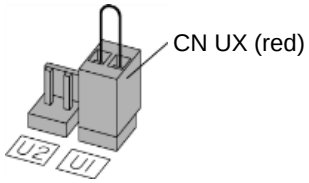
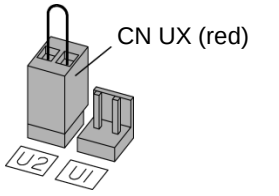
Note When removing the individual connectors, pinch the upper portion of the connector with the fingers, unlock the fastener, and pull. When inserting the connector, push in until the fastener lock engages with the receiving end with a click.

■ **Power supply switching connector "CN UX"（types VXT-203A-4 or above）**

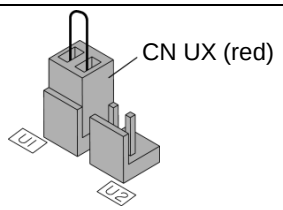
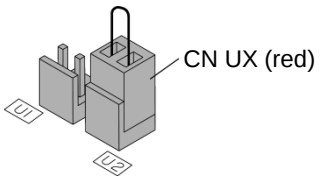
This power supply switching connector "CN UX" is equipped on VXT-203A-4 or above. Set the connector CN UX to U1 side (default) or U2 side depending on the power supply voltage specifications to be connected to the main power supply input terminals (L1/R, L2/S, L3/T) and/or the auxiliary power input terminals for the fan (R1, T1), according to the table below.

For details on the switching procedure, refer to "Figure 2.2-23 Switching Connector Positions" and "Figure 2.2-24 Attachment and Removal of the Switching Connector".

(a) VXT-203A-4 to VXT-290A-4

Setting		
Applicable voltage	398 to 440 V/ 50 Hz, 430 to 480 V/ 60 Hz (Factory default Model: -GA/-GB)	380 to 398V/ 50 Hz, 380 to 430 V/ 60 Hz (Factory default Model: -C)

(b) VXT-361A-4 to VXT-590A-4

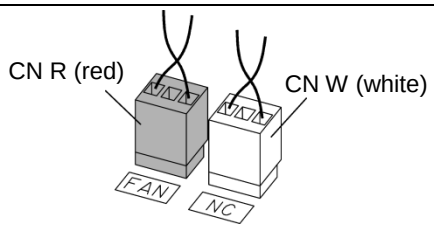
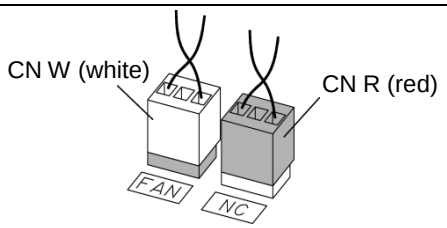
Setting		
Applicable voltage	398 to 440 V/ 50 Hz, 430 to 480 V/ 60 Hz (Factory default Model: -GA/-GB)	380 to 398V/ 50 Hz, 380 to 430 V/ 60 Hz (Factory default Model: -C)

■ **Fan power source switching connector "CN R", "CN W" (types VXT-203A-4 or above)**

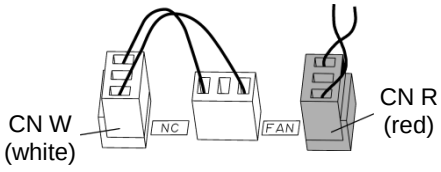
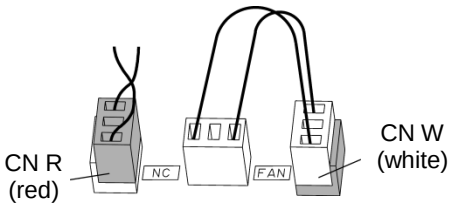
Jaguar VXT- supports direct current power supply input with PWM converters in the standard specification. However, VXT-203A-4 or above contains parts which are driven by AC power supply such as the AC fan, so AC power must also be supplied. When using DC power for the inverter, move connector "CN R" to NC side, move connector "CN W" to FAN side, and connect an AC power source to the auxiliary power input terminals for the fan (R1, T1).

For details on the switching procedure, refer to "Figure 2.2-23 Switching Connector Positions" and "Figure 2.2-24 Attachment and Removal of the Switching Connector".

(a) VXT-203A-4 to VXT-290A-4

Setting		
Purpose	In the case terminals R1 and T1 are NOT used (Factory default)	In the case terminals R1 and T1 are used • DC bus input type • Combination with PWM converter

(b) VXT-361A-4 to VXT-590A-4

Setting		
Purpose	In the case terminals R1 and T1 are NOT used (Factory default)	In the case terminals R1 and T1 are used • DC bus input type • Combination with PWM converter

Note The fan power source switching connector "CN R" is on FAN and "CN W" is on NC when shipped from the factory. When direct current power supply input is not used, do not modify this setting.

Mistakes in the fan power source switching connector setting may prevent the cooling fan from operating, and alarms such as cooling fin overheat *0h1* and charging circuit error *pbf* may be generated.

2.2.8 Operating slide switches

⚠WARNING ⚠

Operation of the slide switches should be conducted **after more than 5 minutes has elapsed** since power is shut off **for types VXT-115A-2 / VXT-72A-4 or below** and **after more than 10 minutes has elapsed for types VXT-85A-4 or above**. Confirm that the LED monitor and the charge lamp are turned off, and that the direct current intermediate circuit voltage between the main circuit terminals P(+)-N(-) is below the safe voltage (below DC+25 V) with a tester before operating the switches.

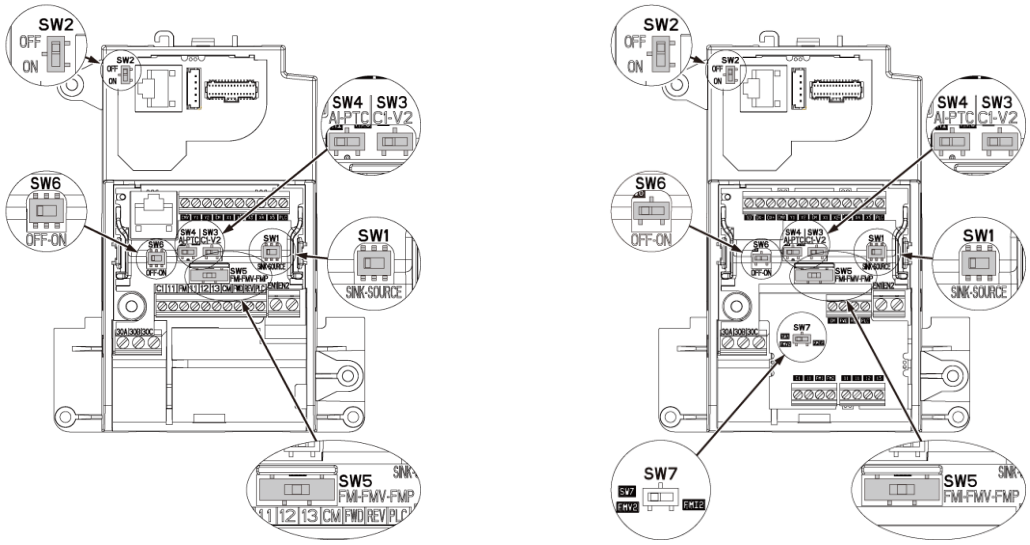
Risk of electric shock exists.

The I/O terminal specification can be changed, such as switching the analog output form, by operating the slide switches on the printed circuit board (Figure 2.2-25 Slide Switch Locations on the Control Printed Circuit Board).

To operate the slide switches, remove the front cover and make the control printed circuit board visible. (For types VXT-85A-4 or above, also open the keypad case).

Refer to “2.2.2 Removal and attachment of the front cover/ terminal cover and wiring guide” to remove the front cover and to open/close the keypad case.

The switch locations on the control printed circuit board are shown in Figure 2.2-25 below.



Model -RJ Model -GB

Figure 2.2-25 Slide Switch Locations on the Control Printed Circuit Board.

	SW1	SW2	SW3	SW4	SW5	SW6	SW7
Options	SINK / SOURCE	OFF / ON	C1 / V2	AI / PTC	FMI / FMV / FMP	OFF / ON	FMV2 / FMI2
Factory default	SOURCE	OFF	C1	AI	FMV	OFF	FMV2

Note Use pointed devices (such as tweezers) to operate the switches. Avoid touching other electronic parts when moving the switches. The switch will be at open state when the slider is in the middle, so make sure to push the slider to the ends.

Functional description of the slide switches is explained in Table 2.2-31 Functional Description of Slide switches.

Table 2.2-31 Functional Description of Slide switches

<table>
<tr><th>Switch symbol</th><th>Functional description</th></tr>
<tr><td>SW1</td><td><Switch to change sink/source setting of digital input terminals>
• This switch determines the type of input (sink or source) to use for digital input terminals [X1] to [X5], FWD, and REV.</td></tr>
<tr><td>SW2</td><td><Switch to change the RS-485 communication port 1 terminating resistor (RS-485 communication port (on the control PCB))>
• Move the switch to the ON side when RS-485 communication is used and the inverter is located at either end of the communication network.</td></tr>
<tr><td>SW3
SW4</td><td><Switch to change terminal [C1] input setting to current/voltage/PTC thermistor>
This switch changes the input type for terminal [C1].
<table>
<tr><th>Input type</th><th>SW3</th><th>SW4</th><th>E59</th><th>H26</th></tr>
<tr><td>Current input (factory default)</td><td>C1 side</td><td>AI side</td><td>0</td><td>0</td></tr>
<tr><td>Voltage input</td><td>V2 side</td><td>AI side</td><td>1</td><td>0</td></tr>
<tr><td>PTC thermistor input</td><td>C1 side</td><td>PTC side</td><td>0</td><td>1</td></tr>
</table></td></tr>
<tr><td>SW5</td><td><Switch to change terminal [FM] output setting to current/voltage/pulse>
This switch changes the output type for terminal [FM]. When operating this switch, also change function code F29.
<table>
<tr><th>Output type</th><th>SW5</th><th>F29</th></tr>
<tr><td>Current output</td><td>FMI side</td><td>1 or 2</td></tr>
<tr><td>Voltage output (factory default)</td><td>FMV side</td><td>0</td></tr>
<tr><td>Pulse output</td><td>FMP side</td><td>3</td></tr>
</table></td></tr>
<tr><td>SW6</td><td><Switch to change the RS-485 communication port 2 terminating resistor (RS-485 communication port (on the terminal board))>
・ Used for the RS-485/CANopen communication. Move the switch to the ON position when the inverter is located at either end of the communication network.</td></tr>
<tr><td>SW7</td><td><Switch to change terminal [FM2] output setting to voltage/current> The terminal is used only on the model with the destination code -C.
This switch changes the output type for terminal [FM2]. When operating this switch, also change function code F32.
<table>
<tr><th>Output type</th><th>SW7</th><th>F32</th></tr>
<tr><td>Voltage output</td><td>FMV2 side</td><td>0</td></tr>
<tr><td>Current output</td><td>FMI2 side</td><td>1 or 2</td></tr>
</table></td></tr>
</table>

Note Exercise caution as expected operation may not result if the setting above is not conducted accurately.

2.3 Attachment and Connection of Keypad

2.3.1 Parts required for connection

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

Part name	Type	Remarks
Keypad extension cable (note 1)	Jaglead1M /2M /3M	Three lengths available (1Mtr, 2Mtr & 3Mtr)
Keypad fixing screws	M3×□ (note 2)	2 screws required (prepared by user)

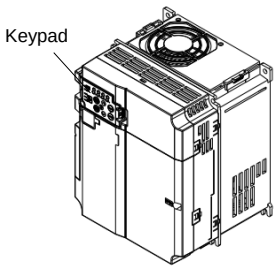
(Note 1) When using commercially available LAN cable, use straight cables (below 20 meters)

(Note 2) When attaching to the cabinet, use a fixing screw of appropriate length to the cabinet thickness.

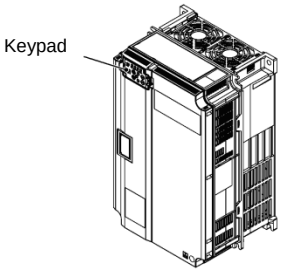
2.3.2 Attachment procedure

The keypad can be attached in the following forms.

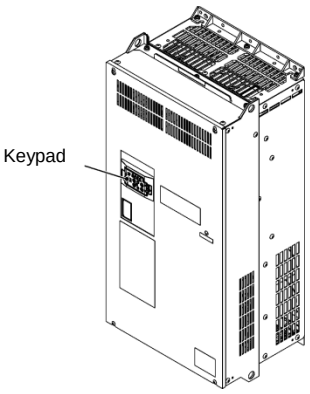
- ■ Attach to the inverter main body (refer to Figure 2.3-1 (a), (b), (c))
- ■ Attach to the cabinet (refer to Figure 2.3-2)
- ■ Operate the panel remotely, on the hand (refer to Figure 2.3-3)



(a) VXT-69A-2



(b) VXT-72A-4



(c) VXT-203A-4

Figure 2.3-1 Attaching the Keypad to the Inverter Main Body

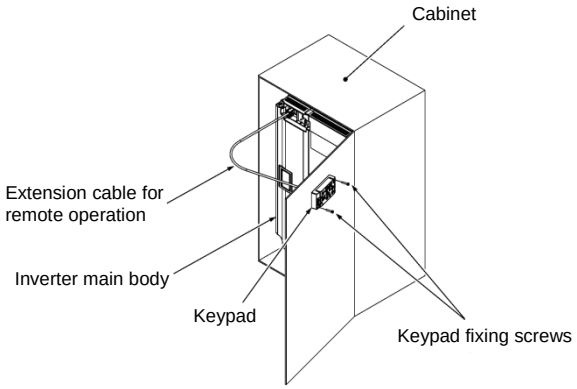


Figure 2.3-2 Attaching the Keypad on the Cabinet

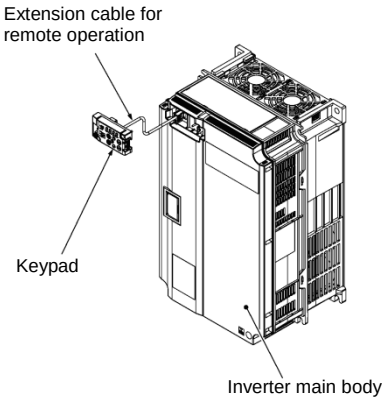


Figure 2.3-3 Operating the Keypad Remotely, on the Hand

■ **Attachment to the cabinet**

(1) Squeeze the hooks at the arrows and pull as shown in Figure 2.3-4.

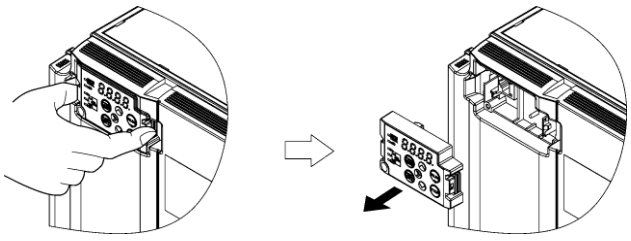


Figure 2.3-4 Removal of the Keypad

(2) Attach the keypad rear cover to the keypad using the included keypad rear cover fixing screw.

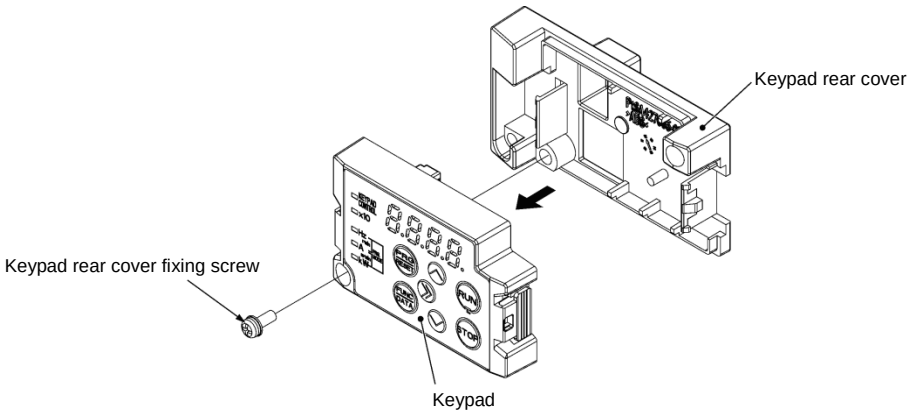


Figure 2.3-5 Attachment of the Keypad

(3) Cut the cabinet to attach the keypad, as shown in Figure 2.3-6.

(Units: mm [inch])

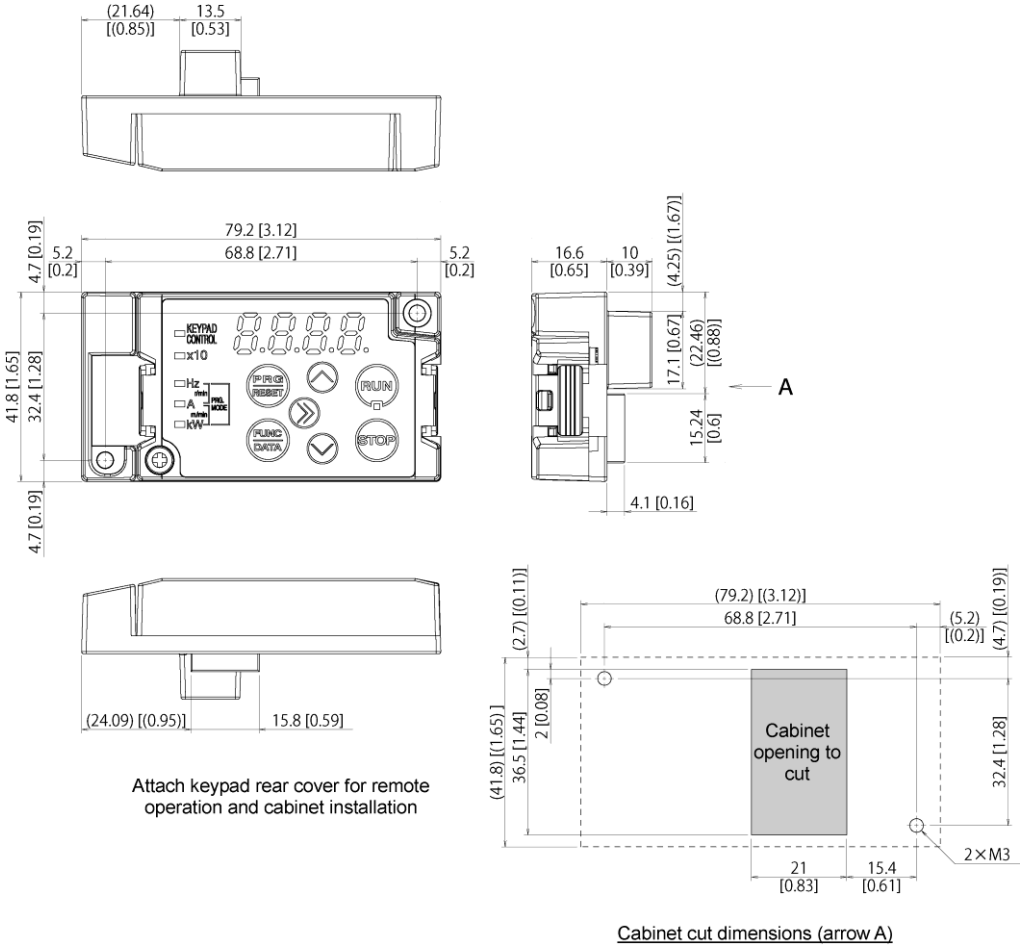


Figure 2.3-6 Fixing Screw Positions and the Dimensions of the Cabinet to Cut

(4) Fix the keypad to the cabinet using 2 keypad rear cover fixing screws. (Refer to Figure 2.3-7) (tightening torque: 0.7 N•m(6.2lb-in))

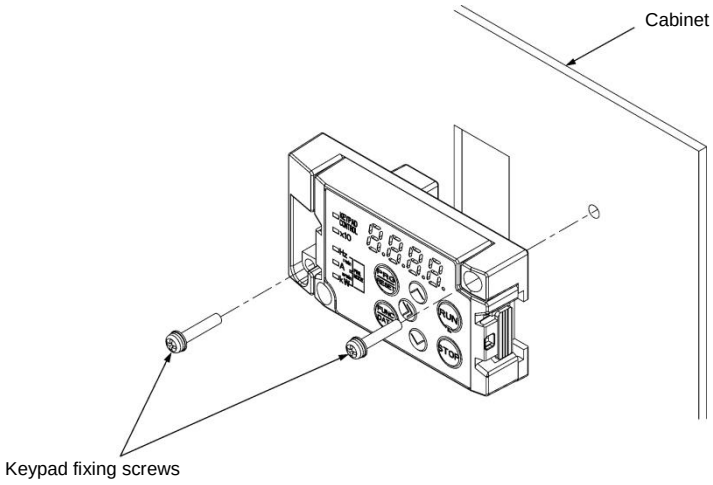


Figure 2.3-7 Attachment of the Keypad

(5) Connect athe commercially available LAN cable (straight) to the keypad RJ-45 connector and the inverter main body RJ-45 connector (modular jack). (Refer to Figure 2.3-8.)

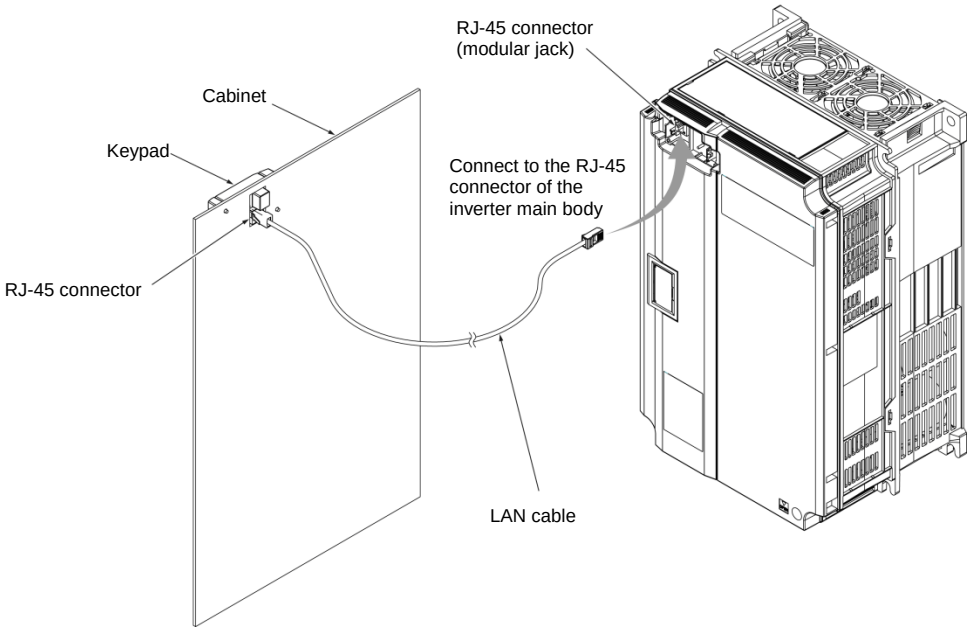


Figure 2.3-8 Connection a Commercially Available LAN Cable between the Keypad and the Inverter Main Body

⚠CAUTION

- Do not connect the inverter to PC LAN ports, Ethernet hubs, or telephone lines. The inverter and the connected instrument may be damaged.

Risk of fire and risk of accidents exist.

■ **Operating remotely, on the hand**

Connect following the procedure (5) in "■ Attachment to the cabinetAttachment to the cabinet Attachment to the cabinetAttachment to the cabinet".

2.4 RJ-45 Cover

The opening for the RS-485 communication cable connection (RJ-45 connector) is located below the keypad, as shown in Figure 2.4-1 and Figure 2.4-2. These models are special order.

■ **Types VXT-69A-2 / VXT-44A-4 / VXT-11A-1 or below**

To connect the RS-485 communication cable, open the RJ-45 cover as shown in Figure 2.4-1.

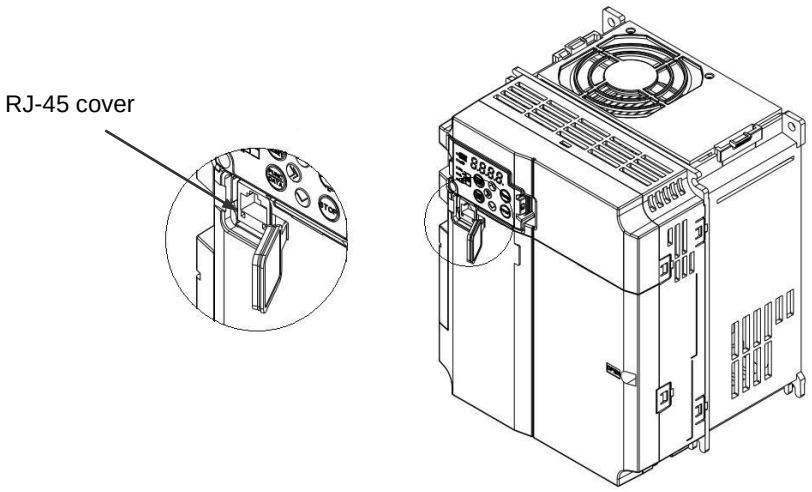


Figure 2.4-1 Connection of the RS-485 Communication Cable

■ **Types VXT-88A-2 / VXT-59A-4 or above**

To connect the RS-485 communication cable, open the RJ-45 cover until the “click” can be heard and connect the cable, as shown in Figure 2.4-2.

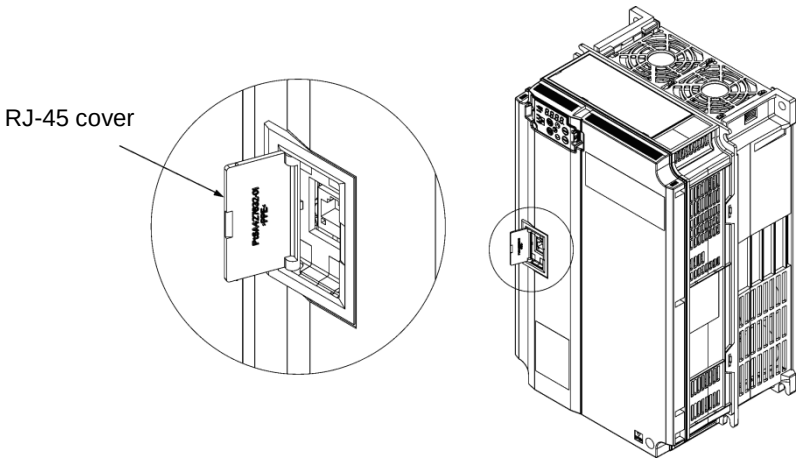


Figure 2.4-2 Connection of the RS-485 Communication Cable

Connect with the PC via the RS-485 converter using the RS-485 communication cable. The PC loader allows editing, confirmation, and management of the inverter function codes, and monitoring of operation data remotely. The operating status and alarms can also be monitored.

Chapter 3 OPERATION USING THE KEYPAD

Refer to the Jaguar VXT User's Manual, Chapter 3 for details of the keypad.

3.1 Names and Functions of Keypad Components

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



Table 3.1-1 Overview of Keypad Functions

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Monitor		Four-digit, 7-segment LED monitor which displays the followings according to the operation modes. ■ In Running mode: Running status information (e.g., output frequency, current, and voltage) When a light alarm occurs, *l-al* is displayed. ■ In Programming mode: Menus, function codes and their data ■ In Alarm mode: Alarm code, which identifies the alarm factor that has activated the protective function.
Operation Keys	PRG RESET	Program/Reset key which switches the operation modes of the inverter. ■ In Running mode: Pressing this key switches the inverter to Programming mode. ■ In Programming mode: Pressing this key switches the inverter to Running mode. ■ In Alarm mode: Pressing this key after removing the alarm factor resets the alarm and switches back to Running mode.
	FUNC DATA	Function/Data key which switches the operations you want to do in each mode as follows: ■ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). When a light alarm is displayed, holding down this key resets the light alarm and switches back to Running mode. ■ In Programming mode: Pressing this key displays the function code or establishes the data entered with ∧ and ∨ keys. ■ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
	RUN	RUN key. Press this key to run the motor.
	STOP	STOP key. Press this key to stop the motor.
	∧ and ∨	UP and DOWN keys. Press these keys to select the setting items and change the function code data displayed on the LED monitor.
	≫	Shift key. Press this key to shift the cursor to the right for entry of a numerical value.

Table 3.1-1 Overview of Keypad Functions (continued)

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Indicators	RUN LED	Lights when running with a run command entered by the (RUN) key, by terminal command ***FWD*** or ***REV***, or through the communications link.
	KEYPAD CONTROL LED	Lights when the inverter is ready to run with a run command entered by the (RUN) key (F02 = 0, 2, or 3). In Programming and Alarm modes, however, pressing the (RUN) key cannot run the inverter even if this indicator lights.
	Unit LEDs (3 LEDs)	These three LED indicators identify the unit of numeral displayed on the LED monitor in Running mode by combination of lit and unlit states of them. Unit: Hz, A, kW, r/min and m/min Refer to the Jaguar VXT User's Manual, “3.3.1 Monitoring the running status” for details.
		While the inverter is in Programming mode, ■Hz the LEDs of Hz and kW light. □A ■kW
	x10 LED	Lights when the data to display exceeds 9999. When this LED lights, the “displayed value x 10” is the actual value. Example: If data is “12,345,” the LED monitor displays *1234* and the x10 LED lights, meaning that “1,234 × 10 = 12,340.”

■ LED monitor

In Run mode, the LED monitor displays running status information (output frequency, current or voltage); in Programming mode, it displays menus, function codes and their data; and in Alarm mode, it displays an alarm code which identifies the alarm factor that has activated the protective function.

If one of LED 4 through LED1 is blinking, it means that the cursor is at this digit, allowing you to change it.
If the decimal point of LED1 is blinking, it means that the currently displayed data is a value of the PID command, not the frequency data usually displayed.

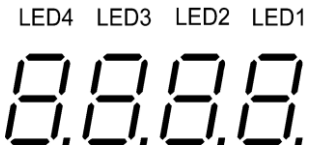


Figure 3.1-1 7-Segment LED Monitor

Table 3.1-2 Alphanumeric Characters on the LED Monitor

Character	7-segment	Character	7-segment	Character	7-segment	Character	7-segment
0	*0*	9	*9*	i	*i*	r	*r*
1	*1*	A	*a*	J	*j*	S	*s*
2	*2*	b	*Bb*	K	*k*	T	*T*
3	*3*	C	*Cc*	L	*l*	u	*U*
4	*4*	d	*d*	M	*m*	V	*u*
5	*5*	E	*e*	n	*n*	W	*w*
6	*6*	F	*f*	o	*o*	X	*x*
7	*7*	G	*g*	P	*p*	y	*y*
8	*8*	H	*h*	q	*q*	Z	*Z*
Special characters and symbols (numbers with decimal point, minus and underscore)							
0. - 9.	* –)	-	⁻	_	_		

3.2 Overview of Operation Modes

The Jaguar VXT features the following three operation modes.

Table 3.2-1 Operation Modes

Operation mode	Description
Running mode	When powered ON, the inverter automatically enters this mode. This mode allows you to specify the reference frequency, PID command value and etc., and run/stop the motor with the RUN / STOP keys. It is also possible to monitor the running status in real time. If a light alarm occurs, the *l-al* appears on the LED monitor.
Programming mode	This mode allows you to configure function code data and check a variety of information relating to the inverter status and maintenance.
Alarm mode	If an alarm condition arises, the inverter automatically enters Alarm mode in which you can view the corresponding alarm code* and its related information on the LED monitor. * Alarm code: Indicates the cause of the alarm condition. For details, first see “Table 6.1-1 Abnormal States Detectable (“Heavy Alarm” and “Light Alarm” Objects)” in Chapter 6 “6.1 Protective Function”, and then read the troubleshooting of each alarm.

Figure 3.2-1 shows the status transition of the inverter between these three operation modes.

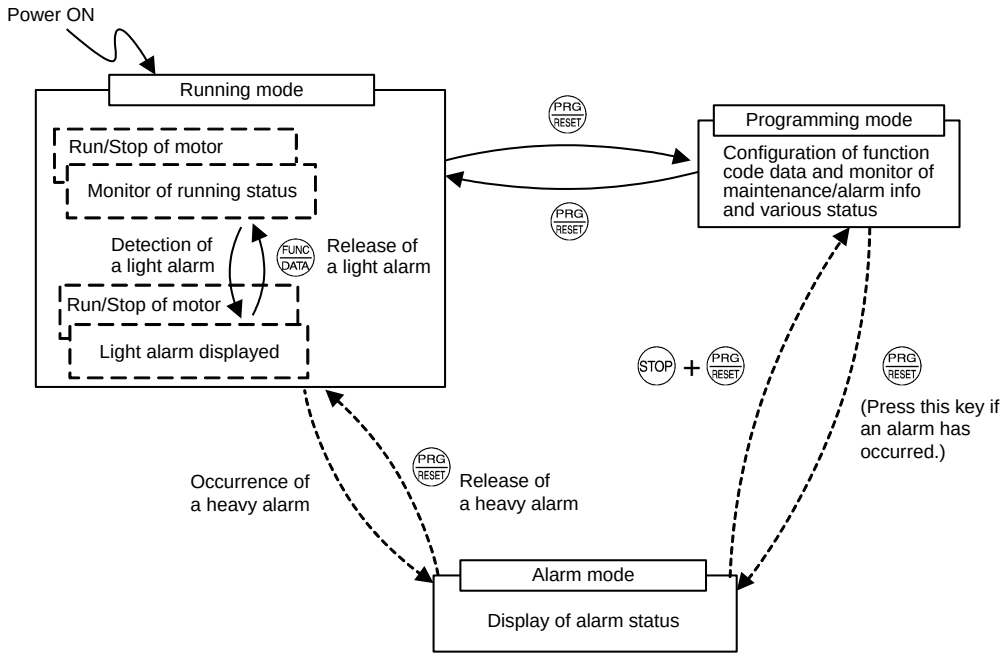


Figure 3.2-1 Status Transition between Operation Modes

Simultaneous keying

Simultaneous keying means pressing two keys at the same time. The simultaneous keying operation is expressed by a “+” letter between the keys throughout this manual.

For example, the expression “STOP + PRG RESET keys” stands for pressing the PRG RESET key with the STOP key held down.

Figure 3.2-2 illustrates the transition of the LED monitor screen during Running mode, the transition between menu items in Programming mode, and the transition between alarm codes at different occurrences in Alarm mode.

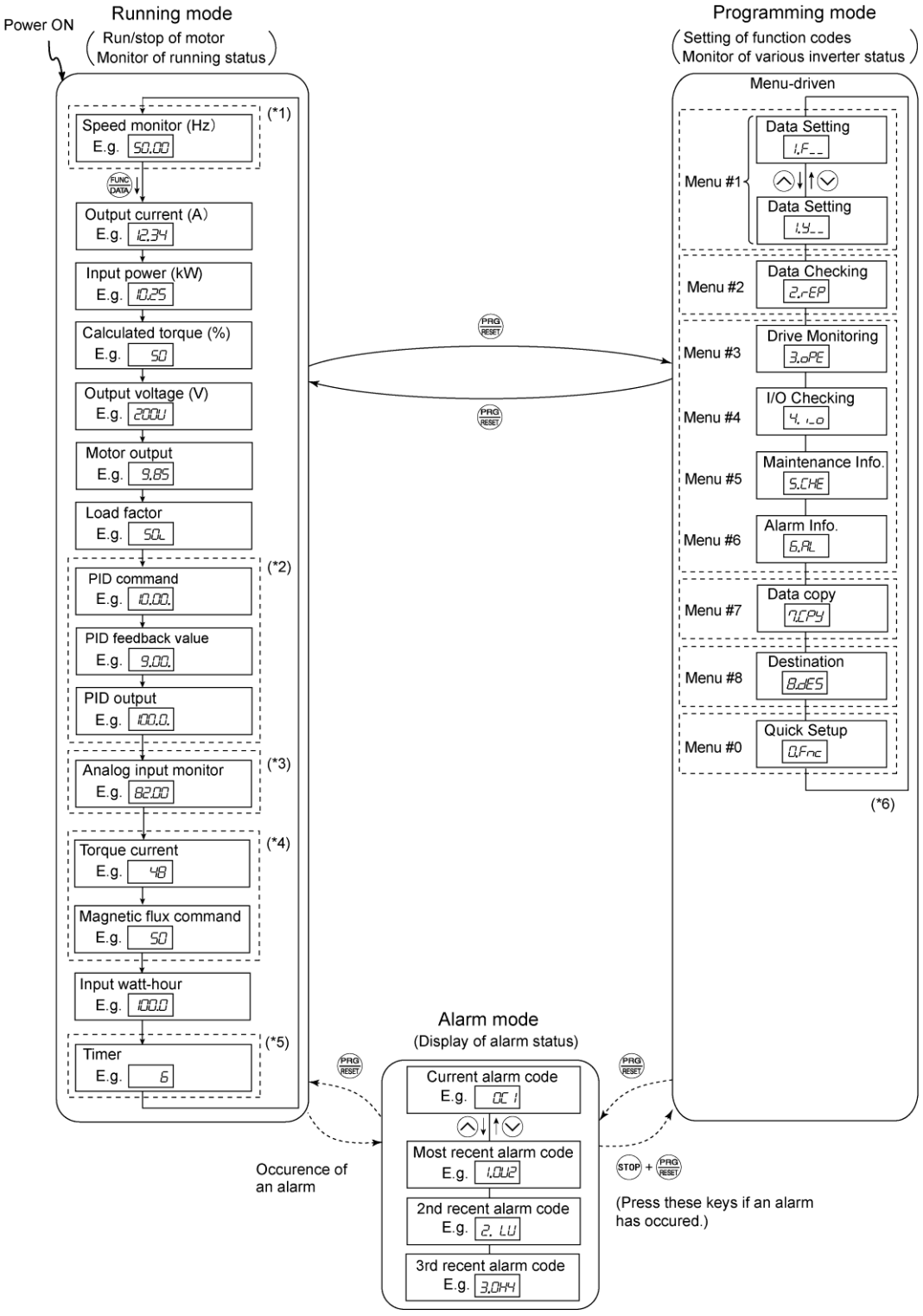


Figure 3.2-2 Transition between Basic Screens in Individual Operation Mode

(*1) The speed monitor allows you to select the desired one from the speed monitor items by using function code E48.

(*2) Applicable only when PID control is active (J01 = 1, 2 or 3).

(*3) The analog input monitor can appear only when the analog input monitor function is assigned to one of the analog input terminals by one of function codes E61 to E63 (= 20).

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

(*5) The Timer screen appears only when the timer operation is enabled with function code C21 (C21 = 1).

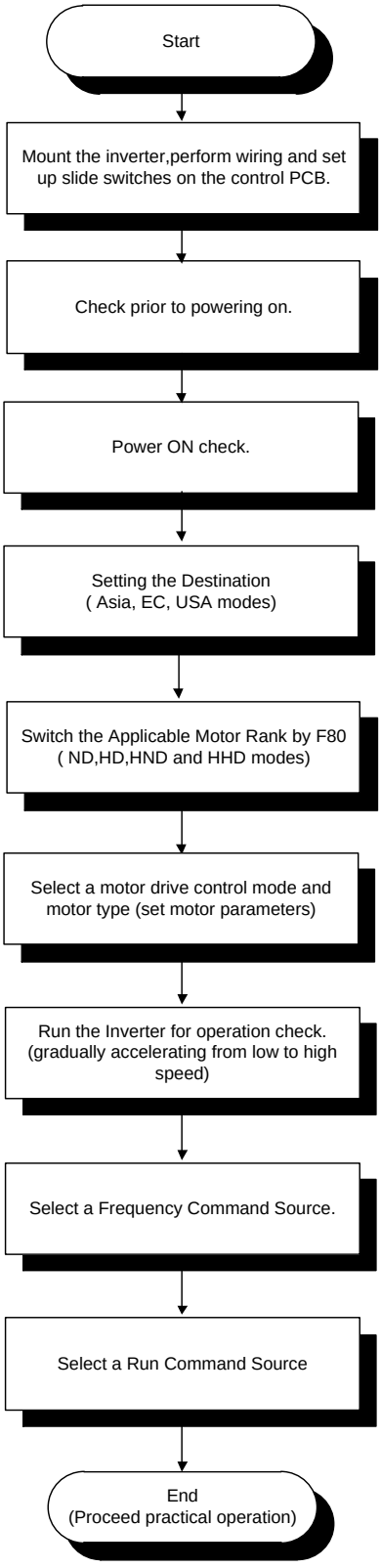
(*6) Applicable only when the full-menu mode is selected (E52 = 2). When a remote keypad with USB is equipped, *'cpy* is displayed.

Chapter 4 TEST RUN PROCEDURE

4.1 Test Run Procedure Flowchart

Make a test run of the motor using the flowchart given below.
This chapter describes the test run procedure with motor 1 dedicated function codes that are marked with an asterisk (*). For motor 2, replace those function codes with asterisk with motor 2 dedicated ones.

📖 For the function codes dedicated to motor 2, see Chapter 5 “FUNCTION CODES.”



(See Chapter 2.)

(See Section 4.2 .)

(See Section 4.3 .)

(See Section 5.2.)

(Section 4.4 .)

(See the Jaguar VXT User's Manual, Section 4.6 to 4.8 .)

(See the Jaguar VXT User's Manual, Section 4.9 .)

(See the Jaguar VXT User's Manual, Section 4.10 .)

(See the Jaguar VXT User's Manual, Section 4.11 .)

Figure 4.1-1 Test Run Procedure

4.2 Checking Prior to Powering On

Check the following before powering on the inverter.

(1) Check that the wiring is correct.

Especially check the wiring to the inverter input terminals (L1/R, L2/S, L3/T or L1/L, L2/N) and output terminals (U, V, and W). Also check that the grounding wires are connected to the grounding terminals (⏚G) correctly. See Figure 4.2-1.

⚠WARNING

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

Otherwise, an electric shock could occur.

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

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

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

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

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

(7) Check that a power factor correction DC reactor (DCR) is connected to the DC reactor terminals P1 and P(+). (ND-mode in case of inverters VXT-139A-4 or above, HD-/HND-mode in case of VXT-168A-4 or above, and HHD-mode in case of VXT-203A-4 or above must be used with a DCR. Be sure to connect the DCR to the inverter.)

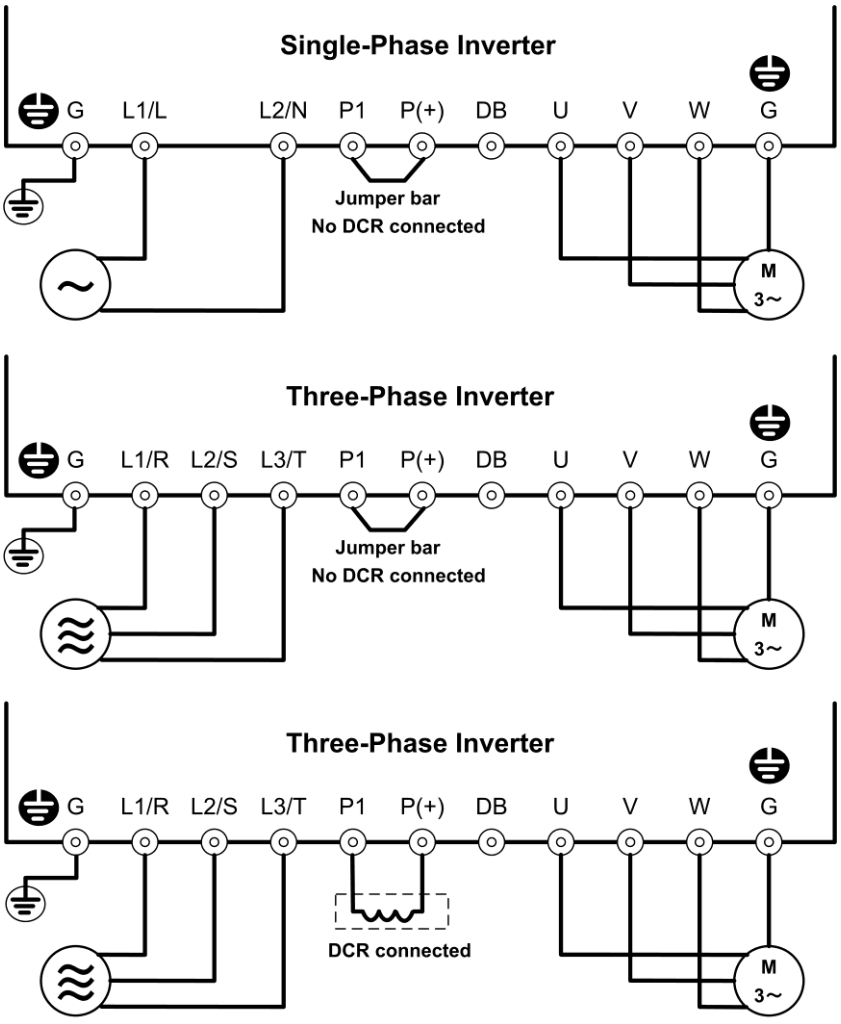


Figure 4.2-1 Connection of Main Circuit Terminals

4.3 Powering ON and Checking

⚠WARNING

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

Otherwise, an electric shock could occur.

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

(1) Check that the LED monitor displays *(des* (indicating that the destination is not set) that is blinking. See Figure 4.3-1.

(2) Check that the inverter (built-in) cooling fans rotate.



Figure 4.3-1 Display of the LED Monitor after Power-on

4.4 Switching the Applicable Motor Rating (ND, HD, HND and HHD Modes)

Changing the data of function code F80 switches the applicable motor rank to match load conditions. In HD, HND or HHD mode, the inverter drives a motor whose capacity is one or two ranks lower than the inverter's one.

F80 data	Drive mode	Application	Applicable motor	Overload capability	Maximum frequency	Operating temperature	Application samples
4	ND mode	General load	Motor whose capacity is equal to the inverter.	120% for 1 min.	120 Hz	40°C (104°F)	Fan, pump, blower, compressor, etc.
3	HD mode	Heavy duty load	Motor whose capacity is one size lower than the inverter.	150% for 1 min.	500 Hz	40°C (104°F)	Wire drawing machine, winding machine, twisting machine, spinning frame, etc.
1	HND mode	General load	Motor whose capacity is one size lower than the inverter.	120% for 1 min.	500 Hz	50°C (122°F)	Fan, pump, blower, compressor, etc.
0	HHD mode	Heavy duty load	Motor whose capacity is two sizes lower than the inverter.	150% for 1 min. 200% for 0.5 s.	500 Hz	50°C (122°F)	Wire drawing machine, winding machine, twisting machine, spinning frame, hoist, machine tool, etc.

The HD-/HND-/HHD-mode inverter brings out the continuous rated current level which enables the inverter to drive a motor with one or two sizes lower capacity, but its overload capability (%) against the continuous current level or the operating temperature increases. For details, see Chapter 12 “SPECIFICATIONS.”

Three-phase 400V series inverters are ND/HD/HND/HHD quadruple rated. However, the VXT-7A-4 and VXT-12A-4 are ND/HD/HHD triple rated.

Three-phase 200V series inverters are HND/HHD dual rated. However, the VXT-12A-2 and VXT-20A-2 are ND/HND dual rated.

Single-phase 200V series inverters are HHD single rating.

The inverter is subject to restrictions on the function code data setting range and internal processing as listed below.

Function codes	Name	ND mode	HD mode	HND mode	HHD mode	Remarks
F21*	DC braking (Braking level)	Setting range: 0 to 60%	Setting range: 0 to 80%		Setting range: 0 to 100%	In the ND/HD/HND mode, a value out of the range, if specified, automatically changes to the maximum value allowable in the ND/HD/HND mode.
F26	Motor sound (Carrier frequency)	ND mode - 0.75 to10 kHz (VXT-2A-4 to VXT-59A-4) - 0.75 to10 kHz (VXT-12A-2 to VXT-20A-2) - 0.75 to 6 kHz (VXT-72A-4 or above) HD/HND mode - 0.75 to16 kHz (VXT-4A-2 to VXT-88A-2) - 0.75 to16 kHz (VXT-2A-4 to VXT-59A-4) - 0.75 to10 kHz (VXT-7-4 to VXT-168A-4) - 0.75 to10 kHz (VXT-115A-2) - 0.75 to 6 kHz (VXT-203A-4 or above) HHD mode - 0.75 to16 kHz (VXT-4A-2 to VXT-115A-2) - 0.75 to16 kHz (VXT-3A-1 to VXT-11A-1) - 0.75 to16 kHz (VXT-2A-4 to VXT-168A-4) - 0.75 to10 kHz (VXT-203A-4 or above)				
F44	Current limiter (Level)	Initial value: 130%	Initial value: 160%	Initial value: 130%	Initial value: VXT-88A-2/ VXT-59A-4 or above : 160% VXT-69A-2/ VXT-44A-4 or below : 180%	Switching the drive mode with function code F80 automatically initializes the F44 data to the value specified at left.
F03*	Maximum frequency	Setting range: 25 to 500 Hz Upper limit: 120 Hz	Setting range: 25 to 500 Hz Upper limit: 500 Hz			In the ND mode, if the maximum frequency exceeds 120 Hz, the actual output frequency is internally limited to 120 Hz.
—	Current indication and output	Based on the rated current level for ND mode	Based on the rated current level for HD mode	Based on the rated current level for HND mode	Based on the rated current level for HHD mode	—

Switching between the drive modes does not automatically change the motor rated capacity (P02*) to the one suitable for the rank-changed motor, so configure the P02* data to match the applied motor rating as required.

Chapter 5
FUNCTION CODES

This chapter explains the table of function codes used in IMO Jaguar VXT, index per purpose, and the detail of each function code.

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5.1 Function Codes Overview

Function codes are used for selecting various functions of IMO Jaguar VXT. Function codes comprise 3 digits or 4 digits of alphanumeric character. The first digit categorizes the group of function code alphabetically and the subsequent 2 or 3 digits identify each code within the group by number.

Function code comprises 12 groups:

Basic function (F code),
Terminal function (E code),
Control code (C code),
Motor 1 parameter (P code),
High-level function (H code) (H1 code),
Motor 2 parameter (A code),
Application function 1 (J code) (J1 code),
Application function 2 (d code),
Customizable logic (U code) (U1 code),
Link function (y code),
Keypad functions (K code), and
Option function (o code) .

The function of each function code is determined according to the data to be set. The following descriptions are for supplementary explanation of function code table. Refer to instruction manual of each option to find the details of the option function (o code).

5.2 Function Codes Table

5.2.1 Supplementary note

■ Change, reflect, and save function code data during operation

Function codes are categorized into those which data change is enabled during operation of the inverter and those which such change is disabled. The meaning of the code in the “Change during operation” column of the function code table is described in the following table.

Code	Change during operation	Reflect and save data
Y*	Allowed	At the point when data is changed by ▲/▼ key, the changed data is immediately reflected on the operation of inverter. However, at this stage, the changed value is not saved to the inverter. In order to save it to the inverter, press FUNC/DATA key. Without saving by FUNC/DATA key and leaving the state of when the change was made by the PRG/RESET key, the data before the change is reflected on the operation of inverter.
Y	Allowed	Even if data is changed by the ▲/▼ key, the changed data will not be reflected on the operation of the inverter as is; by pressing the FUNC/DATA key, the changed value is reflected on the operation of the inverter and is also saved to the inverter.
N	Not allowed	—

■ Copying data

Function code data can be copied collectively by using the optional keypad “OP-KP-USB” (program mode menu number 7 “Data copy”). By using this function, it is possible to read out all function code data and write the same data to a different inverter.

However, if the specification of inverter at the copy source and copy destination is not identical, some function codes may not be copied due to security reason. According to necessity, configure the settings individually for the function codes that are not copied. The behaviour of the function codes regarding data copy is indicated in the “data copy” column in the function code table in the next page and following.

Y: to be copied.
Y1: When inverter capacity is different, copying will not be performed.
Y2: When voltage group is different, copying will not be performed.
N: not to be copied.

■ Negative logic setting of data

Digital input terminal and transistor/contact output terminal can become a signal for which negative logic is specified by function code data setting. Negative logic is a function to reverse ON and OFF state of input or output, and switch Active ON (function enabled with ON: positive logic) and Active OFF (function enabled with OFF: negative logic). However, negative logic may not be enabled depending on the function of the signal.

Negative logic signal can be switched by setting the data with 1000 added to the function code data of the function to be set. For example, the following example shows when coast to a stop command “BX” is selected by function code E01.

Function code data	Action
7	“BX” is ON and coast to a stop (Active ON)
1007	“BX” is OFF and coast to a stop (Active OFF)

■ **Drive control**

The IMO Jaguar VXT runs under any of the following drive controls. Some function codes apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the “Drive control” column in the function code tables given on the following pages.

Abbreviation in “Drive control” column in function code tables	Control target (H18)	Drive control (F42)
V/f	Speed (Frequency for V/f and PG V/f)	0,2: V/f control 1: Dynamic torque vector control
PG V/f		3: V/f control with speed sensor 4: V/f control with speed sensor and auto torque boost
w/ PG		6: Vector control with speed sensor
Torque control	Torque	6: Vector control with speed sensor
PM	Speed	15: Vector control without speed sensor nor pole position sensor

For details about the drive control, refer to the description of F42 “Drive control selection 1.”

Note The IMO Jaguar VXT is a general-purpose inverter whose operation is customized by frequency-basis function codes, like conventional inverters. Under the speed-basis drive control, however, the control target is a motor speed, not a frequency, so convert the frequency to the motor speed according to the following expression.

Motor speed (r/min) = 120 × Frequency (Hz) ÷ Number of poles

5.2.2 Function codes table

The table of function codes to be used in IMO Jaguar VXT is shown below.

■ F codes: Fundamental Functions (Basic function)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
F00	Data protection	0: No data protection, no digital setting protection 1: With data protection, no digital setting protection 2: No data protection, with digital setting protection 3: With data protection, with digital setting protection	Y	Y	0	Y	Y	Y	Y	Y	5-48
F01	Frequency setting 1	0: Keypad key operation (⌃/⌄key) 1: Analog voltage input (Terminal [12]) (from 0 to ±10 VDC) 2: Analog current input (Terminal [C1] (C1 function)) (4 to 20mA DC, 0 to 20mA DC) 3: Analog voltage input (Terminal [12]) + Analog current input (Terminal [C1] (C1 function)) 5: Analog voltage input (Terminal [C1] (V2 function)) (0 to 10 VDC) 7: UP/DOWN control 8: Keypad key operation (⌃/⌄key) (With balanceless bumpless) 10: Pattern operation 11: Digital input/output interface card (option) *5 12: Pulse train input	N	Y	0	Y	Y	Y	N	Y	5-49
F02	Operation method	0: Keypad operation (rotation direction input: terminal block) 1: External signal (digital input) 2: Keypad operation (forward rotation) 3: Keypad operation (Reverse rotation)	N	Y	2	Y	Y	Y	Y	Y	5-60
F03	Maximum output frequency 1	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	Y	Y	5-61
F04	Base frequency 1	25.0 to 500.0Hz	N	Y	50.0	Y	Y	Y	Y	Y	5-62
F05	Rated voltage at base frequency 1	0: AVR disable (output voltage proportional to power voltage) 80 to 240 V : AVR operation (200V class) 160 to 500V : AVR operation (400V class)	N	Y2	200V class 200V 400V class 400V	Y	Y	Y	Y	Y	
F06	Maximum output voltage 1	80 to 240V : AVR operation (200V class) 160 to 500V : AVR operation (400V class)	N	Y2		Y	Y	N	Y	Y	
F07	Acceleration time1	0.00 to 6000 s * 0.00 is for acceleration and deceleration time cancel (when performing soft-start and stop externally)	Y	Y	6.00 or 20.0 *10	Y	Y	Y	N	Y	5-64
F08	Deceleration time1		Y	Y		Y	Y	Y	N	Y	
F09	Torque boost 1	0.0 to 20.0% (% value against base frequency voltage 1)	Y	Y	*2	Y	Y	N	N	N	5-66
F10	Electronic thermal overload protection for motor 1 (Select motor characteristics)	1: Enable (For a general-purpose motor with self-cooling fan) 2: Enable (For an inverter-driven motor (FV) with separately powered cooling fan)	Y	Y	1	Y	Y	Y	Y	Y	5-66
F11	(Overload detection level)	0.00 (disable), current value of 1 to 135% of inverter rated current (Inverter rated current dependent on F80)	Y	Y1 Y2	*3	Y	Y	Y	Y	Y	
F12	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	Y	

▭ indicates quick setup target function code.
*2: Factory defaults are depended on motor capacity. Refer to “5.2.3 Factory default value per applicable electric motor capacitance”.
*3: The motor rated current is automatically set. Refer to “5.2.4 Motor constant”.
*4: 5.0min for inverters of nominal applied motor 22kW or below; 10.0min for those of 30kW or above.
*5: Available at ROM version 0300 or later.
*10: 6.00s for inverters of nominal applied motor 22kW or below; 20.0s for those of 30kW or above.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
F14	Restart mode after momentary power failure (Mode selection)	0: Trip immediately 1: Trip after a recovery from power failure 2: Trip after momentary deceleration is stopped 3: Continue to run (for heavy inertia load or general load) 4: Restart from frequency at power failure (for general load) 5: Restart from starting frequency	Y	Y	0	Y	Y	Y	N	Y	5-69
F15	Frequency limiter (Upper limit)	0.0 to 500.0Hz	Y	Y	70.0	Y	Y	Y	N	Y	5-76
F16	(Lower limit)	0.0 to 500.0Hz	Y	Y	0.0	Y	Y	Y	N	Y	
F18	Bias (for frequency setting 1)	-100.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	N	Y	5-76
F20	DC braking 1 (Braking starting frequency)	0.0 to 60.0Hz	Y	Y	0.0	Y	Y	Y	N	Y	5-77
F21	(Braking level)	0 to 100% (HHD mode), 0 to 80% (HD/HND mode) 0 to 60% (ND mode)	Y	Y	0	Y	Y	Y	N	Y	
F22	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	N	Y	
F23	Starting frequency 1	0.0 to 60.0Hz	Y	Y	0.5	Y	Y	Y	N	Y	5-80
F24	(Holding time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	N	Y	
F25	Stop frequency	0.0 to 60.0 Hz	Y	Y	0.2	Y	Y	Y	N	Y	
F26	Motor sound (Carrier frequency)	ND mode - 0.75 to 10 kHz (VXT-2A to 59A-4) - 0.75 to 6 kHz (VXT-72A-4 or above) HD/HND mode - 0.75 to16 kHz (VXT-4A to 88A-2) - 0.75 to16 kHz (VXT-2A to 59A-4) - 0.75 to16 kHz (VXT-3A to 11A-1) - 0.75 to10 kHz (VXT-72A to 168A-4) - 0.75 to10 kHz (VXT-115A-2) - 0.75 to 6 kHz (VXT-203A-4 or above) HHD mode - 0.75 to16 kHz (VXT-4A to 115A-2) - 0.75 to16 kHz (VXT-2A to 168A-4) - 0.75 to16 kHz (VXT-3A to 11A-1) - 0.75 to10 kHz (VXT-203A-4 or above)	Y	Y	2	Y	Y	Y	Y	Y	5-83
F27	(Tone)	0: Level 0 (Disable) 1 to 3 : Level 1 to 3	Y	Y	0	Y	Y	N	N	N	
F29	Terminal FM (Mode selection)	0: Voltage output (0 to +10 VDC) 1: Current output (4 to 20 mA DC) 2: Current output (0 to 20 mA DC) 3: Pulse output	Y	Y	0	Y	Y	Y	Y	Y	5-84
F30	(Output gain)	0 to 300%	Y*	Y	100	Y	Y	Y	Y	Y	
F31	(Function selection)	0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback value 8: Actual speed/estimated speed *5 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Calibration (+) 15: PID command (SV) 16: PID output (MV) 17: Position error in master-follower operation *5 18: Inverter heat sink temperature 21: PG feedback value *5 111 to 120 Customizable logic output signal 1 to 10	Y	Y	0	Y	Y	Y	N	Y	
F32	Terminal FM 2 *1 (Mode selection)	0: Voltage output (0 to +10 VDC) 1: Current output (4 to 20 mA DC) 2: Current output (0 to 20 mA DC)	Y	Y	0	Y	Y	Y	Y	Y	
F33	Terminal FM (Pulse rate)	25 to 32000 p/s (number of pulse at monitor value 100%)	Y*	Y	1440	Y	Y	Y	Y	Y	
F34	Terminal FM 2 *1 (Output gain)	0 to 300%	Y*	Y	100	Y	Y	Y	Y	Y	
F35	(Function selection)	Same as F31	Y	Y	2	Y	Y	Y	N	Y	

indicates quick setup target function code.
*1: F34 and F35 only exist for GB model and C model (for China).
*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
F37	Load selection/ Auto torque boost/ Auto energy-saving operation 1	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy-saving operation (variable torque load) 4: Auto energy-saving operation (constant torque load) 5: Auto energy-saving operation with auto torque boost	N	Y	1	Y	Y	Y	N	N	5-87
F38	Stop frequency (Detection mode) *5	0: Actual speed / estimated speed 1: Reference speed	N	Y	0	N	N	Y	N	N	5-89
F39	Stop frequency (Holding time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	N	Y	
F40	Torque limiter 1 (Driving)	0 to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	5-89
F41	(Braking)	0 to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	
F42	Drive control selection 1	0: V/f control without slip compensation 1: Vector control without speed sensor (dynamic torque vector) 2: V/f control with slip compensation 3: V/f control with speed sensor *5 4: V/f control with speed sensor and auto torque boost *5 6: Vector control for induction motor with speed sensor *5 15: Vector control for synchronous motor without speed sensor nor pole position sensor *5	N	Y	0	Y	Y	Y	Y	Y	5-95
F43	Current limiter (Mode selection)	0: Disable (No current limiter works.) 1: Enable at constant speed (Disable during ACC/DEC) 2: Enable during ACC/constant speed operation	Y	Y	2	Y	Y	N	N	N	5-99
F44	(Level)	20 to 200% (Rated current of the inverter for 100%)	Y	Y	130	Y	Y	N	N	N	
F50	Electronic thermal overload protection for braking resistor (Discharging capacity)	1 to 9000 kWs OFF (Cancel)	Y	Y1 Y2	OFF	Y	Y	Y	Y	Y	5-100
F51	(Allowable average loss)	0.001 to 99.99 kW	Y	Y1 Y2	0.001	Y	Y	Y	Y	Y	
F52	(Braking resistance value)	0.00: Resistance not required (Compatible mode with Jaguar VXR series) 0.01 to 999 Ω	Y	Y1 Y2	0.00	Y	Y	Y	Y	Y	
F80	Switching between ND, HD, HND and HHD drive modes	0: HHD mode 1: HND mode 3: HD mode 4: ND mode ND/HD mode is not supported for 200V class series.	N	Y	4	Y	Y	Y	Y	Y	5-102

*5: Available at ROM version 0300 or later.

■ E code: Extension Terminal Functions (Terminal function)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
E01	Terminal [X1] function	0 (1000): Select multistep frequency (0 to 1 steps) "SS1"	N	Y	0	Y	Y	Y	N	Y	5-103
E02	Terminal [X2] function	1 (1001): Select multistep frequency (0 to 3 steps) "SS2"	N	Y	1	Y	Y	Y	N	Y	
E03	Terminal [X3] function	2 (1002): Select multistep frequency (0 to 7 steps) "SS4"	N	Y	2	Y	Y	Y	N	Y	
E04	Terminal [X4] function	3 (1003): Select multistep frequency (0 to 15 steps) "SS8"	N	Y	7	Y	Y	Y	N	Y	
E05	Terminal [X5] function	4 (1004): Select ACC/DEC time (2 steps) "RT1"	N	Y	8	Y	Y	Y	N	Y	
		5 (1005): Select ACC/DEC time (4 steps) "RT2"				Y	Y	Y	N	Y	
		6 (1006): Select 3-wire operation "HLD"				Y	Y	Y	N	Y	
		7 (1007): Coast to a stop command "BX"				Y	Y	Y	Y	Y	
		8 (1008): Reset alarm (Abnormal) "RST"				Y	Y	Y	Y	Y	
		9 (1009): External alarm "THR" (9 = Active OFF/ 1009 = Active ON)				Y	Y	Y	Y	Y	
		10 (1010): Ready for jogging "JOG"				Y	Y	Y	N	N	
		11 (1011): Select frequency setting 2/ frequency setting 1 "Hz2/ Hz1"				Y	Y	Y	N	Y	
		12 (1012): Select motor 2 "M2"				Y	Y	Y	Y	Y	
		13: DC braking command "DCBRK"				Y	Y	Y	N	N	
		14 (1014): Select torque limit 2/ torque limit 1 "TL2/ TL1"				Y	Y	Y	Y	Y	
		15: Switch to commercial power (50 Hz) "SW50"				Y	Y	N	N	N	
		16: Switch to commercial power (60 Hz) "SW60"				Y	Y	N	N	N	
		17 (1017): UP command "UP"				Y	Y	Y	N	Y	
		18 (1018): DOWN command "DOWN"				Y	Y	Y	N	Y	
		19 (1019): Allow function code editing (Data change enabled) "WE-KP"				Y	Y	Y	Y	Y	
		20 (1020): Cancel PID control "Hz/PID"				Y	Y	Y	N	Y	
		21 (1021): Switch normal/ inverse operation "IVS"				Y	Y	Y	N	Y	
		22 (1022): Interlock "IL"				Y	Y	Y	Y	Y	
		23 (1023): Cancel torque control *5 "Hz/TRQ"				N	N	N	Y	N	
		24 (1024): Select link operation (RS-485, BUS option) "LE"				Y	Y	Y	Y	Y	
		25 (1025): Universal DI "U-DI"				Y	Y	Y	Y	Y	
		26 (1026): Select auto search for idling motor speed at starting "STM"				Y	Y	N	N	Y	
		30 (1030): Force to stop "STOP" (30 = Active OFF/1030 = Active ON)				Y	Y	Y	Y	Y	
		32 (1032): Pre-excite *5 "EXITE"				N	N	Y	Y	N	
		33 (1033): Reset PID integral and differential terms "PID-RST"				Y	Y	Y	N	Y	
		34 (1034): Hold PID integral term "PID-HLD"				Y	Y	Y	N	Y	
		35 (1035): Select local (Keypad) command "LOC"				Y	Y	Y	Y	Y	
		42 (1042): Activate the limit switch at start point *5 "LS"				Y	Y	N	N	N	
		43 (1043): Start / Reset *5 "S/R"				Y	Y	N	N	N	
		44 (1044): Switch to the serial pulse receiving mode *5 "SPRM"				Y	Y	N	N	N	
		45 (1045): Enter the return mode *5 "RTN"				Y	Y	N	N	N	
		46 (1046): Enable overload stop "OLS"				Y	Y	Y	N	Y	
		47 (1047): Servo lock command *5 "LOCK"				N	N	Y	N	N	
		48: Pulse train input (Only for X5 terminal (E05)) "PIN"				Y	Y	Y	N	Y	
		49 (1049): Pulse train sign "SIGN" (Other than X5 terminal (E01 to E04))				Y	Y	Y	N	Y	
		59 (1059): Enable battery-driven operation *11 "BATRY/UPS"				Y	Y	Y	N	N	
		60 (1060): Select torque bias1 *5 "TB1"				N	N	Y	N	N	
		61 (1061): Select torque bias2 *5 "TB2"				N	N	Y	N	N	
		62 (1062): Hold torque bias *5 "H-TB"				N	N	Y	N	N	
		65 (1065): Check brake "BRKE"				Y	Y	Y	N	N	
		70 (1070): Cancel line speed control *5 "Hz/LSC"				Y	Y	Y	N	N	

*5: Available at ROM version 0300 or later.
*11: Available at ROM version 0500 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
		71 (1071): Hold line speed control frequency in the memory *5 "LSC-HLD"				Y	Y	Y	N	N	
		72 (1072): Count the run time of commercial power-driven motor 1 *5 "CRUN-M1"				Y	Y	Y	Y	N	
		73 (1073): Count the run time of commercial power-driven motor 2 *5 "CRUN-M2"				Y	Y	Y	Y	N	
		76 (1076): Select droop control "DROOP"				Y	Y	Y	N	N	
		78 (1078): Select speed control parameter 1 *5 "MPRM1"				N	Y	Y	Y	Y	
		79 (1079): Select speed control parameter 2 *5 "MPRM2"				N	Y	Y	Y	Y	
		80 (1080): Cancel customizable logic "CLC"				Y	Y	Y	Y	Y	
		81 (1081): Clear all customizable logic timers "CLTC"				Y	Y	Y	Y	Y	
		82 (1082): Cancel anti-regenerative control "AR-CCL"				Y	Y	Y	N	Y	
		100: No function assigned "NONE"				Y	Y	Y	Y	Y	
		171 (1171): PID control multistage command 1 "PID-SS1"				Y	Y	Y	N	Y	
		172 (1172): PID control multistage command 2 "PID-SS2"				Y	Y	Y	N	Y	
		* Inside the ( ) is the negative logic signal (OFF at short-circuit)									
E10	Acceleration time2	0.00 to 6000 s * 0.00 is for acceleration and deceleration time cancel (when performing soft-start and stop externally)	Y	Y	6.00 or 20.0 *10	Y	Y	Y	N	Y	5-119
E11	Deceleration time2		Y	Y		Y	Y	Y	N	Y	
E12	Acceleration time 3		Y	Y		Y	Y	Y	N	Y	
E13	Deceleration time 3		Y	Y		Y	Y	Y	N	Y	
E14	Acceleration time 4		Y	Y		Y	Y	Y	N	Y	
E15	Deceleration time 4		Y	Y		Y	Y	Y	N	Y	
E16	Torque limiter 2 (Driving)	0 to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	5-119
E17	(Braking)	0 to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	Y	Y	
E20	Terminal [Y1] function	0 (1000): Inverter running "RUN"	N	Y	0	Y	Y	Y	Y	Y	5-120
E21	Terminal [Y2] function	1 (1001): Frequency (speed) arrival "FAR"	N	Y	7	Y	Y	Y	N	Y	
E27	Terminal [30A/B/C] function (Relay output)	2 (1002): Frequency (speed) detected "FDT"	N	Y	99	Y	Y	Y	Y	Y	
		3 (1003): Under voltage detected (inverter stopped) "LU"				Y	Y	Y	Y	Y	
		4 (1004): Detected torque polarity "B/D"				Y	Y	Y	Y	Y	
		5 (1005): Inverter output limiting "IOL"				Y	Y	Y	Y	Y	
		6 (1006): Auto-restarting after momentary power failure "IPF"				Y	Y	Y	Y	Y	
		7 (1007): Motor overload early warning "OL"				Y	Y	Y	Y	Y	
		8 (1008): Keypad operation enabled "KP"				Y	Y	Y	Y	Y	
		10 (1010): Inverter ready to run "RDY"				Y	Y	Y	Y	Y	
		15 (1015): Switch MC on the input power lines "AX"				Y	Y	Y	Y	Y	
		16 (1016): Pattern operation stage transition "TU"				Y	Y	Y	N	Y	
		17 (1017): Pattern operation cycle completed "TO"				Y	Y	Y	N	Y	
		18 (1018): Pattern operation stage 1 "STG1"				Y	Y	Y	N	Y	
		19 (1019): Pattern operation stage 2 "STG2"				Y	Y	Y	N	Y	
		20 (1020): Pattern operation stage 4 "STG4"				Y	Y	Y	N	Y	
		21 (1021): Frequency (speed) arrival 2 "FAR2"				Y	Y	Y	N	Y	
		22 (1022): Inverter output limiting with delay "IOL2"				Y	Y	Y	Y	Y	
		25 (1025): Cooling fan in operation "FAN"				Y	Y	Y	Y	Y	
		26 (1026): Auto-resetting "TRY"				Y	Y	Y	Y	Y	
		27 (1027): Universal DO "U-DO"				Y	Y	Y	Y	Y	
		28 (1028): Heat sink overheat early warning "OH"				Y	Y	Y	Y	Y	
		29 (1029): Synchronization completed *5 "SY"				N	Y	Y	N	N	
		30 (1030): Lifetime alarm "LIFE"				Y	Y	Y	Y	Y	
		31 (1031): Frequency (speed) detected 2 "FDT2"				Y	Y	Y	Y	Y	
		33 (1033): Reference loss detected "REF OFF"				Y	Y	Y	N	Y	
		35 (1035): Inverter outputting "RUN 2"				Y	Y	Y	Y	Y	
		36 (1036): Overload prevention controlling "OLP"				Y	Y	Y	N	Y	
		37 (1037): Current detected "ID"				Y	Y	Y	Y	Y	
		38 (1038): Current detected 2 "ID2"				Y	Y	Y	Y	Y	
		39 (1039): Current detected 3 "ID3"				Y	Y	Y	Y	Y	

*5: Available at ROM version 0300 or later.
*10: 6.00s for inverters of nominal applied motor 22kW or below; 20.0s for those of 30kW or above.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
		41 (1041): Low current detected “IDL”				Y	Y	Y	Y	Y	
		42 (1042): PID alarm “PID-ALM”				Y	Y	Y	N	Y	
		43 (1043): Under PID control “PID-CTL”				Y	Y	Y	N	Y	
		44 (1044): Under sleep mode of PID control “PID-STP”				Y	Y	Y	N	Y	
		45 (1045): Low torque detected “U-TL”				Y	Y	Y	Y	Y	
		46 (1046): Torque detected 1 “TD1”				Y	Y	Y	Y	Y	
		47 (1047): Torque detected 2 “TD2”				Y	Y	Y	Y	Y	
		48 (1048): Motor 1 selected “SWM1”				Y	Y	Y	Y	Y	
		49 (1049): Motor 2 selected “SWM2”				Y	Y	Y	Y	Y	
		52 (1052): Running forward “FRUN”				Y	Y	Y	Y	Y	
		53 (1053): Running reverse “RRUN”				Y	Y	Y	Y	Y	
		54 (1054): Under remote mode “RMT”				Y	Y	Y	Y	Y	
		56 (1056): Motor overheat detected by thermistor “THM”				Y	Y	Y	Y	Y	
		57 (1057): Brake control “BRKS”				Y	Y	Y	N	N	
		58 (1058): Frequency (speed) detected 3 “FDT3”				Y	Y	Y	Y	Y	
		59 (1059): Terminal [C1] (C1 function) wire break detected “C1OFF”				Y	Y	Y	Y	Y	
		70 (1070): Speed valid *5 “DNZS”				N	Y	Y	Y	Y	
		71 (1071): Speed agreement *5 “DSAG”				N	Y	Y	N	Y	
		72 (1072): Frequency (speed) arrival 3 “FAR3”				Y	Y	Y	N	Y	
		76 (1076): PG error detected *5 “PG-ERR”				N	Y	Y	N	Y	
		77 (1077): Low DC link bus voltage detection “U-EDC”				Y	Y	Y	Y	Y	
		79 (1079): During decelerating at momentary power failure “IPF2”				Y	Y	Y	Y	Y	
		80 (1080): Stop position override alarm *5 “OT”				N	Y	N	N	N	
		81 (1081): Under positioning *5 “TO”				N	Y	N	N	N	
		82 (1082): Positioning completed *5 “PSET”				N	Y	Y	N	N	
		83 (1083): Current position count over-flowed *5 “POF”				N	Y	N	N	N	
		84 (1084): Maintenance timer counted up “MNT”				Y	Y	Y	Y	Y	
		87 (1087): Frequency arrival and detected “FARFDT”				Y	Y	Y	N	Y	
		90 (1090): Alarm content 1 “AL1”				Y	Y	Y	Y	Y	
		91 (1091): Alarm content 2 “AL2”				Y	Y	Y	Y	Y	
		92 (1092): Alarm content 4 “AL4”				Y	Y	Y	Y	Y	
		93 (1093): Alarm content 8 “AL8”				Y	Y	Y	Y	Y	
		98 (1098): Light alarm “L-ALM”				Y	Y	Y	Y	Y	
		99 (1099): Alarm output “ALM”				Y	Y	Y	Y	Y	
		101 (1101): EN circuit failure detected “DECF”				Y	Y	Y	Y	Y	
		102 (1102): EN terminal input OFF “ENOFF”				Y	Y	Y	Y	Y	
		105 (1105): Braking transistor broken “DBAL”				Y	Y	Y	Y	Y	
		111 (1111): Customizable logic output signal 1 “CLO1”				Y	Y	Y	Y	Y	
		112 (1112): Customizable logic output signal 2 “CLO2”				Y	Y	Y	Y	Y	
		113 (1113): Customizable logic output signal 3 “CLO3”				Y	Y	Y	Y	Y	
		114 (1114): Customizable logic output signal 4 “CLO4”				Y	Y	Y	Y	Y	
		115 (1115): Customizable logic output signal 5 “CLO5”				Y	Y	Y	Y	Y	
		116 (1116): Customizable logic output signal 6 “CLO6”				Y	Y	Y	Y	Y	
		117 (1117): Customizable logic output signal 7 “CLO7”				Y	Y	Y	Y	Y	
		118 (1118): Customizable logic output signal 8 “CLO8”				Y	Y	Y	Y	Y	
		119 (1119): Customizable logic output signal 9 “CLO9”				Y	Y	Y	Y	Y	
		120 (1120): Customizable logic output signal 10 “CLO10”				Y	Y	Y	Y	Y	
		* Inside the ( ) is written the negative logic signal setting (OFF at short-circuit)									
E29	Frequency arrival delay timer (FAR2)	0.01 to 10.00 s	Y	Y	0.10	Y	Y	Y	N	Y	5-129
E30	Frequency arrival detection width (Detection width)	0.0 to 10.0 Hz	Y	Y	2.5	Y	Y	Y	N	Y	

*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
E31	Frequency detection 1 (Level)	0.0 to 500.0 Hz	Y	Y	50.0	Y	Y	Y	N	Y	5-131
E32	(Hysteresis width)	0.0 to 500.0 Hz	Y	Y	1.0	Y	Y	Y	N	Y	
E34	Overload early warning/Current detection (Level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	Y	Y1 Y2	*3	Y	Y	Y	Y	Y	5-132
E35	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E36	Frequency detection 2 (Level)	0.0 to 500.0 Hz	Y	Y	50.0	Y	Y	Y	Y	Y	5-133
E37	Current detection 2/ Low current detection (Level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	Y	Y1 Y2	*3	Y	Y	Y	Y	Y	5-133
E38	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E39	Display coefficient for transport time	0.000 to 9.999	Y	Y	0.000	Y	Y	Y	N	Y	5-133
E42	LED display filter	0.0 to 5.0 s	Y	Y	0.5	Y	Y	Y	Y	Y	5-133
E43	LED monitor (Item selection)	0: Speed monitor (Selectable with E48) 3: Output current 4: Output voltage 8: Calculated torque 9: Input power 10: PID process command 12: PID feedback value 13: Timer value(for timed operation) 14: PID output 15: Load factor 16: Motor output 17: Analog signal input monitor 21: Current position pulse *5 22: Position error pulse *5 23: Torque current (%) *5 24: Magnetic flux command(%) *5 25: Input watt-hour	Y	Y	0	Y	Y	Y	Y	Y	5-134
E44	(Display when stopped)	0: Specified value 1: Output value	Y	Y	0	Y	Y	Y	Y	Y	5-136
E48	LED monitor (Speed monitor item)	0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Reference frequency 3: Motor rotation speed 4: Load rotation speed 5: Line speed 6: Transport time for specified length 7: Speed (%)	Y	Y	0	Y	Y	Y	Y	Y	5-136
E49	Torque Command Monitor *5 (Polarity selection)	0: Torque polarity 1: Plus for driving, Minus for braking	Y	Y	1	Y	Y	Y	Y	Y	5-136
E50	Display coefficient for speed monitor	0.01 to 200.00	Y	Y	30.00	Y	Y	Y	Y	Y	5-137
E51	Display coefficient for “Input watt-hour data”	0.000 (Cancel/Reset). 0.001 to 9999	Y	Y	0.010	Y	Y	Y	Y	Y	5-137
E52	Keypad (Menu display mode)	0: Function code data setting mode (Menu 0, Menu1, and Menu 7) 1: Function code data check mode (Menu 2 and Menu 7) 2: Full-menu mode	Y	Y	0	Y	Y	Y	Y	Y	5-138
E54	Frequency detection 3 (Level)	0.0 to 500.0Hz	Y	Y	50.0	Y	Y	Y	Y	Y	5-138
E55	Current detection 3 (Level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	Y	Y1 Y2	*3	Y	Y	Y	Y	Y	5-138
E56	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	

indicates quick setup target function code.
*3: The motor rated current is automatically set. Refer to “5.2.4 Motor constant” (function code P03).
*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
E59	Terminal [C1] function selection	0: Current input (C1 function) 1: Voltage input (V2 function)	N	Y	0	Y	Y	Y	Y	Y	5-139
E61	Terminal [12] extended function	0: None 1: Auxiliary frequency setting 1 2: Auxiliary frequency setting 2 3: PID process command 5: PID feedback value 6: Ratio setting 7: Analog torque limiter A 8: Analog torque limiter B 9: Torque bias *5 10: Torque command *5 11: Torque current command *5 17: Speed limit for forward rotation *5 18: Speed limit for reverse rotation *5 20: Analog signal input monitor	N	Y	0	Y	Y	Y	Y	Y	5-140
E62	Terminal [C1] (C1 extended function)		N	Y	0	Y	Y	Y	Y	Y	
E63	Terminal [C1] (V2 extended function)		N	Y	0	Y	Y	Y	Y	Y	
E64	Saving of digital reference frequency	0: Auto saving (main power is turned off) 1: Save by turning key ON	Y	Y	0	Y	Y	Y	Y	Y	5-140
E65	Reference loss detection	0: Stop deceleration 20 to 120%, 999: Cancel	Y	Y	999	Y	Y	Y	N	Y	5-141
E76	DC link bus low-voltage detection level	200 to 400 V (200 V class) 400 to 800 V (400 V class)	Y	Y	235 470	Y	Y	Y	Y	Y	5-141
E78	Torque detection 1 (Level)	0 to 300%	Y	Y	100	Y	Y	Y	Y	Y	5-142
E79	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	Y	Y	
E80	Torque detection 2/ low torque detection (Level)	0 to 300%	Y	Y	20	Y	Y	Y	Y	Y	
E81	(Timer)	0.01 to 600.00 s	Y	Y	20.00	Y	Y	Y	Y	Y	
E98	Terminal [FWD] function	0 (1000): Select multistep frequency (0 to 1 steps) "SS1"	N	Y	98	Y	Y	Y	N	Y	5-142
E99	Terminal [REV] function	1 (1001): Select multistep frequency (0 to 3 steps) "SS2"	N	Y	99	Y	Y	Y	N	Y	
		2 (1002): Select multistep frequency (0 to 7 steps) "SS4"				Y	Y	Y	N	Y	
		3 (1003): Select multistep frequency (0 to 15 steps) "SS8"				Y	Y	Y	N	Y	
		4 (1004): Select ACC/DEC time (2 steps) "RT1"				Y	Y	Y	N	Y	
		5 (1005): Select ACC/DEC time (4 steps) "RT2"				Y	Y	Y	N	Y	
		6 (1006): Select 3-wire operation "HLD"				Y	Y	Y	N	Y	
		7 (1007): Coast to a stop command "BX"				Y	Y	Y	Y	Y	
		8 (1008): Reset alarm (Abnormal) "RST"				Y	Y	Y	Y	Y	
		9 (1009): External alarm (9 = Active OFF/1009 = Active ON) "THR"				Y	Y	Y	Y	Y	
		10 (1010): Ready for jogging "JOG"				Y	Y	Y	N	N	
		11 (1011): Select frequency setting 2/ frequency setting 1 "Hz2/ Hz1"				Y	Y	Y	N	Y	
		12 (1012): Select Motor 2 "M2"				Y	Y	Y	Y	Y	
		13: DC braking command "DCBRK"				Y	Y	Y	N	N	
		14 (1014): Select torque limit 2/ torque limit 1 "TL2/ TL1"				Y	Y	Y	Y	Y	
		15: Switch to commercial power (50 Hz) "SW50"				Y	Y	N	N	N	
		16: Switch to commercial power (60 Hz) "SW60"				Y	Y	N	N	N	
		17 (1017): UP command "UP"				Y	Y	Y	N	Y	
		18 (1018): DOWN command "DOWN"				Y	Y	Y	N	Y	
		19 (1019): Allow function code editing (Data change enabled) "WE-KP"				Y	Y	Y	Y	Y	
		20 (1020): Cancel PID control "Hz/PID"				Y	Y	Y	N	Y	
		21 (1021): Switch normal/ inverse operation "IVS"				Y	Y	Y	N	Y	
		22 (1022): Interlock "IL"				Y	Y	Y	Y	Y	
		23 (1023): Cancel torque control *5 "Hz/TRQ"				N	N	N	Y	N	
		24 (1024): Select link operation (RS-485, BUS option) "LE"				Y	Y	Y	Y	Y	
		25 (1025): Universal DI "U-DI"				Y	Y	Y	Y	Y	
		26 (1026): Select auto search for idling motor speed at starting "STM"				Y	Y	N	N	Y	
		30 (1030): Force to stop (30 = Active OFF/1030 = Active ON) "STOP"				Y	Y	Y	Y	Y	
		32 (1032): Pre-excite *5 "EXITE"				N	N	Y	Y	N	

*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
		33 (1033): Reset PID integral and differential terms "PID-RST"				Y	Y	Y	N	Y	
		34 (1034): Hold PID integral term "PID-HLD"				Y	Y	Y	N	Y	
		35 (1035): Select local (Keypad) command "LOC"				Y	Y	Y	Y	Y	
		42 (1042): Activate the limit switch at start point *5 "LS"				Y	Y	N	N	N	
		43 (1043): Start / Reset *5 "S/R"				Y	Y	N	N	N	
		44 (1044): Switch to the serial pulse receiving mode *5 "SPRM"				Y	Y	N	N	N	
		45 (1045): Enter the return mode *5 "RTN"				Y	Y	N	N	N	
		46 (1046): Enable overload stop "OLS"				Y	Y	Y	N	Y	
		47 (1047): Servo lock command *5 "LOCK"				N	N	Y	N	N	
		49 (1049): Pulse train sign "SIGN"				Y	Y	Y	N	Y	
		59 (1059): Enable battery-driven operation *11 "BATRY/UPS"				Y	Y	Y	N	N	
		60 (1060): Select torque bias1 *5 "TB1"				N	N	Y	N	N	
		61 (1061): Select torque bias2 *5 "TB2"				N	N	Y	N	N	
		62 (1062): Hold torque bias *5 "H-TB"				N	N	Y	N	N	
		65 (1065): Check brake "BRKE"				Y	Y	Y	N	N	
		70 (1070): Cancel line speed control *5 "Hz/LSC"				Y	Y	Y	N	N	
		71 (1071): Hold line speed control frequency in the memory *5 "LSC-HLD"				Y	Y	Y	N	N	
		72 (1072): Count the run time of commercial power-driven motor 1 *5 "CRUN-M1"				Y	Y	Y	Y	N	
		73 (1073): Count the run time of commercial power-driven motor 2 *5 "CRUN-M2"				Y	Y	Y	Y	N	
		76 (1076): Select droop control "DROOP"				Y	Y	Y	N	N	
		78 (1078): Select speed control parameter 1 *5 "MPRM1"				N	Y	Y	Y	Y	
		79 (1079): Select speed control parameter 2 *5 "MPRM2"				N	Y	Y	Y	Y	
		80 (1080): Cancel customizable logic "CLC"				Y	Y	Y	Y	Y	
		81 (1081): Clear all customizable logic timers "CLTC"				Y	Y	Y	Y	Y	
		82 (1082): Cancel anti-regenerative control "AR-CCL"				Y	Y	Y	N	Y	
		98: Run forward / stop command "FWD"				Y	Y	Y	Y	Y	
		99: Run reverse / stop command "REV"				Y	Y	Y	Y	Y	
		100: No function assigned "NONE"				Y	Y	Y	Y	Y	
		171 (1171): PID control multistage command 1 "PID-SS1"				Y	Y	Y	N	Y	
		172 (1172): PID control multistage command 2 "PID-SS2"				Y	Y	Y	N	Y	
		* Inside the ( ) is the negative logic signal. (OFF at short-circuit)									

*5: Available at ROM version 0300 or later.
*11: Available at ROM version 0500 or later.

■ C code: Control Functions of Frequency (Control function)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
C01	Jump frequency 1	0.0 to 500.0Hz	Y	Y	0.0	Y	Y	Y	N	Y	5-143
C02	2		Y	Y	0.0	Y	Y	Y	N	Y	
C03	3		Y	Y	0.0	Y	Y	Y	N	Y	
C04	(Skip width)	0.0 to 30.0Hz	Y	Y	3.0	Y	Y	Y	N	Y	
C05	Multistep frequency 1	0.00 to 500.00Hz	Y	Y	0.00	Y	Y	Y	N	Y	5-144
C06	2		Y	Y	0.00	Y	Y	Y	N	Y	
C07	3		Y	Y	0.00	Y	Y	Y	N	Y	
C08	4		Y	Y	0.00	Y	Y	Y	N	Y	
C09	5		Y	Y	0.00	Y	Y	Y	N	Y	
C10	6		Y	Y	0.00	Y	Y	Y	N	Y	
C11	7		Y	Y	0.00	Y	Y	Y	N	Y	
C12	8		Y	Y	0.00	Y	Y	Y	N	Y	
C13	9		Y	Y	0.00	Y	Y	Y	N	Y	
C14	10		Y	Y	0.00	Y	Y	Y	N	Y	
C15	11		Y	Y	0.00	Y	Y	Y	N	Y	
C16	12		Y	Y	0.00	Y	Y	Y	N	Y	
C17	13		Y	Y	0.00	Y	Y	Y	N	Y	
C18	14		Y	Y	0.00	Y	Y	Y	N	Y	
C19	15		Y	Y	0.00	Y	Y	Y	N	Y	
C20	Jogging frequency	0.00 to 500.00 Hz	Y	Y	0.00	Y	Y	Y	N	N	5-144
C21	Pattern operation / timed operation (Mode selection)	0: 1 cycle operation 1: Repetition operation 2: Constant speed operation after 1 cycle operation 3: Timed operation	N	Y	0	Y	Y	Y	N	Y	5-145
C22	(Stage 1)	Special setting: Press FUNC/DATA key three times. 1st: Set run time 0.0 to 6000 s and press FUNC/DATA key. 2nd: Set rotational direction F (forward) or r (reverse) and press FUNC/DATA key. 3rd: Set acceleration/deceleration time 1 to 4 and press FUNC/DATA key.	Y	Y	1st: 0.00 2nd: F 3rd: 1	Y	Y	Y	N	Y	
C23	(Stage 2)		Y	Y		Y	Y	Y	N	Y	
C24	(Stage 3)		Y	Y		Y	Y	Y	N	Y	
C25	(Stage 4)		Y	Y		Y	Y	Y	N	Y	
C26	(Stage 5)		Y	Y		Y	Y	Y	N	Y	
C27	(Stage 6)		Y	Y		Y	Y	Y	N	Y	
C28	(Stage 7)		Y	Y		Y	Y	Y	N	Y	
C30	Frequency setting 2	0: Keypad ▲/▼ key operation 1: Analog voltage input (Terminal [12]) (from 0 to ±10 VDC) 2: Analog current input (Terminal [C1] (C1 function)) (4 to 20 mA DC, 0 to 20 mA DC) 3: Analog voltage input (Terminal [12]) + Analog current input (Terminal [C1] (C1 function)) 5: Analog voltage input (Terminal [C1] (V2 function)) (0 to 10 VDC) 7: UP DOWN control 8: Keypad key operation (▲/▼key) (With balanceless bumpless) 10: Pattern operation 11: Digital input/output interface card (option) *5 12: Pulse train input	N	Y	2	Y	Y	Y	N	Y	5-147
C31	Analog input adjustment (Terminal [12]) (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	5-148
C32	(Gain)	0.00 to 200.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C33	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C34	(Gain base point)	0.00 to 100.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C35	(Polarity selection)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	Y	Y	
C36	Analog input adjustment (Terminal [C1] (C1 function)) (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	
C37	(Gain)	0.00 to 200.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C38	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C39	(Gain base point)	0.00 to 100.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C40	Terminal [C1] (C1 function) range / polarity selection	0: 4 to 20 mA Unipolar 1: 0 to 20 mA Unipolar 10: 4 to 20 mA Bipolar 11: 0 to 20 mA Bipolar	N	Y	0	Y	Y	Y	Y	Y	

*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
C41	Analog input adjustment (Terminal [C1] (V2 function)) (Offset)	-5.0 to 5.0%	Y*	Y	0.0	Y	Y	Y	Y	Y	
C42	(Gain)	0.00 to 200.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C43	(Filter)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	Y	Y	
C44	(Gain base point)	0.00 to 100.00%	Y*	Y	100.0	Y	Y	Y	Y	Y	
C45	(Polarity selection)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	Y	Y	
C50	Bias (for frequency setting 1) (Bias base point)	0.00 to 100.00%	Y*	Y	0.00	Y	Y	Y	N	Y	5-150
C53	Selection of normal/inverse operation (Frequency setting 1)	0: Normal 1: Inverse	Y	Y	0	Y	Y	Y	N	Y	5-150
C55	Analog input adjustment (Terminal 12) (Bias)	-100.00 to 100.00%	Y	Y	0.00	Y	Y	Y	Y	Y	5-148
C56	(Bias base point)	0.00 to 100.00 %	Y	Y	0.00	Y	Y	Y	Y	Y	
C58	(Display unit)	* Same as J105 (However, setting range is, 1 to 80)	Y	Y	2	Y	Y	Y	Y	Y	5-151
C59	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	Y	Y	Y	Y	Y	5-151
C60	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	Y	Y	Y	Y	Y	
C61	Analog input adjustment (Terminal[C1](C1 function)) (Bias)	-100.00 to 100.00 %	Y	Y	0.00	Y	Y	Y	Y	Y	5-148
C62	(Bias base point)	0.00 to 100.00 %	Y	Y	0.00	Y	Y	Y	Y	Y	
C64	(Display unit)	* Same as J105 (However, setting range is, 1 to 80)	Y	Y	2	Y	Y	Y	Y	Y	5-151
C65	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	Y	Y	Y	Y	Y	5-151
C66	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	Y	Y	Y	Y	Y	
C67	Analog input adjustment (Terminal [C1] (V2 function)) (Bias)	-100.00 to 100.00 %	Y	Y	0.00	Y	Y	Y	Y	Y	5-148
C68	(Bias base point)	0.00 to 100.00 %	Y	Y	0.00	Y	Y	Y	Y	Y	
C70	(Display unit)	* Same as J105 (However, setting range is,1 to 80)	Y	Y	2	Y	Y	Y	Y	Y	5-151
C71	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	Y	Y	Y	Y	Y	5-151
C72	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	Y	Y	Y	Y	Y	
C89	Frequency correction 1 by (Numerator)	-32768 to 32767 (Keypad display is 8000 to 7FFFH) (Interpreted as 1 when the value is set to 0)	Y	Y	0001	Y	Y	Y	N	Y	—
C90	Frequency correction 2 by (Denominator)	-32768 to 32767 (Keypad display is 8000 to 7FFFH) (Interpreted as 1 when the value is set to 0)	Y	Y	0001	Y	Y	Y	N	Y	—

■ P codes: Motor 1 Parameters (Motor 1 parameter)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
P01	Motor 1 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	Y	Y	5-152
P02	(Rated capacity)	0.01 to 1000 kW (At P99 = 0 or 4, 15) 0.01 to 1000 HP (At P99 = 1)	N	Y1 Y2	*6	Y	Y	Y	Y	Y	5-152
P03	(Rated current)	0.00 to 2000A	N	Y1 Y2	*6	Y	Y	Y	Y	Y	5-152
P04	(Auto-tuning)	0: Disable 1: Stop tuning 2: Rotation tuning 5: Stop tuning(%R1, %X) *5	N	N	0	Y	Y	Y	Y	Y	5-153
P05	(Online tuning)	0: Invalid 1: Valid	Y	Y	0	Y	Y	N	N	N	5-154
P06	(No-load current)	0.00 to 2000A	N	Y1 Y2	*6	Y	Y	Y	Y	N	5-155
P07	(%R1)	0.00 to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	Y	N	
P08	(%X)	0.00 to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	Y	N	
P09	(Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	N	N	5-155
P10	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1 Y2	0.5	Y	Y	N	N	N	
P11	(Slip compensation gain for braking)	0.0 to 200.0 %	Y*	Y	100.0	Y	Y	Y	N	N	
P12	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1 Y2	*6	Y	Y	Y	N	N	5-156
P13	(Iron loss factor 1)	0.00 to 20.00 %	Y	Y1 Y2	*6	Y	Y	Y	Y	N	5-156
P16	(Magnetic saturation factor 1) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	5-156
P17	(Magnetic saturation factor 2) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
P18	(Magnetic saturation factor 3) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
P19	(Magnetic saturation factor 4) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
P20	(Magnetic saturation factor 5) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
P30	(PMSM drive magnetic pole position detection mode) *5	0: Pull-in by current 1: For IPMSM (Interior permanent magnet synchronous motor) 2: For SPMSM (Surface permanent magnet synchronous motor) 3: Pull-in by current for IPMSM (Interior permanent magnet synchronous motor)	N	Y1 Y2	1	N	N	N	N	Y	5-157
P53	(%X correction factor 1) *5	0 to 300 %	Y	Y1 Y2	100	Y	Y	Y	Y	N	5-157
P55	(Torque current under vector control) *5	0.00 to 2000 A	N	Y1 Y2	*6	N	N	Y	Y	N	5-157
P56	(Induced voltage factor under vector control) *5	50 to 100 %	N	Y1 Y2	*6	N	N	Y	Y	N	
P60	(PMSM armature resistance)*5	0.000 to 50.000 ohm	N	Y1 Y2	*7	N	N	N	N	Y	5-157
P61	(PMSM d-axis inductance)*5	0.00 to 500.00 mH	N	Y1 Y2	*7	N	N	N	N	Y	
P62	(PMSM q-axis inductance)*5	0.00 to 500.00 mH	N	Y1 Y2	*7	N	N	N	N	Y	
P63	(PMSM induced voltage)*5	80 to 240V (200V class); 160 to 500V (400Vclass)	N	Y1 Y2	*7	N	N	N	N	Y	
P64	(PMSM iron loss)*5	0.0 to 20.0 %	Y	Y1 Y2	*7	N	N	N	N	Y	
P65	(PMSM d-axis inductance magnetic saturation correction)*5 *9	0.0 to 100.0 % ; 999	Y	Y1 Y2	*7	N	N	N	N	Y	5-158

indicates quick setup target function code.
*5: Available at ROM version 0300 or later.
*6: Factory defaults are depended on motor capacity. Refer to “5.2.4 Motor constant”.
*7: Factory defaults are the parameters for Asian standard PMSM and depended on motor capacity.
*9: Factory use. Do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
P74	(PMSM reference current at starting)*5	10 to 200 % (100%= motor rated current)	Y*	Y1 Y2	*7	N	N	N	N	Y	5-158
P83	(Reserved for PMSM)*5 *9	0.0 to 50.0; 999	Y	Y1 Y2	999	N	N	N	N	–	5-158
P84	(Reserved for PMSM)*5 *9	0.0 to 100.0; 999	N	Y1 Y2	999	N	N	N	N	–	
P85	(PMSM flux limitation value)	50.0 to 150.0; 999	Y	Y1 Y2	999	N	N	N	N	Y	5-158
P86	(Reserved for PMSM)	0.0 to 100.0%	N	N	0.0	N	N	N	N	–	5-158
P87	(PMSM reference current for polarity discrimination)	0 to 200 %	N	Y1 Y2	60	N	N	N	N	Y	–
P88	(Reserved for PMSM)*5 *9	0 to 100 %; 999	N	Y1 Y2	999	N	N	N	N	–	5-158
P89	(Reserved for PMSM)*5 *9	0; 1 to 100	N	Y1 Y2	0	N	N	N	N	–	
P90	(PMSM overcurrent protection level)*5	0.00(disable); 0.01 to 2000 A	N	Y1 Y2	*7	N	N	N	N	Y	5-158
P99	Motor 1 selection	0: Motor characteristics 0 (KW rated IM) 1: Motor characteristics 1 (HP rated IM) 4: Other IMs 20: Other motors(PMSMs) *5 21: Not used in Europe	N	Y1 Y2	0	Y	Y	Y	Y	Y	5-158

indicates quick setup target function code.
*5: Available at ROM version 0300 or later.
*7: Factory defaults are the parameters for Asian standard PMSM and depended on motor capacity.
*9: Factory use. Do not access these function codes.

■ H codes: High Performance Functions (High level function)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
H02	Data initialization (Method)	0: Standard 1: User	N	Y	0	Y	Y	Y	Y	Y	5-159
H03	(Target)	0: Manual setting value 1: Initial value (factory default value) 2: Initialize motor 1 parameters 3: Initialize motor 2 parameters 11: Initialize the parameters(excluding parameters related to communication) 12: Initialize the parameters related to customizable logic	N	N	0	Y	Y	Y	Y	Y	
H04	Auto-reset (Times)	0: Disable, 1 to 20: Number of retries	Y	Y	0	Y	Y	Y	Y	Y	5-161
H05	(Interval)	0.5 to 20.0 s	Y	Y	5.0	Y	Y	Y	Y	Y	
H06	Cooling fan ON/OFF control	0: Disable (Always Fan ON) 1: Enable (ON/OFF control effective)	Y	Y	0	Y	Y	Y	Y	Y	5-162
H07	Curve acceleration/ deceleration	0: Disable (Linear acceleration/deceleration) 1: S-curve acceleration/deceleration (Weak) 2: S-curve acceleration/deceleration (Arbitrary: According to H57 to H60) 3: Curve acceleration/deceleration	Y	Y	0	Y	Y	Y	N	Y	5-162
H08	Rotational direction limitation	0: Disable 1: Enable (Reverse rotation inhibited) 2: Enable (Forward rotation inhibited)	N	Y	0	Y	Y	Y	N	Y	5-162
H09	Starting mode (Auto search)	0: Disable 1: Enable (Only at restart after momentary power failure) 2: Enable (At normal start and at restart after momentary power failure)	N	Y	0	Y	Y	N	N	N	5-163
H11	Deceleration mode	0: Normal deceleration 1: Coast to a stop	Y	Y	0	Y	Y	Y	N	Y	5-165
H12	Instantaneous overcurrent limiting (Mode selection)	0: Disable 1: Enable	Y	Y	1	Y	Y	N	N	N	5-165
H13	Restart mode after momentary power failure (Restart timer)	0.1 to 20.0 s	Y	Y1 Y2	*2	Y	Y	Y	N	N	5-165
H14	(Frequency fall rate)	0.00: Selected deceleration time, 0.01 to 100.00Hz/s, 999 (According to current limiter)	Y	Y	999	Y	Y	N	N	N	
H15	(Continuous running level)	200 to 300V: (200 V class) 400 to 600V: (400V class)	Y	Y2	235 470	Y	Y	Y	N	Y	
H16	(Allowable momentary power failure time)	0.0 to 30.0s, 999 (Depend on inverter judgment)	Y	Y	999	Y	Y	Y	N	Y	
H18	Torque control *5 (Mode selection)	0: Disable (Speed control) 2: Function (Torque current command) 3: Function (Torque command)	N	Y	0	N	N	Y	Y	N	5-166
H26	Thermistor (for motor) (Mode selection)	0: Disable 1: PTC: *0h4* trip and stop the inverter 2: PTC: Output motor overheat detected “THM” and continue to run	Y	Y	0	Y	Y	Y	Y	Y	5-168
H27	(Level)	0.00 to 5.00 V	Y	Y	1.60	Y	Y	Y	Y	Y	
H28	Droop control	-60.0 to 0.0Hz	Y	Y	0.0	Y	Y	Y	N	N	5-170
H30	Communication link function (Mode selection)	Frequency command / Run command 0: F01/C30 / F02 1: RS-485 (Port 1) / F02 2: F01/C30 / RS-485 (Port 1) 3: RS-485 (Port 1) / RS-485 (Port 1) 4: RS-485 (Port 2) / F02 5: RS-485 (Port 2) / RS-485 (Port 1) 6: F01/C30 / RS-485 (Port 2) 7: RS-485 (Port 1) / RS-485 (Port 2) 8: RS-485 (Port 2) / RS-485 (Port 2)	Y	Y	0	Y	Y	Y	Y	Y	5-171
H42	Capacitance of DC link bus capacitor	For adjustment at replacement (0000 to FFFF (in hexadecimal))	Y	N	–	Y	Y	Y	Y	Y	5-173
H43	Cumulative run time of cooling fan	For adjustment at replacement Displays the cumulative run time of cooling fan in units of ten hours.	Y	N	–	Y	Y	Y	Y	Y	
H44	Startup count for motor 1	For adjustment at replacement (0000 to FFFF in hexadecimal)	Y	N	–	Y	Y	Y	Y	Y	5-177
H45	Mock alarm	0: Disable 1: Occurrence of mock Alarm	Y	N	0	Y	Y	Y	Y	Y	5-177
H46	Starting mode (Auto search delay time 2)	0.1 to 20.0 s	Y	Y1 Y2	*6	Y	Y	N	N	Y	5-177

*2: Factory defaults are depended on motor capacity. Refer to “5.2.3 Factory default value per applicable electric motor capacitance”.
*5: Available at ROM version 0300 or later.
*6: Factory defaults are depended on motor capacity. Refer to “5.2.4 Motor constant”.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
H47	Initial capacitance of DC link bus capacitor	For adjustment at replacement (0000 to FFFF in hexadecimal)	Y	N	–	Y	Y	Y	Y	Y	5-177
H48	Cumulative run time of capacitors on printed circuit boards	For adjustment at replacement Change in cumulative motor run time (Reset is enabled) (in units of ten hours)	Y	N	–	Y	Y	Y	Y	Y	5-173 5-177
H49	Starting mode (Auto search delay time 1)	0.0 to 10.0 s	Y	Y	0.0	Y	Y	Y	N	Y	5-178
H50	Non-linear V/f 1 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	0.0	Y	Y	N	N	N	5-178
H51	(Voltage)	0 to 240 V:AVR operation (200 V class) 0 to 500V:AVR operation (400V class)	N	Y2	0	Y	Y	N	N	N	
H52	Non-linear V/f 2 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	0.0	Y	Y	N	N	N	
H53	(Voltage)	0 to 240V:AVR operation (200V class) 0 to 500V:AVR operation (400V class)	N	Y2	0	Y	Y	N	N	N	
H54	Acceleration time (Jogging)	0.00 to 6000 s	Y	Y	6.00 or 20.0 *10	Y	Y	Y	N	Y	5-178
H55	Deceleration time (Jogging)	0.00 to 6000 s	Y	Y		Y	Y	Y	N	Y	
H56	Deceleration time for forced stop	0.00 to 6000 s	Y	Y		Y	Y	Y	N	Y	
H57	1st S-curve acceleration range (At starting)	0 to 100%	Y	Y	10	Y	Y	Y	N	Y	
H58	2nd S-curve acceleration range (At arrival)	0 to 100%	Y	Y	10	Y	Y	Y	N	Y	
H59	1st S-curve deceleration range (At starting)	0 to 100%	Y	Y	10	Y	Y	Y	N	Y	
H60	2nd S-curve deceleration range (At arrival)	0 to 100%	Y	Y	10	Y	Y	Y	N	Y	
H61	UP/DOWN control (Initial frequency setting)	0: Initial value is 0.00 Hz 1: Last UP/DOWN command value on releasing the run command.	N	Y	1	Y	Y	Y	N	Y	5-178
H63	Low limiter (Mode selection)	0: Limit by F16 (Frequency limiter: Low) and continue to run 1: If the output frequency lowers below the one limited by F16 (Frequency limiter: Low), decelerate to stop the motor.	Y	Y	0	Y	Y	Y	N	Y	5-178
H64	(Lower limiting frequency)	0.0: Depends on F16 (Frequency limiter, Low) 0.1 to 60.0 Hz	Y	Y	1.6	Y	Y	N	N	Y	5-178
H65	Non-linear V/f 3 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	N	Y	0.0	Y	Y	N	N	N	5-178
H66	(Voltage)	0 to 240V: AVR operation (200V class) 0 to 500V: AVR operation (400V class)	N	Y2	0	Y	Y	N	N	N	
H68	Slip compensation 1 (Operating conditions selection)	0: Enable during acceleration/deceleration, enable at base frequency or higher 1: Disable during acceleration/deceleration, enable at base frequency or higher 2: Enable during acceleration/deceleration, disable at base frequency or higher 3: Disable during acceleration/deceleration, disable at base frequency or higher	N	Y	0	Y	Y	N	N	N	5-178
H69	Anti-regenerative control (Mode selection)	0: Disable 2: Torque limit control with force-to-stop (Cancel limit control after three times of deceleration time has passed) 3: DC link bus voltage control with force-to-stop (Cancel voltage control after three times of deceleration time has passed) 4: Torque limit control without force-to-stop 5: DC link bus voltage control without force-to-stop	Y	Y	0	Y	Y	Y	N	Y	5-179
H70	Overload prevention control	0.00: Follow the deceleration time selected 0.01 to 100.00 Hz/s, 999 (Cancel)	Y	Y	999	Y	Y	Y	N	Y	5-180
H71	Deceleration characteristics	0: Disable 1: Enable	Y	Y	0	Y	Y	Y	N	N	5-180
H72	Main power shutdown detection (Mode selection)	0: Disable 1: Enable (Available VXT-88A-2/VXT-59A-4 or above)	Y	Y	1	Y	Y	Y	Y	Y	5-180
H74	Torque limiter *5 (Control target)	0: Torque limit 1: Torque current limit	N	Y	1	N	N	Y	Y	Y	5-181
H76	Torque limiter (Braking) (Frequency rising limiter for braking)	0.0 to 500.0Hz	Y	Y	5.0	Y	Y	N	N	N	5-181
H77	Service life of DC link bus capacitor	0 to 8760 (in units of ten hours)	Y	N	6132 (ND spec)	Y	Y	Y	Y	Y	5-181

*5: Available at ROM version 0300 or later.
*10:6.00s for inverters of nominal applied motor 22kW or below; 20.0s for those of 30kW or above.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
H78	Maintenance interval (M1)	0 (Disable): 1 to 9999 (in units of ten hours)	Y	N	6132 (ND spec)	Y	Y	Y	Y	Y	5-181
H79	Preset startup count for maintenance (M1)	0000 (Disable): 0001 to FFFF (in hexadecimal)	Y	N	0	Y	Y	Y	Y	Y	5-182
H80	Output current fluctuation damping gain for motor 1	0.00 to 1.00	Y	Y	0.20	Y	Y	N	N	N	5-182
H81	Light alarm selection 1	0000 to FFFF (in hexadecimal)	Y	Y	0	Y	Y	Y	Y	Y	5-183
H82	Light alarm selection 2	0000 to FFFF (in hexadecimal)	Y	Y	0	Y	Y	Y	Y	Y	
H84	Pre-excitation *5 (Level)	100 to 400 % (Motor rated magnetizing current for 100%)	Y	Y	100	N	N	Y	Y	N	5-185
H85	(Timer)	0.00; 0.01 to 30.00 s 0.00; Invalid 0.01 to 30.00 s	Y	Y	0.00	N	N	Y	Y	N	
H86	Reserved *9	0 to 2	Y	Y	0	–	–	–	–	–	5-187
H89	Reserved *9	0 to 1	Y	Y	1	–	–	–	–	–	5-187
H90	Reserved *9	0 to 1	Y	Y	0	–	–	–	–	–	5-187
H91	PID feedback wire break detection	0.0 (Alarm disable): 0.1 to 60.0 s	Y	Y	0.0	Y	Y	Y	N	Y	5-187
H92	Continuous running at the momentary power failure (P)	0.000 to 10.000 times; 999 999:Manufacturer adjustment value	Y	Y1 Y2	999	Y	Y	Y	N	Y	5-187
H93	(I)	0.010 to 10.000 s; 999 999:Manufacturer adjustment value	Y	Y1 Y2	999	Y	Y	Y	N	Y	
H94	Cumulative motor run time 1	0 to 9999 Change in cumulative motor run time (Reset is enabled) (in units of 10 hours)	N	N	–	Y	Y	Y	Y	Y	5-181 5-187
H95	DC braking (Braking response mode)	0: Slow response 1: Quick response	Y	Y	1	Y	Y	N	N	N	5-77 5-187
H96	STOP key priority/ Start check function	0: STOP key priority disable/ Start check function disable 1: STOP key priority enable/ Start check function disable 2: STOP key priority disable/ Start check function enable 3: STOP key priority enable/ Start check function enable	Y	Y	0	Y	Y	Y	Y	Y	5-188
H97	Clear alarm data	0: Disable 1: Alarm data clear (Automatically return to 0 after clearing data)	Y	N	0	Y	Y	Y	Y	Y	5-188
H98	Protection/Maintenance function (Mode selection)	0 to 127 (Data is displayed in decimal) Bit 0: Lower the carrier frequency automatically (0: Disable; 1: Enable) Bit 1: Input phase loss protection (0: Disable; 1: Enable) Bit 2: Output phase loss protection (0: Disable; 1: Enable) Bit 3: Main circuit capacitor life judgment selection (0: Factory default referenced; 1 User measurement value standard) Bit 4: Judge the life of main circuit capacitor (0: Disable; 1: Enable) Bit 5: Detect DC fan lock (0: Enable; 1: Disable) Bit 6: Braking transistor error detection (0: Disable; 1: Enable)	Y	Y	*11	Y	Y	Y	Y	Y	5-189
H99	Password 2 setting/check	0000 to FFFF (Hexadecimal)	Y	N	0	Y	Y	Y	Y	Y	5-191
H101	Destination	0: Not selected 1: Japan 2: Asia 3: China 4: Europe 5: Americas 7: Korea	N	Y	4	Y	Y	Y	Y	Y	5-194
H111	UPS operation level	120 to 220 VDC: (200 V class) 240 to 440 VDC: (400 V class)	Y	Y2	220 440	Y	Y	Y	N	N	5-194
H114	Anti-regenerative control (Level)	0.0 to 50.0%, 999: disabled	Y	Y	999	Y	Y	Y	N	Y	5-194
H147	Speed control (Jogging) FF (Gain) *5	0.00 to 99.99 s	Y*	Y	0.00	N	N	Y	N	N	5-194 5-234

*5: Available at ROM version 0300 or later.
*9: Factory use. Do not access these function codes.
*11: VXT-115A-2 or below: 83, VXT72A-4 or below: 83, VXT-12A-1 or below: 83, VXT85A-4 or above: 19.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
H154	Torque bias (Mode selection) *5	0: Invalid 1: Digital torque bias 2: Analog torque bias	N	Y	0	N	N	Y	N	N	5-194
H155	(Level 1)	-300 to +300 %	N	Y	0	N	N	Y	N	N	
H156	(Level 2)	-300 to +300 %	N	Y	0	N	N	Y	N	N	
H157	(Level 3)	-300 to +300 %	N	Y	0	N	N	Y	N	N	
H158	(Mechanical loss compensation)	0 to 300 %	N	Y	0	N	N	Y	N	N	
H159	(Startup timer)	0.00 to 1.00 s	N	Y	0.00	N	N	Y	N	N	
H161	(Shutdown timer)	0.00 to 1.00 s	N	Y	0.00	N	N	Y	N	N	
H162	(Limiter)	0 to 300 %	N	Y	200	N	N	Y	N	N	
H173	Magnetic flux level at light load *5	10 to 100 %	Y	Y	100	N	N	Y	Y	N	5-196
H180	Brake control signal (Check-timer for brake operation)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	N	N	5-196
H193	User initial value (Save)	0: Disable, 1: Save	Y	N	0	Y	Y	Y	Y	Y	5-160
H194	(Protection)	0: Save enable, 1: Protected (Save disable)	Y	Y	0	Y	Y	Y	Y	Y	
H195	DC braking (Braking timer at the startup)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	N	N	N	5-77 5-196
H196	Reserved *5 *9	0.001 to 9.999, 999	Y	Y	999	Y	Y	N	N	N	–
H197	User password 1 (Selection of protective operation)	0: All function codes are disclosed, but the change is not allowed. 1: Only the function code for quick setup can be disclosed/changed. 2: Only the function code for customize logic setting is not disclosed/not changed.	Y	Y	0	Y	Y	Y	Y	Y	5-191
H198	(Setting/check)	0000 to FFFF (Hexadecimal)	Y	N	0	Y	Y	Y	Y	Y	
H199	User password protection valid	0: Disable 1: Protected	Y	N	0	Y	Y	Y	Y	Y	

*5: Available at ROM version 0300 or later.
*9: Factory use. Do not access these function codes.

■ A codes: Motor 2 Parameters (Motor 2 parameters)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
A01	Maximum output frequency 2	25.0 to 500.0Hz	N	Y	50.0	Y	Y	Y	Y	N	–
A02	Base frequency 2	25.0 to 500.0Hz	N	Y	50.0	Y	Y	Y	Y	N	
A03	Rated voltage at base frequency 2	0: AVR disable (output voltage proportional to power voltage) 80 to 240V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	N	Y2	200V class 200V	Y	Y	Y	Y	N	
A04	Maximum output voltage 2	80 to 240V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	N	Y2	400V class 400V	Y	Y	N	Y	N	
A05	Torque boost 2	0.0 to 20.0% (% value against base frequency voltage 2)	Y	Y	*2	Y	Y	N	N	N	
A06	Electronic thermal overload protection for motor 2 (Select motor characteristics)	1: Enable (For a general-purpose motor with self-cooling fan) 2: Enable (For an inverter-driven motor with separately powered cooling fan)	Y	Y	1	Y	Y	Y	Y	N	
A07	(Overload detection level)	0.00 (disable), current value of 1 to 135% of inverter rated current	Y	Y1 Y2	*3	Y	Y	Y	Y	N	
A08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	Y	N	
A09	DC braking 2 (Braking starting frequency)	0.0 to 60.0Hz	Y	Y	0.0	Y	Y	Y	N	N	
A10	(Braking level)	0 to 100% (HHD mode), 0 to 80% (HD/HND mode) 0 to 60% (ND mode)	Y	Y	0	Y	Y	Y	N	N	
A11	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	N	N	
A12	Starting frequency 2	0.0 to 60.0Hz	Y	Y	0.5	Y	Y	Y	N	N	
A13	Load selection / Auto torque boost/ Auto energy-saving operation 2	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy-saving operation (variable torque load) 4: Auto energy-saving operation (constant torque load) 5: Auto energy-saving operation with auto torque boost	N	Y	1	Y	Y	Y	N	N	
A14	Drive control selection 2	0: V/f control without slip compensation 1: Vector control without speed sensor (Dynamic torque vector control) 2: V/f control with slip compensation 3: V/f control with speed sensor 4: V/f control with speed sensor and auto torque boost 6: Vector control for induction motor with speed sensor	N	Y	0	Y	Y	Y	Y	N	
A15	Motor 2 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	Y	N	
A16	(Rated capacity)	0.01 to 1000 kW (At P39 = 0, 4) 0.01 to 1000 HP (At P39 = 1)	N	Y1 Y2	*6	Y	Y	Y	Y	N	
A17	(Rated current)	0.00 to 2000A	N	Y1 Y2	*6	Y	Y	Y	Y	N	
A18	(Auto-tuning)	0: Disable 1: Stop tuning 2: Rotation tuning 5: Stop tuning (%R1, %X)	N	N	0	Y	Y	Y	Y	N	
A19	(Online tuning)	0: Invalid 1:Valid	Y	Y	0	Y	N	N	N	N	
A20	(No-load current)	0.00 to 2000A	N	Y1 Y2	*6	Y	Y	Y	Y	N	
A21	(%R1)	0.00 to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	Y	N	
A22	(%X)	0.00 to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	Y	N	

*2: Factory defaults are depended on motor capacity. Refer to “5.2.3 Factory default value per applicable electric motor capacitance”.
*3: The motor rated current is automatically set. Refer to “5.2.4 Motor constant” (function code P03).
*4: Standard applicable electric motor is 5.0 min for 22 kW or lower and 10.0 min for 30 kW or higher.
*6: Factory defaults are depended on motor capacity. Refer to “5.2.4 Motor constant”.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
A23	Motor 2 (Slip compensation gain for driving)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	N	N	
A24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1 Y2	0.50	Y	Y	N	N	N	
A25	(Slip compensation gain for braking)	0.0 to 200.0%	Y*	Y	100.0	Y	Y	Y	N	N	
A26	(Rated slip frequency)	0.00 to 15.00Hz	N	Y1 Y2	*6	Y	Y	Y	N	N	
A27	(Iron loss factor 1)	0.00 to 20.00%	Y	Y1 Y2	*6	Y	Y	Y	Y	N	
A30	(Magnetic saturation factor 1) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
A31	(Magnetic saturation factor 2) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
A32	(Magnetic saturation factor 3) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
A33	(Magnetic saturation factor 4) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
A34	(Magnetic saturation factor 5) *5	0.0 to 300.0 %	Y	Y1 Y2	*6	N	N	Y	Y	N	
A39	Motor 2 selection	0: Motor characteristics 0 (KW Rated IM) 1: Motor characteristics 1 (HP rated IM) 4: Other IMs	N	Y1 Y2	U:1 ACEJK:0	Y	Y	Y	Y	N	
A40	Slip compensation 2 (Operating conditions selection)	0: Enable during acceleration/deceleration, enable at base frequency or higher 1: Disable during acceleration/deceleration, enable at base frequency or higher 2: Enable during acceleration/deceleration, disable at base frequency or higher 3: Disable during acceleration/deceleration, disable at base frequency or higher	N	Y	0	Y	Y	N	N	N	
A41	Output current fluctuation damping gain for motor 2	0.00 to 1.00	Y	Y	0.20	Y	Y	N	N	N	
A43	Speed control 2 *5 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	N	Y	5-232
A44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	N	Y	
A45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	N	Y	
A46	I (Integral time)	0.001 to 9.999 s; 999 (Cancel integral term)	Y	Y	0.100	N	Y	Y	N	Y	
A47	FF (Gain)	0.00 to 99.99 s	Y	Y	0.00	N	N	Y	N	Y	
A49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	N	N	
A50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	N	N	
A51	Cumulative motor run time 2	0 to 9999 Change in cumulative motor run time (Reset is enabled) (in units of 10 hours)	N	N	–	Y	Y	Y	Y	N	–
A52	Startup counter for motor 2	For adjustment at replacement (0000 to FFFF in hexadecimal)	Y	N	–	Y	Y	Y	Y	N	
A53	Motor 2 (%X correction factor 1)	0 to 300%	Y	Y1 Y2	100	Y	Y	Y	Y	N	
A55	(Torque current under vector control) *5	0.00 to 2000 A	N	Y1 Y2	*6	N	N	Y	Y	N	
A56	(Induced voltage factor under vector control) *5	50 to 100 %	N	Y1 Y2	*6	N	N	Y	Y	N	
A98	Motor 2 (Function selection)	0 to 255 (Data is displayed in decimal, Meaning of each bit 0: Disable; 1 Enable) bit0: Current limiter (F43, F44) bit1: Rotational direction control (H08) bit2: Non-linear V/f (H50 to H53, H65, H66) bit3: PID control (J01 to J62, H91) bit4: Brake signal bit5: Braking timer at the Startup (H195) Bit6 to 7: Reserved *9	N	Y	0	Y	Y	Y	Y	Y	5-199

*5: Available at ROM version 0300 or later.
*6: Factory defaults are depended on motor capacity. Refer to “5.2.4 Motor constant”.
*9: Factory use. Do not change these function codes.

■ b codes: Motor control parameter 3

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
b43	Speed control 3 *5 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	N	Y	5-232
b44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	N	Y	
b45	P (Gain)	0.1 to 200.0	Y*	Y	10.0	N	Y	Y	N	Y	
b46	I (Integral time)	0.001 to 9.999 s; 999 (Cancel integral term)	Y*	Y	0.100	N	Y	Y	N	Y	
b47	FF (Gain)	0.00 to 99.99	Y*	Y	0.00	N	N	Y	N	Y	
b49	(Notch filter resonance frequency)	1 to 200Hz	Y	Y	200	N	N	Y	N	N	
b50	(Notch filter attenuation level)	0 to 20dB	Y	Y	0	N	N	Y	N	N	

*5: Available at ROM version 0300 or later.

■ r codes: Motor control parameter 4

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
r43	Speed control 4 *5 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	N	Y	5-232
r44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	N	Y	
r45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	N	Y	
r46	I (Integral time)	0.001 to 9.999 s; 999 (Cancel integral term)	Y*	Y	0.100	N	Y	Y	N	Y	
r47	FF (Gain)	0.00 to 99.99	Y*	Y	0.00	N	N	Y	N	Y	
r49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	N	N	
r50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	N	N	

*5: Available at ROM version 0300 or later.

■ J codes: Application Functions 1 (Application function 1)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
J01	PID control (Mode selection)	0: Disable 1: Process (normal operation) 2: Process (inverse operation) 3: Speed control (Dancer)	N	Y	0	Y	Y	Y	N	Y	5-201
J02	(Remote command)	0: Keypad key operation (△/▽key) 1: PID process command 1 (Analog input: Terminals 12, C1 and V2) 3: UP/DOWN 4: Communication	N	Y	0	Y	Y	Y	N	Y	5-202
J03	P (Gain)	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	N	Y	5-208
J04	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	N	Y	
J05	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	N	Y	
J06	(Feedback filter)	0.0 to 900.0 s *1	Y	Y	0.5	Y	Y	Y	N	Y	
J10	(Anti-reset windup)	0 to 200%	Y	Y	200	Y	Y	Y	N	Y	5-211
J11	(Select Warnig output)	0: Warning caused by process command value 1: Warning caused by process command value with hold 2: Warning caused by process command value with latch 3: Warning caused by process command value with hold and latch 4: Warning caused by PID error value 5: Warning caused by PID error value with hold 6: Warning caused by PID error value with latch 7: Warning caused by PID error value with hold and latch	Y	Y	0	Y	Y	Y	N	Y	5-212
J12	(Upper limit of warning (AH))	-100% to 100%	Y	Y	100	Y	Y	Y	N	Y	
J13	(Lower limit of warning (AL))	-100% to 100%	Y	Y	0	Y	Y	Y	N	Y	
J15	(Sleep frequency)	0.0 (Disable): 1.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	N	Y	5-214
J16	(Sleep timer)	0 to 60 s	Y	Y	30	Y	Y	Y	N	Y	
J17	(Wakeup frequency)	0.0 to 500.0Hz	Y	Y	0.0	Y	Y	Y	N	Y	
J18	(Upper limit of PID process output)	-150% to 150% ; 999 (Depends on setting of F15)	Y	Y	999	Y	Y	Y	N	Y	5-215
J19	(Lower limit of PID process output)	-150% to 150% ; 999 (Depends on setting of F16)	Y	Y	999	Y	Y	Y	N	Y	
J23	(Wakeup level of PID error)	0.0 to 100.0%	Y	Y	0.0	Y	Y	Y	N	Y	5-214
J24	(Wakeup timer)	0 to 3600 s	Y	Y	0	Y	Y	Y	N	Y	
J57	(Dancer position set point)	-100 to 0 to 100%	Y	Y	0	Y	Y	Y	N	Y	5-215
J58	(Detection width of dancer position error)	0: Disable switching PID constant 1 to 100%: Manually set value	Y	Y	0	Y	Y	Y	N	Y	5-216
J59	P (Gain) 2	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	N	Y	
J60	I (Integral time) 2	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	N	Y	
J61	D (Differential time) 2	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	N	Y	
J62	(PID control block selection)	0 to 3 bit0: Select polarity compensation for PID output/error 0=Plus (Addition); 1=Minus (Subtraction) bit1: Select compensation factor for PID output 0=Ratio (relative to the main setting) 1=Speed command (relative to maximum frequency)	N	Y	0	Y	Y	Y	N	Y	5-216
J63	Overload stop (Item selection)	0: Torque, 1: Current	Y	Y	0	Y	Y	Y	N	Y	5-217
J64	(Detection level)	20 to 200%	Y	Y	100	Y	Y	Y	N	Y	
J65	(Mode selection)	0: Disable 1: Decelerate to stop 2: Coast to a stop	N	Y	0	Y	Y	Y	N	Y	
J66	(Operation mode)	0: During constant speed running and deceleration 1: During constant speed running 2: Anytime	Y	Y	0	Y	Y	Y	N	Y	
J67	(Timer)	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	N	Y	

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
J68	Brake control signal (Brake-release current)	0.00 to 300.00%	Y	Y	100.0	Y	Y	Y	N	N	5-218
J69	(Brake-release frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	Y	N	N	N	
J70	(Brake-release timer)	0.00 to 5.00 s	Y	Y	1.00	Y	Y	Y	N	N	
J71	(Brake-applied frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	Y	Y	N	N	5-218
J72	(Brake-applied timer)	0.00 to 5.00 s	Y	Y	1.00	Y	Y	Y	N	N	
J73	Positioning control *5 (Start timer)	0.0 to 1000.0 s	Y	Y	0.0	Y	Y	N	N	N	5-221
J74	(Start point; upper digits)	-999(83E7) to 999(03E7) -999(83E7) to -1(8001) 0(0000) to 999(03E7)	Y	Y	0	Y	Y	N	N	N	
J75	(Start point; lower digits)	0(0000) to 9999(270F) ; P = -1(FFFF)	Y	Y	0	Y	Y	N	N	N	
J76	(Preset point; upper digits)	-999(83E7) to 999(03E7) -999(83E7) to -1(8001) 0(0000) to 999(03E7)	Y	Y	0	Y	Y	N	N	N	
J77	(Preset point; lower digits)	0(0000) to 9999(270F) ; P = -1(FFFF)	Y	Y	0	Y	Y	N	N	N	
J78	(Creep speed SW point; upper digits)	0 to 999	Y	Y	0	Y	Y	N	N	N	
J79	(Creep speed SW point; lower digits)	0 to 9999	Y	Y	0	Y	Y	N	N	N	
J80	(Creep speed)	0 to 500 Hz	Y	Y	0.0	Y	Y	N	N	N	
J81	(End point; upper digits)	-999(83E7) to 999(03E7) -999(83E7) to -1(8001) 0(0000) to 999(03E7)	Y	Y	0	Y	Y	N	N	N	
J82	(End point; lower digits)	0(0000) to 9999(270F)	Y	Y	0	Y	Y	N	N	N	
J83	(Completion range)	0 to 9999	Y	Y	0	Y	Y	N	N	N	
J84	(End timer)	0.0 to 1000.0 s	Y	Y	0.0	Y	Y	N	N	N	
J85	(Coasting compensation)	0 to 9999	Y	Y	0	Y	Y	N	N	N	
J86	(End point: serial pulse input format)	0: Direction and pulse 1: Forward and reverse pulse	Y	Y	0	Y	Y	N	N	N	
J87	(Preset positioning requirement)	0: Allow to preset at the forward rotation only 1: Allow to preset at the reverse rotation only 2: Allow to preset at any rotations	N	Y	0	Y	Y	N	N	N	
J88	(Direction of detected position)	0: Not switch the direction of detected position 1: Switch the direction of detected position	N	Y	0	Y	Y	N	N	N	
J95	Brake control signal *5 (Brake-release torque)	0.00 to 300.00 %	Y	Y	100.00	N	N	Y	N	N	5-218
J96	(Brake-apply conditions)	0 to 31 Bit0: Speed detection / Speed command (0: Speed detection ; 1: Speed command) Bit1: Reserved Bit2: Reserved Bit3: Reserved Bit4: Brake-apply condition (0: Regardless of run command status (ON or OFF) ; 1: Only when run command is OFF.)	Y	Y	0	N	N	Y	N	N	
J97	Servo lock *5 (Gain)	0.000 to 9.999 times	Y*	Y	0.010	N	N	Y	N	N	5-230
J98	(Completion timer)	0.000 to 1.000 s	Y	Y	0.100	N	N	Y	N	N	
J99	(Completion range)	0 to 9999	Y	Y	10	N	N	Y	N	N	

*5: Available at ROM version 0300 or later.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
J105	PID control (Display unit)	0 to 80 0: Inherit (PID Control 1 feedback unit) 1: none 2: % 4: r/min 7: kW [Flow] 20: m3/s 21: m3/min 22: m3/h 23: L/s 24: L/min 25: L/h [Pressure] 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi PSI (Pounds per square inch absolute) 47: mWG 48: inWG [Temperature] 60: K 61: degreeC 62: degreeF [Concentration] 80: ppm	N	Y	0	Y	Y	Y	N	Y	5-231
J106	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	Y	Y	Y	N	Y	
J107	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	Y	Y	Y	N	Y	
J136	PID multistep command (Multistep command 1)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	N	Y	5-231
J137	(Multistep command 2)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	N	Y	
J138	(Multistep command 3)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	N	Y	

■ d codes: Application Functions 2 (Application function 2)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
d01	Speed control 1 *5 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	N	Y	5-232
d02	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	N	Y	
d03	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	N	Y	
d04	I (Integral time)	0.001 to 9.999 s; 999(Cancel integral term)	Y	Y	0.100	N	Y	Y	N	Y	
d05	FF (Gain)	0.00 to 99.99 s	Y	Y	0.00	N	N	Y	N	Y	
d07	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	N	N	
d08	(Notch filter attenuation level)	0 to 20dB	Y	Y	0	N	N	Y	N	N	
d09	Speed control (Jogging) *5 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	N	N	5-234
d10	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	N	N	
d11	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	N	N	
d12	I (Integral time)	0.001 to 9.999 s; 999(Cancel integral term)	Y*	Y	0.100	N	Y	Y	N	N	
d14	Feedback Input *5 (Pulse input format)	0: Frequency and direction 1: Forward and reverse pulse 2: Quadrature A/B signal(B phase lead) 3: Quadrature A/B signal(A phase lead)	N	Y	2	N	Y	Y	Y	N	5-235
d15	(Encoder pulse resolution)	0014 to EA60(Hexadecimal) pulses (20 to 60000 (Decimal) pulses)	N	Y	0400 (1024)	N	Y	Y	Y	N	
d16	(Pulse scaling factor 1)	1 to 9999	N	Y	1	N	Y	Y	Y	N	
d17	(Pulse scaling factor 2)	1 to 9999	N	Y	1	N	Y	Y	Y	N	
d21	Speed agreement / PG error *5 (Hysteresis width)	0.0 to 50.0 %	Y	Y	10.0	N	Y	Y	N	Y	5-237
d22	(Detection timer)	0.00 to 10.00 s	Y	Y	0.50	N	Y	Y	N	Y	
d23	PG error processing *5	0: Continue to run 1 1: Stop with alarm 1 2: Stop with alarm 2 3: Continue to run 2 4: Stop with alarm 3 5: Stop with alarm 4	N	Y	2	N	Y	Y	N	Y	
d24	Zero speed control *5	0: Disable at startup 1: Enable at startup	N	Y	0	N	N	Y	N	N	5-238
d25	ASR switching time *5	0.000 to 1.000 s	Y	Y	0.000	N	Y	Y	Y	Y	5-238
d32	Speed limit / Over speed level 1 *5	0 to 110 %	Y	Y	100	N	N	Y	Y	Y	5-238
d33	Speed limit / Over speed level 2 *5	0 to 110 %	Y	Y	100	N	N	Y	Y	Y	
d35	Over speed detection level *5	0 to 120 %; 999 999: Depend on d32, d33	Y	Y	999	N	Y	Y	Y	Y	5-238
d41	Application specific function selection *5	0: Invalid 1: Line speed control with speed sensor 2: Master-follower operation (Immediate synchronization mode at the start, without Z phase) 3: Master-follower operation (Start after synchronization mode) 4: Master-follower operation (Immediate synchronization mode at the start, with Z phase)	N	Y	0	N	Y	N	N	N	5-238
d51	Reserved *9	-500 to 500	N	Y	*12	Y	Y	Y	Y	Y	5-241
d52	Reserved *9	-500 to 500	N	Y	*12	Y	Y	Y	Y	Y	
d55	Reserved *9	0000 to 00FF (Display in hexadecimal)	N	Y	0	Y	Y	Y	Y	Y	
d59	Command (Pulse train input) *5 (Pulse input format)	0: Frequency and direction 1: Forward and reverse pulse 2: Quadrature A/B signal(B phase lead) 3: Quadrature A/B signal(A phase lead)	N	Y	0	Y	Y	Y	Y	Y	5-248
d60	(Encoder pulse resolution)	0014 to 0E10 (Hexadecimal) pulses (20 to 3600 (Decimal) pulses)	N	Y	0400 (1024)	N	Y	Y	N	N	5-241
d61	(Filter time constant)	0.000 to 5.000 s	Y	Y	0.005	Y	Y	Y	Y	Y	5-241
d62	(Pulse scaling factor 1)	1 to 9999	Y	Y	1	Y	Y	Y	Y	Y	
d63	(Pulse scaling factor 2)	1 to 9999	Y	Y	1	Y	Y	Y	Y	Y	

*5: Available at ROM version 0300 or later.
*9: Factory use. Do not change these function codes.
*12: VXT-12A-2 or below: 20, VXT-115A-2 or below: 20, VXT-290A-4 or below: 20, VXT-361A-4 and VXT-415A-4:50, VXT-520A-4 or above: 100.

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
d67	PMSM starting mode *5 (Auto search)	0: Disable 1: Enable (At restart after momentary power failure) 2: Enable (At restart after momentary power failure and at normal start)	N	Y	2	N	N	N	N	Y	5-163 5-241
d69	Reserved *9	30.0 to 100.0Hz	Y	Y	30.0	Y	Y	N	N	N	5-241
d70	Speed control limiter *5	0.00 to 100.00 %	Y	Y	100.00	N	Y	N	N	N	5-251
d71	Master follower control *5 (Main speed regulator gain)	0.00 to 1.50 times	Y	Y	1.00	N	Y	Y	N	N	5-242
d72	(APR gain)	0.00 to 200.00 times	Y	Y	15.00	N	Y	Y	N	N	
d73	(APR positive output limiter)	20 to 200 %; 999: Invalid	Y	Y	999	N	Y	Y	N	N	
d74	(APR negative output limiter)	20 to 200 %; 999: Invalid	Y	Y	999	N	Y	Y	N	N	
d75	(Z phase alignment gain)	0.00 to 10.00 times	Y	Y	1.00	N	Y	Y	N	N	
d76	(Offset angle between master and follower)	0 to 359 deg	Y	Y	0	N	Y	Y	N	N	
d77	(Synchronous completion detection angle)	0 to 359 deg	Y	Y	15	N	Y	Y	N	N	
d78	(Excessive error detection level)	0 to 65535 (10 unit pulse)	Y	Y	65535	N	Y	Y	N	N	
d79	Reserved *5 *9	0; 80 to 240 V (200V order) 160 to 500 V (400V order); 999	N	Y2	0	N	N	N	N	Y	5-241
d88	Reserved *5 *9	0.00 to 100.00 %, 999	Y	Y	999	N	N	N	N	Y	
d90	Magnetic flux level during deceleration under vector control *5	100 to 300 %	Y	Y	150	N	N	Y	N	N	5-251
d91	Reserved *9	0.00 to 2.00, 999	Y	Y	999	–	–	–	–	–	5-241
d92	Reserved *5 *9	0.00 to 10.00	Y	Y	0.30	–	–	–	–	–	
d93	Reserved *5 *9	0.00 to 10.00; 999	Y	Y	999	N	N	N	N	Y	
d94	Reserved *5 *9	0.00 to 10.00; 999	Y	Y	999	N	N	N	N	Y	
d95	Reserved *5 *9	0.00 to 10.00; 999	Y	Y	999	N	N	N	N	Y	
d96	Reserved *5 *9	-50.0 to 50.0; 999	Y	Y	999	N	N	N	N	Y	
d97	Reserved *5 *9	-50.0 to 50.0; 999	Y	Y	999	N	N	N	N	Y	
d99	Extension function 1	0 to 127	Y	Y	0						5-251
		Bit 0-2: Reserved *9				–	–	–	–	–	
		Bit 3: JOG operation from communication (0: Disable; 1: Enable)				Y	Y	Y	N	Y	
		Bit 4-8: Reserved *9				–	–	–	–	–	

*5: Available at ROM version 0300 or later.
*9: Factory use. Do not change these function codes.

■ U codes: Application Functions 3 (Customizable logic)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
U00	Customizable logic (Mode selection)	0: Disable 1: Enable (Customizable logic operation) ECL alarm occurs when the value is changed from 1 to 0 during operation.	Y	Y	0	Y	Y	Y	Y	Y	5-254
U01	Customizable logic: Step 1 (Block selection)	[Digital] 0: No function assigned 10 to 15: Through output + General-purpose timer 20 to 25: Logical AND + General-purpose timer 30 to 35: Logical OR + General-purpose timer 40 to 45: Logical XOR + General-purpose timer 50 to 55: Set priority flip-flop + General-purpose timer 60 to 65: Reset priority flip-flop + General-purpose timer 70, 72, 73: Rising edge detector + General-purpose timer 80, 82, 83: Falling edge detector + General-purpose timer 90, 92, 93: Rising & falling edges detector + General-purpose timer 100 to 105: Hold + General-purpose timer 110: Increment counter 120: Decrement counter 130: Timer with reset input General-purpose timer function (Least significant digit 0 to 5) _0: No timer _1: On-delay timer _2: Off-delay timer _3: Pulse (1 shot) _4: Retriggerable timer _5: Pulse train output [Analog] 2001: Adder 2002: Subtracter 2003: Multiplier 2004: Divider 2005: Limiter 2006: Absolute value of input 2007: Inverting adder 2008: Variable limiter 2009: Linear function 2051 to 2056: Comparator1 to 6 2071, 2072: Window comparator1, 2 2101: High selector 2102: Low selector 2103: Average of inputs 2151: Loading function from S13 2201: Clip and map function 2202: Scale converter 3001: Quadratic function 3002: Square root function [Digital, Analog] 4001: Hold 4002: Inverting adder with enable 4003, 4004: Selector 1, 2 4005: LPF(Low-pass filter) with enable 4006: Rate limiter with enable 5000: Selector 3 5100: Selector 4 6001: Reading function code 6002: Writing function code 6003: Temporary change of function code 6101: PID dancer output gain frequency	N	Y	0	Y	Y	Y	Y	Y	

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
U02	Customizable logic: Step 1 (Input 1)	[Digital] 0 to 105: The same as E20 value. However, 27, 111 to 120 cannot be selected	N	Y	100	Y	Y	Y	Y	Y	
U03	(Input 2)	2001 to 2200 (3001 to 3200): Output of Step 1 to 200 4001 (5001): X1 terminal input signal “X1” 4002 (5002): X2 terminal input signal “X2” 4003 (5003): X3 terminal input signal “X3” 4004 (5004): X4 terminal input signal “X4” 4005 (5005): X5 terminal input signal “X5” 4010 (5010): FWD terminal input signal “FWD” 4011 (5011): REV terminal input signal “REV” *4021(5021): Digital input I1 (OPC-DIO) *5 *4022(5022): Digital input I2 (OPC-DIO) *5 *4023(5023): Digital input I3 (OPC-DIO) *5 *4024(5024): Digital input I4 (OPC-DIO) *5 *4025(5025): Digital input I5 (OPC-DIO) *5 *4026(5026): Digital input I6 (OPC-DIO) *5 *4027(5027): Digital input I7 (OPC-DIO) *5 *4028(5028): Digital input I8 (OPC-DIO) *5 *4029(5029): Digital input I9 (OPC-DIO) *5 *4030(5030): Digital input I10 (OPC-DIO) *5 *4031(5031): Digital input I11 (OPC-DIO) *5 *4032(5032): Digital input I12 (OPC-DIO) *5 *4033(5033): Digital input I13 (OPC-DIO) *5 6000 (7000): Final run command RUN “FL_RUN” 6001 (7001): Final run command FWD “FL_FWD” 6002 (7002): Final run command REV “FL_REV” 6003 (7003): Accelerating “DACC” 6004 (7004): Decelerating “DDEC” 6005 (7005): Under anti-regenerative control “REGA” 6006 (7006): Within dancer reference position “DR_REF” 6007 (7007): With/without alarm factor “ALM_ACT” * Inside the ( ) is the negative logic signal. (OFF at short-circuit) [Analog] 8000 to 8021: The value with 8000 added to F31 9001: Analog 12 terminal input signal [12] 9002: Analog C1 terminal input signal [C1] (C1) 9003: Analog V2 terminal input signal [C1] (V2) *9004: Analog 32 terminal input signal [32] *5 *9005: Analog C2 terminal input signal [C2] *5	N	Y	100	Y	Y	Y	Y	Y	
U04	(Function 1)	-9990 to 0.00 to 9990	N	Y	0.00	Y	Y	Y	Y	Y	
U05	(Function 2)		N	Y	0.00	Y	Y	Y	Y	Y	

*: The use of the option card lets those functions remain in effect.
*5: Available at ROM version 0300 or later.

Customizable logic Step 1 to 14 function code is assigned as follows: Setting value is the same as U01 to U05.

	Step1	Step2	Step3	Step4	Step5	Step6	Step7	Step8	Step9	Step10
Block selection	U01	U06	U11	U16	U21	U26	U31	U36	U41	U46
Input 1	U02	U07	U12	U17	U22	U27	U32	U37	U42	U47
Input 2	U03	U08	U13	U18	U23	U28	U33	U38	U43	U48
Function 1	U04	U09	U14	U19	U24	U29	U34	U39	U44	U49
Function 2	U05	U10	U15	U20	U25	U30	U35	U40	U45	U50

	Step11	Step12	Step13	Step14
Block selection	U51	U56	U61	U66
Input 1	U52	U57	U62	U67
Input 2	U53	U58	U63	U68
Function 1	U54	U59	U64	U69
Function 2	U55	U60	U65	U70

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
U71	Customizable logic (Output selection) Output signal 1	0: Disable 1 to 200: Output of Step 1 to 200 “S001” to “S0200”	N	Y	0	Y	Y	Y	Y	Y	
U72	Output signal 2		N	Y	0	Y	Y	Y	Y	Y	
U73	Output signal 3		N	Y	0	Y	Y	Y	Y	Y	
U74	Output signal 4		N	Y	0	Y	Y	Y	Y	Y	
U75	Output signal 5		N	Y	0	Y	Y	Y	Y	Y	
U76	Output signal 6		N	Y	0	Y	Y	Y	Y	Y	
U77	Output signal 7		N	Y	0	Y	Y	Y	Y	Y	
U78	Output signal 8		N	Y	0	Y	Y	Y	Y	Y	
U79	Output signal 9		N	Y	0	Y	Y	Y	Y	Y	
U80	Output signal 10		N	Y	0	Y	Y	Y	Y	Y	
U81	Customizable logic (Function selection) Output signal 1	0 to 172 (1000 to 1172): Same as E01 8001 to 8020: The value with 8000 added to E61	N	Y	100	Y	Y	Y	Y	Y	
U82	Output signal 2		N	Y	100	Y	Y	Y	Y	Y	
U83	Output signal 3		N	Y	100	Y	Y	Y	Y	Y	
U84	Output signal 4		N	Y	100	Y	Y	Y	Y	Y	
U85	Output signal 5		N	Y	100	Y	Y	Y	Y	Y	
U86	Output signal 6		N	Y	100	Y	Y	Y	Y	Y	
U87	Output signal 7		N	Y	100	Y	Y	Y	Y	Y	
U88	Output signal 8		N	Y	100	Y	Y	Y	Y	Y	
U89	Output signal 9		N	Y	100	Y	Y	Y	Y	Y	
U90	Output signal 10		N	Y	100	Y	Y	Y	Y	Y	
U91	Customizable logic timer monitor (Step selection)	0: Monitor disable 1 to 200: Step 1 to 200	Y	N	0	Y	Y	Y	Y	Y	
U92	Customizable logic (The coefficients of the approximate formula) (Mantissa of KA1)	-9.999 to 9.999	N	Y	0.000	Y	Y	Y	Y	Y	
U93	(Exponent part of KA1)	-5 to 5	N	Y	0	Y	Y	Y	Y	Y	
U94	(Mantissa of KB1)	-9.999 to 9.999	N	Y	0.000	Y	Y	Y	Y	Y	
U95	(Exponent part of KB1)	-5 to 5	N	Y	0	Y	Y	Y	Y	Y	
U96	(Mantissa of KC1)	-9.999 to 9.999	N	Y	0.000	Y	Y	Y	Y	Y	
U97	(Exponent part KC1)	-5 to 5	N	Y	0	Y	Y	Y	Y	Y	
U100	Task process cycle setting	0: Auto select from 2, 5, 10 or 20 ms depending on the number of steps 2: 2 ms (Up to 10 step) 5: 5 ms (Up to 50 step) 10: 10 ms (Up to 100 step) 20: 20ms (Up to 200 step) *5	N	Y	0	Y	Y	Y	Y	Y	
U101	Customizable logic (Operating point 1 (X1))	-999.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	Y	Y	5-254 5-277
U102	(Operating point 1 (Y1))		Y	N		Y	Y	Y	Y	Y	
U103	(Operating point 2 (X2))		Y	N		Y	Y	Y	Y	Y	
U104	(Operating point 2 (Y2))		Y	N		Y	Y	Y	Y	Y	
U105	(Operating point 3 (X3))		Y	N		Y	Y	Y	Y	Y	
U106	(Operating point 3 (Y3))		Y	N		Y	Y	Y	Y	Y	
U107	Customizable logic (Auto calculation of the coefficients of the approximate formula)	0: Invalid 1: Execute calculation (When the calculation is finished, the results are stored to the function code U92 to U97)	N	N	0	Y	Y	Y	Y	Y	5-254 5-278

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
U121	Customizable logic (User parameter 1)	-9990.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	Y	Y	5-254
U122	(User parameter 2)					Y	Y	Y	Y	Y	
U123	(User parameter 3)					Y	Y	Y	Y	Y	
U124	(User parameter 4)					Y	Y	Y	Y	Y	
U125	(User parameter 5)					Y	Y	Y	Y	Y	
U126	(User parameter 6)					Y	Y	Y	Y	Y	
U127	(User parameter 7)					Y	Y	Y	Y	Y	
U128	(User parameter 8)					Y	Y	Y	Y	Y	
U129	(User parameter 9)					Y	Y	Y	Y	Y	
U130	(User parameter 10)					Y	Y	Y	Y	Y	
U131	(User parameter 11)					Y	Y	Y	Y	Y	
U132	(User parameter 12)					Y	Y	Y	Y	Y	
U133	(User parameter 13)					Y	Y	Y	Y	Y	
U134	(User parameter 14)					Y	Y	Y	Y	Y	
U135	(User parameter 15)					Y	Y	Y	Y	Y	
U136	(User parameter 16)					Y	Y	Y	Y	Y	
U137	(User parameter 17)					Y	Y	Y	Y	Y	
U138	(User parameter 18)					Y	Y	Y	Y	Y	
U139	(User parameter 19)					Y	Y	Y	Y	Y	
U140	(User parameter 20)					Y	Y	Y	Y	Y	
U171	Customizable logic (Storage area 1)	-9990.00 to 0.00 to 9990.00	Y	Y	0.00	Y	Y	Y	Y	Y	
U172	(Storage area 2)					Y	Y	Y	Y	Y	
U173	(Storage area 3)					Y	Y	Y	Y	Y	
U174	(Storage area 4)*5					Y	Y	Y	Y	Y	
U175	(Storage area 5)*5					Y	Y	Y	Y	Y	
U190	Customizable logic setting step (Step number)	1 to 200	Y	Y	15	Y	Y	Y	Y	Y	
U191	Setting step (Select block)	Same as U01	N	Y	0	Y	Y	Y	Y	Y	
U192	(Input 1)	Same as U02	N	Y	100	Y	Y	Y	Y	Y	
U193	(Input 2)	Same as U03	N	Y	100	Y	Y	Y	Y	Y	
U194	(Function 1)	Same as U04	N	Y	0.00	Y	Y	Y	Y	Y	
U195	(Function 2)	Same as U05	N	Y	0.00	Y	Y	Y	Y	Y	
U196	Customizable logic ROM version Upper digit (Monitor)	0 to 9999	N	N	0	Y	Y	Y	Y	Y	
U197	Customizable logic ROM version Upper digit (For User setting)	0 to 9999	N	Y	0	Y	Y	Y	Y	Y	
U198	Customizable logic ROM version Lower digit (Monitor)	0 to 9999	N	N	0	Y	Y	Y	Y	Y	
U199	Customizable logic ROM version Lower digit (For User setting)	0 to 9999	N	Y	0	Y	Y	Y	Y	Y	

*5: Available at ROM version 0300 or later.

■ y codes: LINK Functions (Link function)

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
y01	RS-485 Communication 1 (Station address)	1 to 255	N	Y	1	Y	Y	Y	Y	Y	5-281
y02	(Communications error processing)	0: Immediately trip with alarm *er8* 1: Trip with alarm *er8* after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If the retry fails, trip with alarm *er8*. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	Y	Y	Y	Y	Y	
y03	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	Y	Y	Y	
y04	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	Y	Y	Y	Y	Y	
y05	(Data length selection)	0: 8 bit 1: 7 bits	Y	Y	0	Y	Y	Y	Y	Y	
y06	(Parity selection)	0: None (Stop bit: 2 bits) 1: Even number parity (Stop bit: 1 bits) 2: Odd number parity (Stop bit: 1 bits) 3: None (Stop bit: 1 bits)	Y	Y	0	Y	Y	Y	Y	Y	
y07	(Stop bit selection)	0: 2 bits 1: 1 bits	Y	Y	0	Y	Y	Y	Y	Y	
y08	(Communication time-out detection timer)	0: Not check of the time-out 1 to 60 s	Y	Y	0	Y	Y	Y	Y	Y	
y09	(Response interval time)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	Y	Y	Y	
y10	(Protocol selection)	0: Modbus RTU protocol 1: IMO Loader protocol (SX protocol) 2: Not used in Europe	Y	Y	1	Y	Y	Y	Y	Y	
y11	RS-485 Communication 2 (Station address)	1 to 255	N	Y	1	Y	Y	Y	Y	Y	
y12	(Communications error processing)	0: Immediately trip with alarm *erp* 1: Trip with alarm *erp* after running for the period specified by timer y13 2: Retry during the period specified by timer y13. If the retry fails, trip with alarm *erp*. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	Y	Y	Y	Y	Y	
y13	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	Y	Y	Y	
y14	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	Y	Y	Y	Y	Y	
y15	(Data length selection)	0: 8 bits 1: 7 bits	Y	Y	0	Y	Y	Y	Y	Y	
y16	(Parity selection)	0: None (Stop bit: 2 bits) 1: Even number parity (Stop bit: 1 bits) 2: Odd number parity (Stop bit: 1 bits) 3: None (Stop bit: 1 bits)	Y	Y	0	Y	Y	Y	Y	Y	
y17	(Stop bit selection)	0: 2 bits 1: 1 bit	Y	Y	0	Y	Y	Y	Y	Y	
y18	(Communication time-out detection timer)	0: Not check of the time-out 1 to 60 s	Y	Y	0	Y	Y	Y	Y	Y	
y19	(Response interval time)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	Y	Y	Y	
y20	(Protocol selection)	0: Modbus RTU protocol 1: IMO Loader protocol (SX protocol) 2: Not used in Europe	Y	Y	0	Y	Y	Y	Y	Y	

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
y21	Built-in CAN communication (Node ID)	1 to 127	N	Y	1	Y	Y	Y	Y	Y	5-284
y24	(Baud rate)	0: 125kbps 1: 20kbit/s 2: 50kbit/s 3: 125kbit/s 4: 250kbit/s 5: 500kbit/s 6: 800kbit/s 7: 1Mbit/s	N	Y	0	Y	Y	Y	Y	Y	
y25	Map the inverter function code1 to RPDO No. 3	0000 to FFFF (in hexadecimal)	N	Y	0000	Y	Y	Y	Y	Y	
y26	Map the inverter function code2 to RPDO No. 3	Data mapped I/O (Write)				Y	Y	Y	Y	Y	
y27	Map the inverter function code3 to RPDO No. 3					Y	Y	Y	Y	Y	
y28	Map the inverter function code4 to RPDO No. 3					Y	Y	Y	Y	Y	
y29	Map the inverter function code1 to TPDO No. 3					Y	Y	Y	Y	Y	
y30	Map the inverter function code2 to TPDO No. 3					Y	Y	Y	Y	Y	
y31	Map the inverter function code3 to TPDO No. 3					Y	Y	Y	Y	Y	
y32	Map the inverter function code4 to TPDO No. 3					Y	Y	Y	Y	Y	
y33	(Operation selection)	0: Disable, 1: Enable	Y	Y	0	Y	Y	Y	Y	Y	
y34	(Communications error processing)	This function code is valid in case of y36=-4 or -5. 1: After the time specified by [y35], coast to a stop and trip with [ert]. 2: If the inverter receives any data within the time specified by [y35], ignore the communications error. After the timeout, coast to a stop and trip with [ert]. 10: Immediately decelerate to a stop. Issue [ert] after stopping. 11: After the time specified by [y35], decelerate to a stop. Issue [ert] after stopping. 12: If the inverter receives any data within the time specified by [y35], ignore the communications error. After the timeout, decelerate to a stop and trip with [ert]. Otherwise: Immediately coast to a stop and trip with [ert].	Y	Y	0	Y	Y	Y	Y	Y	
y35	(Communication time-out detection timer)	0.0 to 60.0	Y	Y	0.0	Y	Y	Y	Y	Y	
y36	(Operation selection in abort status) *5	-5 to 3	Y	Y	1	Y	Y	Y	Y	Y	
y95	Data clear processing for communications error	0: Do not clear the data of function codes Sxx when a communications error occurs. (compatible with the conventional inverters) 1: Clear the data of function codes S01/S05/S19 when a communications error occurs. 2: Clear the run command assigned bit of function code S06 when a communications error occurs. 3: Clear both data of S01/S05/S19 and run command assigned bit of S06 when a communications error occurs. * Related alarms: *er8*, *erp*, *er4*, *er5*, *ert*	Y	Y	0	Y	Y	Y	Y	Y	5-284
y97	Communication data storage selection	0: Store into nonvolatile memory (Rewritable times are limited) 1: Write into temporary memory (Rewritable times are unlimited) 2: Save all data from temporary memory to nonvolatile memory (After all save, return to Data 1)	Y	Y	0	Y	Y	Y	Y	Y	5-284
y98	Bus link function (Mode selection)	Frequency command / Run command 0: Follow H30 / Follow H30 1: Bus link / Follow H30 2: Follow H30 / Bus link 3: Bus link / Bus link	Y	Y	0	Y	Y	Y	Y	Y	5-284
y99	Loader link function (Mode selection)	Frequency command / Run command 0: Follow H30, y98 / Follow H30, y98 1: IMO loader / Follow H30, y98 2: Follow H30, y98 / IMO loader 3: IMO loader / IMO loader	Y	N	0	Y	Y	Y	Y	Y	5-285

*5: Available at ROM version 0300 or later.

■ K codes: Keypad functions for TP-A1-E2C

Code	Name	Data setting range	Change when running	Data copying	Factory Default	Drive control					Related page
						V/f	PG V/f	w/ PG	Torque control	PM	
K01	Multifunction keypad TP-A1-E2C (Language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian 6: Chinese 8: Russian 9: Greek 10: Turkish 11: Polish 12: Czech 13: Swedish 14: Portuguese 15: Dutch 16: Malay 17: Vietnamese 18: Thai 19: Indonesian 100: User-Customizable language	Y	Y	1	Y	Y	Y	Y	Y	–
K02	(Backlight OFF time)	0: Always OFF 1 to 30 min	Y	Y	5	Y	Y	Y	Y	Y	–
K03	(Backlight brightness adjustment)	0 (dark) - 10 (bright)	Y	Y	5	Y	Y	Y	Y	Y	–
K04	(Contrast adjustment)	0 (low) - 10 (high)	Y	Y	5	Y	Y	Y	Y	Y	–
K08	(LCD monitor status display)	0: Not displayed 1: Fully displayed	Y	Y	1	Y	Y	Y	Y	Y	–
K15	(Sub-monitor display selection)	0: Operation guide display 1: Bar graph display	Y	Y	0	Y	Y	Y	Y	Y	–
K16	(Sub-monitor 1 display selection)	1 to 35 1: Output frequency 1 (before slip compensation) 2: Output frequency 2 (after slip compensation) 3: Reference frequency 4: Motor rotation speed 5: Load rotation speed 6: Line speed 7: Transport time for specified length 8: Speed (%) 13: Output current 14: Output voltage 18: Calculated torque 19: Input power 25: Load factor 26: Motor output 27: Analog input monitor 31: Current position pulse 32: Position error pulse 33: Torque current (%) 34: Magnetic flux command (%) 35: Input watt-hour	Y	Y	13	Y	Y	Y	Y	Y	–
K17	(Sub-monitor 2 display selection)		Y	Y	19	Y	Y	Y	Y	Y	–
K20	(Bar graph 1 display selection)	1: Output frequency 1 (before slip compensation) 13: Output current 14: Output voltage 18: Calculated torque 19: Input power 25: Load factor 26: Motor output	Y	Y	1	Y	Y	Y	Y	Y	–
K21	(Bar graph 2 display selection)		Y	Y	13	Y	Y	Y	Y	Y	–
K22	(Bar graph 3 display selection)		Y	Y	19	Y	Y	Y	Y	Y	–
K91	(< key shortcut selection)	0: disabled	Y	Y	0	Y	Y	Y	Y	Y	–
K92	(> key shortcut selection)	11 to 99: respective mode	Y	Y	64	Y	Y	Y	Y	Y	–

The keypad function K codes are used when the multi-function keypad (VXT-KP-LED) is connected. For details about the K codes, refer to the instruction manual for the keypad.

5.2.3 Factory default value per applicable electric motor capacitance

Applicable electric motor capacity		Torque boost 1 to 2 F09/ A05	Restart mode after momentary power failure (Restart timer) H13
kW	HP		
0.4	1/2	3.5	0.5
0.75	1	6.5	
1.5	2	4.9	
2.2	3	4.5	
3.7	5	4.1	
5.5	7.5	3.4	
7.5	10	2.7	
11	15	2.1	1.0
15	20	1.6	
18.5	25	1.3	
22	30	1.1	
30	40	0.0	
37	50		
45	60		1.5
55	75	0.0	
75	100		
90	125		
110	150		
132	175		2.0
160	200		
200	250		2.5
220	300		
280	400		
315	450		4.0
355	500		

5.2.4 Motor constants

[1] When Kw rated, or other motors are selected by motor selection (Function code P99/ A39 = 0 or 4)

■ **3-phase 200V class, standard motor**

Motor rated capacity setting range (kW) P02/A16	Applicable motor capacity (kW)	Rated current (A) P03/A17 *1	No-load current (A) P06/A20 *1	%R1 (%) P07/A21 *1	%X (%) P08/A22 *1	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting mode (Auto search delay time 2) H46
0.01 to 0.09	0.06	0.44	0.40	13.79	11.75	1.77	14.00	0.5
0.10 to 0.19	0.1	0.68	0.55	12.96	12.67	1.77	14.00	
0.20 to 0.39	0.2	1.30	1.06	12.95	12.92	2.33	12.60	
0.40 to 0.74	0.4	2.30	1.66	10.20	13.66	2.40	9.88	
0.75 to 1.49	0.75	3.60	2.30	8.67	10.76	2.33	7.40	
1.50 to 2.19	1.5	6.10	3.01	6.55	11.21	2.00	5.85	
2.20 to 3.69	2.2	9.20	4.85	6.48	10.97	1.80	5.91	0.6
3.70 to 5.49	3.7	15.00	7.67	5.79	11.25	1.93	5.24	0.8
5.50 to 7.49	5.5	22.50	11.00	5.28	14.31	1.40	4.75	1.0
7.50 to 10.99	7.5	29.00	12.50	4.50	14.68	1.57	4.03	1.2
11.00 to 14.99	11	42.00	17.70	3.78	15.09	1.07	3.92	1.3
15.00 to 18.49	15	55.00	20.00	3.25	16.37	1.13	3.32	2.0
18.50 to 21.99	18.5	67.00	21.40	2.92	16.58	0.87	3.34	
22.00 to 29.99	22	78.00	25.10	2.70	16.00	0.90	3.28	
30.00 to 36.99	30	107.0	38.90	2.64	14.96	0.80	3.10	2.3
37.00 to 44.99	37	130.0	41.50	2.76	16.41	0.80	2.30	2.5
45.00 to 54.99	45	156.0	47.50	2.53	16.16	0.80	2.18	
55.00 to 74.99	55	190.0	58.60	2.35	16.20	0.94	2.45	2.6
75.00 to 89.99	75	260.0	83.20	1.98	16.89	0.80	2.33	2.8
90.00 to 109.9	90	310.0	99.20	1.73	16.03	0.80	2.31	3.2
110.0 or above	110	376.0	91.20	1.99	20.86	0.66	1.73	3.5

*1: F05: The value for the model, in which the rated voltage at base frequency 1 is not 200V, becomes the optimal value, which is different from the above value.

■ **3-phase 200V class, standard motor (Cont.)**

Motor rated capacity setting range (kW) P02/A16	Magnetic saturation factor 1 P16/A30	Magnetic saturation factor 2 P17/A31	Magnetic saturation factor 3 P18/A32	Magnetic saturation factor 4 P19/A33	Magnetic saturation factor 5 P20/A34	Torque current under vector control P55/A55	Induced voltage factor under vector control P56/A56
0.01 to 0.09	93.8	87.5	75.0	62.5	50.0	0.20	85
0.10 to 0.19	93.3	86.1	74.4	63.6	50.7	0.34	85
0.20 to 0.39	89.7	81.9	66.9	54.5	43.3	0.68	85
0.40 to 0.74	88.7	81.3	67.0	55.2	43.8	1.36	85
0.75 to 1.49	88.3	77.7	62.6	51.8	41.1	2.55	85
1.50 to 2.19	92.1	82.8	71.1	58.1	46.2	5.09	85
2.20 to 3.69	85.1	74.6	61.7	50.3	39.8	7.47	85
3.70 to 5.49	86.0	76.9	61.3	49.5	39.1	12.57	85
5.50 to 7.49	88.6	79.2	64.9	52.7	41.8	18.68	85
7.50 to 10.99	87.7	80.0	67.1	56.1	45.6	25.47	85
11.00 to 14.99	91.3	83.3	69.9	58.0	47.0	37.36	85
15.00 to 18.49	90.5	83.5	72.1	60.7	49.5	50.94	85
18.50 to 21.99	90.7	83.0	70.7	59.9	48.7	62.83	85
22.00 to 29.99	89.7	81.3	68.9	59.1	48.4	74.72	85
30.00 to 36.99	90.2	81.6	68.7	57.2	45.8	101.9	85
37.00 to 44.99	88.7	78.9	65.4	54.2	43.4	125.7	85
45.00 to 54.99	89.0	79.7	66.8	55.4	44.4	152.8	85
55.00 to 74.99	89.2	79.3	64.7	53.6	43.1	186.8	85
75.00 to 89.99	88.1	78.0	64.3	54.2	42.9	254.7	85
90.00 to 109.9	88.8	79.0	65.0	54.0	44.0	305.7	85
110.0 or above	90.5	82.6	70.7	58.7	47.8	373.6	85

■ **3-phase 400V class,**

■ **standard motor**

Motor rated capacity setting range (kW) P02/A16	Applicable motor capacity (kW)	Rated current (A) P03/A17 *1	No-load current (A) P06/A20 *1	%R1 (%) P07/A21 *1	%X (%) P08/A22 *1	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting mode (Auto search delay time 2) H46
0.01 to 0.09	0.06	0.22	0.20	13.79	11.75	1.77	14.00	0.5
0.10 to 0.19	0.1	0.35	0.27	12.96	12.67	1.77	14.00	
0.20 to 0.39	0.2	0.65	0.53	12.95	12.92	2.33	12.60	
0.40 to 0.74	0.4	1.15	0.83	10.20	13.66	2.40	9.88	
0.75 to 1.49	0.75	1.80	1.15	8.67	10.76	2.33	7.40	
1.50 to 2.19	1.5	3.10	1.51	6.55	11.21	2.00	5.85	
2.20 to 3.69	2.2	4.60	2.43	6.48	10.97	1.80	5.91	0.6
3.70 to 5.49	3.7	7.50	3.84	5.79	11.25	1.93	5.24	0.8
5.50 to 7.49	5.5	11.50	5.50	5.28	14.31	1.40	4.75	1.0
7.50 to 10.99	7.5	14.50	6.25	4.50	14.68	1.57	4.03	1.2
11.00 to 14.99	11	21.00	8.85	3.78	15.09	1.07	3.92	1.3
15.00 to 18.49	15	27.50	10.00	3.25	16.37	1.13	3.32	2.0
18.50 to 21.99	18.5	34.00	10.70	2.92	16.58	0.87	3.34	
22.00 to 29.99	22	39.00	12.60	2.70	16.00	0.90	3.28	
30.00 to 36.99	30	54.00	19.50	2.64	14.96	0.80	3.10	2.3
37.00 to 44.99	37	65.00	20.80	2.76	16.41	0.80	2.30	2.5
45.00 to 54.99	45	78.00	23.80	2.53	16.16	0.80	2.18	
55.00 to 74.99	55	95.00	29.30	2.35	16.20	0.94	2.45	2.6
75.00 to 89.99	75	130.0	41.60	1.98	16.89	0.80	2.33	2.8
90.00 to 109.9	90	155.0	49.60	1.73	16.03	0.80	2.31	3.2
110.0 to 131.9	110	188.0	45.60	1.99	20.86	0.66	1.73	3.5
132.0 to 159.9	132	224.0	57.60	1.75	18.90	0.66	1.80	4.1
160.0 to 199.9	160	272.0	64.50	1.68	19.73	0.66	1.50	4.5
200.0 to 219.9	200	335.0	71.50	1.57	20.02	0.66	1.36	4.7
220.0 to 249.9	220	365.0	71.80	1.60	20.90	0.58	1.25	
250.0 to 279.9	250	415.0	87.90	1.39	18.88	0.54	1.33	5.0
280.0 to 314.9	280	462.0	93.70	1.36	19.18		1.27	5.5
315.0 to 354.9	315	520.0	120.0	0.84	16.68	0.45	1.81	5.6
355.0 to 399.9	355	580.0	132.0	0.83	16.40	0.43	1.77	
400.0 to 449.9	400	670.0	200.0	0.62	15.67	0.29	1.58	7.5
450.0 to 499.9	450	770.0	270.0	0.48	13.03	0.23	1.84	9.8
500.0 to 559.9	500	835.0		0.51	12.38	0.18	1.80	
560.0 to 629.9	560	940.0		0.57	13.94	0.20	1.61	
630.0 to 709.9	630	1050.0	355.0	0.46	11.77	0.17	1.29	10.5
710.0 or above	710	1150.0	290.0	0.54	14.62	0.21	0.97	

*1: F05: The value for the model, in which the rated voltage at base frequency 1 is not 400V, becomes the optimal value, which is different from the above value.

■ **3-phase 400V class,**

■ **standard motor (Cont.)**

Motor rated capacity setting range (kW) P02/A16	Magnetic saturation factor 1 P16/A30	Magnetic saturation factor 2 P17/A31	Magnetic saturation factor 3 P18/A32	Magnetic saturation factor 4 P19/A33	Magnetic saturation factor 5 P20/A34	Torque current under vector control P55/A55	Induced voltage factor under vector control P56/A56
0.01 to 0.09	93.8	87.5	75.0	62.5	50.0	0.10	85
0.10 to 0.19	93.3	86.1	74.4	63.6	50.7	0.17	85
0.20 to 0.39	89.7	81.9	66.9	54.5	43.3	0.34	85
0.40 to 0.74	88.7	81.3	67.0	55.2	43.8	0.68	85
0.75 to 1.49	88.3	77.7	62.6	51.8	41.1	1.27	85
1.50 to 2.19	92.1	82.8	71.1	58.1	46.2	2.55	85
2.20 to 3.69	85.1	74.6	61.7	50.3	39.8	3.74	85
3.70 to 5.49	86.0	76.9	61.3	49.5	39.1	6.28	85
5.50 to 7.49	88.6	79.2	64.9	52.7	41.8	9.34	85
7.50 to 10.99	87.7	80.0	67.1	56.1	45.6	12.74	85
11.00 to 14.99	91.3	83.3	69.9	58.0	47.0	18.68	85
15.00 to 18.49	90.5	83.5	72.1	60.7	49.5	25.47	85
18.50 to 21.99	90.7	83.0	70.7	59.9	48.7	31.41	85
22.00 to 29.99	89.7	81.3	68.9	59.1	48.4	37.36	85
30.00 to 36.99	90.2	81.6	68.7	57.2	45.8	50.94	85
37.00 to 44.99	88.7	78.9	65.4	54.2	43.4	62.83	85
45.00 to 54.99	89.0	79.7	66.8	55.4	44.4	76.41	85
55.00 to 74.99	89.2	79.3	64.7	53.6	43.1	93.39	85
75.00 to 89.99	88.1	78.0	64.3	54.2	42.9	127.4	85
90.00 to 109.9	88.8	79.0	65.0	54.0	44.0	152.8	85
110.0 to 131.9	90.5	82.6	70.7	58.7	47.8	186.8	85
132.0 to 159.9	90.3	81.9	69.8	57.8	46.6	211.7	90
160.0 to 199.9	92.2	84.8	71.1	58.6	46.9	256.6	90
200.0 to 219.9	91.9	85.5	72.3	60.0	47.6	320.8	90
220.0 to 249.9	93.1	86.1	72.9	60.8	48.6	352.8	90
250.0 to 279.9	92.2	84.9	72.7	60.5	48.9	400.9	90
280.0 to 314.9	92.7	85.6	72.9	60.9	48.9	449.1	90
315.0 to 354.9	92.7	85.6	72.9	60.9	48.9	505.2	90
355.0 to 399.9	92.7	85.6	72.9	60.9	48.9	569.3	90
400.0 to 449.9	92.7	85.6	72.9	60.9	48.9	641.5	90
450.0 to 499.9	92.7	85.6	72.9	60.9	48.9	721.7	90
500.0 to 559.9	92.7	85.6	72.9	60.9	48.9	801.9	90
560.0 to 629.9	92.7	85.6	72.9	60.9	48.9	898.1	90
630.0 to 709.9	92.7	85.6	72.9	60.9	48.9	1010	90
710.0 or above	92.7	85.6	72.9	60.9	48.9	1139	90

[2] When HP rating motor is selected by motor selection (Function code P99/A39 = 1)

■ **3-phase 200V class, HP rating motor**

Motor rated capacity setting range (HP) P02/A16	Applicable motor Capacity (HP)	Rated current (A) P03/A17	No-load current (A) P06/A20	%R1 (%) P07/A21	%X (%) P08/A22	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting mode (Auto search delay time 2) H46
0.01 to 0.11	0.1	0.44	0.40	13.79	11.75	2.50	14.00	0.5
0.12 to 0.24	0.12	0.68	0.55	12.96	12.67	2.50	14.00	
0.25 to 0.49	0.25	1.40	1.12	11.02	13.84	2.50	12.60	
0.50 to 0.99	0.5	2.00	1.22	6.15	8.80	2.50	9.88	
1.00 to 1.99	1	3.00	1.54	3.96	8.86	2.50	7.40	
2.00 to 2.99	2	5.80	2.80	4.29	7.74	2.50	5.85	
3.00 to 4.99	3	7.90	3.57	3.15	20.81	1.17	5.91	0.6
5.00 to 7.49	5	12.6	4.78	3.34	23.57	1.50	5.24	0.8
7.50 to 9.99	7.5	18.6	6.23	2.65	28.91	1.17	4.75	1.0
10.00 to 14.99	10	25.3	8.75	2.43	30.78	1.17	4.03	1.2
15.00 to 19.99	15	37.3	12.7	2.07	29.13	1.00	3.92	1.3
20.00 to 24.99	20	49.1	9.20	2.09	29.53	1.00	3.32	2.0
25.00 to 29.99	25	60.0	16.70	1.75	31.49	1.00	3.34	
30.00 to 39.99	30	72.4	19.80	1.90	32.55	1.00	3.28	
40.00 to 49.99	40	91.0	13.60	1.82	25.32	0.47	3.10	2.3
50.00 to 59.99	50	115.0	18.70	1.92	24.87	0.58	2.30	2.5
37.00 to 44.99	60	137.0	20.80	1.29	26.99	0.35	2.18	
75.00 to 99.99	75	174.0	28.60	1.37	27.09	0.35	2.45	2.6
100.0 to 124.9	100	226.0	37.40	1.08	23.80	0.23	2.33	2.8
125.0 to 149.9	125	268.0	29.80	1.05	22.90	0.35	2.31	3.2
150.0 or above	150	337.0	90.40	0.96	21.61	0.39	1.73	3.5

■ **3-phase 200V class, HP rating motor (Cont.)**

Motor rated capacity setting range (HP) P02/A16	Magnetic saturation factor 1 P16/A30	Magnetic saturation factor 2 P17/A31	Magnetic saturation factor 3 P18/A32	Magnetic saturation factor 4 P19/A33	Magnetic saturation factor 5 P20/A34	Torque current under vector control P55/A55	Induced voltage factor under vector control P56/A56
0.01 to 0.11	93.8	87.5	75.0	62.5	50.0	0.21	85
0.12 to 0.24	93.3	86.1	74.4	63.6	50.7	0.27	85
0.25 to 0.49	89.7	81.9	66.9	54.5	43.3	0.53	85
0.50 to 0.99	88.7	81.3	67.0	55.2	43.8	1.09	85
1.00 to 1.99	88.3	77.7	62.6	51.8	41.1	2.21	85
2.00 to 2.99	92.1	82.8	71.1	58.1	46.2	4.43	85
3.00 to 4.99	85.1	74.6	61.7	50.3	39.8	6.64	85
5.00 to 7.49	86.0	76.9	61.3	49.5	39.1	11.07	85
7.50 to 9.99	88.6	79.2	64.9	52.7	41.8	16.60	85
10.00 to 14.99	87.7	80.0	67.1	56.1	45.6	22.15	85
15.00 to 19.99	91.3	83.3	69.9	58.0	47.0	33.22	85
20.00 to 24.99	90.5	83.5	72.1	60.7	49.5	44.30	85
25.00 to 29.99	90.7	83.0	70.7	59.9	48.7	55.37	85
30.00 to 39.99	89.7	81.3	68.9	59.1	48.4	66.45	85
40.00 to 49.99	90.2	81.6	68.7	57.2	45.8	88.60	85
50.00 to 59.99	88.7	78.9	65.4	54.2	43.4	110.7	85
37.00 to 44.99	89.0	79.7	66.8	55.4	44.4	132.9	85
75.00 to 99.99	89.2	79.3	64.7	53.6	43.1	166.1	85
100.0 to 124.9	88.1	78.0	64.3	54.2	42.9	221.5	85
125.0 to 149.9	88.8	79.0	65.0	54.0	44.0	276.9	85
150.0 or above	90.5	82.6	70.7	58.7	47.8	332.2	85

■ **3-phase 400V class, HP rating motor**

Motor rated capacity setting range (HP) P02/A16	Applicable motor Capacity (HP)	Rated current (A) P03/A17	No-load current (A) P06/A20	%R1 (%) P07/A21	%X (%) P08/A22	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting mode (Auto search delay time 2) H46
0.01 to 0.11	0.1	0.22	0.20	13.79	11.75	2.50	14.00	0.5
0.12 to 0.24	0.12	0.34	0.27	12.96	12.67	2.50	14.00	
0.25 to 0.49	0.25	0.70	0.56	11.02	13.84	2.50	12.60	
0.50 to 0.99	0.5	1.00	0.61	6.15	8.80	2.50	9.88	
1.00 to 1.99	1	1.50	0.77	3.96	8.86	2.50	7.40	
2.00 to 2.99	2	2.90	1.40	4.29	7.74	2.50	5.85	
3.00 to 4.99	3	4.00	1.79	3.15	20.81	1.17	5.91	0.6
5.00 to 7.49	5	6.30	2.39	3.34	23.57	1.50	5.24	0.8
7.50 to 9.99	7.5	9.30	3.12	2.65	28.91	1.17	4.75	1.0
10.00 to 14.99	10	12.7	4.37	2.43	30.78	1.17	4.03	1.2
15.00 to 19.99	15	18.7	6.36	2.07	29.13	1.00	3.92	1.3
20.00 to 24.99	20	24.6	4.60	2.09	29.53	1.00	3.32	2.0
25.00 to 29.99	25	30.0	8.33	1.75	31.49	1.00	3.34	
30.00 to 39.99	30	36.2	9.88	1.90	32.55	1.00	3.28	
40.00 to 49.99	40	45.5	6.80	1.82	25.32	0.47	3.10	2.3
50.00 to 59.99	50	57.5	9.33	1.92	24.87	0.58	2.30	2.5
60.00 to 74.99	60	68.7	10.4	1.29	26.99	0.35	2.18	
75.00 to 99.99	75	86.9	14.3	1.37	27.09	0.35	2.45	2.6
100.0 to 124.9	100	113.0	18.7	1.08	23.80	0.23	2.33	2.8
125.0 to 149.9	125	134.0	14.9	1.05	22.90	0.35	2.31	3.2
150.0 to 174.9	150	169.0	45.2	0.96	21.61	0.39	1.73	3.5
175.0 to 199.9	175	188.5	45.2	0.96	21.61	0.39	1.80	4.1
200.0 to 249.9	200	231.0	81.8	0.72	20.84	0.23	1.50	4.5
250.0 to 299.9	250	272.0	41.1	0.71	18.72	0.35	1.36	4.7
300.0 to 324.9	300	323.0	45.1	0.53	18.44	0.23	1.25	
325.0 to 349.9	325	342.9	45.1	0.53	18.44	0.23	1.33	5.0
350.0 to 399.9	350	375.0	68.3	0.99	19.24	0.46	1.27	5.5
400.0 to 449.9	400	429.0	80.7	1.11	18.92	0.46	1.81	5.6
450.0 to 499.9	450	481.0	85.5	0.95	19.01	0.48	1.77	
500.0 to 599.9	500	534.0	99.2	1.05	18.39	0.45	1.58	7.5
600.0 to 699.9	600	638.0	140.0	0.85	18.38	0.39	1.84	9.8
700.0 to 749.9	700						1.70	
750.0 to 799.9	750							
800.0 or above	800							10.5

■ **3-phase 400V class, HP rating motor (Cont.)**

Motor rated capacity setting range (HP) P02/A16	Magnetic saturation factor 1 P16/A30	Magnetic saturation factor 2 P17/A31	Magnetic saturation factor 3 P18/A32	Magnetic saturation factor 4 P19/A33	Magnetic saturation factor 5 P20/A34	Torque current under vector control P55/A55	Induced voltage factor under vector control P56/A56
0.01 to 0.11	93.8	87.5	75.0	62.5	50.0	0.10	85
0.12 to 0.24	93.3	86.1	74.4	63.6	50.7	0.13	85
0.25 to 0.49	89.7	81.9	66.9	54.5	43.3	0.27	85
0.50 to 0.99	88.7	81.3	67.0	55.2	43.8	0.55	85
1.00 to 1.99	88.3	77.7	62.6	51.8	41.1	1.11	85
2.00 to 2.99	92.1	82.8	71.1	58.1	46.2	2.21	85
3.00 to 4.99	85.1	74.6	61.7	50.3	39.8	3.32	85
5.00 to 7.49	86.0	76.9	61.3	49.5	39.1	5.54	85
7.50 to 9.99	88.6	79.2	64.9	52.7	41.8	8.30	85
10.00 to 14.99	87.7	80.0	67.1	56.1	45.6	11.07	85
15.00 to 19.99	91.3	83.3	69.9	58.0	47.0	16.61	85
20.00 to 24.99	90.5	83.5	72.1	60.7	49.5	22.15	85
25.00 to 29.99	90.7	83.0	70.7	59.9	48.7	27.69	85
30.00 to 39.99	89.7	81.3	68.9	59.1	48.4	33.22	85
40.00 to 49.99	90.2	81.6	68.7	57.2	45.8	44.30	85
50.00 to 59.99	88.7	78.9	65.4	54.2	43.4	55.37	85
60.00 to 74.99	89.0	79.7	66.8	55.4	44.4	66.45	85
75.00 to 99.99	89.2	79.3	64.7	53.6	43.1	83.06	85
100.0 to 124.9	88.1	78.0	64.3	54.2	42.9	110.7	85
125.0 to 149.9	88.8	79.0	65.0	54.0	44.0	138.4	85
150.0 to 174.9	90.5	82.6	70.7	58.7	47.8	166.1	85
175.0 to 199.9	90.3	81.9	69.8	57.8	46.6	183.0	90
200.0 to 249.9	92.2	84.8	71.1	58.6	46.9	209.2	90
250.0 to 299.9	91.9	85.5	72.3	60.0	47.6	261.5	90
300.0 to 324.9	93.1	86.1	72.9	60.8	48.6	313.8	90
325.0 to 349.9	92.2	84.9	72.7	60.5	48.9	339.9	90
350.0 to 399.9	92.7	85.6	72.9	60.9	48.9	366.1	90
400.0 to 449.9	92.7	85.6	72.9	60.9	48.9	418.4	90
450.0 to 499.9	92.7	85.6	72.9	60.9	48.9	470.7	90
500.0 to 599.9	92.7	85.6	72.9	60.9	48.9	523.0	90
600.0 to 699.9	92.7	85.6	72.9	60.9	48.9	627.6	90
700.0 to 749.9	92.7	85.6	72.9	60.9	48.9	732.2	90
750.0 to 799.9	92.7	85.6	72.9	60.9	48.9	784.0	90
800.0 or above	92.7	85.6	72.9	60.9	48.9	837.0	90

5.3 Description of Function Codes

This section describes details of function code. In principle, explanation is given for each function code in order of group and numerical order. However, function codes that are strongly related to one function are explained together in the first paragraph.

5.3.1 F codes (Basic functions)

F00	Data protection

This is a function to protect currently set data by disabling to make changes in function code data (except F00) and all types of command values (frequency setting, PID command) by ⏶/⏷ key operation from keypad.

F00 data	Change of function code		Changing digital reference data with the ⏶/⏷ keys
	Change from keypad	Change from communication	
0	Allowed	Allowed	Allowed
1	Not allowed *	Allowed	Allowed
2	Allowed	Allowed	Not allowed
3	Not allowed *	Allowed	Not allowed

*Although it is not possible to change function code from keypad, function code F00 can be changed.

F00 data can be changed by the double key operation using "STOP key +⏶ key" or "STOP key +⏷ key".

As a similar function related to data protection, "Allow function code editing (Data change enabled) 'WE-KP'" which can be assigned to a digital input terminal is available (🕮 Function code E01 to E05 Data = 19).

By combining data protection F00, protection of function code functions as follows:

Input signal "WE-KP"	Change in function code	
	Change from keypad	Change from communication
OFF	Not allowed	Allowed
ON	Follow setting of F00	

Note

- If "enable data change with keypad" [WE-KP] is set to a digital input terminal by mistake, it is not possible to make changes in function codes. In this case, after shortening (ON) the terminal to which temporarily "WE-KP" function is assigned, and the terminal [CM], change to a different function.
- "WE-KP" is the change enable signal for function code, this is not the function to protect frequency setting and PID command by ⏶⏷ key operation.

F01	**Frequency setting 1** **Related function codes:** **F18 bias (for frequency setting 1)** **C30 frequency setting 2** **C31 to C35 analog input adjustment (Terminal [12])** **C36 to C39 analog input adjustment (Terminal [C1] (C1 function))** **C40 terminal [C1] (C1 function) (Range / polarity selection)** **C41 to C45 analog input adjustment (Terminal [C1] (V2 function))** **C55 to C56 analog input adjustment (Terminal [12]) (Bias･Bias base point)** **C61 to C62 analog input adjustment (Terminal [C1] (C1 function) (Bias･Bias base point)** **C67 to C68 analog input adjustment (Terminal [C1] (V2 function)) (Bias･Bias base point)** **C50 bias (for frequency setting 1) (Bias base point)** **H61 UP/DOWN control initial value selection** **d59, d61 to d63 Command (Pulse train input)**

Select setting method of frequency setting. Set frequency setting 1 by function code F01, frequency setting 2 by C30.

F01, C30 data	Command sources
0	Frequency setting by keypad (refer to the following descriptions to find the setting method)
1	Set by voltage value to be input in the terminal [12] (0 to ±10VDC, Maximum output frequency /DC±10V)
2	Setting by current value to be input in the terminal [C1] (C1 function) (4 to 20mADC or 0 to 20 mADC, Maximum output frequency / 20 mADC) (Set slide switch SW4 of printed circuit board to [AI] side (factory default state), SW3 to [C1] side (factory default state), respectively.) (It is necessary to select C1 function (factory default state) by E59=0) (It is necessary to disable PTC input function by H26=0)
3	Set by the addition result of voltage value to be input in the terminal [12] (0 to ±10VDC, Maximum output frequency /±10 VDC) and current value to be input in the terminal [C1] (C1 function) (4 to 20 mA DC or 0 to 20 mA DC, Maximum output frequency/20 mA DC) When the addition result becomes maximum output frequency or higher, it is restricted by the maximum output frequency)
5	Set by voltage value to be input in the terminal [C1] (V2 function) (0 to +10 VDC, Maximum output frequency /+10 VDC) (Set slide switch SW4 of printed circuit board to [AI] side (factory default state), SW3 to [V2] side, respectively.) (It is necessary to select V2 function by E59 = 1) (It is necessary to disable PTC input function by H26 = 0)
7	Set by UP command “UP” and DOWN command “DOWN” assigned to the digital input terminal It is necessary to assign UP command (Data = 17) and DOWN command (Data =18) to the digital input terminal [X1] to [X5]. (E01 toE05)
8	Frequency setting by keypad (with balanceless bumpless function)
10	Set by pattern operation (C21 to C28)
11	Enable a digital input/output interface card (option). (For details, refer to the Digital Input Output Interface Card Instruction Manual.)
12	Setting by pulse train input “PIN” (Data = 48), which was assigned to the digital input terminal [X5], or the optional PG interface card. Note: When using X5 terminal with pulse train input, it might be affected by noise from other wire. Keep away from other wire from the wire to X5 terminal as far as possible.

Setting method of reference frequency

[1] Frequency setting by keypad (F01 = 0 (Factory default state), 8)

(1) Set the data of function code F01 to “0” or “8”. When keypad is at program mode or alarm mode, it is not possible to perform frequency setting with ▲/▼ keys. In order to enable frequency setting with ▲/▼ keys, shift to the operation mode.

(2) When ▲/▼ key is pressed, reference frequency is displayed and the least significant digit of the reference frequency flashes.

(3) By pressing the ▲/▼ key again, it is possible to change the reference frequency. To save the set frequency, press FUNC/DATA key. (E64=0: Factory default state). When the frequency is saved, it is possible to operate with the saved frequency next time the power is turned on.

Tip

- Automatic saving method (Function code E64 = 0) is available other than the above method as a data saving method of frequency setting.
- While the data of function code F01 is set to “0” or “8”, when frequency setting method other than frequency setting 1 (frequency setting 2, communication, multistep frequency) is selected as frequency setting, it is not possible to change the reference setting with ▲/▼ keys even if keypad is at operation mode. In this case, pressing ▲/▼ keys displays the currently selected reference frequency.
- When frequency setting is performed with ▲/▼ keys, the least significant digit displayed flashes and the data is changed from the least significant digit and the changing digit gradually shifts to the upper digit.
- In order to perform setting such as reference frequency, press ▲/▼ once and when the least significant digit flashes, push down the ▶▶ key, and then, the flashing digit will move. Therefore, it is possible to change the large numerical number easily. This operation is called cursor movement.
- When the data of function code F01 is set to “8”, balanceless bumpless function becomes enabled. When switching to frequency setting with keypad from frequency setting method other than keypad, the switched initial value of frequency setting with keypad takes the value of the frequency setting before it is switched. By using this function, even if frequency setting is switched, it is possible to perform operation without shock.

[2] Setting up a reference frequency using analog input (F01 = 1 to 3, 5)

It is possible to arbitrarily specify a frequency setting from the analog inputs (voltage value to be input to terminal [12] or terminal [C1] (V2 function) or current value to be input to terminal [C1] (C1 function)) by multiplying them with the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted.

Adjustment constants of frequency setting 1

F01 data	Input terminal	Input range	Bias		Gain		Polarity selection	Filter	Offset
			Bias	Base point	Gain	Base point			
1	[12]	0 to +10V, -10 to +10V	F18	C50	C32	C34	C35	C33	C31
2	[C1] (C1 function)	4 to 20 mA 0 to 20 mA	F18	C50	C37	C39	C40	C38	C36
3	[12]+ [C1] (C1 function) (Set by result of addition)	0 to +10V, -10 to +10V	F18	C50	C32	C34	C35	C33	C31
		4 to 20 mA 0 to 20 mA	F18	C50	C37	C39	C40	C38	C36
5	[C1] (V2 function)	0 to +10V	F18	C50	C42	C44	C45	C43	C41

Adjustment constants of frequency setting 2

C30 data	Input terminal	Input range	Bias		Gain		Polarity selection	Filter	Offset
			Bias	Base point	Gain	Base point			
1	[12]	0 to +10V, -10 to +10V	C55	C56	C32	C34	C35	C33	C31
2	[C1] (C1 function)	4 to 20 mA 0 to 20 mA	C61	C62	C37	C39	C40	C38	C36
3	[12]+ [C1] (C1 function) (Set by result of addition)	0 to +10V, -10 to +10V	C55	C56	C32	C34	C35	C33	C31
		4 to 20 mA 0 to 20 mA	C61	C62	C37	C39	C40	C38	C36
5	[C1] (V2 function)	0 to +10V	C67	C68	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

■ Filter (C33, C38, C43)

C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. The larger the time constant, the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

■ Terminal [12] Polarity selection (C35)

C35 configures the polarity and therefore the input range for analog input voltage.

C35 data	Modes for terminal inputs
0	-10 to +10 V
1	0 to +10 V (Negative value of voltage is regarded as 0 V)

■ **Terminal [C1] (C1 function) range / polarity selection (C40)**

C40 data	Terminal input range	Handling when bias value is set to minus
0	4 to 20 mA (Factory default)	Limit below 0 point with 0
1	0 to 20mA	
10	4 to 20mA	Enable below 0 point as minus value.
11	0 to 20mA	

■ **Terminal [C1] (V2 function) polarity selection (C45)**

C45 data	Modes for terminal inputs
0	0 to +10V When bias value is set to minus, enable below 0 point as a minus value.
1	0 to +10V (factory default) When bias value is set to minus, limit below 0 point by 0.

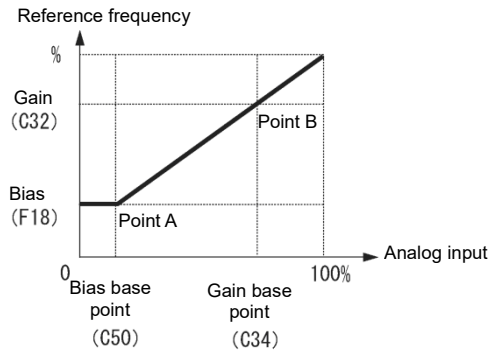
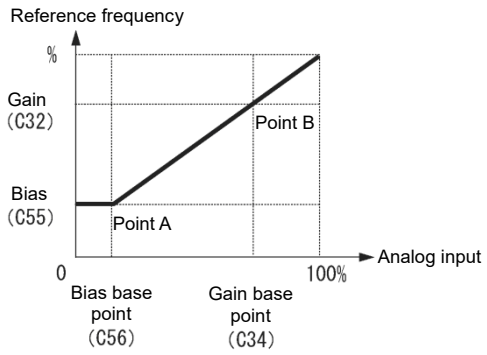
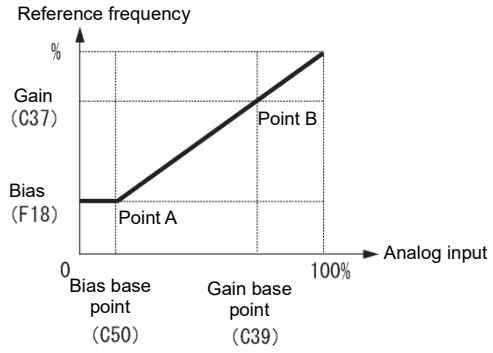
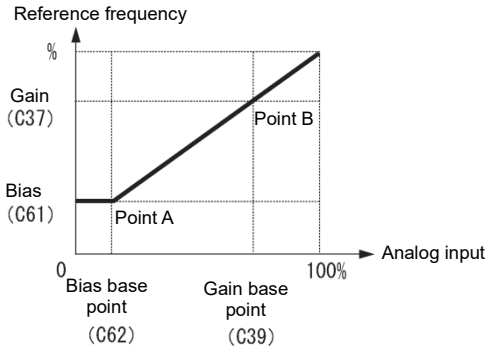
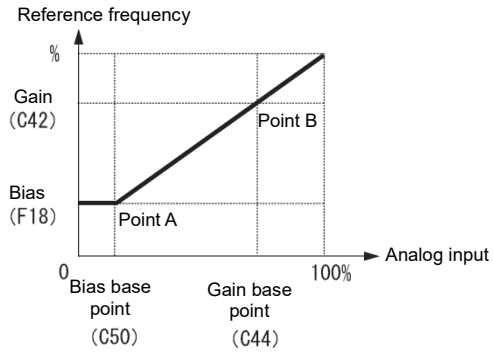
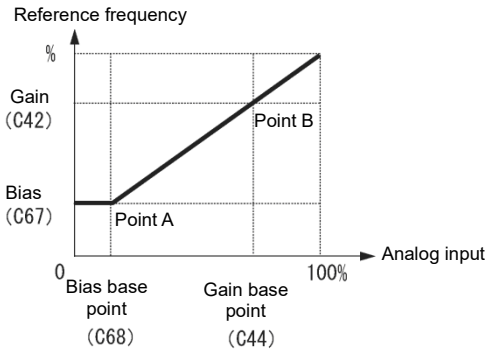
In order to use [C1] terminal as C1 function, V2 function, and PTC function, the following setting are necessary.

[C1] terminal	SW3	SW4	E59	H26	C40
When using C1 function (4 to 20 mA)	C1 side	AI side	0	0	0,10
When using C1 function (0 to 20 mA)	C1 side	AI side	0	0	1,11
When using V2 function (0 to +10V)	V2 side	AI side	1	0	Not relevant
When using PTC function	C1 side	PTC side	Not relevant	1, 2	Not relevant

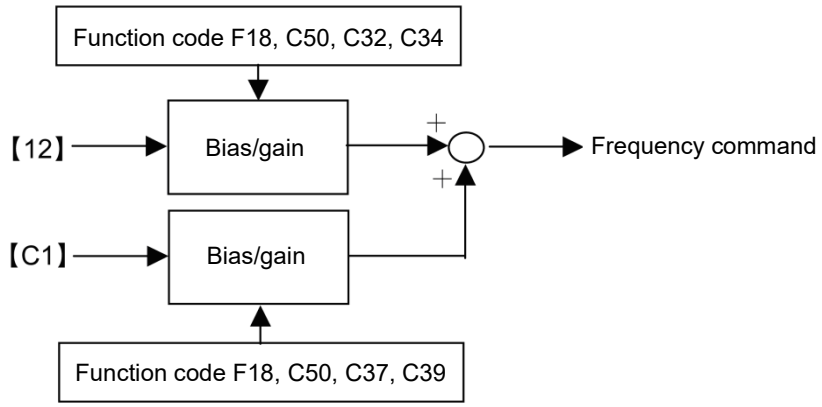
For details of SW3 and SW4, refer to Chapter 2, Section 2.2.8.

Caution is necessary because if the above switch settings are not performed accurately, unexpected frequency setting may be performed for the inverter.

■ **Gain•Bias**

Terminal	<Frequency setting 1: F01>	<Frequency setting 2: C30>
[12]		
[C1] (C1 function)		
[C1] (V2 function)		

Note For [12] + [C1] (C1 function) (setting by the result of addition), bias and gain are reflected to [12] and [C1] (C1 function) individually, and added by frequency command value of the result.



For single polarity (Terminal [12] (C35=1), Terminal [C1] (C1 function), Terminal [C1] (V2 function)

As the above diagram indicates, for reference frequency and analog input of frequency setting 1, it is possible to set arbitrary relationship by A point (determined by bias (F18) and bias reference point (C50)) and B point (determined by the gain corresponding to each analog input and the gain reference point (C32 and C34, C37 and C39, and C42 and C44)).

For reference frequency and analog input of frequency setting 2 (C30), it is possible to set arbitrary relationship by A point (determined by bias and bias reference point (C55 and C56, C61 and C62, and C67 and C68)) and B point (determined by the gain corresponding to each analog input and the gain reference point (C32 and C34, C37 and C39, and C42 and C44)).

Both data of bias and gain are set with 100% as the maximum frequency. The data of bias reference point and gain reference point are set up with full scale of analog input (10V or 20mA) as100%.

By setting the bias to minus value, even if the analog input is unipolar, it is possible to perform frequency setting as bipolar. For terminal [C1] (C1 function), C40 is set to 10 or 11, and for terminal [C1] (V2 function), C45 is set to 1, and then, the frequency setting at analog input at or below 0 point becomes negative polarity, as a result, it becomes possible to perform forward and reverse operation only by analog command.

Note

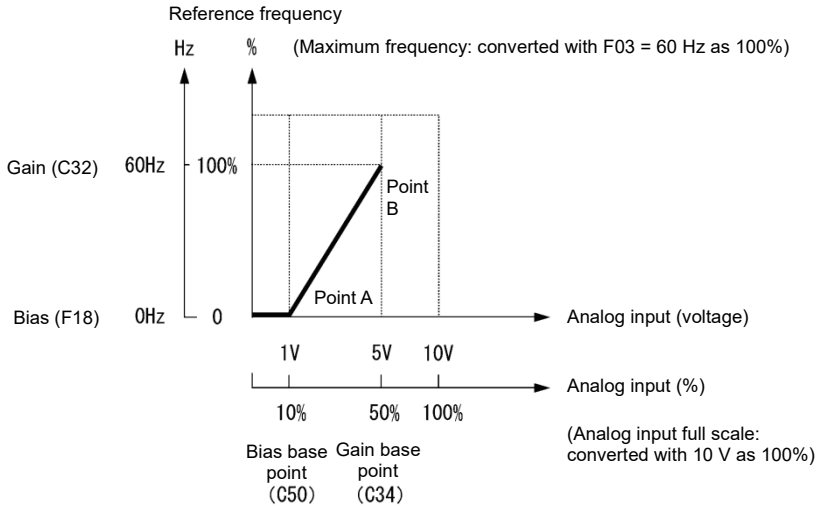
<Frequency setting 1: F01>

- Analog input at or below bias reference point (C50) is restricted by bias value (F18).
- When the value set in bias reference point (C50)≥ each gain reference point (C34, C39, C44), it is judged as incorrect setting and reference point becomes 0 Hz.

<Frequency setting 2: C30>

- Analog input at or below bias reference point (C56, C62, and C68) is restricted by bias value (C55, C61 and C67).
- When the value set in bias reference point (C56, C62, C68) ≧ each gain reference point (C34, C39, C44), it is judged as incorrect setting and reference point becomes 0 Hz.

Example) When setting reference frequency to 0 to 60 Hz by analog input (terminal [12]) 1 to 5V
(When maximum frequency is F03=60 Hz)



(A point)

In order to set reference frequency to 0 Hz when analog input is 1V, set bias (F18) to 0%. At this point, 1V has to become the bias reference point and 1V is equivalent to 10% against full scale 10V of terminal [12], therefore, set the bias reference point (C50) to 10%.

(B point)

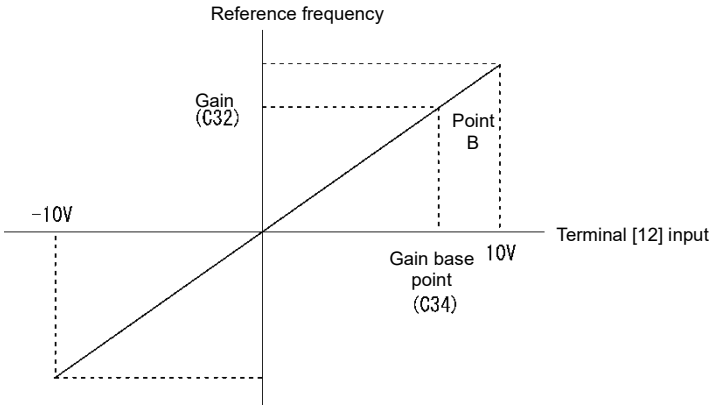
In order to set reference frequency so that the frequency becomes the highest when analog input is 5V, set the gain (C32) to 100%. At this point, 5V has to become the gain reference point and 5V is equivalent to 50% against full scale 10V of terminal [12], therefore, set the gain reference point (C34) to 50%.

Note The setting method without changing reference point and by using gain and bias individually is the same as for older model IMO Jaguar Drives.

For bipolar (Terminal [12] (C35=0))

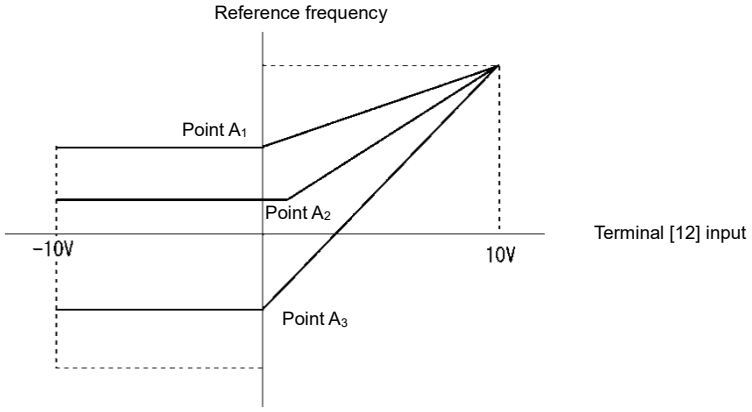
For terminal [12], by setting function code C35 to “0”, it is possible to use bipolar input (-10V to +10V).

When both bias (F18) and bias reference point (C50) are set to “0”, command becomes forward and reverse symmetric as shown in the diagram below.



Note

- When bias (F18) and bias reference point (C50) is set to arbitrary value (A1 point, A2 point, and A3 point, etc.), as shown in the diagram below, it is determined by the bias value (F18).



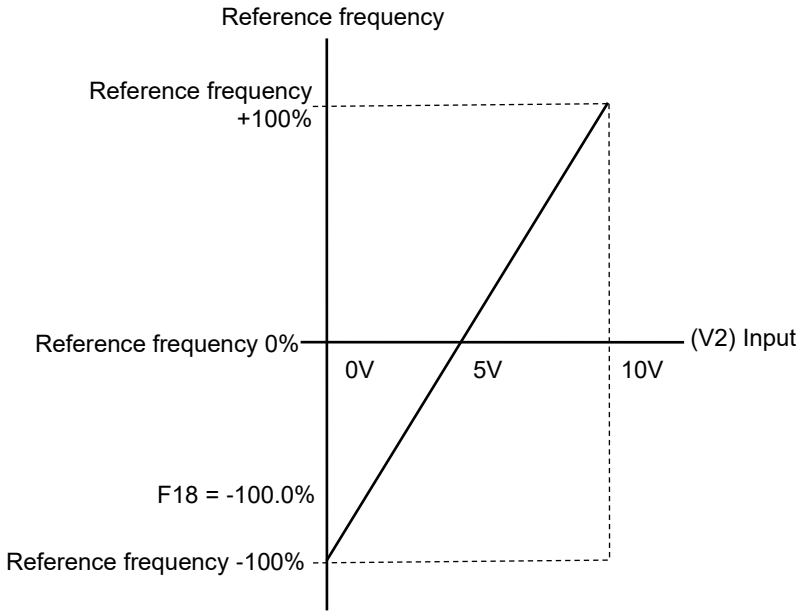
Note

- To input bipolar (0 to ±10 VDC) analog voltage at analog input (terminal [12]), set function code C35 to “0”. When the data of C35 is “1”, only DC 0 to +10V is effective and negative polar input DC0 to -10V is regarded as 0 (Zero) V.
- When setting reference frequency by display other than frequency (Hz), please change the speed monitor unit in E48.

When operating unipolar analog input as bipolar (terminal [C1] (C1 function) (C40 = 10, 11), terminal [C1] (V2 function) (C45 = 0)

For C1 function set C40 = 10, 11, for V2 function set C45 = 0, and by setting bias value to minus value, it is possible to obtain a negative reference frequency.

Example of frequency setting by V2 function when -100% is set to the bias value is shown in the diagram below.



[3] Frequency setting by digital input signal “UP”/“DOWN” (F01=7)

As frequency setting, UP/DOWN control is selected, and when the terminal command UP or DOWN is turned on with Run command ON, the output frequency increases or decreases accordingly, within the range from 0 Hz to the maximum frequency.

To perform frequency setting by UP/DOWN control, it is necessary to set the data of function code F01 to “7” and assign “UP command [UP], down command [DOWN]” to the digital input terminals.
(🕮 Function code E01 to E05 Data = 17, 18)

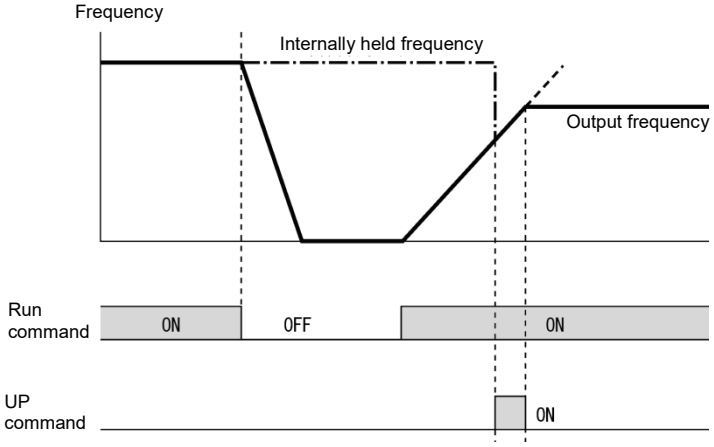
Input signal “UP”	Input signal “DOWN”	Action
Data = 17	Data = 18	
OFF	OFF	The output frequency will be held
ON	OFF	Increase output frequency by currently selected acceleration time
OFF	ON	Decrease output frequency by currently selected deceleration time
ON	ON	The output frequency will be held

■ UP/DOWN control initial value selection

Set initial value of reference frequency when starting UP/DOWN control.

H61 data	Initial value of frequency setting when starting UP/DOWN control.
0	Mode to fix to “0” When restarting operation (including when the power to the inverter is turned ON), initial value of setting frequency by UP/DOWN control is cleared with “0”. Increase speed by UP command.
1	This is the mode to set reference frequency at the previous UP/DOWN control as the initial value. The inverter internally holds the output frequency set by UP/DOWN control and starts to control from the previous operation frequency at the next restart (including powering ON).

Note At the restart of operation, before the internal frequency reaches the previous output frequency, when UP/DOWN command is input, output frequency at the point is held internally and UP/DOWN control starts from that value. Therefore, the previous output frequency data is overwritten and deleted.



< Initial value of UP/DOWN control when setting method of frequency setting is switched>

The initial value when setting method of frequency setting is set to UP/DOWN control is shown in the following table.

Setting method prior to switching	Switching signal	Initial value of UP/DOWN control	
		H61=0	H61=1
Setting other than UP/DOWN (F01, C30)	Frequency setting 2/ Frequency setting 1	Reference frequency by setting method prior to switching	
PID control	PID Cancel	Reference frequency by PID control (PID output)	
Multistep frequency	Multistep frequency selection	Reference frequency by setting method prior to switching	Reference frequency by previous UP/DOWN control
Communication	Link operation selection		

[4] Frequency setting using digital inputs (option DIO interface card) (F01 = 11)

The frequency setting with binary (8,12bit) or BCD code via option DIO interface card (OPC-DIO) is also available to be selected. Refer to the Digital Input Output Interface Card Instruction Manual.

[5] Frequency setting using pulse train input (F01 = 12)

■ Selecting the pulse train input format (d59)

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

The table below lists pulse train formats and their operations.

Pulse train input format selected by d59	Operation overview
0: Frequency and direction	Frequency/speed command according to the pulse train rate is given to the inverter. The pulse train sign specifies the polarity of the frequency/speed command. • For the inverter without an optional PG interface card Pulse train input: “PIN” assigned to the digital terminal [X5] (data = 48) Pulse train sign: “SIGN” assigned to a digital terminal other than [X5] (data = 49) If no SIGN is assigned, polarity of any pulse train input is positive.
1: Forward and reverse pulse	Frequency/speed command according to the pulse train rate is given to the inverter. The forward rotation pulse gives a frequency/speed command with positive polarity, and a reverse rotation pulse, with negative polarity.
2: Quadrature A/B signals (B phase lead)	Pulse trains generated by A and B phases with 90 degree phase difference give a frequency/speed command to the inverter based on their pulse rate and the phase difference (B phase advanced).
3: Quadrature A/B signals (A phase lead)	When YA, YB are connected in reverse, if you change this function code, the inverter can receive the pulse signal correctly.

Format of data 1 to 3 refer to d14.

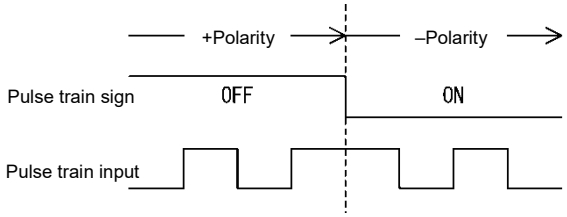


Figure 5.3-1 Data 0, pulse train sign/Pulse train input.

■ **Pulse scaling factor 1 (d62), pulse scaling factor 2 (d63)**

For pulse train input, set the relationship between input pulse frequency and frequency setting value by function code d62 (Command (pulse train input) pulse scaling factor 1) and d63 (command (pulse train input) pulse scaling factor 2).

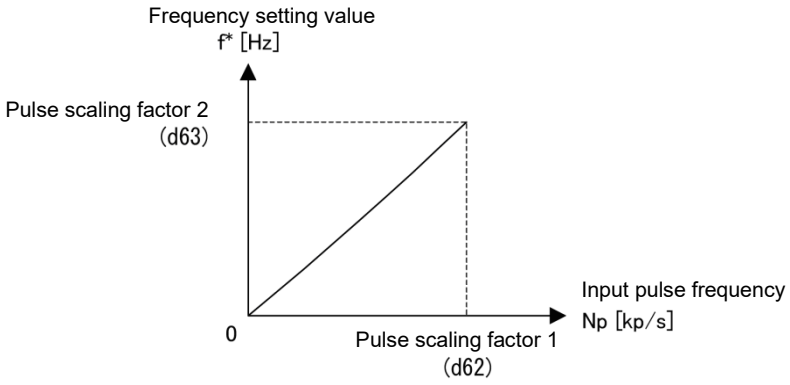


Figure 5.3-2 Relationship between input pulse frequency and frequency setting value

As shown in the figure above, set input pulse frequency [kp/s] to function code d62 (command (pulse train input) pulse scaling factor 1) and set frequency setting value [Hz] (when the input pulse frequency becomes the value set to function code d62) to function code d63 (command (pulse train input) pulse scaling factor 2). At this time, the relationship formula of input pulse frequency to be entered and frequency setting value f* (or speed command value) is as follows:

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

f* [Hz]: Frequency setting value

Np [kp/s]: Input pulse frequency to be input

Depending on the pulse train sign, polarity of the command is determined. Rotation direction of the motor is determined by the polarity of pulse train input and “FWD”/”REV” command. The relationship between the pulse train input polarity and rotation direction is specified in Table 5.3-1.

Table 5.3-1 The relationship between the pulse train input polarity and rotation direction

Polarity according to the pulse train input	Run command	Rotational direction
+	“FWD” (Forward rotation command)	Forward rotation
+	“REV” (Reverse rotation command)	Reverse rotation
-	“FWD” (Forward rotation command)	Reverse rotation
-	“REV” (Reverse rotation command)	Forward rotation

■ **Filter time constant (d61)**

Set filter time constant for pulse train input. The larger the time constant, the slower the response. Specify the proper filter time constant by taking into account the response speed of the machine. If the pulse is lower and frequency command fluctuates, set larger time constant.

■ **Switching frequency setting**

Switch frequency setting 1 (F01) and frequency setting 2 (C30) by the signal “Frequency setting 2/frequency setting 1” “Hz2/ Hz1”, which was assigned to the external digital input terminal.

(Refer to Function code E01 to E05 (Data =11) to find the details of “Hz2/ Hz1”.

Input signal “Hz2/ Hz1”	Frequency setting method to be selected
OFF	Frequency setting 1 (F01)
ON	Frequency setting 2 (C30)

F02	Operation method

Select setting method of run command. Indicate instruction method of run/stop and rotation direction (forward/reverse rotation) for each setting method.

F02 data	Setting method of run command	
	Run/stop	Rotation direction command
0: Keypad operation (Rotation direction input: Terminal block)	RUN/STOP keys	“FWD”, “REV”
1: External signal (digital input)	“FWD”, “REV”	
2: Keypad operation (forward rotation)	RUN/STOP keys	Rotation direction command is unnecessary (Forward rotation operation only, reverse rotation operation disabled)
3: Keypad operation (Reverse rotation)	RUN/STOP keys	Rotation direction command is unnecessary (Reverse rotation operation only, forward rotation operation disabled)

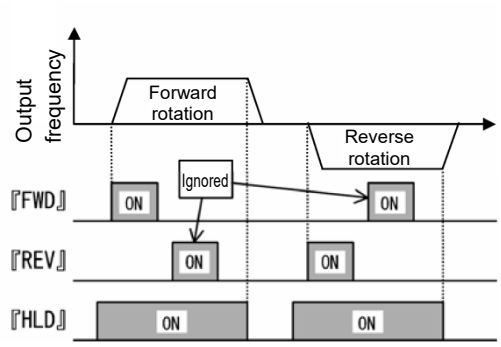
Digital input signal, “FWD”, “REV” needs to be assigned to terminals [FWD], [REV].
(📖 Function code E98, E99 data = 98, 99)

Note
- F02 cannot be changed when “FWD” or “REV” is ON.
- If F02 = 1 and when assignment of terminal [FWD] or [REV] is changed from other function to “FWD” function or “REV” function, turn the terminal [FWD] and [REV] off in advance (motor may rotate due to change in the setting).

■ **3-wire operation by external signal**

Although external signal of “FWD” and “REV” is 2-wire operation at the initial state, by assigning “Select 3-wire operation (HLD)”, it is possible to use as self-hold signal at 3-wire operation by using “FWD”, “REV” and “HLD” signals. When “HLD” is ON, inverter self-holds “FWD” or “REV” signal, and the hold state can be released by OFF. If there is no “HOLD” function assignment, “FWD” and “REV” become 2-wire operation.

📖 Refer to Function code E01 to E05 (Data =6) to find the details of “HLD”.



As a setting method of run command, high-priority setting methods (remote/local switch (refer to Chapter 3, Section 3.3.7), communication, etc.) are available in addition to the above mentioned settings.

F03	Maximum frequency 1

F03 specifies the maximum frequency that the inverter outputs. When the device to be driven is set to rated or higher, the device may be damaged. Make sure to make an adjustment to design mode value of the machinery.

- Data setting range: 25.0 to 500.0 (Hz)

Modes	Control mode	Data setting range	Remarks
HD/HND/HHD mode	V/f control	500 Hz	
ND mode	V/f control	120 Hz	Restricted internally.*

* When setting is performed by exceeding the maximum setting range (for example, 500 Hz), speed setting and analog output (FMA) become input/output mode of full scale/setting value (10V/ 500Hz). However, it is internally restricted (for example, 120Hz), therefore, even if 10V is input for setting value, the value is restricted internally by 2.4 V (equivalent to 120 Hz), not by 500Hz.

Use function code F80 to switch between ND, HD, HND and HHD drive modes.

⚠WARNING

Inverter can perform setting of high speed operation easily. When changing the setting, make sure to check the motor and machine mode before use.

Injuries could occur. Failure may occur.

Note When changing maximum output frequency (F03) in order to make the operation frequency a larger value, change the frequency limiter (upper limit) (F15) as well.

F04, F05 F06	**Base frequency 1, Rated voltage at base frequency 1** **Maximum output voltage 1** **Related function codes: H50, H51 Non-linear V/f 1 (Frequency, voltage)** **H52, H53 Non-linear V/f 2 (Frequency, voltage)** **H65, H66 Non-linear V/f 3 (Frequency, voltage)**

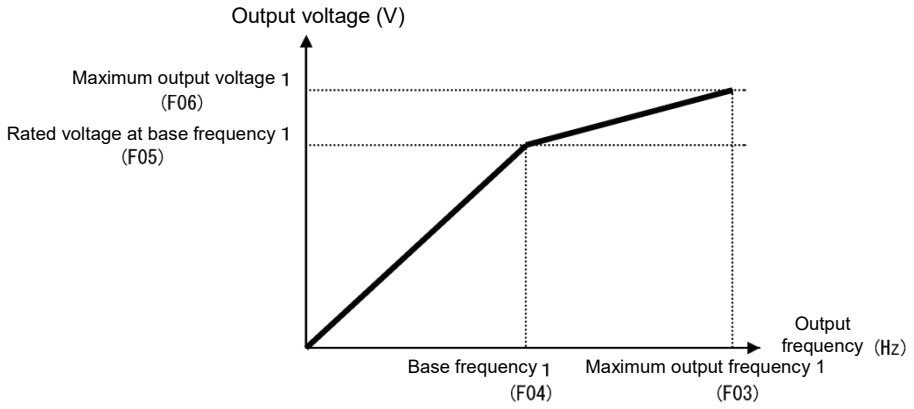
Set the base frequency and base frequency voltage that are essential to operation of the motor. By combining related function codes H50 to H53, H65, and H66, it is possible to set non-linear V/f pattern (weak or strong voltage by arbitrary point) and perform setting of V/f characteristics that is suitable for the load.

Impedance of the motor becomes larger with high frequency, and when output voltage becomes less, output torque may be reduced. In order to prevent this, increase the voltage at high frequency by setting function code F06 (maximum output voltage 1). However, it is not possible to output voltage at or higher than the input power voltage of the inverter.

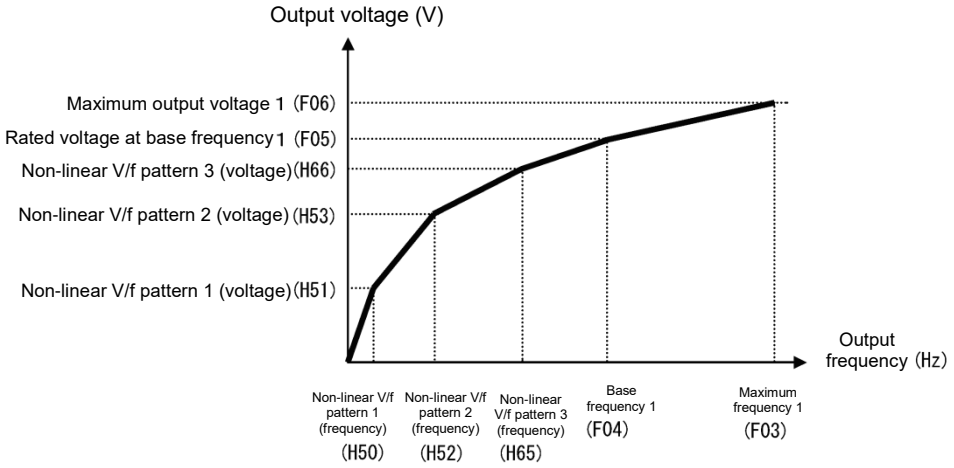
Point of V/f	Function code		Remarks
	Frequency	Voltage	
Maximum output frequency	F03	F06	During auto torque boost, vector control with/ without speed sensor, the maximum output voltage setting is disabled.
Base frequency	F04	F05	
Non-linear V/f 3	H65	H66	This code is disabled during auto torque boost, vector control with/ without speed sensor.
Non-linear V/f 2	H52	H53	
Non-linear V/f 1	H50	H51	

<Setting example>

■ **Normal V/f pattern setting**



■ **Non-linear V/f pattern setting (3 points)**



■ Base frequency (F04)

Set the data in accordance with rated frequency of the motor (given on the nameplate of the motor).

- Data setting range: 25.0 to 500.0 (Hz) (limited to 120 Hz (max.) in ND mode)

■ Rated voltage at base frequency (F05)

Set the data to “0” in accordance with rated voltage of the motor (given on the nameplate of the motor).

- Data setting range: 0 : AVR disable
  80 to 240 (V) : AVR operation (at 200 V class)
  160 to 500 (V) : AVR operation (at 400 V class)
- When data is set to “0”, the base frequency voltage becomes equivalent to inverter input voltage. When input voltage fluctuates, output voltage fluctuates as well.
- When data is set to arbitrary voltage other than “0”, automatically keeps the output voltage constant. When control function such as auto torque boost, auto energy-saving operation, and skip compensation is used, it is necessary to adjust to the rated voltage (given on the nameplate of the motor) of the motor.

Note The voltage that the inverter can output is lower than the input voltage of the inverter. Appropriately set the voltage in accordance with the motor.

■ Non-linear V/f 1, 2, 3 (Frequency) (H50, H52, H65)

Set frequency at the arbitrary point of non-linear V/f pattern.

- Data setting range: 0.0 (Cancel), 0.1 to 500.00 (Hz)

Note When 0.0 is set, the setting becomes the pattern without using non-linear V/f pattern.
(limited to 120 Hz (max.) in ND mode)

■ Non-linear V/f 1, 2, 3 (Voltage) (H51, H53, H66)

Set voltage at the arbitrary point of non-linear V/f pattern.

- Data setting range: 0 to 240 (V) : AVR operation (at 200 V class)
  0 to 500 (V) : AVR operation (at 400 V class)

■ Maximum output voltage 1 (F06)

Set the voltage at maximum output frequency 1 (F03).

- Data setting range: 80 to 240 (V) : AVR operation (at 200 V class)
  160 to 500 (V) : AVR operation (at 400V class)

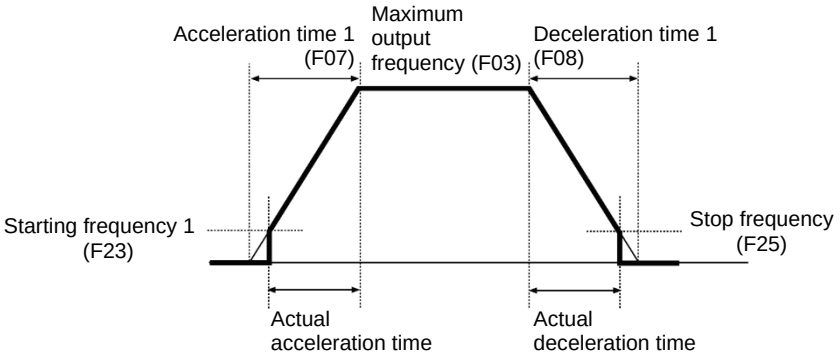
Note When rated voltage at base frequency (F05) is “0”, the data of non-linear V/f (H50 to H53, H65, and H66) and F06 becomes invalid (linear V/f for at or below base frequency, and constant voltage for at or higher than base frequency).

F07, F08	**Acceleration time1, Deceleration time 1** **Related function codes:** **E10, E12, E14 Acceleration time 2, 3, 4** **E11, E13, E15 Deceleration time 2, 3, 4** **H07 Curve acceleration/deceleration** **H56 Deceleration time for forced stop** **H54, H55 Acceleration/deceleration time (Jogging)** **H57 to H60 Acceleration/deceleration range No. 1, No.2 S-curve range**

Acceleration time sets the time taken by the output frequency to reach the maximum output frequency from 0Hz, and deceleration time sets the time taken by the output frequency to reach 0Hz from the maximum frequency.

- Data setting range: 0.00 to 6000 (s)

For V/f control



■ **Acceleration/Deceleration time**

Type of Acceleration/deceleration time	Function code		Select ACC/DEC time (📖 Function code E01 to E05)		
	Acceleration time	Deceleration time			
ACC/DEC time 1	F07	F08	"RT2" OFF	"RT1" OFF	Switch by acceleration/deceleration selection "RT1" "RT2". (Data = 4 or 5) When there is no assignment, acceleration/deceleration time 1 (F07, F08) are valid.
ACC/DEC time 2	E10	E11	OFF	ON	
ACC/DEC time 3	E12	E13	ON	OFF	
ACC/DEC time 4	E14	E15	ON	ON	
At jogging	H54	H55	When Ready for jogging "JOG" is ON, switch to the mode with which jogging operation is possible. (Data = 10) (📖 Function code C20)		
At Force to stop	-	H56	Turning the Force to stop "STOP" command OFF causes the motor to decelerate to a stop in accordance with the deceleration time for forced stop (H56). After the motor stops, the inverter enters the alarm state with the alarm *er6* displayed. (Data = 30)		

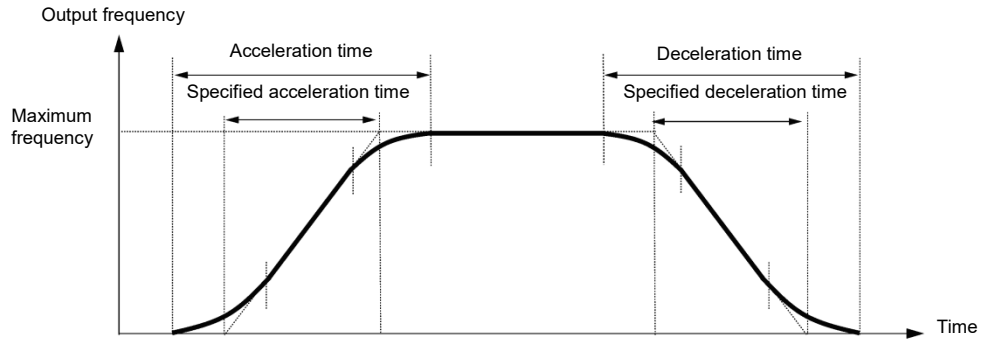
■ **Curve acceleration/deceleration (H07)**

Select acceleration/deceleration pattern (change pattern of frequency) at acceleration/deceleration

H07 data	Curve acceleration/ deceleration	Action		Function code
0	Disable (Linear acceleration/deceleration)	Acceleration/deceleration with constant acceleration.		-
1	S-curve acceleration/deceleration (Weak)	Smoothen the speed change and reduce shock when starting acceleration and right before the speed becomes constant, as well as when starting deceleration and right before the deceleration stops.	Weak: Fix acceleration/deceleration change rate to 5% of the maximum output frequency within each S-curve range.	-
2	S-curve acceleration/deceleration (Arbitrary)		Arbitrary: It is possible to set acceleration/deceleration change rate arbitrarily within each S-curve range.	H57, H58 H59, H60
3	Curve acceleration/deceleration	Linear acceleration/deceleration (constant torque) at or below base frequency and acceleration becomes gradually slower at or higher than the base frequency, and acceleration/deceleration with constant load rate (rated output). It is possible to accelerate/decelerate with the maximum capability.		-

S-curve acceleration/deceleration

For the purpose of decreasing the shock on the load machine side, smoothen the speed change at the start of acceleration and right before it becomes constant speed, and at the start of deceleration and right before the stop of deceleration. As for s-curve acceleration/deceleration values, fix with 5% for S-curve acceleration/deceleration (weak), and for S-curve acceleration/deceleration (arbitrary), it is possible to set individually for each 4 locations by function codes H57 to 60. The specified acceleration/deceleration time determines acceleration of linear part and the actual acceleration/deceleration time becomes longer than the specified acceleration /deceleration time.



	At the start of acceleration	At the end of acceleration	At the start of deceleration	At the end of deceleration
S-curve (Weak)	5%	5%	5%	5%
S-curve (Arbitrary) Setting range: 0 to 100%	H57 At acceleration No. 1 S-curve range (At starting)	H58 At acceleration No. 2 S-curve range (At arrival)	H59 At deceleration No. 1 S-curve range (At starting)	H60 At acceleration No. 2 S-curve range (At the arrival)

Acceleration/Deceleration time

< S-curve acceleration/deceleration (Weak): When frequency change is 10% or higher than the maximum frequency>

Acceleration or deceleration time (s) = $(2 \times 5/100 + 90/100 + 2 \times 5/100) \times$ reference acceleration or deceleration time

= $1.1 \times$ reference acceleration or deceleration time

< S-curve acceleration/deceleration (Arbitrary: When 10% at the start, 20% at the end): When frequency change is 30% or higher than the maximum frequency.>

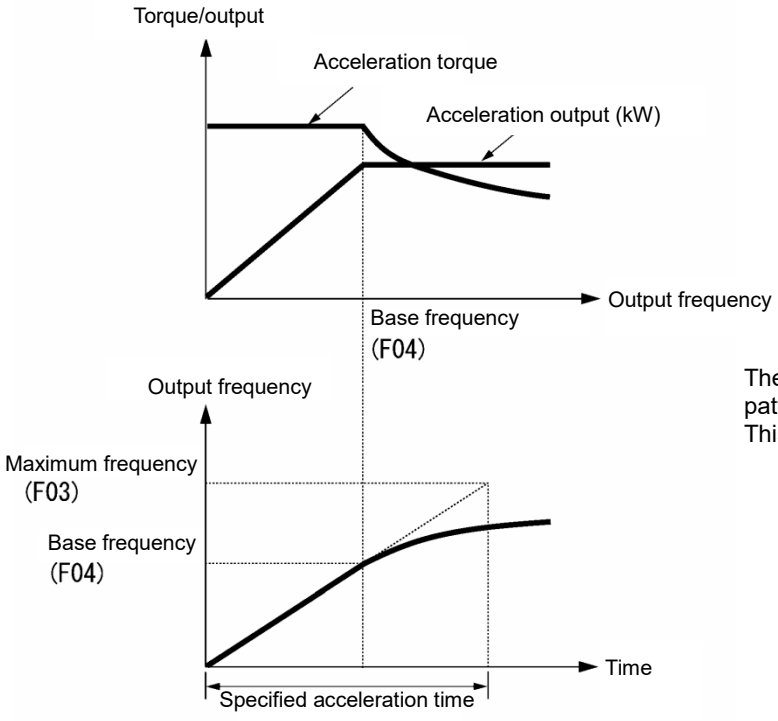
Acceleration or deceleration time (s) = $(2 \times 10/100 + 70/100 + 2 \times 20/100) \times$ (reference acceleration or deceleration time)

= $1.3 \times$ (reference acceleration or deceleration time)

Curve acceleration/deceleration

This is a pattern to perform linear acceleration/deceleration (rated torque) at or below base frequency and acceleration becomes gradually slower at or higher than the base frequency, and acceleration/deceleration with constant load rate (rated output).

It is possible to accelerate/decelerate with the maximum capability of the motor to be driven by the inverter.



The diagram on the left shows pattern at acceleration.
This is the same as at deceleration.

Note
- When S-curve acceleration/deceleration and curve acceleration/deceleration is selected by curve acceleration/deceleration H07, the actual acceleration/deceleration time becomes longer than the set value.
- If acceleration/deceleration time is set shorter than necessary, current limiting function, torque limit or anti-regenerative function may operate and acceleration/deceleration time may become longer than the set value.

F09	Torque boost 1 (Refer to F37)

For details of torque boost 1 setting, refer to the section of function code F37.

F10 to F12	Electronic thermal overload Protection for motor 1 (Select motor characteristics, Thermal time constant)

In order to detect overload of motor (electronic thermal function by inverter output current), set temperature characteristics of motor (Select motor characteristics (F10), thermal time constant (F12), and overload detection level (F11).

When overload of motor is detected, inverter is turned off, protecting the motor with motor overload alarm *0l1*.

Note Improper setting of the electronic thermal function may result in a failure to protect the motor from burning.

Note Temperature characteristics of motor is used for motor overload early warning “OL” as well. Even if only overload early warning is used, it is necessary to set temperature characteristics of the motor (F10, F12). (🕮 Function code E34)

For disabling motor overload alarm, set F11 = 0.00 (Disable).

Note For PTC thermistor built-in motor, by connecting PTC thermistor to terminal [C1], it is possible to protect the motor. Refer to H26 to find the details.

■ **Select motor characteristics (F10)**

F10 selects characteristics of cooling system of the motor.

F10 data	Function
1	Self-cooling fan of general-purpose motor (Self-cooling) (When operating with low frequency, cooling performance decreases.)
2	Inverter-driven motor, High-speed motor with separately powered cooling fan (Keep constant cooling capability irrespective to output frequency)

Figure 5.3-3 shows electronic thermal operation characteristics diagram when F10=1 is set. The characteristics coefficient α1 and α3 and the switch coefficient f2, f3 differ depending on the characteristics of the motor.

Each coefficient that is set by motor characteristics that is selected by motor capacitance and motor selection (P99) is shown in Table 5.3-2, Table 5.3-3 and Table 5.3-4.

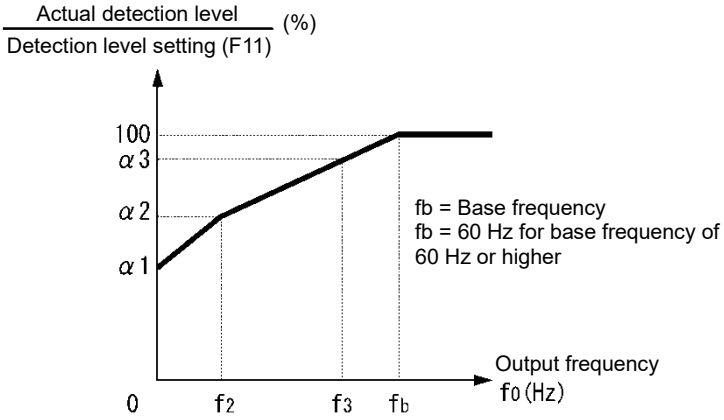


Figure 5.3-3 Characteristics diagram of motor cooling system

Table 5.3-2 When P99 = 0, 4 (Motor characteristics 0, Other)

Motor capacity	Thermal time constant τ (Factory default)	Thermal time constant setting Standard current value Imax	Characteristics coefficient switch frequency		Characteristics coefficient		
			f_2	f_3	α1	α2	α3
0.4, 0.75 kW	5 min	Continuous allowance current value x 150%	5 Hz	7Hz	75%	85%	100%
1.5 to 3.7 kW					85%	85%	100%
5.5 to 11 kW				6Hz	90%	95%	100%
15 kW				7Hz	85%	85%	100%
18.5, 22 kW				5Hz	92%	100%	100%
30 to 45 kW	10 min		Base frequency × 33%	Base frequency × 83%	54%	85%	95%
55 to 90 kW					51%	95%	95%
110 kW or above					53%	85%	90%

Table 5.3-3 When P99 = 1 (Motor characteristics 1)

Motor capacity	Thermal time constant τ (Factory default)	Thermal time constant setting Standard current value Imax	Characteristics coefficient switch frequency		Characteristics coefficient		
			f_2	f_3	α1	α2	α3
0.4 to 22 kW	5 min	Continuous allowance current value x 150%	Base frequency × 33%	Base frequency × 33%	69%	90%	90%
30 to 45 kW	10 min			Base frequency × 83%	54%	85%	95%
55 to 90 kW					51%	95%	95%
110 kW or above					53%	85%	90%

Table 5.3-4 When P99 = 20,21 (Motor characteristics)

Motor capacity	Thermal time constant τ (Factory default)	Thermal time constant setting Standard current value Imax	Characteristics coefficient switch frequency		Characteristics coefficient		
			f_2	f_3	α1	α2	α3
18.5kW to less than 110 kW	5 min	Continuous allowance current value x 150%	Base frequency × 33%	Base frequency × 83%	53%	85%	95%
110 kW or above	10 min				53%	85%	90%

When F10=2 is set, cooling effect by output frequency will not decrease, therefore, overload detection level becomes constant value (F11) without decrease.

■ **Overload detection level (F11)**

F11 sets operation level of electronic thermal.

- Data setting range: 1 to 135% of the rated current value of inverter (continuous allowance current value)

Normally, set to the motor continuous allowance current (in general, about 1.0 to 1.1 times of motor rated current) when operating at base frequency.

For disabling electronic thermal as disable, set F11 = 0.00: Disable.

■ **Thermal time constant (F12)**

F12 sets thermal time constant of the motor. For overload detection level that is set by F11, set the electronic thermal operation time when 150% of current is flowing continuously. Thermal time constant of general-purpose motor is 5 minutes for 22 kW or lower, and 10 minutes (factory default state) for 30kW or higher.

- Data setting range: 0.5 to 75.0 (min)

(Example) When the data of function code F12 is set to “5” (5 minutes).

As shown in Figure 5.3-4, when 150% of current of operation level that was set flows for 5 minutes, motor overload (alarm *0l1*) protection function will operate. In addition, with 120%, it operates after 12.5 minutes.

The time when alarm actually occurs is shorter than the set data because the time until the current reaches 150% level after exceeding the continuous allowance current (100%) is considered.

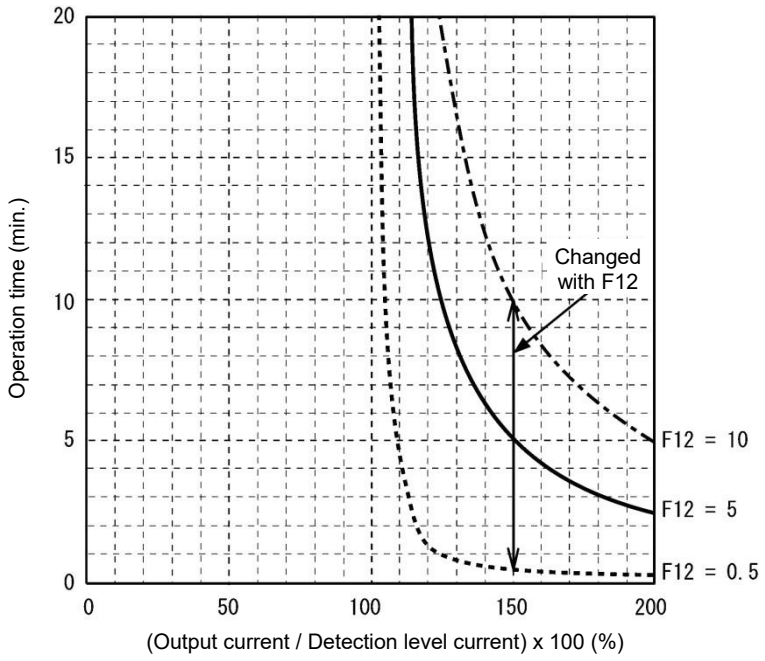


Figure 5.3-4 Example of current-operation time characteristics

F14	**Restart mode after momentary power failure (Mode selection)** **Related function codes: H13 (Restart timer)** **H14 (frequency lowering rate)** **H15 (Continuous running level)** **H16 (Allowable momentary power failure time)** **H92 Continuous running at the momentary power failure (P)** **H93 Continuous running at the momentary power failure (I)**

Set the operation for when momentary power failure occurs (trip operation, restart operation method at auto-restarting)

■ **Restart mode after momentary power failure (Mode selection) (F14)**

V/f control (F42=0,2,3), dynamic torque vector control(F42=1,4), PM motor control(F42=15)

<table>
<tr><th rowspan="2">F14 data</th><th colspan="2">Operation contents</th></tr>
<tr><th>Without auto search</th><th>With auto search</th></tr>
<tr><td>0: Trip immediately</td><td colspan="2">When momentary power failure occurs while operating the inverter, and at the time when undervoltage is detected by the DC link bus voltage of the inverter, undervoltage alarm lu is outputted, the inverter output shuts down, and the motor coasts to a stop.</td></tr>
<tr><td>1: Trip after a recovery from power failure</td><td colspan="2">When momentary power failure occurs while operating the inverter, and at the time when undervoltage is detected by the DC link bus voltage of the inverter , the inverter output shuts down and the motor coasts to stop, but the undervoltage alarm will not be outputted.
When auto-started from momentary power failure, undervoltage alarm lu is outputted.</td></tr>
<tr><td>2: Trip after momentary deceleration is stopped</td><td colspan="2">As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-stop control is invoked.
Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm lu is issued.</td></tr>
<tr><td rowspan="3">3: Continue to run (for heavy inertia load or general load)</td><td colspan="2">As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-stop control is invoked.
Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor, and operation is continued to wait for auto-restarting. If there is not enough energy for regeneration and when undervoltage is detected, the inverter output shuts down and the motor coasts to a stop.</td></tr>
<tr><td>If run command is entered at auto-restarting, restart from the frequency of when undervoltage is detected.</td><td>If run command is entered at auto-restarting, auto-searching is performed, motor speed is estimated, and restart from the frequency.</td></tr>
<tr><td colspan="2">This setting is most suitable for the fan with large inertia moment of load.</td></tr>
<tr><td rowspan="3">4: Restart from frequency at power failure (for general load)</td><td colspan="2">When momentary power failure occurs while operating the inverter, and at the time when undervoltage is detected by the DC link bus voltage of the inverter, the inverter output shuts down, and the motor coasts to a stop.</td></tr>
<tr><td>If run command is entered at auto-restarting, restart from the frequency of when undervoltage is detected.</td><td>If run command is entered at auto-restarting, auto-searching is performed, motor speed is estimated, and restart from the frequency.</td></tr>
<tr><td colspan="2">This setting is most suitable for the case (fan) when load inertial moment is large, and motor speed does not decrease so much even if the motor coasts to a stop due to momentary power failure.</td></tr>
<tr><td rowspan="3">5: Restart from starting frequency</td><td colspan="2">When momentary power failure occurs while operating the inverter, and at the time when undervoltage is detected by the DC link bus voltage of the inverter, the inverter output shuts down, and the motor coasts to a stop.</td></tr>
<tr><td>If run command is entered at auto-restarting, restart from the starting frequency that was set by function code F23.</td><td>If run command is entered at auto-restarting, auto-searching is performed, motor speed is estimated, and restart from the frequency.</td></tr>
<tr><td colspan="2">This setting is most suitable for the case (pump etc.) when load inertia moment is small, when the load is heavy, and motor speed decreases up to 0 in a short time after the motor coasts to a stop due to momentary power failure.</td></tr>
<tr><td colspan="3">With auto-searching: Auto-searching is selected by starting mode selection “STM” ON or H09/d67 = 1 or 2.
Refer function code H09/d67 (Starting mode) to find the detail of starting mode selection “STM” ON auto-searching.</td></tr>
</table>

⚠WARNING

When momentary power failure restart operation (F14 = 3 to 5) is selected, operation will resume automatically at auto-restarting. Design your machinery so that safety is ensured even at restarting.

Otherwise an accident could occur.

Under vector control with speed sensor (F42=6)

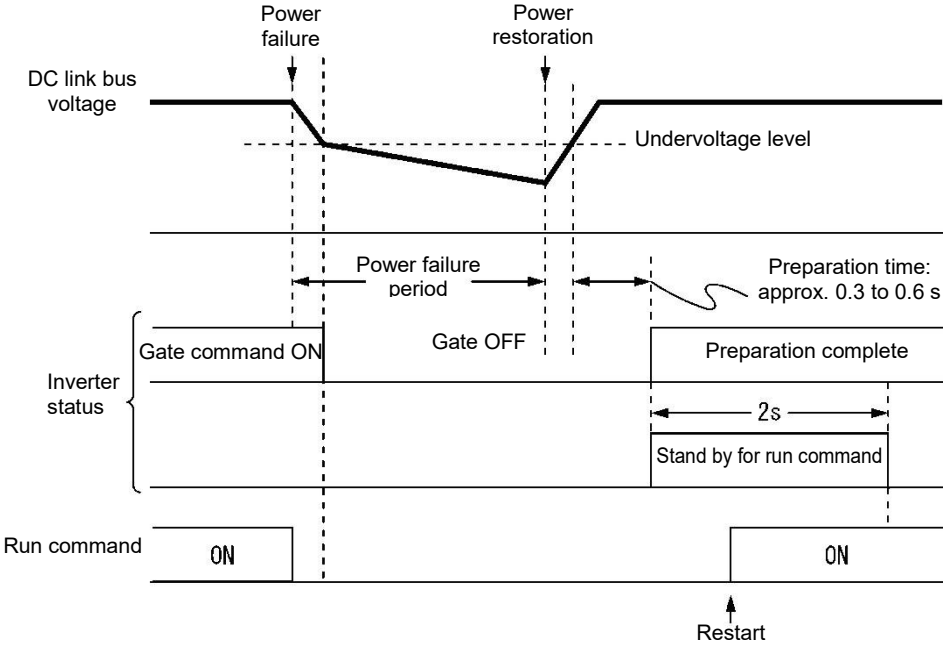
Data for F14	Description
0: Trip immediately	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm */u* and shuts down its output so that the motor enters a coast-to-stop state.
1: Trip after a recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm */u*. The moment the power is restored, an undervoltage alarm */u* is issued, while the motor remains in a coast-to-stop state.
2: Trip after momentary deceleration is stopped	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-stop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm */u* is issued.
3: Continue to run	If the F14 data is set to "3," then the "Continue to run" function is enabled.
4: Restart from frequency at power failure 5: Restart from starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state. Even if the F14 data is set to "3," the "Continue to run" function is disabled. If a run command has been input, restoring power restarts the inverter at the motor speed detected by the speed sensor.

■ **Restart mode after momentary power failure (Basic operation: Without auto-searching setting)**

When inverter detected that DC link bus voltage becomes at or drops below undervoltage level while operating, it is judged as a momentary power failure. When load is light and momentary power failure is very short, momentary power failure may not be detected and motor operation might be continued because DC link bus voltage does not drop so much.

When inverter judges the state as momentary power failure, returns to momentary power failure restart mode and prepares for restart. After power is auto-restarted, the inverter becomes at inverter ready to run state after elapse of initial charging time. At momentary power failure, power of external circuit (relay circuit etc.), which controls the inverter, decreases as well, and run command may be turned off. Therefore, when the inverter becomes at inverter ready to run state, wait 2 seconds for input of run command. When input of run command is confirmed within 2 seconds, initiate restarting according to F14 (mode selection). When there is no input of run command at run command input waiting state, momentary power failure restart mode will be released and start from normal starting frequency. Therefore, input run command within 2 seconds after auto-restarting or hold run command by off-delay timer or mechanical latch relay.

In case of F02=0 (run command from keypad and rotation direction command determined by terminal), it operates in the same way as above. For rotation direction fixed mode (F02 = 2, 3), run command is held within the inverter, therefore, it restarts immediately at inverter ready to run state.



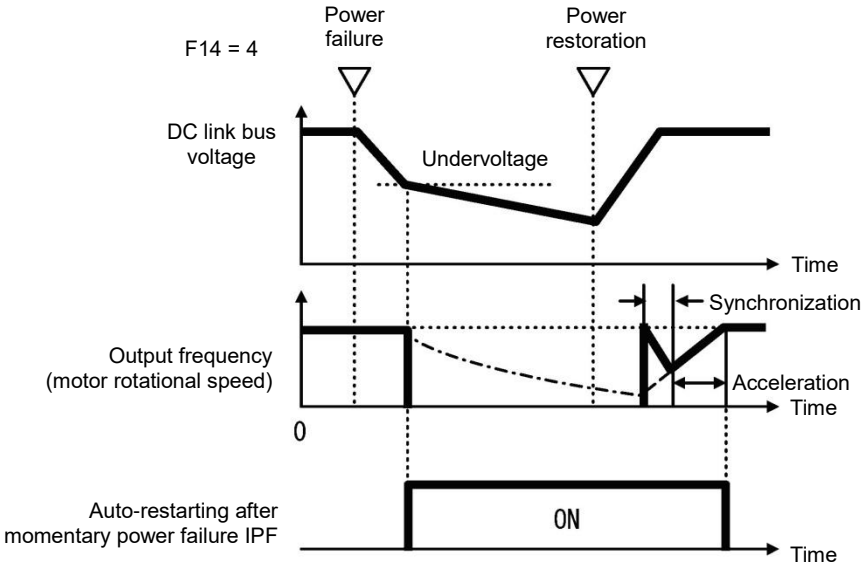
Note

- At auto-restarting, inverters waits 2 seconds for input of run command, however, if allowable momentary power failure time (H16) is elapsed after the state is judged as power failure, the state of run command input waiting for 2 seconds will be canceled and normal starting operation is performed.
- When coast to a stop command “BX” is entered during power failure, momentary power failure restart waiting state is released and return to normal run mode, and when run command is inputted, start from normal starting frequency.
- Detection of momentary power failure within the inverter is performed by detecting DC link bus voltage drop of the inverter. With the structure in which a magnetic contactor is equipped on the output side of the inverter, there will be no operation power of the magnetic contactor at momentary power failure and the magnetic contactor becomes at open state. When the magnetic contactor becomes open, connection of inverter and motor is released and load of the inverter is shutdown. Therefore, it becomes difficult to decrease DC link bus voltage of the inverter and it may not be judged as a momentary power failure. If this is the case, momentary power failure restart will not be performed normal. As a countermeasure against this case, by connecting auxiliary contact signal of the magnetic contactor to the interlock signal “IL” it is possible to detect momentary power failure without fail.

  Function code E01 to E05 Data = 22

Terminal command “IL”	Meaning
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

When motor speed decreases during momentary power failure, and when restarting from frequency of before momentary power failure after power is recovered (auto-restarting), current limiter becomes active and output frequency of the inverter decreases automatically. When output frequency and motor rotation speed synchronize, the speed is accelerated up to the original output frequency. Refer to the figure below. However, it is necessary to enable instantaneous overcurrent limiting (H12 = 1) to bring in synchronization of the motor.



- Auto-restarting after momentary power failure “IPF”

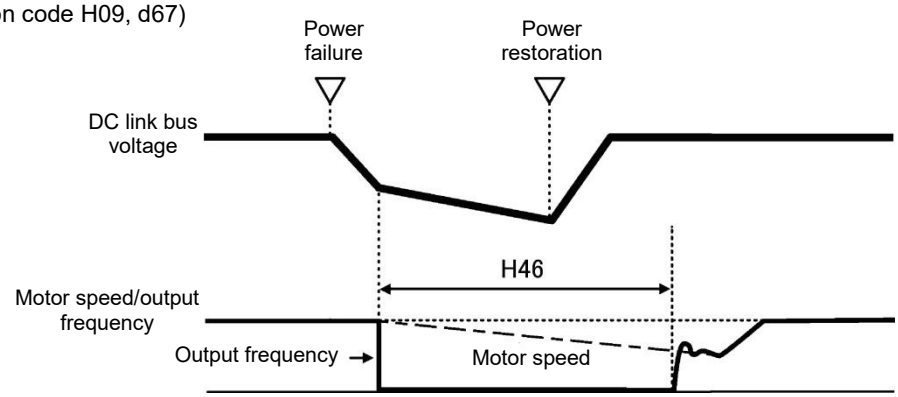
During momentary power failure auto-restarting “IPF” signal is turned on until returning to original frequency after auto-restarting after momentary power failure occurred. When “IPF”: is turned ON, motor speed decreases, therefore, take necessary measures. (🕮 Function code E20, E21, E27 Data = 6)

■ **Restart mode after momentary power failure (Basic operation: With auto-searching setting)**

Auto-searching is not performed normally if there is residual voltage of the motor.

Therefore, it is necessary to secure the time until residual voltage runs out.

Restart mode after momentary power failure secures the necessary time with function code H46 starting mode (auto search delay time 2). Even if starting conditions are satisfied, inverter does not start unless auto-search delay time elapses after inverter goes into OFF state. Inverter starts after elapse of auto-searching delay time.
(🕮 Function code H09, d67)

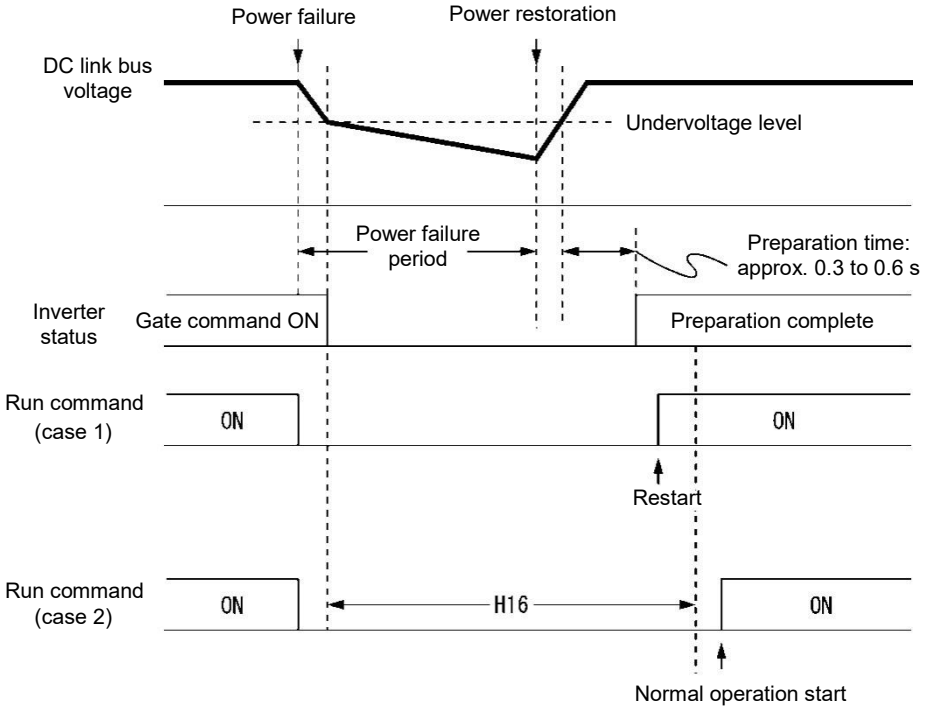


Note

- When operating auto-searching, it is necessary to perform auto-tuning in advance.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.
- During auto search, if an overcurrent or overvoltage trip occurs, the inverter will restart the auto search.
- Use 60 Hz or below for auto-searching
- Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.
- When output circuit filter is equipped on the output side of the inverter, auto-searching must be disabled.

■ **Restart mode after momentary power failure (Allowable momentary power failure time) (H16)**

Sets the maximum time from when momentary power failure (undervoltage level) occurs until restart (setting range: 0.0 to 30.0 s). Set coast to a stop time which is allowable for machine and equipment. Momentary power failure restart operation should be performed within the specified time, however, if the set time is exceeded, the inverter judges the state as a power shut down, and then operates as powering on again without performing momentary power failure restart operation.



When allowable momentary power failure time (H16) is set to “999”, momentary power failure restart is performed until DC link bus voltage decreases by momentary power failure restart allowance voltage (50 V for 200 V class, 100 V for 400 V class), however, if the voltage becomes at or below the momentary power failure allowance voltage, the state is judged as a power shut down. As a result, the inverter operates as powering ON again without performing momentary power failure restart operating.

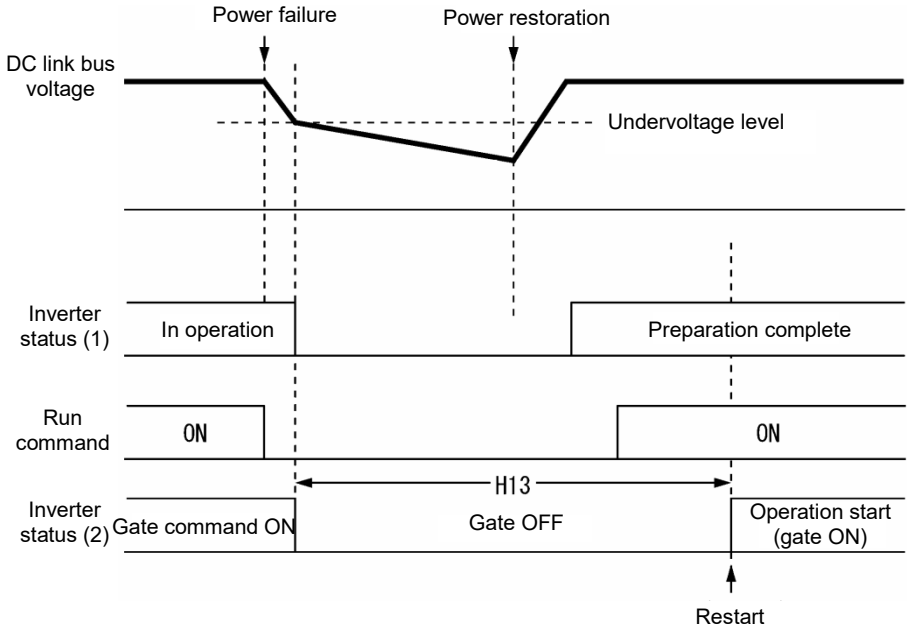
Power supply voltage	Allowance voltage of momentary power failure restart
200V	50V
400V	100V

Note The time until voltage decreases to the momentary power failure restart allowance voltage from undervoltage differs greatly depending on the inverter capacity and with/without option.

■ **Restart mode after momentary power failure (Restart timer) (H13) (Exclusive to V/f control for IM)**

H13 set the time until restart is performed after momentary power failure occurred. (At auto-searching setting, use H46 (auto search holding time 2)).

Restarting at the state when residual voltage of the motor is high, inrush current becomes greater or temporarily becomes at regeneration state, and overcurrent alarm may occur. For security reason, in order to restart after residual voltage is reduced to some extent, adjust H13. Even if auto-restarted, restart cannot be performed until the holding time (H13) elapses.



Factory default: At the factory default state, setting is performed so that it is appropriate to the standard motor (refer to “5.2.3 Factory default value per applicable electric motor capacitance“). Basically, there is no need to modify the default setting. However, when problems occur due to the long holding time or decrease in flow rate of pump becomes significant, change to about half of the standard value and make sure that alarm etc. will not occur.

■ **Restart Mode after Momentary Power Failure (H14)(Exclusive to V/f control for IM)**

At momentary power failure restart operation, when inverter output frequency and motor rotation speed does not synchronize, overcurrent occurs and current limiter will operate. when current limit is detected, automatically decrease the output frequency and synchronize with the motor rotation speed. H14 sets the slope of lowering output frequency (frequency lowering rate in Hz/s).

H14 data	Output frequency lowering operation
0.00	Decrease by the selected deceleration time.
0.01 to 100.00 (Hz/s)	Decrease by the lowering rate that is set by H14.
999	Depending on the PI regulator of current limiting processing (PI constant is fixed value within the inverter), the rate will decrease.

Note When frequency lowering rate is increased, regeneration operation is performed at the moment when output frequency of the inverter and rotation speed of inverter synchronize, and overvoltage trip may occur. When frequency lowering rate is reduced, the time until output frequency of the inverter and motor rotation speed synchronize (current limiting operation) becomes longer, and protection operation of inverter overload may be activated.

■ **Restart mode after momentary power failure (Continuous running level) (H15)**
Continued operation at the momentary power failure (P, I) (H92, H93)

• Trip after momentary deceleration is stopped

When trip after deceleration stopped is selected (F14 = 2), at momentary power failure restart operation (Mode selection), momentary power failure occurs while operating the inverter, and deceleration stop control starts when DC link bus voltage of the inverter becomes at or drops below the continuous running level.

Adjust voltage level of DC link bus to start deceleration stop control by H15.

Under decelerate-to-stop control, the inverter decelerates its output frequency keeping the DC link bus voltage constant using a PI regulator.

P (proportional) and I (integral) components of the PI regulator are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.

• Continue to run

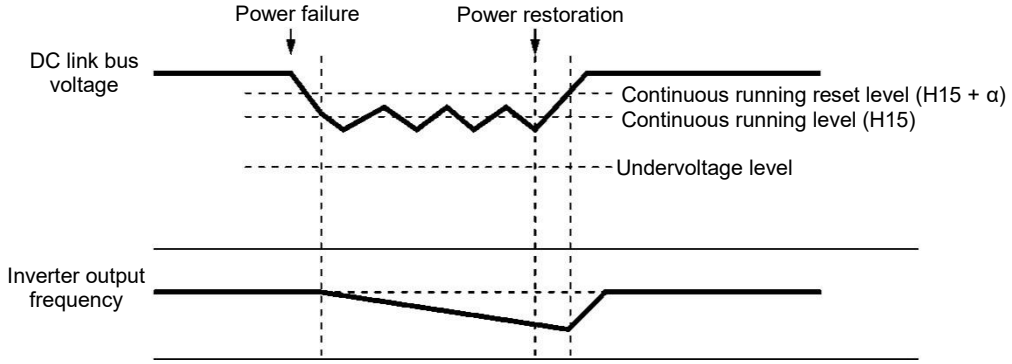
When momentary power failure restart operation (Continue to run) is selected (F14 = 3) at momentary power failure restart (operation selection), momentary power failure occurs while operating the inverter and continue to run control starts when DC link bus voltage of the inverter becomes at or drops below the continue to run level.

Adjust continue to run level to start continue to run control by H15.

Under the continue to run control, the inverter continues to run keeping the DC link bus voltage constant using the PI regulator.

P (proportional) and I (integral) components of the PI regulator are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.



Power supply group	Alpha (α)	
	22 kW or below	30 kW or above
200 V	5 V	10 V
400 V	10 V	20 V

Note Even if “Deceleration stop control” or “Continue to run”, is selected, the inverter may not be able to perform the function when the inertia of the load is small or the load is heavy, due to undervoltage caused by the control delay. In such a case, when “Deceleration stop control” is selected, the inverter allows the motor to coast to a stop; when “Continue to run” is selected, the inverter saves the output frequency being applied when the undervoltage alarm occurs and perform momentary power failure restart operation.

When the input power voltage for the inverter is high, setting the continue to run level high makes the control more stable even if the inertia of the load is relatively small. Raising the continuous running level too high, however, might cause the continue to run control activated even during normal operation.

When the input power voltage for the inverter is extremely low, continue to run control might be activated even during normal operation, at the beginning of acceleration or at an abrupt change in load. To avoid this, lower the continuous running level. Lowering it too low, however, might cause undervoltage that results from voltage drop due to the control delay.

Before you change the continuous running level, make sure that the continuous running control will be performed properly, by considering the fluctuations of the load and the input voltage.

F15, F16	Frequency limiter (Upper limit), Frequency limiter (Lower limit) Related function codes: H63 Lower limit Limiter (Mode selection)

■ **Frequency limiter (Upper limit) (Lower limit) (F15, F16)**

F15 and F16 specify the upper and lower limits of the output frequency or reference frequency, respectively.

Frequency Limiter		Object to which the limit is applied
Frequency limiter (Upper)	F15	Output frequency
Frequency limiter (Lower)	F16	Reference frequency
Note	When the limit is applied to the reference frequency or reference speed, delayed responses of control may cause an overshoot or undershoot, and the frequency may temporarily go beyond the limit level.	

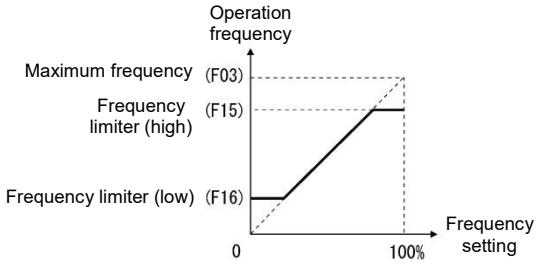
- Data setting range: 0.0 to 500.0 (Hz)

■ **Low Limiter (Mode selection) (H63)**

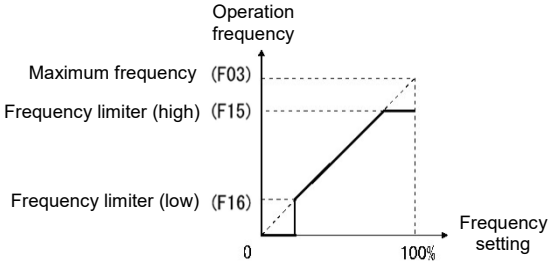
H63 specifies the operation to be carried out when the reference frequency drops below the low level specified by F16, as follows:

H63 data	Action
0	The output frequency will be held at the low level specified by F16.
1	The inverter decelerates to stop the motor.

Refer to the figure below.



(For H63 = 0)



(For H63 = 1)

Note
- When changing the frequency limiter (Upper) (F15) in order to raise the reference frequency, be sure to change the maximum frequency (F03) accordingly.
- Set each function code related to operation frequency so that the relationship among data becomes the following magnitude relationship.
  - F15>F16, F15>F23, F15>F25
  - F03>F16

  However, F23 is the starting frequency, and F25 is stop frequency

  If any wrong data is specified for these function codes, the inverter may not run the motor at the desired speed, or cannot start it normally.

F18	Bias (for frequency setting 1) (Refer to F01)

Refer to the description of function code F01 to find the details of bias (Frequency setting 1) setting.

F20 to F22	**DC braking1 (Starting frequency, braking level, braking time)**
H95	**DC braking (Braking response mode)**
H195	**DC braking (Braking timer at the startup)**

These function codes specify the DC braking that prevents motor 1 from running by inertia during decelerate-to-stop operation.

If the motor enters a decelerate-to-stop operation by turning OFF the run command or by decreasing the reference frequency below the stop frequency, the DC braking starts when output frequency reached the DC braking starting frequency. Set braking starting frequency (F20), braking level (F21), and braking time (F22) to start DC braking when deceleration is stopped.

Setting the braking time to “0.00” (F22 = 0) disables the DC braking.

By H195, it is possible to perform DC braking when starting up inverter. By doing so, it is efficient for preventing from falling down when the brake is released, and prompt torque startup when starting up.

■ Braking starting frequency (F20)

F20 specifies the frequency at which the DC braking starts its operation during motor decelerate-to-stop state.

- Data setting range: 0.0 to 60.0 (Hz)

■ Braking level (F21)

F21 specifies the output current level to be applied when the DC braking is activated. The function code data should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

- ND:0 to 60(%), HD/HND:0 to 80%,HHD:0 to 100%



The inverter rated output current differs between the ND/HD/HND/HHD modes.

■ Braking time (F22)

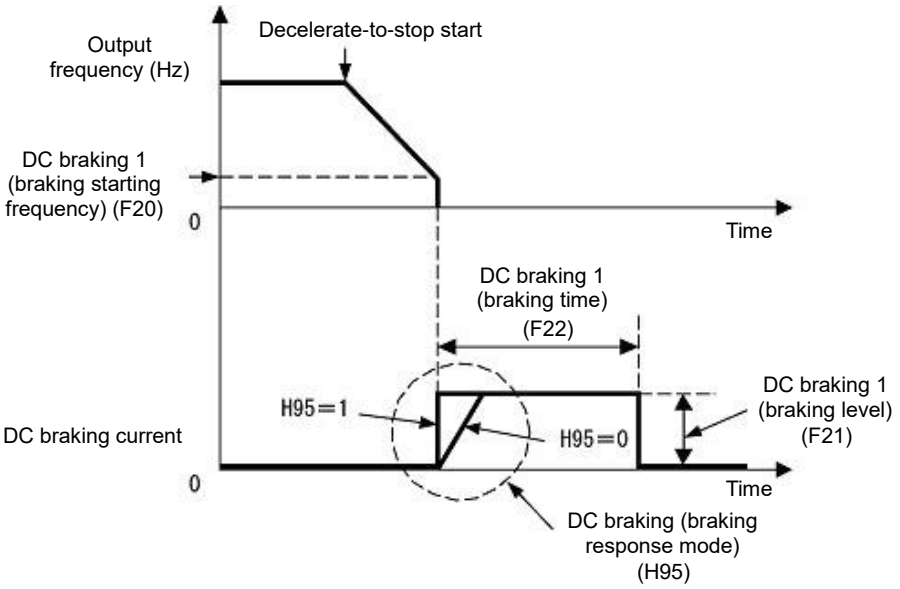
F22 specifies the braking period that activates DC braking.

- Data setting range: 0.00 (Disable), 0.01 to 30.00 (s)

■ **Braking response mode (H95)**

H95 specifies the DC braking response mode.

H95 data	Characteristics	Note
0	Slow response. Slows the rising edge of the current, thereby preventing reverse rotation at the start of DC braking.	Insufficient braking torque may result at the start of DC braking.
1	Quick response. Quickens the rising edge of the current, thereby accelerating the build-up of the braking torque.	Reverse rotation may result depending on the moment of inertia of the mechanical load and the coupling mechanism.



Tip It is also possible to input DC braking command “DCBRK” by using an external digital input signal as the terminal command. As long as the DCBRK is ON, the inverter performs DC braking, regardless of the braking time specified by F22.
(🕮 Refer to function code E01 to E05 Data =13 to find the details of “DCBRK”)

Turning the “DCBRK” ON even when the inverter is in a stopped state activates the DC braking. This feature allows the motor to be excited before starting, resulting in smoother acceleration (quicker build-up of acceleration torque) (under V/f control).

Depending on the timing of the activation of “DCBRK”, alarm of overvoltage or overcurrent occurs.

Note In general, specify data of function code F20 at a value close to the rated slip frequency of motor. If an extremely high value is set, control may become unstable and an overvoltage alarm may result in some cases.

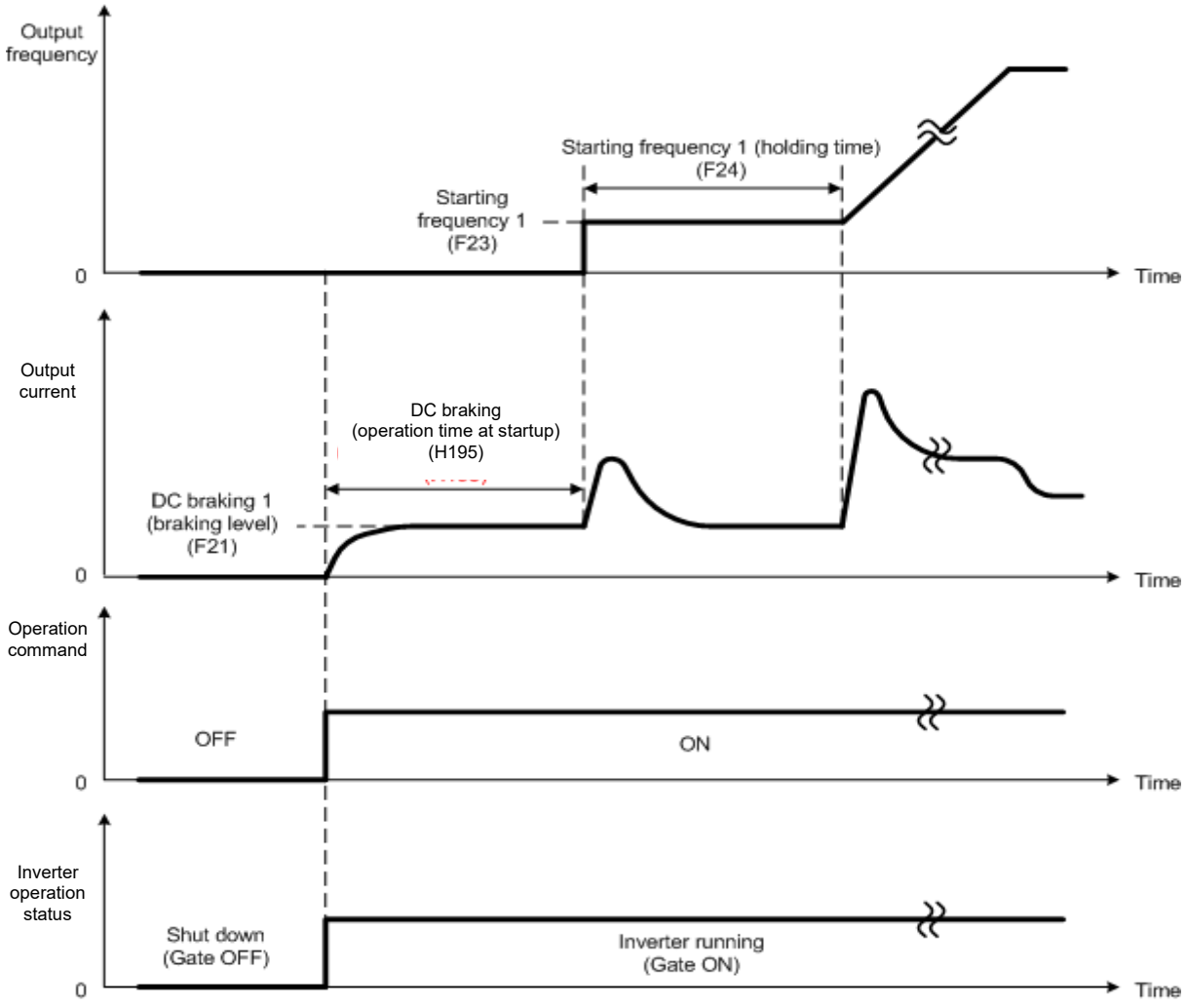
⚠CAUTION
The DC braking function of the inverter does not provide any holding mechanism. **Injuries could occur.**

■ Braking timer at the startup (H195)

When starting up inverter by run command, it is possible to start by operating DC braking.

This is particularly useful in applications such as hoists and elevators where the inverter runs at low speed braking mode after starting up, preventing loads from falling.

- Data setting range: 0.00: No DC braking at the start up 0.01 to 30.00 (s)

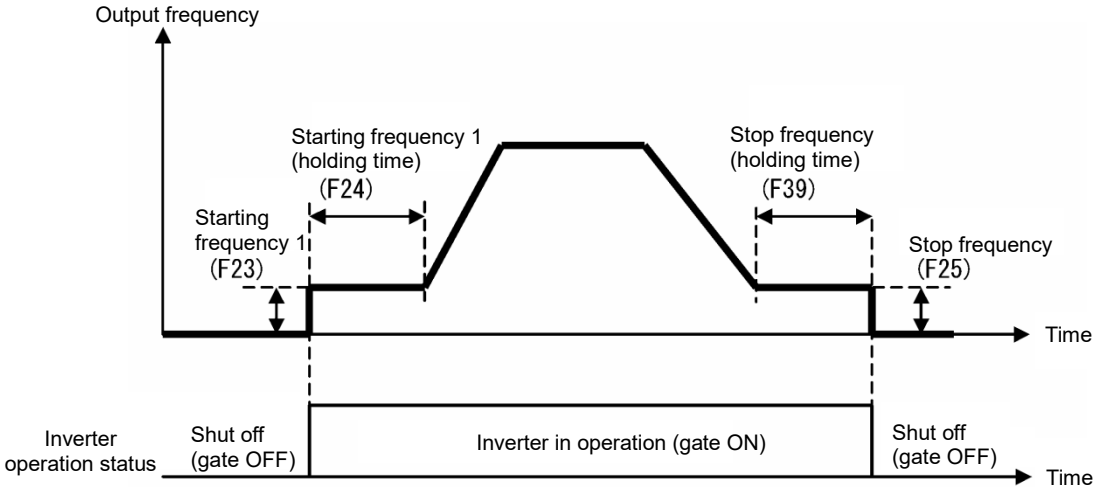


F23 to F25	Starting frequency 1, Starting frequency 1 (Holding time) and Stop frequency Related function codes: F38 and F39 (Stop frequency, Detection mode and Holding time) d24 (Zero speed control)

Under V/f control

At the startup of an inverter, the initial output frequency is equal to the starting frequency. The inverter stops its output when the output frequency reaches the stop frequency. Set the starting frequency to a level at which the motor can generate enough torque for startup. Generally, set the rated slip frequency of the motor as the starting frequency.

Specifying the holding time for the starting frequency compensates for the delay time for the establishment of a magnetic flux in the motor; specifying that for the stop frequency stabilizes the motor speed at the stop of the inverter.



■ Starting frequency 1 (F23)

F23 specifies the starting frequency at the startup of an inverter.

- Data setting range: 0.0 to 60.0 (Hz)
  Under V/f control, even if the start frequency is set at 0.0 Hz, the inverter starts its output at 0.1 Hz.

■ Starting frequency 1 (Holding time) (F24)

F24 specifies the holding time for the starting frequency 1.

- Data setting range: 0.00 to 10.00 (s)

■ Stop frequency (F25)

F25 specifies the stop frequency at the stop of the inverter.

- Data setting range: 0.0 to 60.0 (Hz)
  Under V/f control, even if the stop frequency is set at 0.0 Hz, the inverter stops its output at 0.1 Hz.

■ Stop frequency (Holding time) (F39)

F39 specifies the holding time for the stop frequency.

- Data setting range: 0.00 to 10.00 (s)

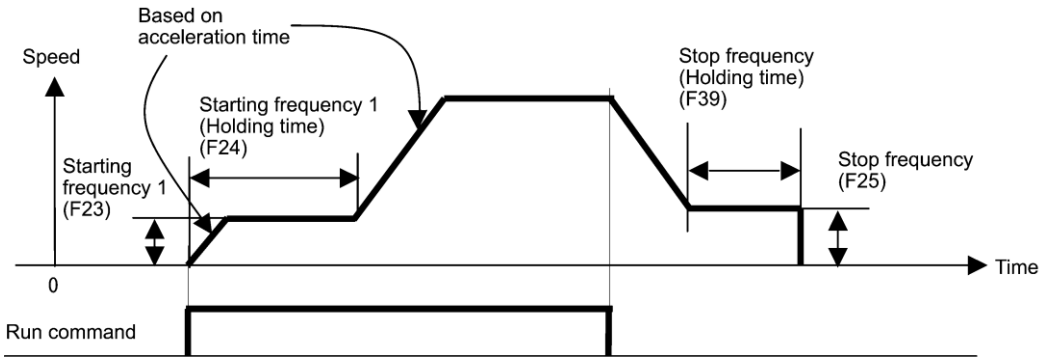
Note If the starting frequency is lower than the stop frequency, the inverter does not output any power as long as the reference frequency does not exceed the stop frequency.

Under vector control with speed sensor

At the startup, the inverter first starts at the “0” speed and accelerates to the starting frequency according to the specified acceleration time. After holding the starting frequency for the specified period, the inverter again accelerates to the reference speed according to the specified acceleration time.

The inverter stops its output when the reference speed or actual speed (specified by F38 under vector control with speed sensor only) reaches the stop frequency specified by F25.

Specifying the holding time for the starting frequency compensates for the delay time for the establishment of a magnetic flux in the motor; specifying that for the stop frequency stabilizes the motor speed at the stop of the inverter.



■ **Starting frequency 1 (F23)**

F23 specifies the starting frequency at the startup of an inverter.

- Data setting range: 0.0 to 60.0 (Hz)

■ **Starting frequency 1 (Holding time) (F24)**

F24 specifies the holding time for the starting frequency 1.

- Data setting range: 0.00 to 10.00 (s)

■ **Stop frequency (F25)**

F25 specifies the stop frequency at the stop of the inverter.

- Data setting range: 0.0 to 60.0 (Hz)

■ **Stop frequency (Holding time) (F39)**

F39 specifies the holding time for the stop frequency.

- Data setting range: 0.00 to 10.00 (Hz)

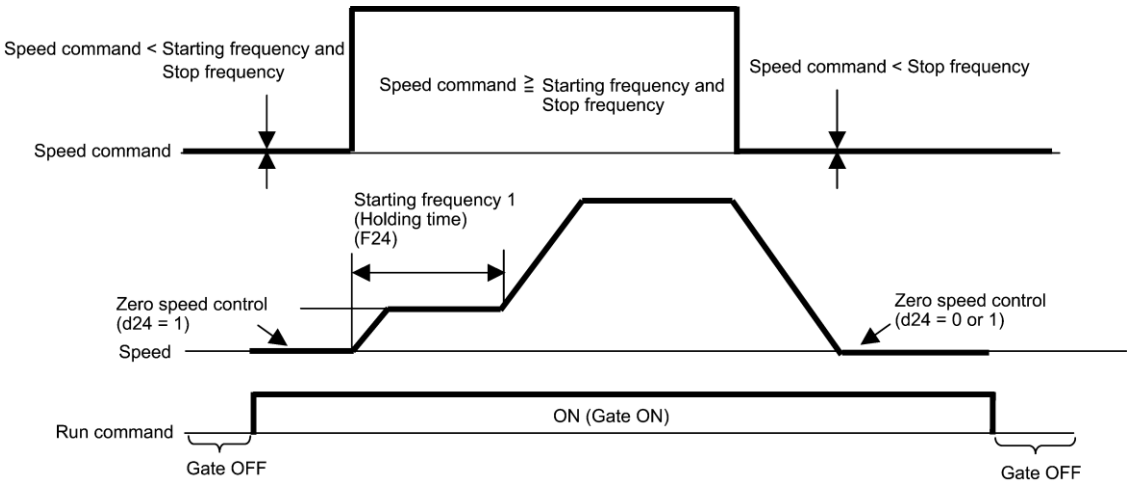
■ **Zero speed control (d24) (Under vector control with speed sensor only)**

To enable zero speed control under vector control with speed sensor, it is necessary to set the speed command (frequency command) below the starting and stop frequencies. If the starting and stop frequencies are 0.0 Hz, however, zero speed control is enabled only when the speed command is 0.00 Hz. d24 specifies the operation for zero speed control at the startup of the inverter.

Data for d24	Zero speed control at startup	Descriptions
0	Not allowed	When it is smaller than the stop frequency and start frequency the speed command, zero speed control does not work even ON the operation command. Zero speed control to work once you have started once it is set to higher than the starting frequency the speed command.
1	Allowed	Setting the speed command at below the starting and stop frequencies and turning a run command ON enables zero speed control.

The table below shows the conditions for zero speed control to be enabled or disabled.

	Speed command	Run command	Data for d24	Operation
At startup	Below the starting and stop frequencies	OFF	—	Stop (Gate OFF)
		ON	0	Stop (Gate OFF)
			1	Zero speed control
At stop	Below the stop frequency	ON	—	Zero speed control
		OFF	—	Stop (Gate OFF)



■ **Stop Frequency (Detection mode) (F38) (Under vector control with speed sensor only)**

F38 specifies whether to use the actual speed or reference one as a decision criterion to shut down the inverter output. Usually the inverter uses the detected speed. However, if the inverter undergoes a load exceeding its capability, e.g., an excessive load, it cannot stop because the motor cannot stop so that the detected speed may not reach the stop frequency level. If such a situation could arise, select the reference speed that can reach the stop frequency level even if the detected speed does not, in order to stop the inverter without fail achieving a fail-safe operation.

- Data setting range: 0 (Detected speed)
  1 (Reference speed)

F26, F27	Motor Sound (Carrier frequency, Tone) Related function codes: H98 Protection/Maintenance function (Mode selection)

■ **Motor Sound (Carrier frequency) (F26)**

Adjust carrier frequency. By changing carrier frequency, it is possible to reduce an audible noise generated by the motor or electromagnetic noise from the inverter itself, and to decrease a leakage current from the main output (secondary) wiring.

Setting frequency of carrier frequency differs depending on each model overload rating (ND/HD/HND/HHD).

Item	Characteristics		
Carrier frequency	Low	to	High
Motor sound noise emission	High	↔	Low
Motor temperature (due to harmonics components)	High	↔	Low
Ripples in output current waveform	Large	↔	Small
Leakage current	Low	↔	High
Electromagnetic noise emission	Low	↔	High
Inverter loss	Low	↔	High

Setting range of carrier frequency is as follows.

Modes	0.75 to 6kHz	0.75 to 10kHz	0.75 to 16kHz
VXT – xxxA -2 (HHD)	—	—	4A to 115A
VXT – xxxA -2 (HND)	—	115A	4A to 88A
VXT – xxxA -4 (ND)	72A or above	2A to 59A	—
VXT – xxxA -4 F(HD/HND)	203A or above	72A to 168A	2A to 59A
VXT – xxxA -4 (HHD)	—	203A or above	2A to 168A
VXT – xxxA -1 (HND/HHD)	—	—	3A to 12A

Note

Specifying a carrier frequency that is too low will cause the output current waveform to have a large amount of ripple. As a result, the motor loss increases, causing the motor temperature to rise. Furthermore, the large amount of ripple tends to cause a current limiting alarm. When the carrier frequency is set to 1 kHz or lower, therefore, reduce the load so that the inverter output current comes to be 80% or less of the rated current.

When a high carrier frequency is specified, the temperature of the inverter may rise due to the ambient temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overload (*0lu*) . With consideration for motor noise, the automatic reduction of carrier frequency can be disabled. Refer to the description of H98.

It is recommended to set the carrier frequency at 5 kHz or above under vector control with speed sensor. DO NOT set it at 1 kHz or below.

Running a PMSM at low carrier frequency may overheat the permanent magnet due to the output current harmonics, resulting in demagnetization. When decreasing the carrier frequency setting, therefore, be sure to check the allowable carrier frequency of the motor.

When using a standard PMSM with the rated load, decrease the carrier frequency. Setting a high carrier frequency decreases not only the harmonic components of the output current but also the allowed continuous running inverter output current.

■ **Motor Sound (Tone) (F27)**

F27 changes the motor running sound tone (only for motors under V/f control). This setting is effective when the carrier frequency specified by function code F26 is 7 kHz or lower. Changing the tone level may reduce the high and harsh running noise from the motor.

Note If the tone level is set too high, the output current may become unstable, or mechanical vibration and noise may increase. Also, this function code may not be very effective for certain types of motor.

F27 data	Function
0	Disable (Level 0)
1	Enable (Level 1)
2	Enable (Level 2)
3	Enable (Level 3)

F29 to F35 **Terminal [FM], [FM2] (Mode selection, Output gain, Function selection, Pulse rate)**

These function codes allow outputting monitor data such as output frequency and output current to terminals [FM], [FM2] as analog DC voltage, current, and pulse ([FM] only). In addition, voltage and current output level on terminals [FM], [FM2] is adjustable.

Note When switching voltage, current, and pulse, it is necessary to switch both mode selection function code and switch on the PCB.

Terminal [FM2] is mounted only on GB specification and C specification (for China).

There is no pulse output function for terminal [FM2]

Terminal	Mode selection function	Gain	Function	Pulse rate	Switch
[FM]	F29	F30	F31	F33	SW5
[FM2]	F32	F34	F35	None	SW7

■ **Mode selection (F29, F32)**

F29 and F32 select output form of terminals [FM], [FM2]. Accordingly, change the switches SW5, SW7 on the control PCB.

For details of the switches on the control PCB, refer to Chapter 12 “SPECIFICATIONS.”

F29 data	Terminal [FM] output form	Control PCB switch (SW5)
0	Voltage output (0 to +10 VDC)	FMV side
1	Current output (4 to 20 mA DC)	FMI side
2	Current output (0 to 20mA DC)	
3	Pulse output	FMP side

F32 data	Terminal [FM2] Output form	Control PCB switch (SW7)
0	Voltage output (0 to +10 VDC)	FMV side
1	Current output (4 to 20 mA DC)	FMI side
2	Current output (0 to 20mA DC)	

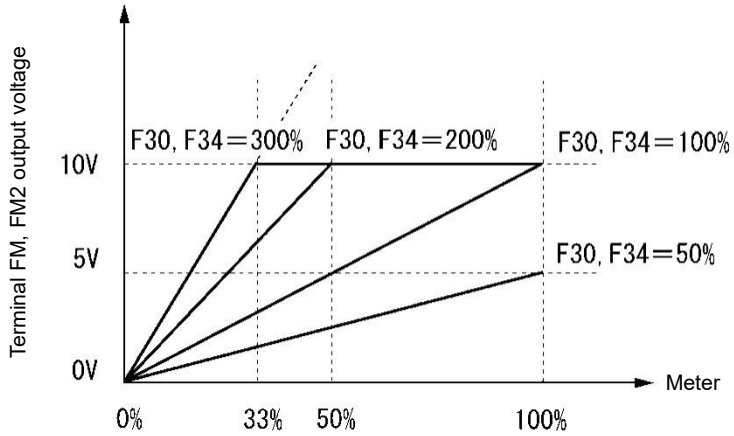
Note The output current is not isolated from analog input, and does not have an isolated power supply.

Therefore, if an electrical potential relationship between the inverter and peripheral equipment has been established, e.g., by connecting an analog input, cascade connection of a current output device is not available.

Keep the optimum connection wire length.

■ **Output gain (F30, F34)**

F30, F34 allows you to adjust the output voltage within the range of 0 to 300%.



■ **Function selection (F31, F35)**

F31, F35 specify which data is monitored at the output terminals [FM], [FM2].

F31/F35 data	[FMA] output	Data	Definition of monitor amount 100%
0	Output frequency 1 (before slip compensation)	Output frequency of the inverter (Equivalent to the motor synchronous speed)	Maximum frequency (F03)
1	Output frequency 2 (after slip compensation)	Output frequency of the inverter	Maximum frequency (F03)
2	Output current	Output current (RMS) of the inverter	Twice the inverter rated current (Inverter rated output current depending on F80 setting)
3	Output voltage	Output voltage (RMS) of the inverter	200 V class: 250 V 400 V class: 500 V
4	Output torque	Motor shaft torque	Twice the rated motor torque
5	Load factor	Load factor (Equivalent to the indication of the load meter)	Twice the rated motor load
6	Input power	Input power of the inverter	Twice the rated output power (Inverter rated output power depending on F80)
7	PID feedback value	Feedback value under PID control	100% of the feedback amount
8	Actual speed/ estimated speed	Speed detected through the PG interface, or estimated speed under vector control without speed sensor	Maximum speed as 100%
9	DC link bus voltage	DC link bus voltage of the inverter	200 V class: 500 V 400 V class: 1000 V
10	Universal AO	Command from communication (🕮 RS-485 communication user manual)	20,000/100%
13	Motor output	Motor output (kW)	Twice the rated motor output (P02/A16 setting value)
14	Calibration (+)	For meter calibration Full scale output	Always full scale (equivalent to 100%) Output
15	PID command (SV)	Command value under PID control	PID command 100%
16	PID output (MV)	Output level of the PID processor under PID control (Frequency command)	Maximum frequency (F03)

F31/F35 data	[FMA] output	Data	Definition of monitor amount 100%
17	Position error in master-follower operation	Deviation in angle	0% to 50% to 100%, representing a deviation of -180° to 0° to +180° respectively
18	Inverter heat sink temperature	Heat sink detection temperature of inverter	200°C/100%
21	PG feedback value	Actual speed (When PG interface option card is mounted, the speed is always calculated and output regardless of the control method.)	Maximum speed as 100%
111	Customizable logic output signal 1	Enable only at analog output	100% / 100%
112	Customizable logic output signal 2	Enable only at analog output	100% / 100%
113	Customizable logic output signal 3	Enable only at analog output	100% / 100%
114	Customizable logic output signal 4	Enable only at analog output	100% / 100%
115	Customizable logic output signal 5	Enable only at analog output	100% / 100%
116	Customizable logic output signal 6	Enable only at analog output	100% / 100%
117	Customizable logic output signal 7	Enable only at analog output	100% / 100%
118	Customizable logic output signal 8	Enable only at analog output	100% / 100%
119	Customizable logic output signal 9	Enable only at analog output	100% / 100%
120	Customizable logic output signal 10	Enable only at analog output	100% / 100%

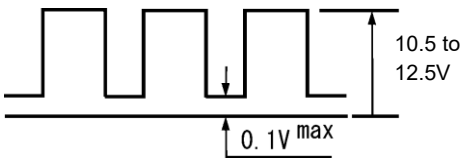
Note If F31 = 16 (PID output), J01 = 3 (Dancer control), and J62 = 2 or 3 (Ratio compensation enabled), the PID output is equivalent to the ratio against the primary reference frequency and may vary within 300% of the frequency. The monitor displays the PID output in a converted absolute value (%). To indicate the value up to the full-scale of 300%, set F30 data to “33” (%).

■ **Pulse rate (F33)**

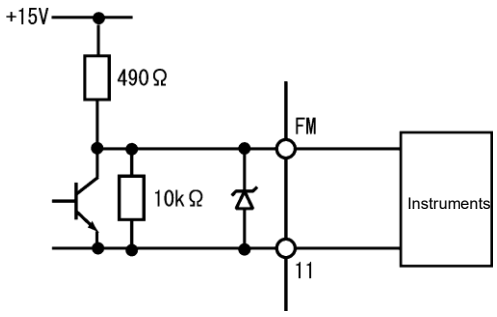
F33 specifies the pulse rate at which the output of the monitored item selected reaches 100%, in accordance with the modes of the pulse counter to be connected.

- Data setting range: 25 to 32000 (pulse/s)

Pulse output waveform



Pulse output circuit



F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1 Related function codes: F09 Torque boost 1

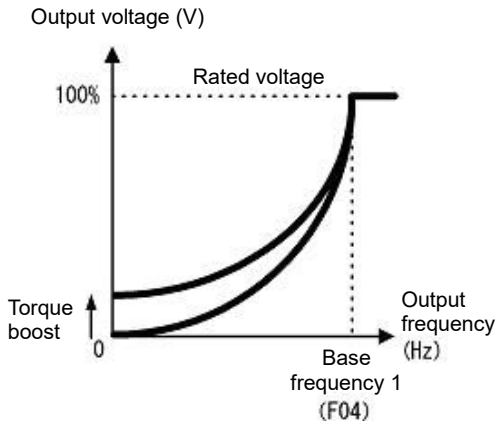
F37 specifies V/f pattern, torque boost type, and auto energy saving operation in accordance with the characteristics of the load.

F37 data	V/f characteristics	Torque boost	Auto Energy-saving Operation	Applicable load
0	Variable torque V/f pattern	By F09 torque boost	Disabled	Variable torque load (General-purpose fan and pumps)
1	Linear V/f pattern			Constant torque load
2		Auto torque Boost		Constant torque load (To be selected if a motor may be over-excited at no load)
3	Variable torque V/f pattern	By F09 torque boost	Enabled	Variable torque load (General-purpose fan and pumps)
4	Linear V/f pattern			Constant torque load
5		Auto torque Boost		Constant torque load (To be selected if a motor may be over-excited at no load)

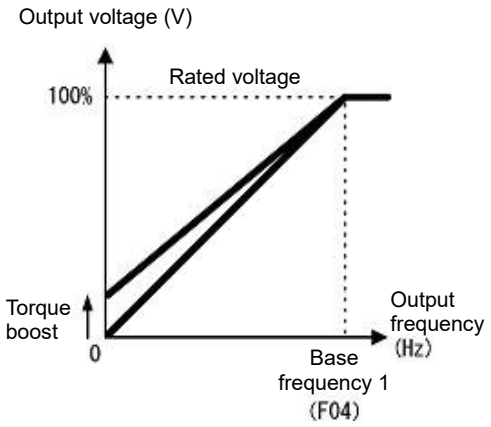
Note If a required “load torque + acceleration toque” is 50% or more of the rated torque, it is recommended to select the linear V/f pattern. Factory defaults are set to linear V/f pattern.

■ V/f characteristics

The IMO Jaguar VXT series of inverters offer a variety of V/f patterns and torque boosts, which include V/f patterns suitable for variable torque load such as general fans and pumps and for constant torque load (including special pumps requiring high starting torque). Two types of torque boosts are available: manual and automatic.



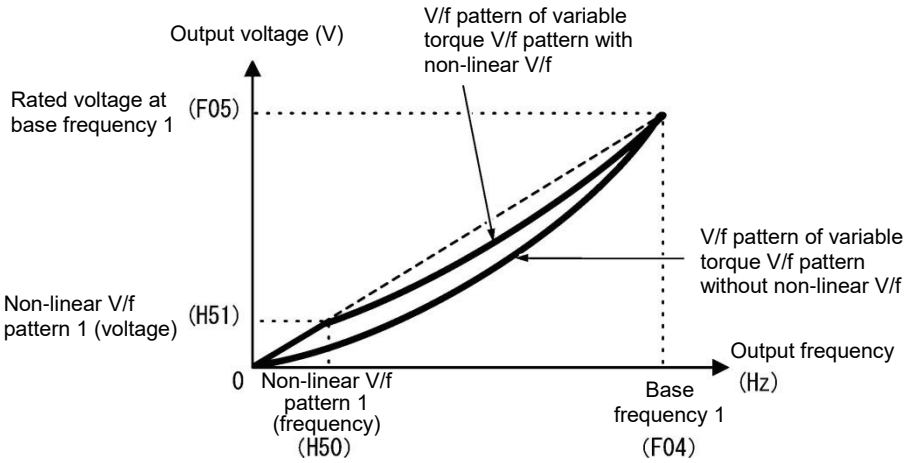
Variable torque V/f pattern (F37 = 0)



Linear V/f pattern (F37 = 1)

Tip When the variable torque V/f pattern is selected (F37 = 0 or 3), the output voltage may be low at a low frequency zone, resulting in insufficient output torque, depending on the characteristics of the motor and load. In such a case, it is recommended to increase the output voltage at the low frequency zone using the non-linear V/f pattern.

Recommended value: H50 = 1/10 of the base frequency
H51 = 1/10 of the voltage at base frequency



■ **Torque boost**

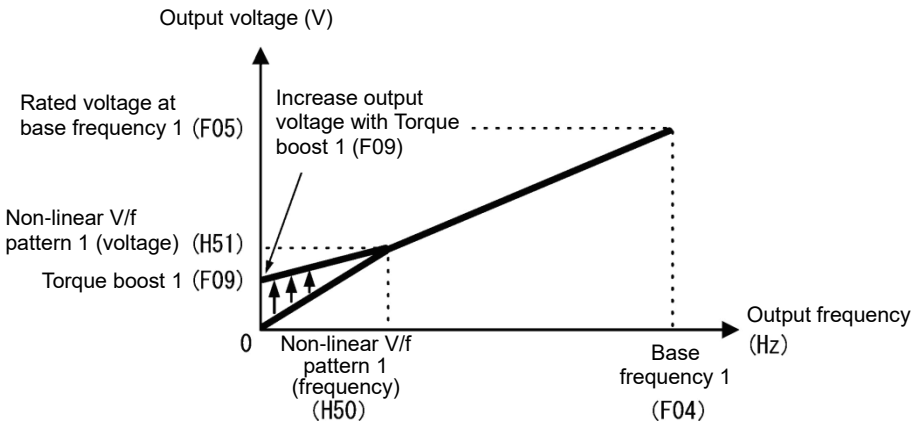
- **Manual torque boost by F09 (Manual adjustment)**
- Data setting range: 0.0 to 20.0 (%), (100%/base frequency voltage)

In torque boost using F09, constant voltage is added to the basic V/f pattern, regardless of the load. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using F09. Specify an appropriate level that guarantees smooth Startup and yet does not cause over-excitation at no or light load.

Torque boost using F09 ensures high driving stability since the output voltage remains constant regardless of the load fluctuation.

Specify the function code F09 data in percentage to the base frequency voltage. At factory shipment, boost amount with which approx. 100% of starting torque can be assured, is specified.

Note
- Specifying a high torque boost level will generate a high torque, but may cause overcurrent due to over-excitation at no load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.
- When the non-linear V/f pattern and the torque boost are used together, the torque boost takes effect below the frequency on the non-linear V/f pattern's point.



- **Auto torque boost**

This function automatically optimizes the output voltage to fit the motor with its load. Under light load, auto torque boost decreases the output voltage to prevent the motor from over-excitation. Under heavy load, it increases the output voltage to increase the output torque of the motor.

Note
- This function controls in accordance with motor characteristics. Therefore, set the base frequency 1 (F04), rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01 through P03 and P06 through P99) in line with the motor capacity and characteristics, or else perform auto-tuning (P04).
- When a special motor is driven or the load does not have sufficient rigidity, the maximum torque might decrease or the motor operation might become unstable. In such cases, do not use auto torque boost but choose manual torque boost using F09 (F37 = 0 or 1).

F38, F39	Stop frequency (Detection mode and holding time) Refer to F23.

For details about the setting of the stop frequency (detection mode and holding time), refer to the description of F23.

F40, F41	Torque limiter 1 (Driving), Torque limiter 1 (Braking) Related function codes: E16, E17 Torque limiter 2 (Driving), Torque limiter 2 (Braking) H74 Torque limiter (Control target) H76 Torque control (Braking) (Frequency rising limit for braking)

Under V/f control (F42=0,1,2,3,4)

If the inverter output torque exceeds the specified levels of the torque limiters (F40, F41, E16, E17, and E61 to E63), the inverter controls the output frequency and limits the output torque for preventing a stall.

To use the torque limiters, it is necessary to configure the function codes listed in Table 5.3-5.

Note In braking, the inverter increases the output frequency to limit the output torque. Depending on the conditions during operation, the output frequency could dangerously increase. H76 (Frequency rising limit for braking) is provided to limit the increasing frequency component.

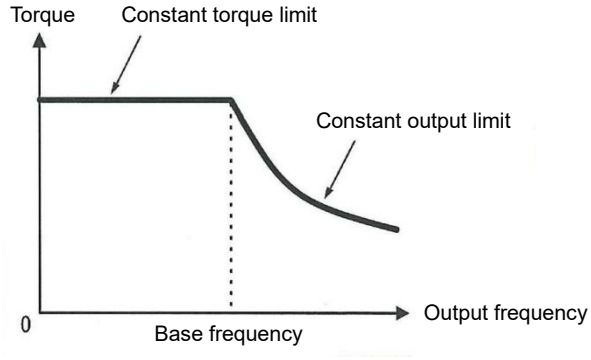
Table 5.3-5 Related function codes

Function code	Name	V/f control	Remarks
F40	Torque limiter 1 (Driving)	Y	
F41	Torque limiter 1 (Braking)	Y	
E16	Torque limiter 2 (Driving)	Y	
E17	Torque limiter 2 (Braking)	Y	
H74	Torque limiter (Control target)	N	
H76	Torque limiter (Frequency rising limit for braking)	Y	
E61 to E63	Terminal [12], [C1] (C1 function) • (V2 function) Extension function selection	Y	7: Analog torque limit value A 8: Analog torque limit value B

■ **Torque limit control mode**

Torque limit is performed by limiting torque current flowing across the motor.

The graph below shows the relationship between the torque and the output frequency at the constant torque current limit.



■ **Torque limiter (F40, F41, E16, E17) Data setting range: 0 to 300%; 999 (Disable)**

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Function code	Name	Torque limit feature
F40	Torque limiter 1 (Driving)	Driving torque current limiter 1
F41	Torque limiter 1 (Braking)	Braking torque current limiter 1
E16	Torque limiter 2 (Driving)	Driving torque current limiter 2
E17	Torque limiter 2 (Braking)	Braking torque current limiter 2

Note Although the setting range of the torque is 300%, the torque limiter determined by the overload current of the unit internally limits the torque current output. Therefore, the torque current output is automatically limited at a value lower than 300%, the maximum setting value.

■ **Analog torque limiter (E61 to E63)**

The torque limit value can be specified by analog inputs (voltage or current) through terminals [12], [C1] (C1 function), and [C1] (V2 function). Assign by Extension function selection function codes E61, E62, E63 (Terminal [12], [C1] (C1 function), [C1] (V2 function) as follows.

E61, E62, E63 data	Function	Description
7	Analog torque limiter A	Used when analog inputs are used as torque limiters. Input modes: 200% / 10 V or 20 mA
8	Analog torque limiter B	

If these terminals have been set up to have the same data, the operation priority is given in the following order: E61 > E62 > E63

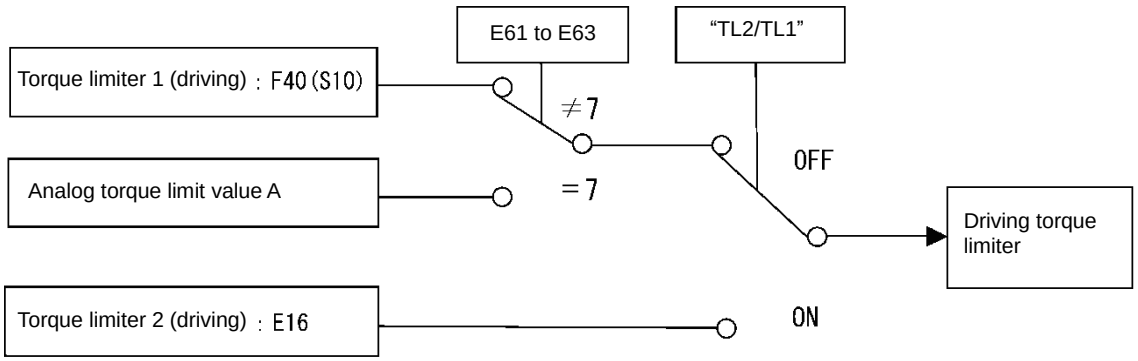
Refer to E59 on how to use terminals [C1] (C1 function) and [C1] (V2 function).

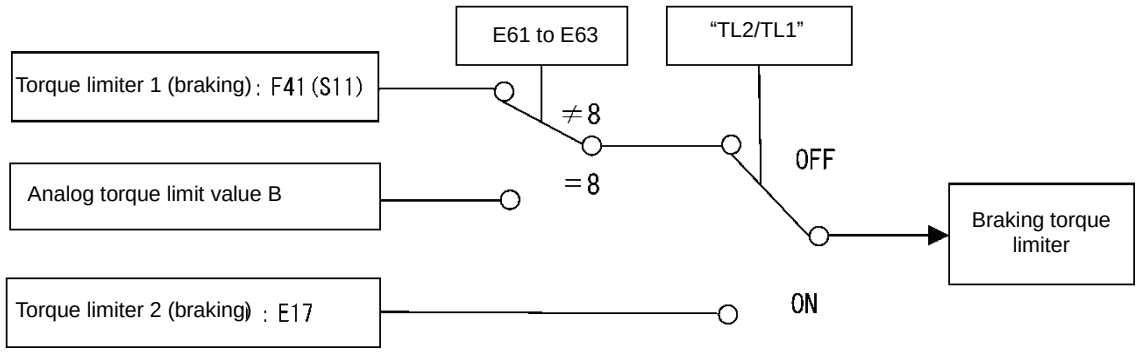
■ **Torque limiter levels specified via communications link (S10, S11)**

The torque limiter levels can be changed via the communications link. Communication dedicated codes S10, S11 interlock with the function codes F40, F41.

■ **Switching torque limiters**

The torque limiters can be switched by the function code setting and the terminal command “TL2/TL1” (Select torque limiter level 2/1) assigned to any of the digital input terminals. To assign the Torque limiter 2/Torque limiter 1, “TL2/TL1” set Data = 14 in function codes from E01 to E05. If no “TL2/TL1” is assigned, torque limiter levels 1-1 and 1-2 (F40 and F41) take effect by default.





■ **Torque limiter (Braking) (Frequency rising limit for braking) (H76) Data setting range: 0.0 to 500.0 (Hz)**

H76 specifies the rising limit of the frequency in limiting torque for braking. The Factory defaults are 5.0 Hz. If the increasing frequency during braking reaches the limit value, the torque limiters no longer function, resulting in an overvoltage trip. Such a problem may be avoided by increasing the setting value of H76.

Note The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting. Avoid concurrent activation of these limiters.

Under vector control with speed sensor (F42=6)

If the inverter's output torque exceeds the specified levels of the torque limiters (F40, F41, E16, E17, and E61 to E63), the inverter controls the speed regulator's output (torque command) in speed control or a torque command in torque control in order to limit the motor-generating torque.

To use the torque limiters, it is necessary to configure the function codes listed in the Table 5.3-6.

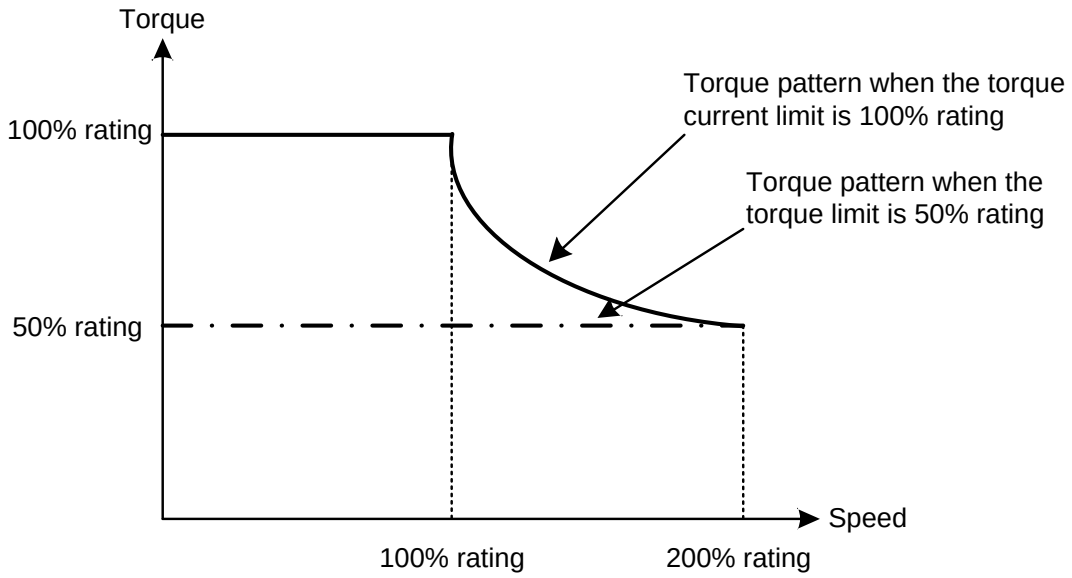
Table 5.3-6 Related function codes

Function code	Name	Vector control	Remarks
F40	Torque limiter 1 (Driving)	Y	
F41	Torque limiter 1 (Braking)	Y	
E16	Torque limiter 2 (Driving)	Y	
E17	Torque limiter 2 (Braking)	Y	
H74	Torque limiter (Control target)	Y	
E61 to E63	Terminal [12], [C1] (C1 function) • (V2 function) Extension function selection	Y	7: Analog torque limit value A 8: Analog torque limit value B

■ **Torque limiter (Control target) (H74)**

Under vector control, the inverter can limit motor-generating torque or output power, as well as a torque current (default).

Data for H74	Control target
0	Motor-generating torque limit
1	Torque current limit



■ Torque limiters 1 (Driving, Braking), and 2 (Driving, Braking) (F40, F41, E16 and E17)

- Data setting range: 0 to 300 (%), 999 (Disable)

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Function code	Name
F40	Torque limiter 1 (Driving)
F41	Torque limiter 1 (Braking)
E16	Torque limiter 2 (Driving)
E17	Torque limiter 2 (Braking)

Note The torque limiter determined depending on the overload current actually limits the torque current output. Therefore, the torque current output is automatically limited at a value lower than 300%, the maximum setting value.

■ Analog torque limiter (E61 to E63)

The torque limit value can be specified by analog inputs (voltage or current) through terminals [12], [C1] (C1 function), and [C1] (V2 function). Assign by Extension function selection function codes E61, E62, E63 (Terminal [12], [C1] (C1 function), [C1] (V2 function) as follows.

E61, E62, E63 data	Function	Description
7	Analog torque limiter A	Used when analog inputs are used as torque limiters. Input modes: 200% / 10 V or 20 mA
8	Analog torque limiter B	

If these terminals have been set up to have the same data, the operation priority is given in the following order: E61 > E62 > E63

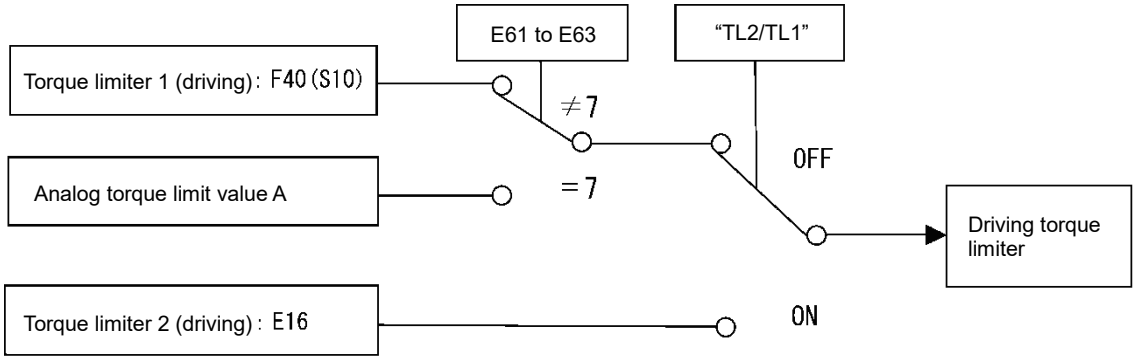
Refer to E59 on how to use terminals [C1] (C1 function) and [C1] (V2 function).

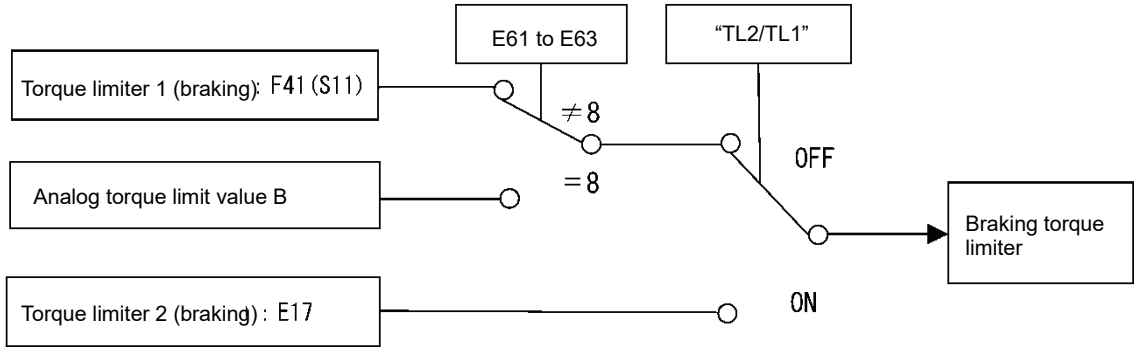
■ Torque limiter levels specified via communications link (S10, S11)

The torque limiter levels can be changed via the communications link. Function codes S10 and S11 exclusively reserved for the communications link correspond to function codes F40 and F41.

■ **Switching torque limiters**

The torque limiters can be switched by the function code setting and the terminal command “TL2/TL1” (Select torque limiter level 2/1) assigned to any of the digital input terminals. To assign the Torque limiter 2/Torque limiter 1, “TL2/TL1” set Data = 14 by function codes from E01 to E05. If no “TL2/TL1” is assigned, torque limiter levels 1-1 and 1-2 (F40 and F41) take effect by default.





Note The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting (undesirable oscillation of the system). Avoid concurrent activation of these limiters.

Under vector control without speed sensor nor pole position sensor

When a PMSM is driven under vector control without speed sensor nor pole position sensor, the torque limiters are used like as IM driven under vector control without speed sensor.

Note When switching control target motor and control method with the function code F42, the Factory defaults are also switched.
The factory default for PMSM is 200%.

Table 5.3-7 Related function codes

Function code	Name	Vector control	Remarks
F40	Torque limiter 1 (Driving)	Y	Factory defaults are “200%” (F42=15)
F41	Torque limiter 1 (Braking)	Y	
E16	Torque limiter 2 (Driving)	Y	Factory defaults are “999”
E17	Torque limiter 2 (Braking)	Y	
E61 to E63	Terminal [12], [C1] (C1 function) • (V2 function) Extension function selection	Y	7: Analog torque limit value A 8: Analog torque limit value B

F42	Drive control selection 1 Related function codes: H68 Slip Compensation 1 (Operating conditions)

F42 specifies the motor drive control.

F42 data	Control mode	Basic control	Speed feedback	Speed control
0	V/f control without slip compensation	V/f control	Disable	Frequency control
1	Vector control without speed sensor (dynamic torque vector)			With slip compensation Frequency control
2	V/f control with slip compensation			
3	V/f control with speed sensor		Enable	Frequency control with automatic speed regulator (ASR)
4	V/f control with speed sensor and auto torque boost			
6	Vector control for induction motor with speed sensor	Vector control		Speed control with automatic speed regulator (ASR)
15	Vector control for synchronous motor without speed sensor nor pole position sensor		Estimated speed	

■ **V/f control without slip compensation (F42=0)**

Under this control, the inverter controls a motor with the voltage and frequency according to the V/f pattern specified by function codes. This control disables all automatically controlled features such as the slip compensation, so no unpredictable output fluctuation occurs, enabling stable operation with constant output frequency.

■ **V/f control with slip compensation (F42=2)**

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

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

Function code		Action
P12	Rated slip frequency	Specify the rated slip frequency.
P09	Slip compensation gain for driving	Adjust the slip compensation amount for driving. Slip compensation amount for driving = Rated slip x Slip compensation gain for driving
P11	Slip compensation gain for braking	Adjust the slip compensation amount for braking. Slip compensation amount for braking = Rated slip x Slip compensation gain for braking
P10	Slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the setting.

To improve the accuracy of slip compensation, perform auto-tuning.

H68 enables or disables the slip compensation function 1 according to the motor driving conditions.

H68 data	Motor driving conditions		Motor driving frequency zone	
	Accel / Decel	During constant speed	Base frequency or below	Above the base frequency
0	Enable	Enable	Enable	Enable
1	Disable	Enable	Enable	Enable
2	Enable	Enable	Enable	Disable
3	Disable	Enable	Enable	Disable

■ **Vector control without speed sensor (dynamic torque vector) (F42=1)**

To get the maximal torque out of a motor, this control calculates the motor torque matched to the load applied and uses it to optimize the voltage and current vector output.

When the vector control without speed sensor (dynamic torque vector) is selected, automatically auto torque boost and slip compensation become enabled. This control is effective for improving the system response to external disturbances such as load fluctuations, and the motor speed control accuracy.

Note that the inverter may not respond to a rapid load fluctuation.

Note For slip compensation in case of vector control without speed sensor, constants of motor are used. Therefore, satisfy the following conditions below. If these conditions cannot be satisfied, sufficient control performance may not be obtained.

- A single motor is controlled per inverter.
- The prerequisite is that motor parameter P02, P03, P06 to P13 are accurately set or auto-tuning is performed.
- Under vector control without speed sensor, the capacity of the motor to be controlled must be not less than two ranks lower of the nominal applied motor capacity. Otherwise, the inverter may not control the motor due to decrease of the current detection resolution.
- The wiring distance between the inverter and motor should be 50 m (164 ft) or less. If it is longer, the inverter may not control the motor due to leakage current flowing through stray capacitance to the ground or between wires. Especially, small capacity inverters whose rated current is also small may be unable to control the motor correctly even if the wiring is less than 50 m (164 ft). In that case, make the wiring length as short as possible or use a wire with small stray capacitance (e.g., loosely-bundled cable) to minimize the stray capacitance.

■ **V/f control with speed sensor (F42=3)**

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. Under V/f control with speed sensor, the inverter detects the motor rotation using the encoder mounted on the motor shaft and compensates for the decrease in slip frequency by the PI control to match the motor rotation with the reference speed. This improves the motor speed control accuracy.

■ **V/f control with speed sensor and auto torque boost (F42=4)**

The difference from “V/f control with speed sensor” stated above is to calculate the motor torque that matches to the load applied, and use it to optimize the voltage and current vector output for getting the maximal torque from the motor.

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

■ **Vector control for synchronous motor without speed sensor nor pole position sensor (F42=15)**

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

Note When changing function code F42 to data 15 “Vector control for synchronous motor without speed sensor nor pole position sensor” by the keypad, then the inverter automatically updates data of F03,F04,F05 and others.

■ **Vector control with speed sensor (F42=6)**

This control requires an optional PG (pulse generator) and an optional PG interface card to be mounted on a motor shaft and an inverter, respectively. The inverter detects the motor's rotational position and speed according to PG feedback signals and uses them for speed control. It also decomposes the motor drive current into the exciting and torque current components, and controls each of components as vectors.

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

The control method performs speed control with higher accuracy and quicker response than vector control without speed sensor.

Note

Since slip compensation, dynamic torque vector control, and vector control with speed sensor use motor parameters, the following conditions should be satisfied to obtain full control performance.

- A single motor is controlled per inverter.
- Motor parameters P02, P03, P06 to P20, P55 and P56 are properly configured. Or, auto-tuning (P04) is performed.
- Under vector control without speed sensor, the capacity of the motor to be controlled must be not less than two ranks lower of the nominal applied motor capacity; under vector control with speed sensor, it is the same as that of the nominal applied motor capacity. Otherwise, the inverter may not control the motor due to decrease of the current detection resolution.
- The wiring distance between the inverter and motor should be 164 ft (50 m) or less. If it is longer, the inverter may not control the motor due to leakage current flowing through stray capacitance to the ground or between wires. Especially, small capacity inverters whose rated current is also small may be unable to control the motor correctly even if the wiring is less than 164 ft (50 m). In that case, make the wiring length as short as possible or use a wire with small stray capacitance (e.g., loosely-bundled cable) to minimize the stray capacitance.

■ **Control parameters which are initialized when the control method F42 is changed**

When control method (F42) is switched between synchronous motor and induction motor, the data of related function codes are also switched to the default value. See the table below.

Function code	Switch F42 between 15 and others	Change P02	H03=2 with F42=0 to 4,6	H03=2 with F42=15
F03	Y	N	N	N
F04	Y	N	N	Y
F05	Y	N	N	Y
F06	Y	N	N	Y
F10	N	N	N	Y
F11	Y	N	N	Y
F12	Y	N	N	Y
F15	Y	N	N	N
F23	Y	N	N	N
F26	Y	N	N	N
F40 to F41	Y	N	N	N
E50	Y	N	N	N
P01	Y	N	Y	Y
P02	N	N	N	N
P03	Y	Y	Y	Y
P05 to P13	N	Y	Y	Y
P16-P20	N	Y	Y	Y
P30	N	Y	Y	Y
P53	N	Y	Y	Y
P55 to P56	N	Y	Y	Y
P60 to P64	N	Y	Y	Y
P65	N	Y	Y	Y
P74	N	Y	Y	Y
P83	N	Y	Y	Y
P84	N	Y	Y	Y
P85	N	Y	Y	Y
P87 to P89	N	Y	Y	Y
P90	N	Y	Y	Y
P99	Y	N	N	N
H46	N	Y	Y	Y
d01 to d04	Y	N	N	N

Y: Switched N: Not switched

F43, F44	Current limiter (Mode selection and Level) Related function codes: H12 Instantaneous overcurrent limiting (Mode selection)

When the output current of the inverter exceeds the level specified by the current limiter (F44), the inverter automatically manages its output frequency to prevent a stall and limits the output current. According to limit value based on Inverter's rated current, the default setting of the current limiter is 160% for HHD/HD mode, and 130% for HND/ND mode, respectively (Initial value is automatically written when selecting ND/HD/HND/HHD by function code F80) If overload current, higher than the current limiter level, flows instantaneously so that the output frequency decrease due to the current limiter causes a problem, consider to increase the current limiter level.

The current limiter mode should be also selected with F43. If F43 = 1, the current limiter is enabled only during constant speed operation. If F43 = 2, it is enabled during both of acceleration and constant speed operation. Choose F43 = 1 if you need to run the inverter at full capability during acceleration and to limit the output current during constant speed operation.

■ Mode selection (F43)

F43 selects the motor running state in which the current limiter becomes active.

F43 data	Running states that enable the current limiter		
	During acceleration	During constant speed	During deceleration
0	Disabled	Disabled	Disabled
1	Disabled	Action	Disabled
2	Action	Action	Disabled

■ Level (F44)

F44 specifies the operation level at which the output current limiter becomes activated, as a ratio of the inverter rating.

- Data setting range: 20 to 200 (%) of rated current of the inverter
  (Inverter's rated current changes according to the setting value of function code F80.)

■ Instantaneous overcurrent limiting (Mode selection) (H12)

H12 specifies whether the inverter invokes the current limit processing or enters the overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level. Under the current limit processing, the inverter immediately turns OFF its output gate to suppress the further current increase and continues to control the output frequency.

H12 data	Function
0	Disable (An overcurrent trip occurs at the instantaneous overcurrent limiting level.)
1	Enable (An instantaneous overcurrent limiting operation is activated)

If any problem could occur when the motor torque temporarily drops during current limiting processing, it is necessary to cause an overcurrent trip (H12 = 0) and actuate a mechanical brake at the same time.

Note
- Since the current limit operation with F43 and F44 is performed by software, it may cause a delay in control. If you need a quick response current limiting, also enable the instantaneous overcurrent limiting with H12.
- If an excessive load is applied when the current limiter operation level is set extremely low, the inverter will rapidly lower its output frequency. This may cause an overvoltage trip or dangerous turnover of the motor rotation due to undershooting. Depending on the load, extremely short acceleration time may activate the current limiting to suppress the increase of the inverter output frequency, causing hunting (undesirable oscillation of the system) or activating the inverter overvoltage trip (alarm $0u$). When specifying the acceleration time, therefore, you need to take into account machinery characteristics and moment of inertia of the load.

Note
- The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting. Avoid concurrent activation of these limiters.
- Vector control with speed sensor itself contains the current control system, so it disables the current limiter specified by F43 and F44, as well as automatically disabling the instantaneous overcurrent limiting (specified by H12). Accordingly, the inverter causes an overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level.

F50 to F52	Electronic thermal overload protection for braking resistor (Discharging capability, Allowable average loss and Braking resistance value)

These function codes specify the electronic thermal overload protection feature for the braking resistor.

Set the discharging capability, allowable average loss and resistance to F50, F51 and F52, respectively. These values are determined by the inverter and braking resistor models. For the discharging capability, allowable average loss and resistance, refer to Chapter 11 “11.8.4 Specifications.”

The values listed in the tables are for standard models and 10% ED models of the braking resistors which IMO provides. When using a braking resistor of any other manufacturer, confirm the corresponding values with the manufacturer and set the function codes accordingly.

Set 0.00 to F52 when replacing from IMO Jaguar VXR.

Note Depending on the thermal characteristics of the braking resistor, the electronic thermal overload protection feature may act so that the inverter issues the overheat protection alarm *dbh* even if the actual temperature rise is not large enough. If this happens, review the relationship between the performance index of the braking resistor and settings of related function codes.

Tip Using the standard models of braking resistor or using the braking unit and braking resistor together can output temperature detection signal for overheat. Assign terminal command THR (“Enable external alarm trip”) to any of digital input terminals [X1] to [X5], [FWD] and [REV] and connect that terminal and its common terminal to braking resistor’s terminals 2 and 1.

Calculating the discharging capability and allowable average loss of the braking resistor and configuring the function code data

When using any non-IMO braking resistor, inquire to the resistor manufacturer about the resistor rating and then configure the related function codes.

The calculation procedures for the discharging capability and allowable average loss of the braking resistor differ depending on the application of the braking load as shown below.

<Applying braking load during deceleration>

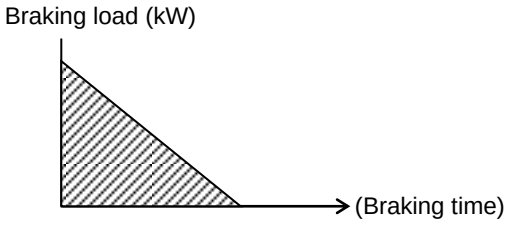
In usual deceleration, the braking load decreases as the speed slows down. In the deceleration with constant torque, the braking load decreases in proportion to the speed.

Use Expressions (1) and (3) given below.

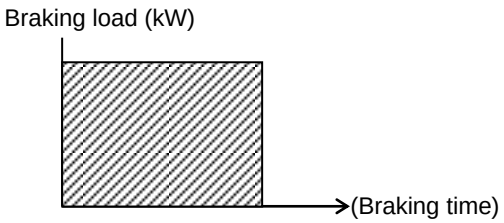
Applying braking load during running at a constant speed

Different from during deceleration, in applications where the braking load is externally applied during running at a constant speed, the braking load is constant.

Use Expressions (2) and (4) given below.



<Applying braking load during deceleration>



<Applying braking load during running at a constant speed>

■ **Discharging capability (F50)**

The discharging capability refers to kWs allowance for a single braking cycle. It can be calculated from breaking

F50 data	Function
1 to 9000	1 to 9000 (kWs)
OFF	Disable the electronic thermal overload protection

$$\text{Discharging capability (kWs)} = \frac{\text{Braking time (s)} \times \text{Motor rated capacity (kW)}}{2} \quad (1)$$

$$\text{Discharging capability (kWs)} = \text{Braking time (s)} \times \text{Motor rated capacity (kW)} \quad (2)$$

■ **Allowable average loss (F51)**

Allowance average loss is the resistor capacitor that enables continuous operation of motor. It can be calculated from ED (%) and motor capacity (kW).

F51 data	Function
0.001 to 99.99	0.001 to 99.99 (kW)

$$\text{Allowable average loss (kWs)} = \frac{\frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)}}{2} \quad (3)$$

$$\text{Allowable average loss (kWs)} = \frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)} \quad (4)$$

■ **Braking resistance value (F52)**

F52 specifies the resistance of the braking resistor.

F52 data	Function
0.00	Braking resistor protection method by IMO Jaguar VXR series method (Resistance not required)
0.01 to 999	0.01 to 999 (Ω)

F80	Switching between ND,HD,HND and HHD drive modes

ND is the standard mode for specifications other than J (for Japanese) model, therefore, it is possible to alleviate ambient temperature condition and increase overload capability by switching to HHD/HND/HD modes. However, rated current (applicable motor capacity) becomes one or two frames lower.

To change the data of function code F80 data, double key operation with "STOP key + ▲/▼ key" is necessary.

F80 data	Drive mode	Application	Rated current level	Ambient temperature	Overload capability	Maximum output frequency
0	HHD mode	Heavy load	Capable of driving a motor whose capacity is the same as the inverter capacity.	50°C (122°F)	150% 1min, 200% 0.5s	500Hz
1	HND mode	Light load	Capable of driving a motor whose capacity is one rank higher than the inverter capacity.	50°C (122°F)	120% 1 min	500Hz
3	HD mode	Medium load	Capable of driving a motor whose capacity is one rank higher than the inverter capacity.	40°C (104°F)	150% 1 min	500Hz
4	ND mode	Light load	Capable of driving a motor whose capacity is two ranks higher than the inverter capacity.	40°C (104°F)	120% 1 min	120Hz

For the concrete rated current level, refer to Chapter 12 "SPECIFICATIONS." Factory defaults are 0: HHD for Japan and 4: ND for other countries.

Note When, by changing the mode, the motor capacity becomes 75kW or higher, make sure to connect direct current reactor (DCR) according to the motor capacity. However, it is not necessary when using PWM converter.

Failure may occur

ND, HD, HND, and HHD-mode inverters are subject to restrictions on the function code data setting range and internal processing as listed below.

Function code	Name	Remarks
F21	DC braking 1 (Braking level)	Upper limit restriction
F26	Motor sound (Carrier frequency)	Upper limit restriction
F44	Current limiter (Level)	Default setting, setting value
F03	Maximum frequency	Allowed output frequency range
A10	DC braking 2 (Braking level)	Upper limit
J68	Brake Signal Brake-release current	Upper limit

Refer to explanation of each function code and selection guidance in Chapter 10 "10.4.2 Guideline for selecting inverter drive mode and capacity."

5.3.2 E codes (Extension terminal functions)

E01 to E05	Terminals [X1] to [X5] function Related function codes: Terminal E98 [FWD] function Terminal E99 [REV] function

E01 to E05, E98 and E99 assign commands to general-purpose, programmable, digital input terminals, [X1] to [X5], [FWD], and [REV].

These function codes can also switch the logic system between normal and negative to define how the inverter logic interprets the ON or OFF state of each terminal. The factory default setting is normal logic system “Active ON.” Functions assigned to digital input terminals [X1] to [X5], [FWD] and [REV] are as shown below. Descriptions that follow are given in normal logic system. Each signal has been described at data allocation order. However, the signal is related has been described together. Refer to the function codes in the “Related function codes” column, if any.

The IMO Jaguar VXT runs under “V/f: V/f control, dynamic torque vector control,” “PG V/f: V/f control with speed sensor,” “IM CLV: vector control with speed sensor,” “IM TC: Torque control with speed sensor,” or “PM SLV: vector control without speed sensor nor pole position sensor for permanent magnet synchronous motor.” Some terminal commands assigned apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the “Control mode” column in the table given below.

⚠CAUTION

- Run commands (e.g., Run forward “FWD”), stop commands (e.g., Coast to a stop “BX”), and frequency change commands can be assigned to digital input terminals. Depending on the state of digital input terminals, modifying a single function code setting may cause abrupt start of operation or significant change of the speed. Ensure safety before modifying the function code settings.
- Functions for switching run or frequency command sources (such as “SS1, SS2, SS4, SS8”, “Hz2/Hz1”, “Hz/PID”, “IVS” and “LE”) can be assigned to the digital input terminals. Switching these signals may cause a sudden motor start or an abrupt change in speed depending on the condition.

An accident or physical injury may result.

Data		Terminal commands assigned	Symbol	Control mode					Related function codes
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
0	1000	Select multistep frequency (1 to 15 steps)	“SS1”	Y	Y	Y	N	Y	C05 to C19
1	1001		“SS2”	Y	Y	Y	N	Y	
2	1002		“SS4”	Y	Y	Y	N	Y	
3	1003		“SS8”	Y	Y	Y	N	Y	
4	1004	Select ACC/DEC time (2 steps)	“RT1”	Y	Y	Y	N	Y	F07, F08, E10 to E15
5	1005	Select ACC/DEC time (4 steps)	“RT2”	Y	Y	Y	N	Y	
6	1006	Select 3-wire operation	“HLD”	Y	Y	Y	N	Y	F02
7	1007	Coast to a stop command	“BX”	Y	Y	Y	Y	Y	—
8	1008	Reset alarm	“RST”	Y	Y	Y	Y	Y	—
1009	9	External alarm	“THR”	Y	Y	Y	Y	Y	—
10	1010	Ready for jogging	“JOG”	Y	Y	Y	N	Y	C20 H54, H55, d09 to d13
11	1011	Select frequency setting 2/1	“Hz2/Hz1”	Y	Y	Y	N	Y	F01, C30
12	1012	Select motor 2	“M2”	Y	Y	Y	Y	Y	A42
13	-	DC braking command	“DCBRK”	Y	Y	Y	N	N	F20 to F22
14	1014	Select torque limit 2/ Torque limit 1	“TL2/TL1”	Y	Y	Y	Y	Y	F40, F41 E16, E17
15	—	Switch to commercial power (50Hz)	“SW50”	Y	Y	N	N	N	—
16	—	Switch to commercial power (60Hz)	“SW60”	Y	Y	N	N	N	—
17	1017	UP command	“UP”	Y	Y	Y	N	Y	Frequency setting: F01, C30 PID command: J02
18	1018	DOWN command	“DOWN”	Y	Y	Y	N	Y	

Data		Terminal commands assigned	Symbol	Control mode					Related function codes
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
19	1019	Allow function code editing (Data change enabled)	“WE-KP”	Y	Y	Y	Y	Y	F00
20	1020	Cancel PID control	“Hz/PID”	Y	Y	Y	N	Y	J01 to J19, J57 to J62
21	1021	Switch normal/inverse operation	“IVS”	Y	Y	Y	N	Y	C53, J01
22	1022	Interlock	“IL”	Y	Y	Y	Y	Y	F14
23	1023	Cancel torque control	“Hz/TRQ”	N	N	N	Y	N	H18
24	1024	Select link operation (RS-485, BUS option)	“LE”	Y	Y	Y	Y	Y	H30, y98
25	1025	Universal DI	“U-DI”	Y	Y	Y	Y	Y	—
26	1026	Select auto search for idling motor speed at starting	“STM”	Y	Y	N	N	Y	H09, d67
1030	30	Force to stop	“STOP”	Y	Y	Y	Y	Y	F07, H56
32	1032	Pre-excite	“EXITE”	N	N	Y	Y	N	H84, H85
33	1033	Reset PID integral and differential terms	“PID-RST”	Y	Y	Y	N	Y	J01 to J19, J57 to J62
34	1034	Hold PID integral term	“PID-HLD”	Y	Y	Y	N	Y	
35	1035	Select local (keypad) command	“LOC”	Y	Y	Y	Y	Y	(See Section 3.3.7)
42	1042	Activate the limit switch at start point	“LS”	Y	Y	N	N	N	J73 to J88
43	1043	Start/Reset	“S/R”	Y	Y	N	N	N	
44	1044	Switch to the serial pulse receiving mode	“SPRM”	Y	Y	N	N	N	
45	1045	Enter the return mode	“RTN”	Y	Y	N	N	N	
46	1046	Enable overload stop	“OLS”	Y	Y	Y	N	Y	J63 to 67
47	1047	Servo-lock command	“LOCK”	N	N	Y	N	N	J97 to J99
48	—	Pulse train input (Only for X5 terminal (E05))	“PIN”	Y	Y	Y	N	Y	F01, C30 d62, d63
49	1049	Pulse train sign (Other than X5 terminal (E01 to E04))	“SIGN”	Y	Y	Y	N	Y	
59	1059	Enable battery-driven operation	“BATRY/UPS”	Y	Y	Y	Y	Y	-
60	1060	Select torque bias1	“TB1”	N	N	Y	N	N	H154 to H162
61	1061	Select torque bias2	“TB2”	N	N	Y	N	N	
62	1062	Hold torque bias	“H-TB”	N	N	Y	N	N	
65	1065	Check brake	“BRKE”	Y	Y	Y	N	Y	J68 to 96
70	1070	Cancel line speed control	“Hz/LSC”	Y	Y	Y	N	N	d41
71	1071	Hold line speed control frequency in the memory	“LSC-HLD”	Y	Y	Y	N	N	
72	1072	Count the run time of commercial power-driven motor 1	“CRUN-M1”	Y	Y	Y	Y	N	H44,H94
73	1073	Count the run time of commercial power-driven motor 2	“CRUN-M2”	Y	Y	Y	Y	N	
76	1076	Select droop control	“DROOP”	Y	Y	Y	N	Y	H28
78	1078	Select speed control parameter 1	“MPRM1”	N	N	Y	Y	N	d01 to d08
79	1079	Select speed control parameter 2	“MPRM1”	N	N	Y	Y	N	
80	1080	Cancel customizable logic	“CLC”	Y	Y	Y	Y	Y	E01 toE05, U81 to U90
81	1081	Clear all customizable logic timers	“CLTC”	Y	Y	Y	Y	Y	
82	1082	Cancel anti-regenerative control	“AR-CCL”	Y	Y	Y	N	Y	H69

Data		Terminal commands assigned	Symbol	Control mode					Related function codes
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
98	—	Run forward (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	"FWD"	Y	Y	Y	Y	Y	F02
99	—	Run reverse (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	"REV"	Y	Y	Y	Y	Y	
100	—	No function assigned	"NONE"	Y	Y	Y	Y	Y	U81 to U90
171	1171	PID control multistage command 1	"PID-SS1"	Y	Y	Y	N	Y	J136 to J138
172	1172	PID control multistage command 2	"PID-SS2"	Y	Y	Y	N	Y	

Note Negative logic (Active OFF) command cannot be assigned to the functions marked with "-" in the "Active OFF" column.

The "External alarm" (data = 1009) and "Force to stop" (data = 1030) are fail-safe terminal commands. In the case of "External alarm" when data = 1009, "Active ON" (alarm is triggered when ON); when data = 9, "Active OFF" (alarm is triggered when OFF).

Terminal function assignment and data setting

■ **Select multistep frequency – "SS1", "SS2", "SS4", and "SS8" (Function code data = 0, 1, 2, and 3)**

The combination of the ON/OFF states of digital input signals "SS1", "SS2", "SS4" and "SS8" selects one of 16 different frequency commands defined beforehand by 15 function codes C05 to C19 (Multistep frequency 1 to 15). With this, the inverter can drive the motor at 16 different preset frequencies. (🕮 Function codes C05 to C19)

■ **Select ACC/DEC time – "RT1" and "RT2" (Function code data = 4 and 5)**

These terminal commands switch between ACC/DEC time 1 to 4 (F07, F08 and E10 through E15).

(🕮 Functions codes F07 and F08)

■ **Select 3-wire operation – "HLD" (Function code data = 6)**

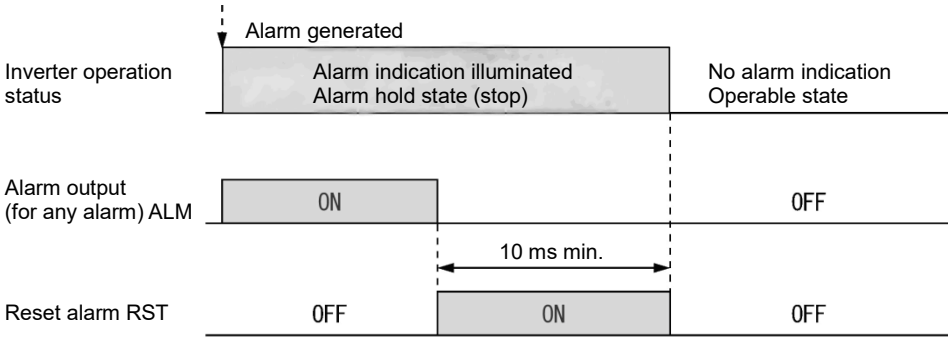
Turning this terminal command ON self-holds the forward "FWD", reverse "REV", run command, to enable 3-wire inverter operation. (🕮 Function code F02)

■ **Coast to a stop command -- "BX" (Function code data = 7)**

Turning "BX" ON immediately shuts down the inverter output. The motor coasts to a stop, without issuing any alarm.

■ **Reset alarm – "RST" (Function code data = 8)**

Turning this terminal command ON clears the ALM state--alarm output (for any alarm). Turning it OFF erases the alarm display and clears the alarm hold state. When you turn the "RST" command ON, keep it ON for 10 ms or more. This command should be kept OFF for the normal inverter operation.



■ **External alarm – "THR" (Function code data = 9)**

Turning this terminal command OFF immediately shuts down the inverter output (so that the motor coasts to a stop), displays the alarm *0h2*, and issues the alarm output (for any alarm) ALM. The THR command is self-held, and is reset when an alarm reset takes place.

Tip Use this alarm trip command from external equipment when you have to immediately shut down the inverter output in the event of an abnormal situation in peripheral equipment.

■ **Ready for jogging – "JOG" (Function code data = 10)**

This terminal command is used to jog or inch the motor for positioning a workpiece.

Turning this command ON makes the inverter ready for jogging. (🕮 Function code C20)

■ **Select frequency setting 2/1 – "Hz2/Hz1" (Function code data = 11)**

Turning this terminal command ON and OFF switches the frequency command source between frequency setting 1 (F01) and frequency setting 2 (C30). (🕮 Function code F01)

■ **Select motor 2 – "M2" (Function code data = 12)**

The terminal command M2 switches to either of the 1st and 2nd motors.

■ **DC braking command – "DCBRK" (Function code data = 13)**

This terminal command gives the inverter a DC braking command through the inverter's digital input.

(Requirements for DC braking must be satisfied.) (🕮 Function codes F20 to F22)

■ **Select torque limit 2/1 – "TL2/TL1" (Function code data = 14)**

This terminal command switches between torque limiter 1 (F40 and F41) and torque limiter 2-1, 2-2 (E16 and E17). (🕮 Function codes F40 and F41)

■ **Switch to commercial power for 50 Hz or 60 Hz – "SW50" and "SW60" (Function code data = 15 and 16)**

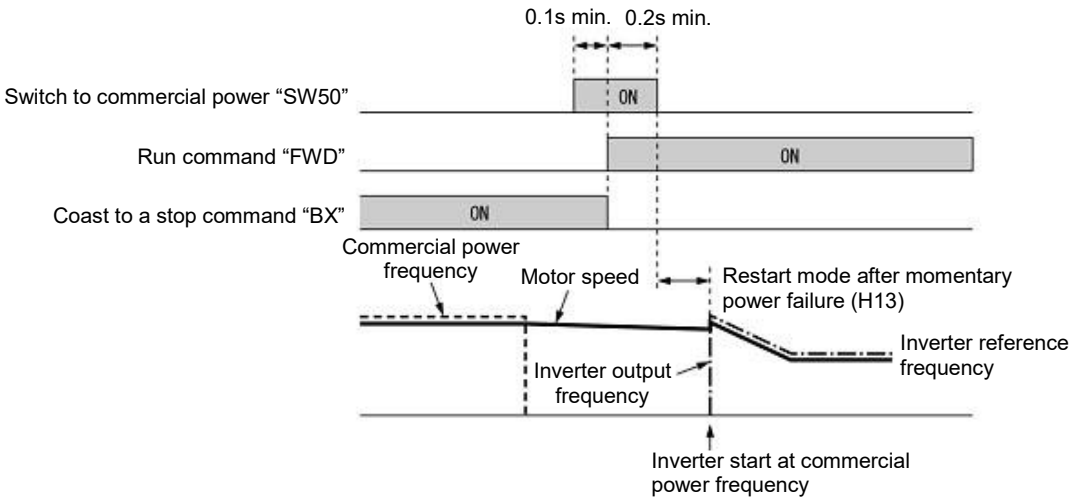
When an external sequence switches the motor drive power from the commercial line to the inverter, the terminal command SW50 or SW60 enables the inverter to start running the motor with the current commercial power frequency, regardless of settings of the reference/output frequency in the inverter. A running motor driven by commercial power is carried on into inverter operation. This command helps you smoothly switch the motor drive power source from the commercial power to the inverter power.

For details, refer to the table below, "Operation timing scheme", "Example of Sequence Circuit" and "Example of Operation Time Scheme" on the following pages.

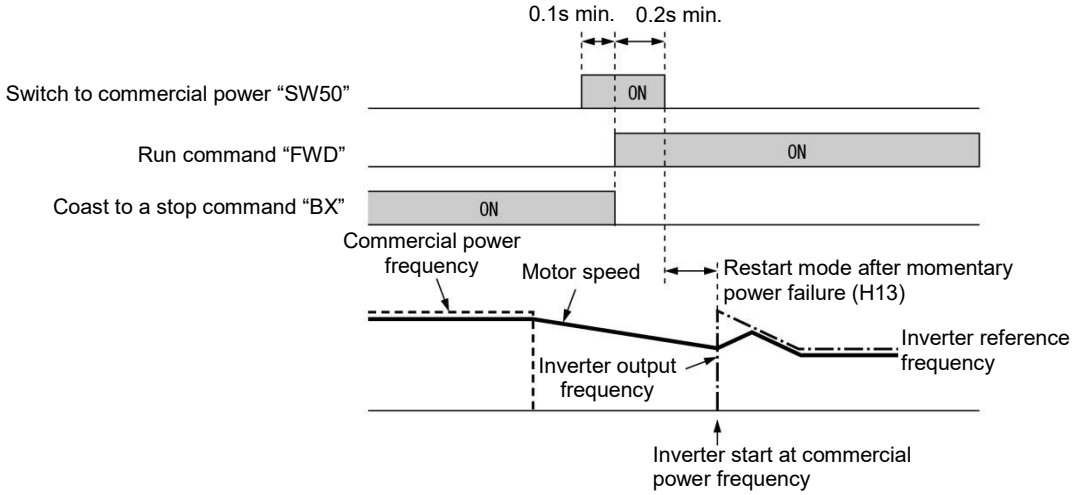
Terminal command assigned	Action	
Switch to commercial power for 50 Hz "SW50"	Starts at 50 Hz.	Note Do not concurrently assign both SW50 and SW60.
Switch to commercial power for 60 Hz "SW60"	Starts at 60 Hz.	

<Operation timing scheme>

- When the motor speed remains almost the same during coast-to-stop:



- When the motor speed decreases significantly during coast-to-stop (with the current limiter activated)



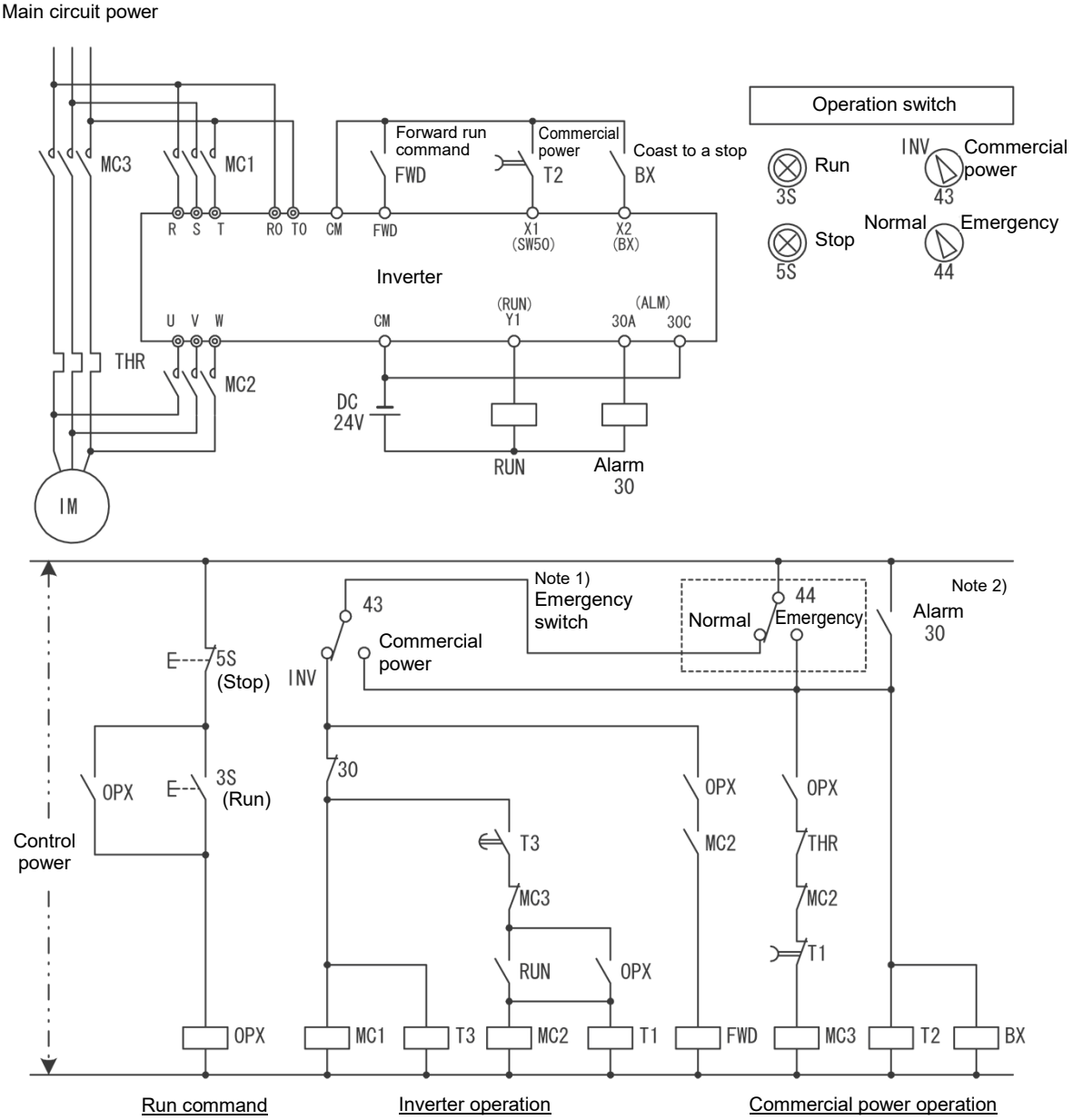
Note

- Secure more than 0.1 second after turning ON the “Switch to commercial power” signal before turning ON a run command.
- Secure more than 0.2 second of an overlapping period with both the “Switch to commercial power” signal and run command being ON.
- If an alarm has been issued or BX has been ON when the motor drive source is switched from the commercial power to the inverter, the inverter will not be started at the commercial power frequency and will remain OFF. After the alarm has been reset or “BX” turned OFF, operation at the frequency of the commercial power will not be continued, and the inverter will be started at the ordinary starting frequency.

If you wish to switch the motor drive source from the commercial line to the inverter, be sure to turn “BX” OFF before the “Switch to commercial power” signal is turned OFF.

- When switching the motor drive source from the inverter to commercial power, adjust the inverter’s reference frequency at or slightly higher than that of the commercial power frequency beforehand, taking into consideration the motor speed down during the coast-to-stop period produced by switching.
- Note that when the motor drive source is switched from the inverter to the commercial power, a high inrush current will be generated, because the phase of the commercial power usually does not match the motor speed at the switching. Make sure that the power supply and all the peripheral equipment are capable of withstanding this inrush current.
- If you have enabled “Restart mode after momentary power failure” (F14 = 3, 4, or 5), keep “BX” ON during commercial power driven operation to prevent the inverter from restarting after a momentary power failure.

<Example of Sequence Circuit>

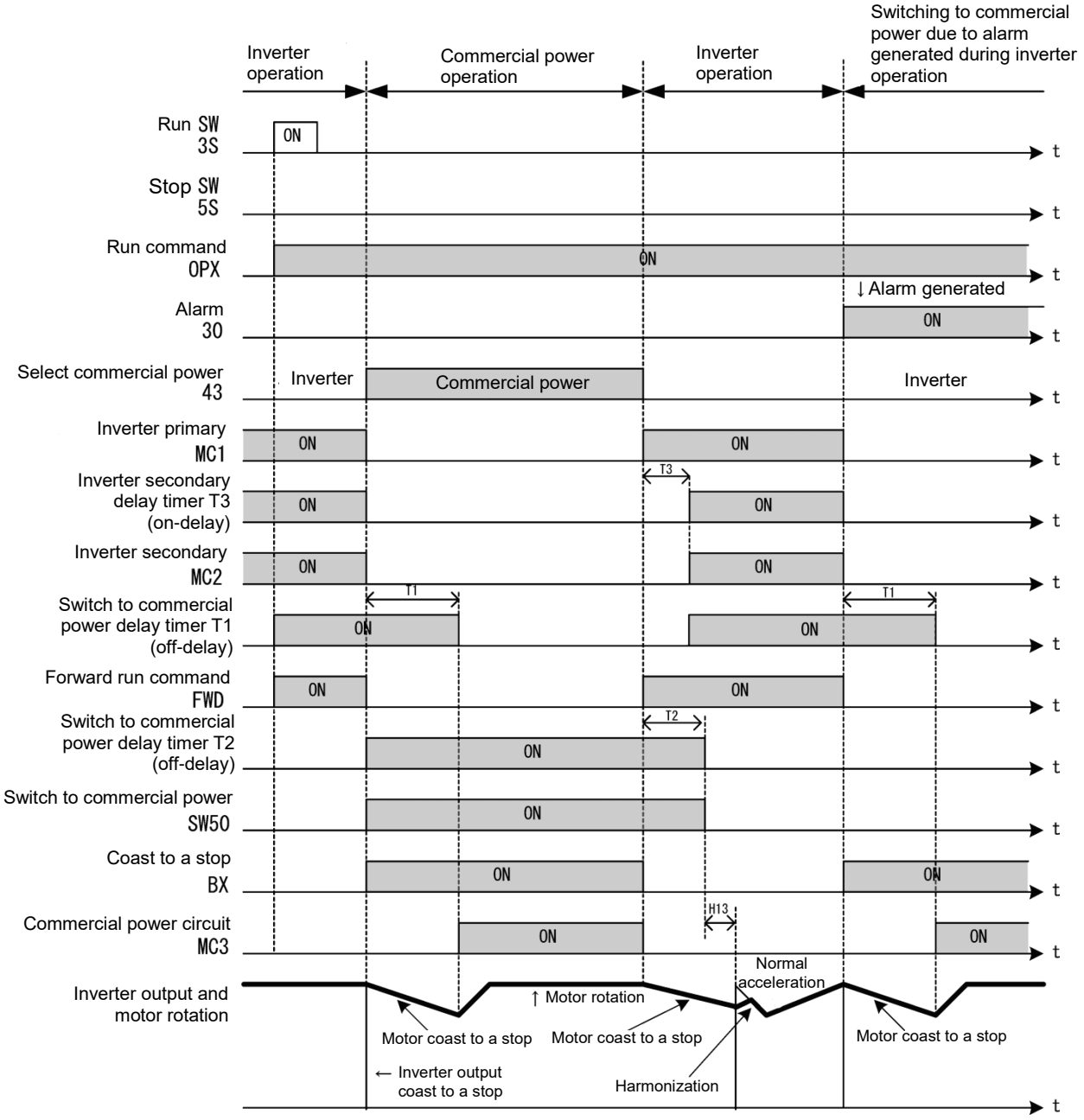


Note 1) Emergency switch

Manual switch provided for the event that the motor drive source cannot be switched normally to the commercial power due to a serious problem of the inverter

Note 2) When any alarm has occurred inside the inverter, the motor drive source will automatically be switched to the commercial power.

<Example of Operation Time Scheme>



■ **“UP” (Increase output frequency) and “DOWN” (Decrease output frequency) commands -- UP and DOWN (Function code data = 17 and 18)**

- Frequency command: Turning the terminal command “UP” or “DOWN” ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency. (🕮 Function code F01 data = 7)
- PID command: Turning the terminal command “UP” or “DOWN” ON causes the PID command value to increase or decrease, respectively, within the range from 0 to 100%. (🕮 Function code J02 (data= 3)

■ **Allow function code editing – “WE-KP” (Function code data = 19)**

Turning the terminal command “WE-KP” OFF protects function code data from accidentally getting changed by pressing the keys on the keypad. Only when this terminal command is ON, you can change function code data from the keypad. (🕮 Function code F00)

■ **Cancel PID control – “Hz/PID” (Function code data = 20)**

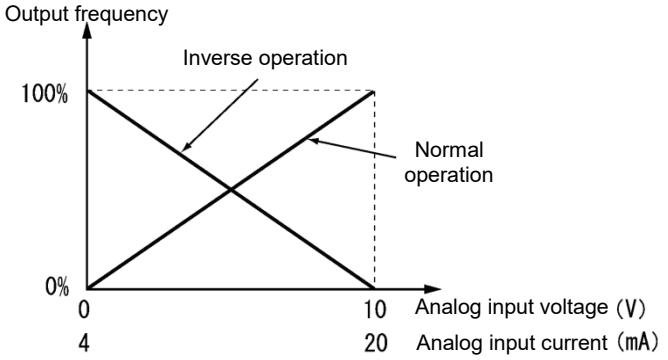
Turning this terminal command “Hz/PID” ON disables PID control. If the PID control is disabled with this command, the inverter runs the motor with the reference frequency manually set by any of the multistep frequency, keypad, analog input, etc.

Terminal command “Hz/PID”	Function
OFF	Enable PID control
ON	Disable PID control (Enable manual settings)

(🕮 Function codes J01 to J19, J57 to J62)

■ **Switch normal/inverse operation – “IVS” (Function code data = 21)**

This terminal command switches the output frequency control between normal (proportional to the input value) and inverse in analog frequency setting or under PID process control. To select the inverse operation, turn the IVS ON.



Tip The normal/inverse switching operation is useful for air-conditioners that require switching between cooling and heating. In cooling, the speed of the fan motor (output frequency of the inverter) is increased to lower the temperature. In heating, the speed of the fan motor (output frequency of the inverter) is reduced to lower the temperature. This switching is realized by the IVS.

- **When the inverter is driven by an external analog frequency setting sources (terminals [12] and [C1] (C1 function) and [C1] (V2 function)):**

Switching normal/inverse operation can apply only to the analog frequency command sources (terminals [12] and [C1] (C1 function) and [C1] (V2 function)) in frequency setting 1 (F01) and does not affect frequency setting 2 (C30) or UP/DOWN control. As shown below, the combination of the “Selection of normal/inverse operation for frequency setting 1” (C53) and the terminal command “IVS” determines the final operation.

C53 data	Terminal command “IVS”	Action
0: Normal operation	OFF	Normal
0: Normal operation	ON	Inverse
1: Inverse operation	OFF	Inverse
1: Inverse operation	ON	Normal

- **When process control is performed by the PID processor integrated in the inverter:**

The terminal command Hz/PID (“Cancel PID control”) can switch PID control between enabled (process is to be controlled by the PID processor) and disabled (process is to be controlled by the manual frequency setting). In either case, the combination of the “PID control” (J01) or “Selection of normal/inverse operation for frequency setting 1” (C53) and the terminal command IVS determines the final operation as listed Table 5.3-8 and Table 5.3-9.

Table 5.3-8 When PID control is enabled:
The normal/inverse operation selection for the PID processor output (reference frequency) is as follows.

PID control (Mode selection) (J01)	Terminal command “IVS”	Action
1: Enable (normal operation)	OFF	Normal
	ON	Inverse
2: Enable (inverse operation)	OFF	Inverse
	ON	Normal

Table 5.3-9 When PID control is disabled:
The normal/inverse operation selection for the manual reference frequency is as follows.

Selection of normal/inverse operation for frequency setting 1 (C53)	Terminal command “IVS”	Action
0: Normal operation	-	Normal
1: Inverse operation	-	Inverse

Note When process control is performed by the PID control facility integrated in the inverter, the “IVS” is used to switch the PID processor output (reference frequency) between normal and inverse, and has no effect on any normal/inverse operation selection of the manual frequency setting.

(🕮 Function codes J01 to J19, J57 to J62)

■ Interlock – “IL” (Function code data = 22)

In a configuration where a magnetic contactor (MC) is installed in the power output (secondary) circuit of the inverter, the momentary power failure detection feature provided inside the inverter may not be able to accurately detect a momentary power failure by itself. Using a digital signal input with the interlock command IL assures the accurate detection. (🕮 Function code F14)

Terminal command “IL”	Meaning
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

■ Cancel torque control -- “Hz/TRQ” (Function code data = 23)

When torque control is enabled (H18 = 2 or 3), assigning the terminal command “Hz/TRQ” (Cancel torque control) to any of the general-purpose digital input terminals (data = 23) enables switching between speed control and torque control.

Cancel torque control signal “Hz/TRQ”	Operation
ON	Cancel torque control (Enable speed control)
OFF	Enable torque control

■ Select link operation (RS-485, BUS option) – “LE” (Function code data = 24)

Turning this terminal command “LE” ON gives priority to frequency commands or run commands received via the RS-485 communications link (H30) or the fieldbus option (y98). No LE assignment is functionally equivalent to the “LE” being ON. (🕮 Function codes H30 and y98)

■ **Universal DI -- "U-DI" (Function code data = 25)**

Universal DI "U-DI" assigned to digital input terminals allow to monitor signals from peripheral equipment connected to those inputs from an upper controller via an RS-485 or fieldbus communications link. Input terminals assigned to "U-DI" are simply monitored and do not operate the inverter.

🕮 For an access to universal DI via the RS-485 or fieldbus communications link, refer to their respective Instruction Manuals.

■ **Select auto search for idling motor speed at starting – "STM" (Function code data = 26)**

This digital terminal command determines, at the start of operation, whether or not to search for idling motor speed and follow it. (🕮 Function code H09)

■ **Force to stop – "STOP" (Function code data = 30)**

Turning this terminal command "STOP" OFF causes the motor to decelerate to a stop in accordance with the H56 data (Deceleration time for forced stop). After the motor stops, the inverter enters the alarm state with the alarm *er6* displayed. (🕮 Function code F07)

■ **Pre-excite -- "EXITE" (Function code data = 32)**

Turning this terminal command ON activates the pre-excitation feature. Even if this pre-excitation command is not assigned, specifying H85 (Pre-excitation: Time) to other than "0.00" enables the inverter to automatically start pre-excitation of the motor when it is turned ON. (This applies exclusively to the inverters under vector control with speed sensor.) (🕮 Function codes H84 and H85.)

■ **Reset PID integral and differential terms – "PID-RST" (Function code data = 33)**

Turning this terminal command "PID-RST" ON resets the integral and differential components of the PID processor. (🕮 Function codes J01 to J19, J23, J24, J57 to J62)

■ **Hold PID integral term – "PID-HLD" (Function code data = 34)**

Turning this terminal command "PID-HLD" ON holds the integral components of the PID processor. (🕮 Function codes J01 to J19, J23, J24, J57 to J62)

■ **Select local (keypad) command – "LOC" (Function code data = 35)**

This terminal command "LOC" switches the sources of run and frequency commands between remote and local.

🕮 For details of switching between remote and local modes, refer to Chapter 3 "3.3.7 Remote and local modes."

■ **The positioning control signals -- "LS", "S/R", "SPRM" and "RTN" (Function code data = 42 to 45)**

(🕮 Function codes J73 to J88)

■ **Enable overload stop – "OLS" (Function code data = 46)**

Turning this terminal command ON enables the overload stop function; turning it OFF disables the function. If no OLS is assigned, the function is enabled. (🕮 Function codes J63 to J67)

■ **Servo-lock command -- "LOCK" (Function code data = 47)**

Turning this terminal command ON enables a servo-lock command; turning it OFF disables a servo-lock command. (🕮 Function codes J97 to J99)

■ **Pulse train input – "PIN" (Only for X5 terminal (E05)) (Function code data = 48), Pulse train sign – "SIGN" (For all terminal except X5 terminal (E05)) (Function code data = 49)**

Assigning the command "PIN" to digital input terminal [X5] enables the frequency command by the pulse train input. Assigning the command "SIGN" to one of the digital input terminals except [X5] enables the pulse train sign input to specify the polarity of frequency command. (🕮 Function code F01)

■ **Battery/UPS operation valid command “BATRY/UPS” (Function code data = 59)**

The Battery/UPS operation can drive the motor during undervoltage situation. This can realize rescue operation which rescues the passengers from the cage stopped halfway due to power failure in the lift application.

IMO Jaguar VXT has two types of operation and those are selectively used depending on the inverter capacity.

When “BATRY/UPS” is assigned to the digital input terminal, the operation becomes same as F14 = 0 regardless of F14 setting, and the inverter trips immediately .

When “BATRY/UPS” is on, the input open phase protection operation becomes invalid regardless of the function code H98 bit 1 setting.

Battery/UPS operation is divided into battery operation and UPS operation. Battery operation assumes that operation is performed by supplying the main power from the battery, and control power from the UPS. Please note that depending on the inverter capacity, battery operation and UPS operation may not be possible for certain models.

Note

(1) Connect the battery power supply before or simultaneously with turning on the ***BATRY/UPS*** signal.

(2) Between the period from turning on of the ***BATRY/UPS*** signal and MC2 (and power supply start from the battery) to the state that the battery operation is possible, the delay time “T1” + “T2” indicated in the above “time chart” occurs.

(3) Do not turn on the ***BATRY/UPS*** signal when the voltage is same or higher than the specified undervoltage level (before /u is indicated after the power failure). If the ***BATRY/UPS*** signal is turned on with the voltage same or higher than the undervoltage value, the specified level, the short circuit for charging resistor 73X remains on.

(4) During the battery operation, avoid driving with application of the heavy load. Operate with no load or braking load.
(Sufficient torque cannot be obtained by the battery voltage, and the motor may stall in such case.)

(5) Operate the motor at a low speed, and pay attention to the battery capacity.
In addition, when the high voltage is supplied (such as when 300 VDC power supply at 200 V class inverter and 600 VDC power supply at 400 V class inverter), operate normally without the battery.

(6) During the normal operation, it is required to turn off the ***BATRY/UPS*** signal. If the main power is turned on with the ***BATRY/UPS*** signal on, the 73X remains ON, causing the rectifier diode getting damaged.

■ **UPS operation (Available in VXT-115A-2 ／ VXT-85A-4 / VXT-12A-1 or below)**

When this terminal command is turned on, the undervoltage protection is invalidated. In that case, the motor can be operated by the inverter with undervoltage status by the UPS power.

Also the function codes are able to set during UPS operation. However, please note the following.

Alarm *er1* or *erf* may occur if power supply is turned OFF while the inverter is writing data to memory. In that case, the function code data are initialized by setting the data of H03 to “1”.

Related function codes	Setting range
H111 : UPS operation Level	120 to 220 VDC: (200 V class), 240 to 440 VDC: (400 V class)

Note **Prerequisite of UPS operation**

(1) Terminal function ***BATRY/UPS*** (data = 59) can be assigned to any digital input terminal.

(2) As shown in Figure 5.3-5, voltage is supplied from the UPS to the main circuit (L1/R-L3/T or L2/S-L3/T).

(3) Required voltage level will differ depending on the operation speed and load.

(4) The terminal that ***BATRY/UPS*** (data = 59) is assigned has to be turned on simultaneously with the MC2.

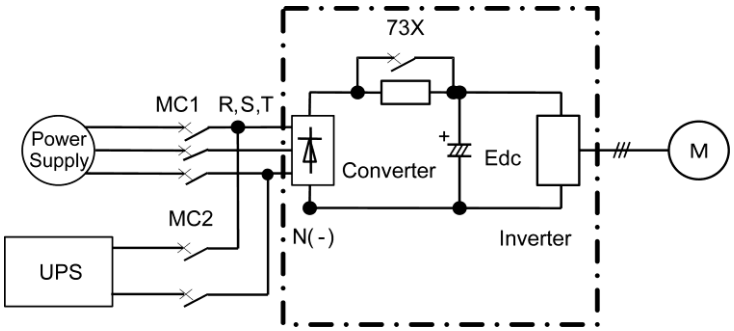


Figure 5.3-5 Connection diagram example
(VXT-115A-2 or below, VXT-85A-4 or below, VXT-12A-1 or below)

UPS operation (When *BATRY/UPS* = ON)

(1) The inverter can run the motor starting from the voltage level specified with H111.

(2) The ***RDY*** (“Inverter ready to run” signal) is forced to go OFF.

(3) The circuit of charging resistor is shorted (73X = ON) after the delay time T1 (0.2 sec) from the timing which ***BATRY/UPS*** terminal being turned on and the DC link bus voltage exceeds UPS operation level (specified with H111) or above. In addition, after the delay time T2 (max. 0.1 sec.), the UPS operation starts. For T1 specifications, see the table below.

(4) During the UPS operation, the inverter can run the motor.

(5) S-curve acceleration/deceleration becomes invalid.

Power supply condition	VXT-115A-2 or below VXT-85A-4 or below VXT-12A-1 or below
Time required for turning on the control power supply, switching to the power supply from the battery, and then to turning on the charging resistor short circuit 73X	T1=0.2 sec
Time required from the occurrence of momentary power failure in the control power supply ON status, switching to the power supply from the battery, and turning on of the short circuit 73X for the charging resistor	

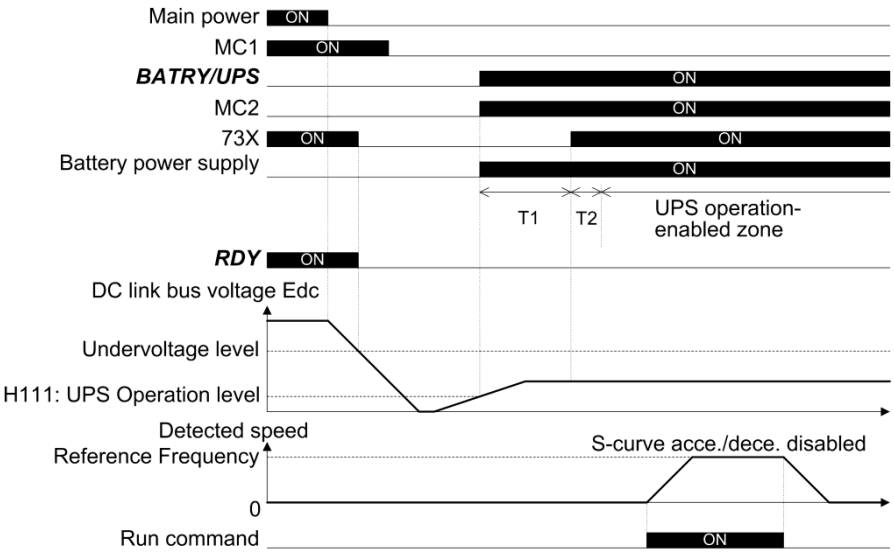


Figure 5.3-6 UPS operation timing chart

■ **Battery operation (Available with VXT-88A-2 or above, VXT-59A-4 or above)**

When this terminal command is turned on, the undervoltage protection is invalidated. In that case, the motor can be operated by the inverter with undervoltage status by the battery power.

In addition, the main power down detection also becomes invalid regardless of H72 setting.

Note **Prerequisite of battery operation**

(1) Terminal function ***BATRY/UPS*** (data = 59) can be assigned to any digital input terminal.

(2) As shown in Figure 5.3-7 and Figure 5.3-8, DC link bus voltage is supplied from the battery to the main circuit (L1/R-L3/T or L2/S-L3/T).

(3) The specified voltage (sinusoidal waveform or DC voltage) is input to auxiliary power terminal (R0-T0).

(4) In case of VXT-203A-4 or above, input the specified power supply (sinusoidal waveform) to the fan power supply auxiliary input (R1-T1) as shown in Figure 5.3-9, and change the fan power supply switching connector as shown in Figure 5.3-10 in order to execute the battery operation.

(5) The terminal that ***BATRY/UPS*** (data = 59) is assigned has to be turned on simultaneously with the MC2.

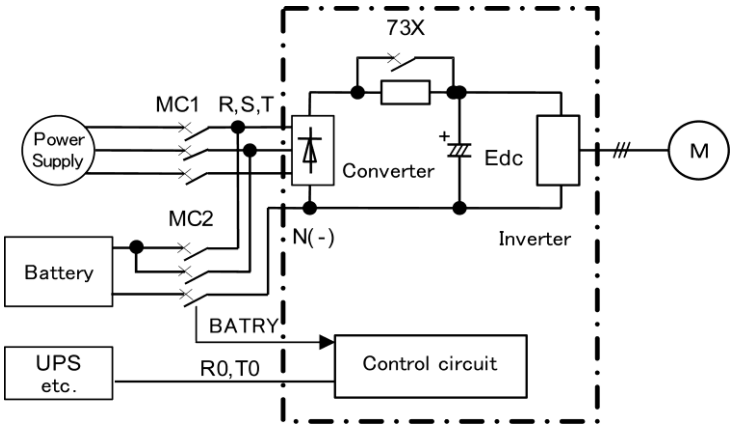


Figure 5.3-7 Connection diagram example (VXT-115A-2 or below, VXT-168A-4 or below)

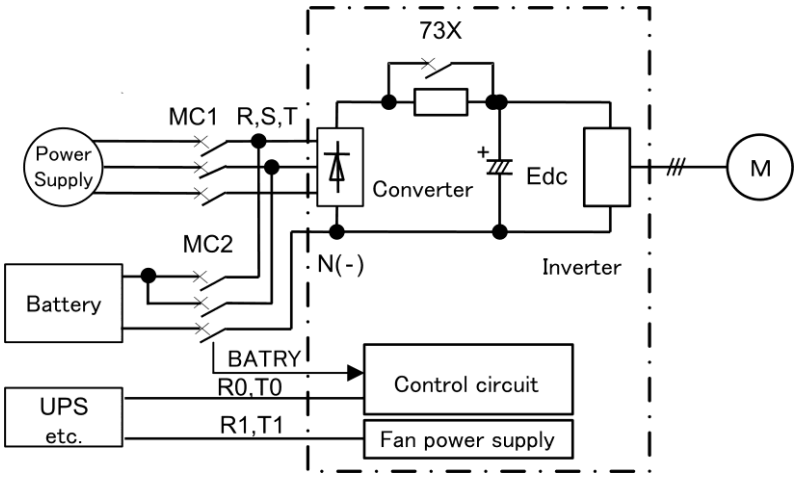


Figure 5.3-8 Connection diagram example (VXT-203A-4 or above)

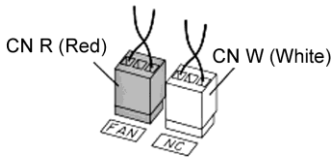
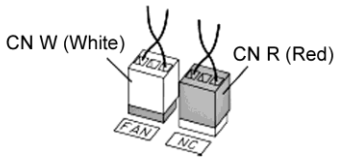
Setting		
Application	When the terminals R1 and T1 are not used	When the terminal R1, T1 is used (Battery operation)

Figure 5.3-9 Fan power supply switching

Battery operation (When *BATRY/UPS* = ON)

(1) Undervoltage protection function (lu)becomes non-operating status.

(2) The inverter can operate the motor even under the undervoltage condition.

(3) Operation ready complete ***RDY*** signal is turned off.

(4) The circuit of charging resistor is shorted (73X = ON) after the delay time T1 from the ***BATRY/UPS*** terminal being turned on. In addition, after the delay time T2 (max. 0.1 sec.), the battery operation starts. For T1 specifications, see Table 5.3-10 on the next page.

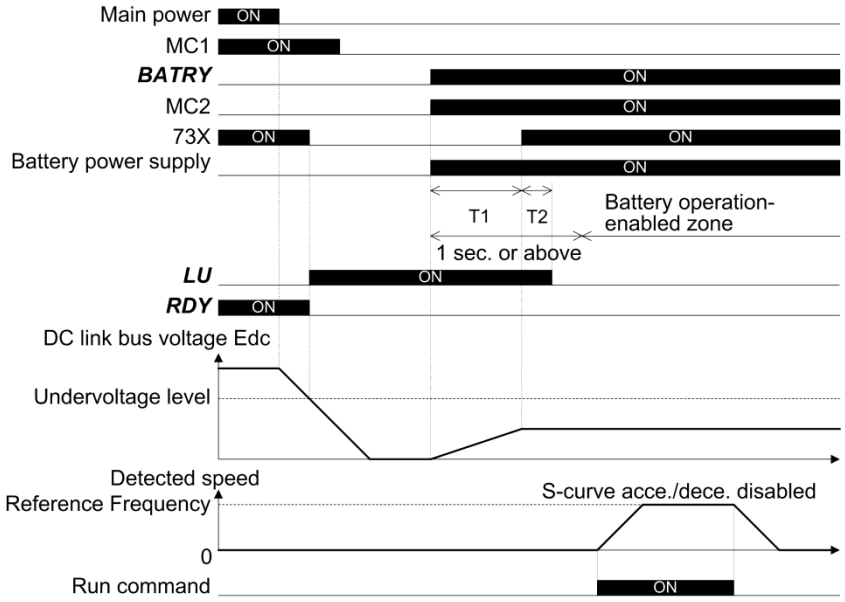


Figure 5.3-10 Battery operation timing chart

Table 5.3-10

Power supply condition	VXT-88A-2 or above VXT-59A-4 or above
Time required for turning on the control power supply, switching to the power supply from the battery, and then to turning on the charging resistor short circuit 73X	T1=500 ms
Time required from the occurrence of momentary power failure in the control power supply ON status, switching to the power supply from the battery, and turning on of the short circuit 73X for the charging resistor	

(5) S-curve acceleration/deceleration becomes invalid.

(6) The operable speed during the battery operation is calculated by using the following expression.

$$\text{Frequency command} \le \frac{\text{Battery voltage} - 5[\text{v}]}{\sqrt{2} \times \text{Base voltage (F05)}} \times \text{Base frequency (F04)} \times k$$

Here,

Battery voltage : 24 VDC or higher (200 V class)
48 VDC or higher (400 V class)

Rated frequency : F04

Rated voltage : F05 (Motor rated voltage (V))

K : Safety factor (Lower than 1 Approx. 0.8)

■ **Select torque bias 1, 2 -- “TB1”, “TB2” (Function code data = 61, 62)**

The combination of the ON/OFF states of digital input signals “TB1” and “TB2” selects one of 3 different level torque-bias commands defined beforehand by 3 function codes H155 to H157 (Torque-bias level 1, level 2 and level 3). Change during drive is invalid. (🕮 Function codes H154 to H162)

input signals		Torque-bias to be selected
“TB2”	“TB1”	
OFF	OFF	Disable torque-bias
OFF	ON	H155 Torque-bias level 1
ON	OFF	H156 Torque-bias level 2
ON	ON	H157 Torque-bias level 3

■ **Hold torque bias -- “H-TB” (Function code data = 63)**

Turning this terminal command ON enables a torque-bias hold command. This command directs to preserve the torque-bias data supplied via an analog input. (🕮 Function codes H154 to H162)

■ **Check brake – BRKE (Function code data = 65)**

If the status of the brake signal BRKS fails to agree with the status of the brake check signal BRKE during inverter operation, the inverter enters an alarm stop state with *er6*.

This signal is used as a feedback signal for the brake signal BRKS. When the mechanical brake does not operate, it causes the inverter to trip to activate the mechanical brake. The response delay time for BRKS and BRKE can be adjusted with H180: Brake response time. (🕮 Function codes J68 to J96, H180)

■ **Cancel line speed control -- “Hz/LSC” (Function code data = 70)**

Turning ON Hz/LSC cancels line speed control. This disables the frequency compensation of PI operation, resulting in no compensation for a take-up roll getting bigger and an increase in the winding speed.

Use this signal to temporarily interrupt the control for repairing a thread break, for example. (🕮 Function code d41)

“Hz/LSC”	Function
OFF	Enable line speed control (depending on d41 setting)
ON	Cancel line speed control(V/f control, without compensation for a take-up roll getting bigger)

■ **Hold line speed control frequency in the memory -- “LSC-HLD” (Function code data = 71)**

If “LSC/HLD” is ON under line speed control frequency, stopping the inverter (including an occurrence of an alarm and a coast-to-stop command) or turning OFF “Hz/LSC” saves the current frequency command compensating for a take-up roll getting bigger, in the memory. At the time of restart, the saved frequency command applies and the inverter keeps the line speed constant. (🕮 Function code d41)

“LSC-HLD”	Function
OFF	Disable (No saving operation)
ON	Enable (Saving the frequency command compensating for a take-up roll getting bigger)

■ **Count the run time of commercial power-driven motor-1 and motor-2 -- “CRUN-M1” and “CRUN-M2” (Function code data = 72, 73)**

These two terminal commands enable the inverter to count the cumulative run time of motor-1 and motor-2 even when they are driven by commercial power (not by the inverter).

When the “CRUN-M1” or “CRUN-M2” is ON, the inverter judges that the motor-1 or motor-2 is driven by commercial power, respectively, and counts the run time of the corresponding motor. (🕮 Function codes H44,H94)

■ **Select droop control– "DROOP" (Function code data = 76)**

This terminal command "DROOP" toggles droop control on and off.

Terminal command "DROOP"	Droop control
ON	Enable
OFF	Disable

(🕮 Function code H28)

■ **Select speed control parameter 1, 2 -- "MPRM1", "MPRM2" (Function code data = 78, 79)**

The combination of the ON/OFF states of digital input signals "MPRM1" and "MPRM2" selects one of 4 different level speed control parameter sets for vector control with speed sensor. (🕮Function codes d01 to d08)

■ **Cancel customizable logic – "CLC" (Function code data = 80), Clear all customizable logic timers – "CLTC" (Function code data = 81)**

Terminal command "CLC" stops the operation of customizable logic. Terminal command "CLTC" clears all customizable logic timers. (🕮 Function codes U codes)

■ **Cancel anti-regenerative control – "AR-CCL" (Function code data = 82)**

Terminal command "AR-CCL" ON disables anti-regenerative control. (🕮 Function code H69)

■ **PID control multistage command 1, 2 – "PID-SS1", "PID-SS2" (Function code data = 171, 172)**

"PID-SS1" and "PID-SS2" can be used to select 4 different PID commands. (🕮 Function codes J136 to J138)

■ **Run forward – "FWD" (Function code data = 98)**

Turning this terminal command ON runs the motor in the forward direction; turning it OFF decelerates it to stop.

Tip This terminal command "FWD" can be assigned only to E98 or E99.

■ **Run reverse – "REV" (Function code data = 99)**

Turning this terminal command "REV" ON runs the motor in the reverse direction; turning it OFF decelerates it to stop.

Tip This terminal command "REV" can be assigned only to E98 or E99.

■ **No function assigned – "NONE" (Function code data = 100)**

It allows the inverter to run unaffected by ON/OFF of signals. It is used when a signal is externally input using customizable logic. It is also used to temporarily disable a terminal function.

E10 to E15	**Acceleration time 2 to 4, Deceleration time 2 to 4**	**(Refer to F07)**

Refer to the description of F07.

E16, E17	**Torque limiter 2 (driving), 2 (braking)**	**(Refer to F40)**

For the torque limiter 2 (driving) and 2 (braking) settings, refer to the description of F40.

E20 to E21 E27	**Terminals [Y1] function to [Y2] function Terminal [30A/B/C] function (Relay output)**

E20 through E21 and E27 assign output signals to general-purpose, programmable output terminals, [Y1], [Y2] and [30A/B/C]. These function codes can also switch the logic system between normal and negative to define how the inverter interprets the ON or OFF state of each terminal. The factory default setting is normal logic system "Active ON."

Terminals [Y1] and [Y2] are transistor outputs and terminals [30A/B/C] are contact outputs. In normal logic, if an alarm occurs, the relay will be energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. In negative logic, the relay will be de-energized so that [30A] and [30C] will be opened, and [30B] and [30C] closed. This may be useful for the implementation of failsafe power systems.

Note

- When negative logic is employed, output signal is OFF(active) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds (for 22 kW or below) or 3 seconds (for 30 kW or above) after power-ON, so introduce such a mechanism that masks them during the transient period.
- Terminals [30A/B/C] use mechanical contacts. They cannot stand frequent ON/OFF switching. Where frequent ON/OFF switching is anticipated (for example, by using frequency arrival signal), use transistor outputs [Y1] and [Y2] instead.
  The service life of a relay is approximately 200,000 times if it is switched ON and OFF at one-second intervals. For signals expected to be turned ON/OFF frequently, use terminals [Y1] and [Y2] for output.

The tables given on the following pages list functions that can be assigned to terminals [Y1], [Y2], and [30A/B/C]. The descriptions are, in principle, arranged in the numerical order of assigned data. However, the signal is related has been described together. Refer to the function codes or signals in the "Related function codes/signals (data)" column, if any.

Explanations of each function are given in normal logic system "Active ON."

Data		Terminal commands assigned	Symbol	Control mode					Related function codes/ Related signals (data)
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
0	1000	Inverter running	"RUN"	Y	Y	Y	Y	Y	—
1	1001	Frequency (speed) arrival	"FAR"	Y	Y	Y	N	Y	E30
2	1002	Frequency (speed) detected	"FDT"	Y	Y	Y	Y	Y	E31, E32
3	1003	Undervoltage detected (Inverter stopped)	"LU"	Y	Y	Y	Y	Y	—
4	1004	Detected torque polarity	"B/D"	Y	Y	Y	Y	Y	—
5	1005	Inverter output limiting	"IOL"	Y	Y	Y	Y	Y	—
6	1006	Auto-restarting after momentary power failure	"IPF"	Y	Y	Y	Y	Y	F14
7	1007	Motor overload early warning	"OL"	Y	Y	Y	Y	Y	E34, F10, F12
8	1008	Keypad operation enabled	"KP"	Y	Y	Y	Y	Y	—
10	1010	Inverter ready to run	"RDY"	Y	Y	Y	Y	Y	—
15	1015	Switch MC on the input power lines	"AX"	Y	Y	Y	Y	Y	—
16	1016	Pattern operation stage transition	"TU"	Y	Y	Y	N	Y	C21 to C28
17	1017	Pattern operation cycle completed	"TO"	Y	Y	Y	N	Y	
18	1018	Pattern operation stage No. 1	"STG1"	Y	Y	Y	N	Y	
19	1019	Pattern operation stage No. 2	"STG2"	Y	Y	Y	N	Y	
20	1020	Pattern operation stage No. 4	"STG4"	Y	Y	Y	N	Y	
21	1021	Frequency (speed) arrival 2	"FAR2"	Y	Y	Y	N	Y	E29
22	1022	Inverter output limiting (with delay)	"IOL2"	Y	Y	Y	Y	Y	IOL (5)
25	1025	Cooling fan in operation	"FAN"	Y	Y	Y	Y	Y	H06
26	1026	Auto-resetting	"TRY"	Y	Y	Y	Y	Y	H04, H05
27	1027	Universal DO	"U-DO"	Y	Y	Y	Y	Y	—
28	1028	Heat sink overheat early warning	"OH"	Y	Y	Y	Y	Y	—
29	1029	Synchronization completed	"SY"	N	Y	Y	N	N	d71 to d78
30	1030	Lifetime alarm	"LIFE"	Y	Y	Y	Y	Y	H42

Data		Terminal commands assigned	Symbol	Control mode					Related function codes/ Related signals (data)
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
31	1031	Frequency (speed) detection 2	“FDT2”	Y	Y	Y	Y	Y	E32, E36
33	1033	Reference loss detected	“REF OFF”	Y	Y	Y	N	Y	E65
35	1035	Inverter outputting	“RUN2”	Y	Y	Y	Y	Y	RUN (0)
36	1036	Overload prevention controlling	“OLP”	Y	Y	Y	N	Y	H70
37	1037	Current detected	“ID”	Y	Y	Y	Y	Y	E34, E35, E37, E38, E55, E56
38	1038	Current detected 2	“ID2”	Y	Y	Y	Y	Y	
39	1039	Current detected 3	“ID3”	Y	Y	Y	Y	Y	
41	1041	Low current detected	“IDL”	Y	Y	Y	Y	Y	
42	1042	PID alarm	“PID-ALM”	Y	Y	Y	N	Y	J11 to J13
43	1043	Under PID control	“PID-CTL”	Y	Y	Y	N	Y	J01
44	1044	Under sleep mode of PID control	“PID-STP”	Y	Y	Y	N	Y	J08, J09
45	1045	Low torque detected	“U-TL”	Y	Y	Y	Y	Y	E78 to E81
46	1046	Torque detected 1	“TD1”	Y	Y	Y	Y	Y	
47	1047	Torque detected 2	“TD2”	Y	Y	Y	Y	Y	
48	1048	Motor 1 selected	“SWM1”	Y	Y	Y	Y	Y	—
49	1049	Motor 2 selected	“SWM2”	Y	Y	Y	Y	Y	
52	1052	Running forward	“FRUN”	Y	Y	Y	Y	Y	—
53	1053	Running reverse	“RRUN”	Y	Y	Y	Y	Y	—
54	1054	Under remote mode	“RMT”	Y	Y	Y	Y	Y	(Refer to Section 3.3.7)
56	1056	Motor overheat detected by thermistor	“THM”	Y	Y	Y	Y	Y	H26, H27
57	1057	Brake control	“BRKS”	Y	Y	Y	N	N	J68 to J72
58	1058	Frequency (speed) detected 3	“FDT3”	Y	Y	Y	Y	Y	E32, E54
59	1059	Terminal [C1] (C1 function)wire break detected	“C1OFF”	Y	Y	Y	Y	Y	—
70	1070	Speed valid	“DNZS”	N	Y	Y	Y	Y	F25, F38
71	1071	Speed agreement	“DSAG”	N	Y	Y	N	Y	d21, d22
72	1072	Frequency (speed) arrival 3	“FAR3”	Y	Y	Y	N	Y	E30
76	1076	PG error detected	“PG-ERR”	N	Y	Y	Y	N	d21 to d23
77	1077	Low DC link bus voltage detection	“U-EDC”	Y	Y	Y	Y	Y	E76
79	1079	During deceleration in momentary power failure	“IPF2”	Y	Y	Y	Y	Y	F14, F15
80	1080	Stop position override alarm	“OT”	N	Y	N	N	N	J73 to J88
81	1081	Under positioning	“TO”	N	Y	N	N	N	
82	1082	Positioning completed	“PSET”	N	Y	Y	N	N	
83	1083	Current position count over-flowed	“POF”	N	Y	N	N	N	
84	1084	Maintenance timer counted up	“MNT”	Y	Y	Y	Y	Y	H44, H78, H79
87	1087	Frequency arrival and frequency detected	“FARFDT”	Y	Y	Y	N	Y	E30, E31, E32
90	1090	Alarm content 1	“AL1”	Y	Y	Y	Y	Y	—
91	1091	Alarm content 2	“AL2”	Y	Y	Y	Y	Y	
92	1092	Alarm content 4	“AL4”	Y	Y	Y	Y	Y	
93	1093	Alarm content 8	“AL8”	Y	Y	Y	Y	Y	
98	1098	Light alarm	“L-ALM”	Y	Y	Y	Y	Y	H81, H82
99	1099	Alarm output (for any alarm)	“ALM”	Y	Y	Y	Y	Y	—
101	1101	EN circuit failure detected	“DECF”	Y	Y	Y	Y	Y	
102	1102	EN terminal input OFF	“ENOFF”	Y	Y	Y	Y	Y	
105	1105	Braking transistor broken	“DBAL”	Y	Y	Y	Y	Y	H98
111	1111	Customizable logic output signal 1	“CLO1”	Y	Y	Y	Y	Y	U71 to U75, U81

Data		Terminal commands assigned	Symbol	Control mode					Related function codes/ Related signals (data)
Active ON	Active OFF			V/f	PG V/f	IM CLV	IM TC	PM SLV	
112	1112	Customizable logic output signal 2	“CLO2”	Y	Y	Y	Y	Y	to U90
113	1113	Customizable logic output signal 3	“CLO3”	Y	Y	Y	Y	Y	
114	1114	Customizable logic output signal 4	“CLO4”	Y	Y	Y	Y	Y	
115	1115	Customizable logic output signal 5	“CLO5”	Y	Y	Y	Y	Y	
116 to 120	1116 to 1120	Customizable logic output signal 6 to 10	“CLO6” to “CLO10”	Y	Y	Y	Y	Y	

Note Any negative logic (Active OFF) command cannot be assigned to the functions marked with “-” in the “Active OFF” column.

■ **Inverter running – “RUN” (Function code data = 0), Inverter outputting – “RUN2” (Function code data = 35)**

These output signals tell the external equipment that the inverter is running at a starting frequency or higher. If assigned in negative logic (Active OFF), these signals can be used to tell the “Inverter being stopped” state.

Output signal	Basic function	Remarks
RUN	These signals come ON when the inverter is running. Under V/f control: These signals come ON if the inverter output frequency exceeds the starting frequency, and go OFF if it drops below the stop frequency. The “RUN” signal can also be used as a “Speed valid” signal.	Goes OFF even during DC braking.
RUN2		Comes ON even during DC braking, pre-excitation, zero speed control.

■ **Frequency (speed) arrival– “FAR” (Function code data = 1), Frequency (speed) arrival 3 – “FAR3” (Function code data = 72)**

These output signals come ON when the difference between the output frequency (detected speed) and reference frequency (reference speed) comes within the frequency arrival hysteresis width specified by E30.

(🕮Function code E30)

■ **Frequency (speed) detected – “FDT” (Function code data = 2), Frequency (speed) detected 2 – “FDT2” (Function code data = 31), Frequency (speed) detected 3 – “FDT3” (Function code data = 58)**

These output signasl FDT, FDT2 or FDT3 come ON when the output frequency (detected speed) exceeds the frequency detection level specified by E31, E36 or E54, respectively, and go OFF when the output frequency (detected speed) drops below the “Frequency detection level (E31, E36 or E54) - Hysteresis width (E32).”

(🕮 Function codes E31 and E32)

■ **Undervoltage detected (Inverter stopped) – “LU” (Function code data = 3)**

This output signal comes ON when the DC link bus voltage of the inverter drops below the specified undervoltage level. When this signal is ON, the inverter cannot run even if a run command is given. It goes OFF when the voltage exceeds the level.

■ **Detected torque polarity – “B/D” (Function code data = 4)**

The inverter issues the driving or braking polarity signal to this digital output judging from the internally calculated torque or torque command. This signal goes OFF when the detected torque corresponds to driving, and it goes ON when it corresponds to braking.

■ **Inverter output limiting – “IOL” (Function code data = 5), Inverter output limiting with delay – “IOL2” (Function code data = 22)**

The output signal IOL comes ON when the inverter is limiting the output frequency by activating any of the following actions (minimum width of the output signal: 100 ms). The output signal IOL2 comes ON when any of the following output limiting operation continues for 20 ms or more.

- Torque limiting (F40, F41, E16 and E17, Maximum internal value)
- Current limiting by software (F43 and F44)
- Instantaneous overcurrent limiting by hardware (H12 = 1)
- Automatic deceleration (Anti-regenerative control) (H69)

Note When the “IOL” is ON, it may mean that the output frequency may have deviated from the reference frequency because of the limiting functions above.

■ **Auto-restarting after momentary power failure – “IPF” (Function code data = 6)**

This output signal is ON either during continuous running after a momentary power failure or during the period after the inverter detects an undervoltage condition and shuts down the output until restart has been completed (the output has reached the reference frequency). (🕮 Function code F14)

■ **Motor overload early warning – “OL” (Function code data = 7)**

The OL signal is used to detect a symptom of an overload condition (alarm code *0l1*) of the motor so that the user can take an appropriate action before the alarm actually happens. (🕮 Function code E34)

■ **Keypad operation enabled – “KP” (Function code data = 8)**

This output signal comes ON when the (RUN) / (STOP) keys are specified as the run command source.

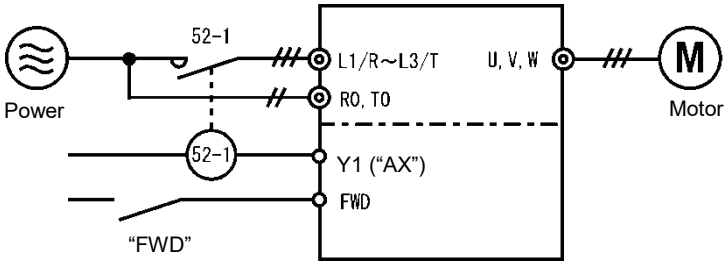
■ **Inverter ready to run – “RDY” (Function code data = 10)**

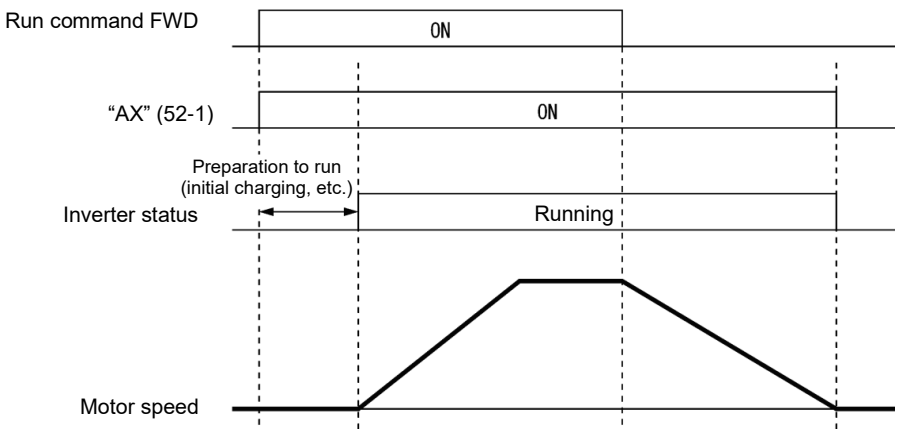
This output signal comes ON when the inverter becomes ready to run by completing hardware preparation (such as initial charging of DC link bus capacitors and initialization of the control circuit) and no protective functions are activated.

■ **Switch MC on the input power lines – “AX” (Function code data = 15)**

In response to a run command FWD, this output signal controls the magnetic contactor on the commercial-power supply side. It comes ON when the inverter receives a run command. It goes OFF after the motor decelerates to stop with a stop command received. This signal immediately goes OFF upon receipt of a coast-to-stop command or when an alarm occurs.

“AX” can be selected where there is control power such as with VXT-88A-2 or above, VXT-59A-4 or above.





■ **Pattern operation stage No. 1 – “STG1” (Function code data = 18), Pattern operation stage No. 2 –**

"STG2" (Function code data = 19), Pattern operation stage No. 4 – "STG4" (Function code data = 20)

Outputs the stage (operation process) currently performed during pattern operation.

Operation pattern stage No.	Output terminal signal		
	STG1	STG2	STG4
Stage 1	ON	OFF	OFF
Stage 2	OFF	ON	OFF
Stage 3	ON	ON	OFF
Stage 4	OFF	OFF	ON
Stage 5	ON	OFF	ON
Stage 6	OFF	ON	ON
Stage 7	ON	ON	ON

■ **Frequency (speed) arrival 2 – "FAR2" (Function code data = 21)**

The signals come ON when the difference between the output frequency before torque limiting and reference frequency is within the frequency arrival hysteresis width specified by E30 and the frequency arrival delay specified by E29 has elapsed. (🕮 Function codes E29 and E30)

■ **Cooling fan in operation – "FAN" (Function code data = 25)**

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control. (🕮 Function code H06)

■ **Auto-resetting – "TRY" (Function code data = 26)**

This output signal comes ON when auto resetting (resetting alarms automatically) is in progress.
(🕮 Function codes H04 and H05)

■ **Universal DO -- "U-DO" (Function code data = 27)**

Assigning this output signal to an inverter's output terminal and connecting the terminal to a digital input terminal of peripheral equipment, allows an upper controller to send commands to the peripheral equipment via the RS-485 or the fieldbus communications link. The universal DO can be used as an output signal independent of the inverter operation.

🕮 For the procedure for access to Universal DO via the RS-485 or fieldbus communications link, refer to the respective instruction manual.

■ **Heat sink overheat early warning – "OH" (Function code data = 28)**

This output signal is used to issue a heat sink overheat early warning that enables you to take a corrective action before an overheat trip *0h1* actually happens.

ON at [(Overheat trip (*0h1*) temperature) – 5°C (41°F)] or higher

OFF at [(Overheat trip (*0h1*) temperature) - 8°C (46°F)] or lower

This signal comes ON also when the internal air circulation DC fan (VXT-203A-4 or above for 400 V class series) is locked.

■ **Synchronization completed -- "SY" (Function code data = 29)**

This output signal comes ON when the control target comes inside the synchronization completion detection angle in synchronous running.

For details about master-follower operation, refer to function codes J73 to J88.

■ **Lifetime alarm – "LIFE" (Function code data = 30)**

This output signal comes ON when it is judged that the service life of any one of capacitors (DC link bus capacitors or electrolytic capacitors on the printed circuit boards) or cooling fan has expired. This signal should be used as a guide for replacement of the capacitors and cooling fan. If this signal comes ON, use the specified maintenance procedure to check the service life of these parts and determine whether the parts should be replaced or not.
(🕮 Function code H42)

This signal comes ON also when the internal air circulation DC fan (VXT-203A-4 or above for 400 V class series) is locked.

■ **Reference loss detected – "REF OFF" (Function code data = 33)**

This output signal comes ON when an analog input used as a frequency command source is in a reference loss state (as specified by E65) due to a wire break or a weak connection. This signal goes OFF when the normal operation under the analog input is resumed. (🕮 Function code E65)

■ **Overload prevention controlling – "OLP" (Function code data = 36)**

This output signal comes ON when overload prevention control is activated.
(The minimum ON-duration is 100 ms.) (🕮 Function code H70)

■ **Current detected – "ID" (Function code data = 37), Current detected 2 – "ID2" (Function code data = 38), Current detected 3 – "ID3" (Function code data = 39)**

When the inverter output current exceeds the level specified by E34, E37 or E55 for the period specified by E35, E38 or E56, the ID, ID2 or ID3 signal turns ON, respectively. (The minimum ON-duration is 100 ms.)
(🕮 Function code E34)

■ **Low current detected – "IDL" (Function code data = 41)**

When the inverter output current falls to or below the level specified by E34, E37 or E55 for the period specified by E35, E38 or E56, the ID, ID2 or ID3 signal turns ON, respectively. (The minimum ON-duration is 100 ms.)
(🕮 Function code E34)

■ **PID alarm – "PID-ALM" (Function code data = 42)**

Assigning this output signal enables PID control to output absolute-value alarm or deviation alarm.
(🕮 Function codes J11 to J13)

■ **Under PID control – "PID-CTL" (Function code data = 43)**

This output signal comes ON when PID control is enabled ("Cancel PID control" (Hz/PID) = OFF) and a run command is ON. (🕮 Function code J01)

Note When PID control is enabled, the inverter may stop due to the slow flowrate stopping function or other reasons. If that happens, the "PID-CTL" signal remains ON. As long as the "PID-CTL" signal is ON, PID control is effective, so the inverter may abruptly resume its operation, depending on the feedback value in PID control.

⚠WARNING

When PID control is enabled, even if the inverter stops its output during operation because of sensor signals or other reasons, operation will resume automatically. Design your machinery so that safety is ensured even in such cases.

Otherwise an accident could occur.

■ **Under sleep mode of PID control – "PID-STP" (Function code data = 44)**

This output signal is ON when the inverter is in a stopped state due to the slow flowrate stopping function under PID control.) (🕮 Function codes J15 to J17, J23 J24)

■ **Low torque detected – "U-TL" (Function code data = 45)**

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Low torque detection (Level)) for the period specified by E81 (Low torque detection (Timer)). (minimum width of the output signal: 100 ms) (🕮 Function codes E78 to E81)

■ **Frequency arrival AND frequency detected – “FARFDT” (Function code data = 87)**

The FARFDT, which is an ANDed signal of FAR and FDT, comes ON when both signal conditions are met.

(🕮 Function codes E30 to E32)

■ **Torque detected 1 – “TD1” (Function code data = 46),Torque detected 2 – “TD2” (Function code data = 47)**

This output signal TD1 or TD2 comes ON when the torque value calculated by the inverter or torque command exceeds the level specified by E78 or E80 (Torque detection (Level)) for the period specified by E79 or E81 (Torque detection (Timer)), respectively. (minimum width of the output signal: 100 ms)

(🕮 Function codes E78 to E81)

■ **Motor 1, and 2 selected – “SWM1” and “SWM2” (Function code data = 48 and 49)**

The output signal “SWM1” or “SWM2” comes ON corresponding to the motor selected by the signal “M2” or the selected function code group. (🕮 Function code A42)

■ **Running forward – “FRUN” (Function code data = 52) Running reverse – “RRUN” (Function code data = 53)**

Output signal	Assigned data	Running forward	Running reverse	Inverter stopped
“FRUN”	52	ON	OFF	OFF
“RRUN”	53	OFF	ON	OFF

■ **Under remote mode – “RMT” (Function code data = 54)**

This output signal comes ON when the inverter switches from local to remote mode.

🕮 For details of switching between remote and local modes, refer to Chapter 3 “3.3.7 Remote and local modes.”

■ **Motor overheat detected by thermistor – “THM” (Function code data = 56)**

When the PTC thermistor on the motor detects an overheat, the inverter turns this signal ON and continues to run, without entering the alarm *0h4* state. This feature applies only when H26 data is set to “2.”

(🕮 Function codes H26 and H27)

■ **Brake control – “BRKS” (Function code data = 57)**

This signal outputs a brake control command that releases or applies the brake. (🕮 Function codes J68 to J72)

■ **Terminal [C1] (C1 function)wire break detected – “C1OFF” (Function code data = 59)**

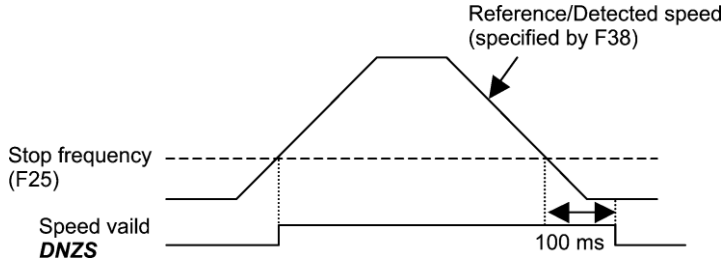
This output signal comes ON when the inverter detects that the input current to terminal [C1] (C1 function) drops below 2 mA interpreting it as the terminal [C1] wire broken.

■ **Speed valid -- “DNZS” (Function code data = 70)**

This output signal comes ON when the reference speed or detected one exceeds the stop frequency specified by function code F25. It goes OFF when the speed is below the stop frequency for 100 ms or longer.

Under vector control with speed sensor, F38 switches the decision criterion between the reference speed and actual speed. Under vector control without speed sensor, the reference speed is used as a decision criterion.

🕮 Function codes F25 and F38.



■ **Speed agreement -- “DSAG” (Function code data = 71)**

This output signal comes ON when the deviation of the detected speed from the speed command after the acceleration/deceleration processor is within the allowable range specified by d21. It goes OFF when the deviation is beyond the range for longer than the period specified by d22. This feature allows you to check whether the speed controller is working correctly.

🕮 Function codes d21 and d22.

■ **PG error detected -- “PG-ERR” (Function code data = 76)**

This output signal comes ON when the inverter detects a PG error with the d23 (PG error processing) data being set to “0: Continue to run,” in which the inverter does not enter the alarm state.

🕮 Function codes d21 through d23.

■ **Low DC link bus voltage detection – “U-EDC” (Function code data = 77)**

This output signal comes ON when the DC intermediate voltage drops below E76 (DC link bus low-voltage detection level), and it goes OFF when the DC intermediate voltage exceeds E76. (🕮 Function code E76)

■ **During decelerating at momentary power failure – “IPF2” (Function code data = 79)**

When F14 data is set to 2 or 3, this output signal comes ON when the DC intermediate voltage drops below H15 (Continue to run level) and continue to run control starts. When the power returns and the DC intermediate voltage becomes “at least 10 V higher than the voltage specified by H15,” the signal goes OFF.

Even when F14 data is set to 4 or 5, the signal comes ON when the DC intermediate voltage drops below the undervoltage level, and it goes OFF when the DC intermediate voltage becomes “at least 10 V higher than the undervoltage level.” (🕮 Function codes F14 and H15)

■ **The positioning control signals -- “OT”, “TO” and “POF” (Function code data = 80, 81, 83)**

These signals are used to the positioning control function. (🕮 Function codes J73 to J88)

■ **Positioning completed -- “PSET” (Function code data = 82)**

This output signal comes ON as a positioning completion signal. This signal is used to the servolock function and the positioning control function.

(🕮 Function codes to J97 to J99 for the servo lock function, function codes J73 to J88 for the positioning control function)

■ **Maintenance timer counted up – “MNT” (Function code data = 84)**

Once the inverter’s cumulative run time or the startup times for the motor 1 exceeds the previously specified count, this output signal comes ON. (🕮 Function codes H78 and H79)

■ **Alarm content – "AL1", "AL2", "AL4", "AL8" (Function code data = 90, 91, 92, 93)**

Outputs the state of operation of the inverter protective functions.

Alarm content (inverter protective function)	Alarm code	Output terminal			
		AL1	AL2	AL4	AL8
Instantaneous overcurrent protection, earth fault protection, fuse blown	*0c1, 0c2, 0c3 ef, fu5*	ON	OFF	OFF	OFF
Overvoltage protection	*0u1, 0u2, 0u3*	OFF	ON	OFF	OFF
Undervoltage protection, input phase loss	*lu, lin*	ON	ON	OFF	OFF
Motor overload, electronic thermal (motors 1 to 4)	*0l1 ,0l2 ,0l3 0l4*	OFF	OFF	ON	OFF
Inverter overload	*0lu*	ON	OFF	ON	OFF
INV overheat protection, inverter internal overheat, charging resistor overheat	*0h1, 0h3, 0h6*	OFF	ON	ON	OFF
External alarm, DB resistor overheat, motor overheat	*0h2, dbh, 0h4*	ON	ON	ON	OFF
Memory error, CPU error, undervoltage save error, hardware combiation error	*er1, er3, erf, erh*	OFF	OFF	OFF	ON
Keypad communications error, option communications error	*er2, er4*	ON	OFF	OFF	ON
Option error	*er5 ert*	OFF	ON	OFF	ON
Charging circuit error, operating procedure error, EN circuit error, DB transistor failure detection	*pbf, er6, ecf, dba*	ON	ON	OFF	ON
Tuning error, output phase loss protection	*er7, 0pl*	OFF	OFF	ON	ON
RS485 communications error	*er8, erp*	ON	OFF	ON	ON
Overspeed protection, PG error, excessive positioning error Speed mismatch (excessive speed deviation), positioning control error	*0s, pg, ere, ero*	OFF	ON	ON	ON
PID feedback wire break, mock alarm Other alarm	*c0f, err*	ON	ON	ON	ON

*No terminal outputs a signal during normal operation.

■ **Light alarm – "L-ALM" (Function code data = 98)**

This output signal comes ON when a light alarm occurs. (🕮 Function codes H81 and H82)

■ **Alarm output (for any alarm) – "ALM" (Function code data = 99)**

This output signal comes ON if any of the protective functions is activated and the inverter enters Alarm mode.

■ **EN circuit failure detected – "DECF" (Function code data = 101)**

The signal comes ON when any error is detected in the circuit for EN terminal.

■ **EN terminal input OFF – "ENOFF" (Function code data = 102)**

The signal comes ON when the EN terminal is turned OFF.

■ **Braking transistor broken – "DBAL" (Function code data = 105)**

If the inverter detects a breakdown of the braking transistor, it displays the braking transistor alarm (*dba*) and also issues the output signal "DBAL". Detection of the breakdown of a braking transistor can be cancelled by H98. (VXT-72A-4 or below, VXT-115A-2 or below, VXT-12A-1 or below) (🕮 Function code H98)

Note A breakdown of the braking transistor could lead to a damage of the braking resistor or inverter's internal units. To prevent the secondary damage, use "DBAL" to cut off power to the magnetic contactor in inverter primary circuits upon detection of a breakdown of the built-in braking transistor.

■ **Customizable logic output signal 1 to 10 – "CLO1" to "CLO10" (Function code data =111 to 120)**

Outputs the result of customizable logic operation. (🕮 Function codes U codes)

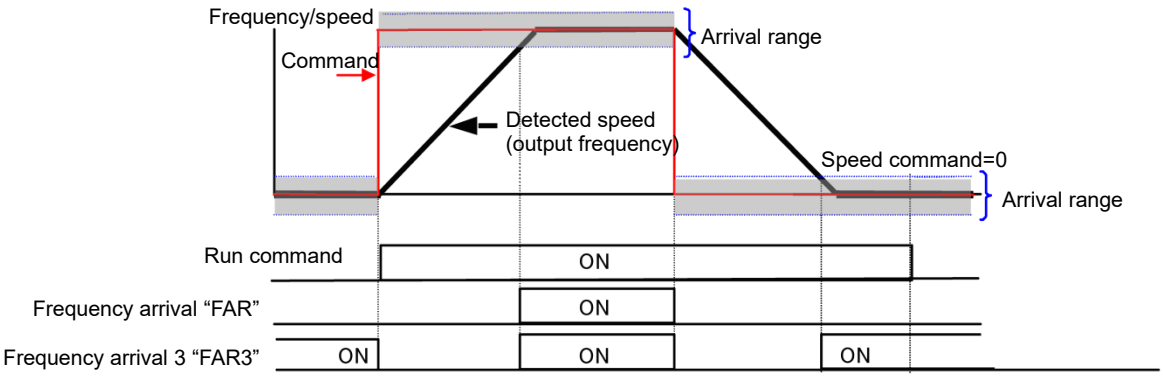
E29 **E30**	**Frequency arrival delay timer (FAR2)** **Frequency arrival detection width (Detection width)**

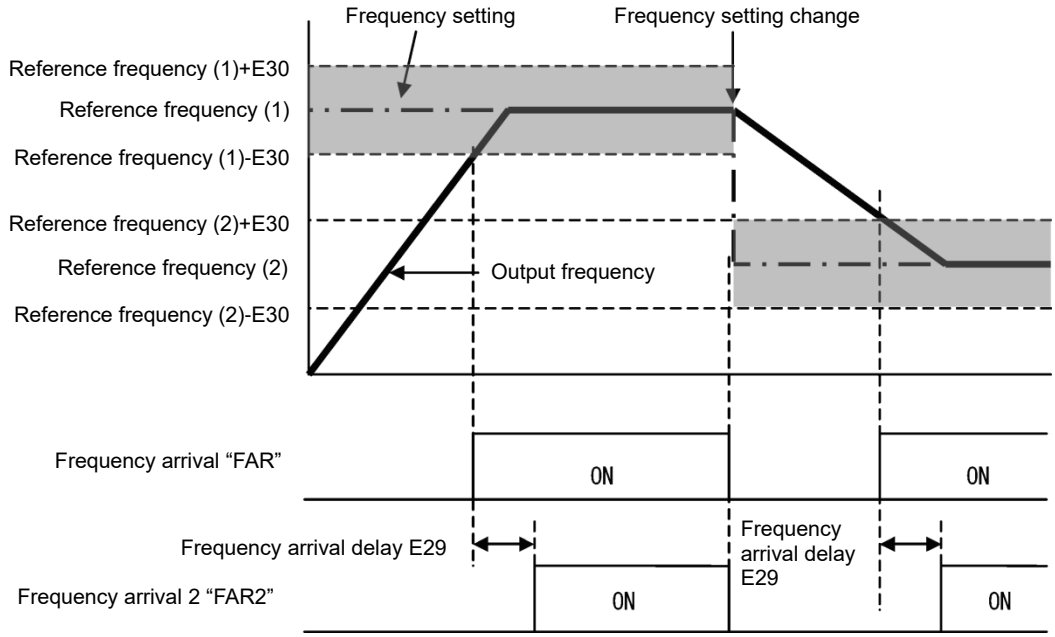
E30 specifies the detection level for the Frequency (speed) arrival signal "FAR", Frequency (speed) arrival signal 2 "FAR2" and the Frequency (speed) arrival signal 3 "FAR3".

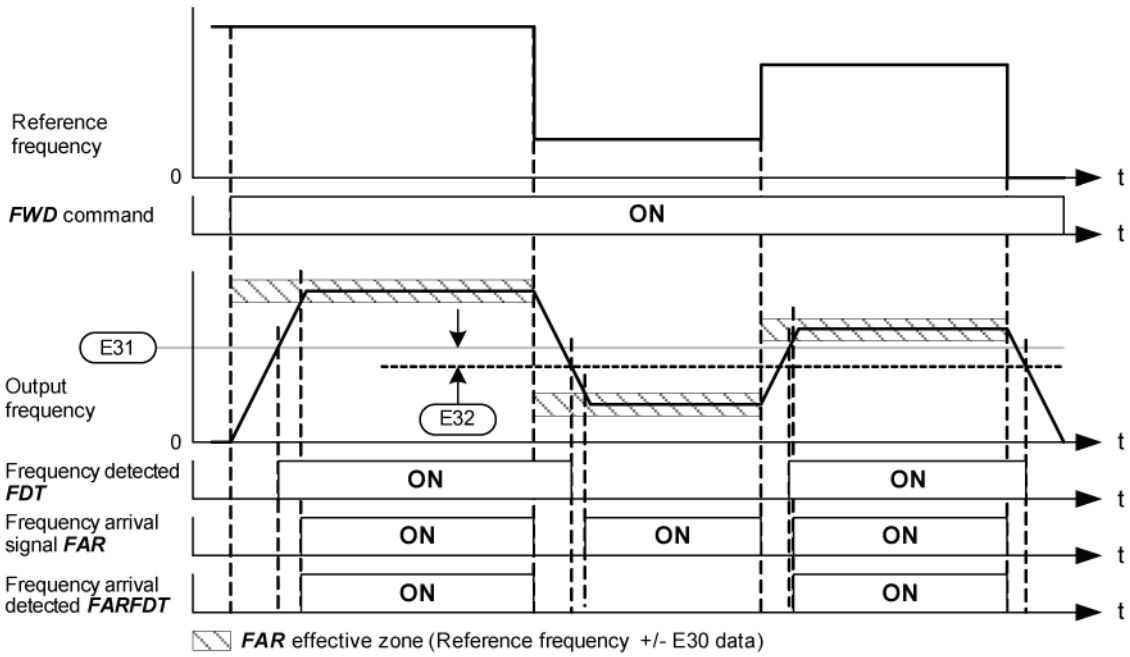
Output signal	E20, E21, E27 assigned data	Operating condition 1	Operating condition 2
"FAR"	1	The signals come ON when the difference between the output frequency (estimated/actual speed) and the reference frequency (reference speed) comes within the frequency arrival width specified by E30.	FAR always goes OFF when the run command is OFF or the reference speed is "0."
"FAR3"	72		When the run command is OFF, the inverter regards the reference speed as "0," so FAR3 comes ON as long as the output frequency (estimated/ actual speed) is within the range of "0 ± the frequency arrival width specified by E30."
"FAR2"	21	The signal comes ON when the difference between the output frequency (before torque and current limiting) and the reference frequency (reference speed) comes within the frequency arrival width specified by E30.	This signal always goes OFF when the run command is OFF or the reference speed is "0." The delay can be specified by E29.

- Data setting range: E30: 0.0 to 10.0 (Hz), E29: 0.01 to 10.00 (s)

The operation timings of each signal are as shown below.





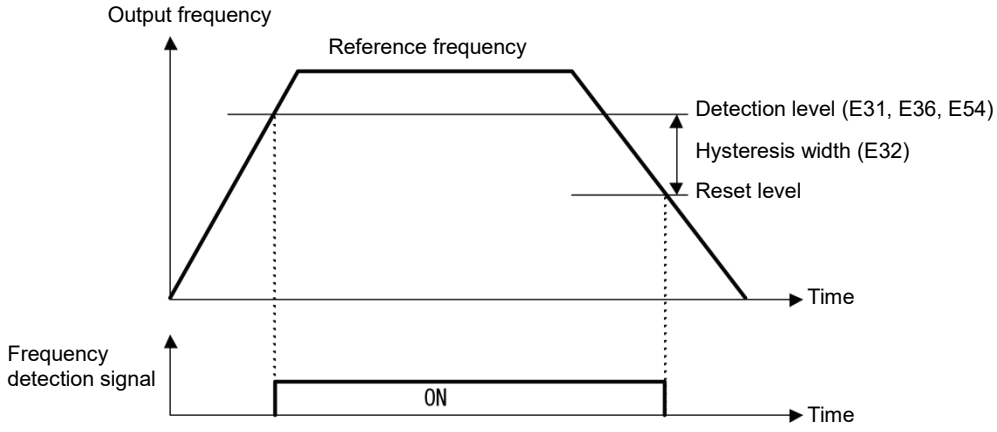


E31, E32	**Frequency detection (level and hysteresis width)** **Related function codes: E36 (Frequency detection 2, level), E54 (Frequency detection 3, level)**

When the output frequency exceeds the frequency detection level specified by E31, the “Frequency (speed) detection signal” comes ON; when it drops below the “Frequency detection level minus Hysteresis width specified by E32,” it goes OFF.

The following three settings are available.

Name	Output signal	E20,E21, E27 Assigned data	Operation level	Hysteresis width
			Range: 0.0 to 500.0Hz	Range: 0.0 to 500.0Hz
Frequency detection	“FDT”	2	E31	E32
Frequency detection 2 (level)	“FDT2”	31	E36	
Frequency detection 3 (level)	“FDT3”	58	E54	



E34, E35	**Overload early warning/Current detection (level and timer)** **Related function codes:** **E37, E38 (Current detection 2/Low current detection level and timer)** **E55, E56 (Current detection 3, level and timer)**

These function codes define the detection level and time for the Motor overload early warning “OL”, Current detected “ID”, Current detected 2 “ID2”, Current detected 3 “ID3”, and Low current detected “IDL” output signals.

Output signal	E20,E21, E27 Assigned data	Detection level	Timer	Motor characteristics	Thermal time constant
		Range: See below	Range: 0.01 to 600.00 s	Range: See below	Range: 0.5 to 75.0 min
“OL”	7	E34	—	F10	F12
“ID2”	37	E34	E35	—	—
“ID2”	38	E37	E38		
“ID3”	39	E55	E56		
“IDL”	41	E37	E38		

- Data setting range

  Detection level: 0.00 (Disable), 1 to 200% of inverter rated current

  Motor characteristics 1: Enable (For a general-purpose motor with shaft-driven cooling fan)

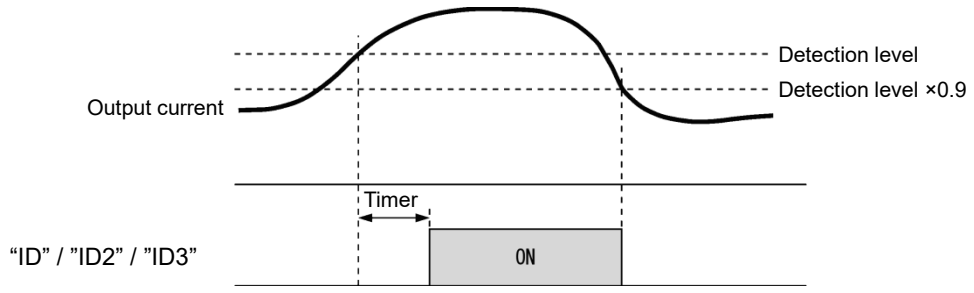
  2: Enable (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan)

■ Motor overload early warning signal – “OL”

The OL signal is used to detect a symptom of an overload condition (alarm code *0l1*) of the motor so that the user can take an appropriate action before the alarm actually happens. The OL signal turns ON when the inverter output current exceeds the level specified by E34. In typical cases, set E34 data to 80 to 90% against F11 data (Electronic thermal overload protection for motor 1, Overload detection level). Set the temperature characteristics of the motor with electronic thermal (motor characteristics selection, thermal time constant).

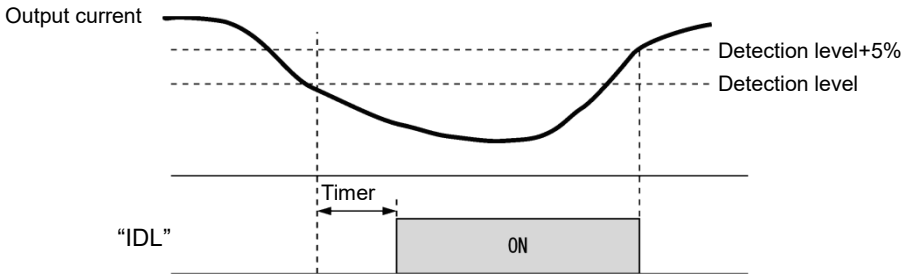
■ Current detected, Current detected 2 and Current detected 3 – “ID”, “ID2” and “ID3”

When the inverter output current exceeds the level specified by E34, E37 or E55 for the period specified by E35, E38 or E56, the ID, ID2 or ID3 signal turns ON, respectively. When the output current drops below 90% of the specified detection level, the ID, ID2 or ID3 turns OFF. (The minimum ON-duration is 100 ms.)



■ **Low current detected – "IDL"**

This signal turns ON when the output current drops below the level specified by E37 (Low current detection, Level) for the period specified by E38 (Timer). When the output current exceeds the "Low current detection level plus 5% of the inverter rated current," it goes OFF. (The minimum ON-duration is 100 ms.)



E36	Frequency detection 2 (refer to E31)

Refer to the description of E31.

E37, E38	Current detection 2/Low current detection (level and timer) (refer to E34)

For details about Current detection 2/Low current detection (level) (timer), refer to the description of E34.

E39	Display coefficient for transport time Related function code: E50 (Display coefficient for speed monitor)

E39 specifies the constant-rate feeding time, load shaft speed, coefficient for line speed setting, and coefficient for output status monitor indication.

Formula

$$\text{Constant rate (min)} = \frac{\text{Display coefficient for speed monitor(E50)}}{\text{Display coefficient for transport time (E39)}}$$

Load shaft speed = (E50: Display coefficient for transport time) x Frequency (Hz)

Line speed = (E50: Display coefficient for transport time) x Frequency (Hz)

The "Frequency" in the above formula is set frequency when each indication is the setting value (constant-rate feeding time setting, load shaft speed setting, and line speed setting), whereas it is output frequency before slip compensation when the indication is output status monitor.

When the constant-rate feeding time is 999.9 (min) or greater, or the denominator on the above formula is 0, "999.9" is displayed.

E42	LED display filter

Excluding speed monitor (when E43 = 0), E42 specifies a filter time constant to be applied for displaying the output frequency, output current and other running status monitored on the LED monitor on the keypad. If the display varies unstably so as to be hard to read due to load fluctuation or other causes, increase this filter time constant.

- Data setting range: 0.0 to 5.0 (s)

E43	LED monitor (Item selection) Related function code: E48 LED monitor (speed monitor item)

E43 specifies the running status item to be monitored and displayed on the LED monitor.
Specifying the speed monitor with E43 provides a choice of speed-monitoring formats selectable with E48 (LED monitor).

Monitor item	Display sample on the LED monitor	LED indication	Unit	Meaning of displayed value	E43 data
Speed monitor	Function code E48 specifies what to be displayed on the LED monitor and LED indicators.				0
Output frequency 1 (before slip compensation)	5*00	■Hz□A□kW	Hz	Indicated value = Output frequency (Hz)	(E48 = 0)
Output frequency 2 (after slip compensation)	5*00	■Hz□A□kW	Hz	Indicated value = Output frequency (Hz)	(E48 = 1)
Reference frequency	5*00	■Hz□A□kW	Hz	Indicated value = Reference frequency (Hz)	(E48 = 2)
Motor rotation speed	1500	■Hz■A□kW	min^{-1}	$\text{Indicated value} = \text{Output frequency(Hz)} \times \frac{120}{\text{P01}}$	(E48 = 3)
Load rotation speed	30*0	■Hz■A□kW	min^{-1}	Indicated value = Output frequency (Hz) × E50	(E48 = 4)
Line speed	30*0	□Hz■A■kW	m/min	Indicated value = Output frequency (Hz) × E50	(E48 = 5)
Transport time for specified length	5*00	□Hz□A□kW	min	Indicated value = E50/(Output frequency × E39)	(E48 = 6)
Speed (%)	5*0	□Hz□A□kW	%	$\text{Indicated value} = \frac{\text{Output frequency (Hz)}}{\text{Maximum frequency}} \times 100$	(E48 = 7)
Output current	1"34	□Hz■A□kW	A	Current output from the inverter in RMS	3
Output voltage	200u	□Hz□A□kW	V	Output voltage (RMS) of the inverter	4
Calculated torque	50	□Hz□A□kW	%	Motor output torque in % (Calculated value)	8
Input power	1*25	□Hz□A■kW	kW	Input power to the inverter	9
PID process command	1*0*	□Hz□A□kW	-	PID command and its feedback converted into physical quantities of the object to be controlled (e.g. temperature)	10
PID feedback value	)0*	□Hz□A□kW	-		12
Timer value	100	□Hz□A□kW	s	Timer value (remaining run time)	13
PID output	10**	□Hz□A□kW	%	PID output in % as the maximum frequency (F03) being at 100%	14
Load factor	50;	□Hz□A□kW	%	Load factor of the motor in % as the rated output being at 100%	15
Motor output	)85	□Hz□A■kW	kW	Motor output in kW	16
Analog signal input monitor	8"00	□Hz□A□kW	-	An analog input to the inverter in a format suitable for a desired scale.	17
Current position pulse	1234	□Hz□A□kW	pulse	The current position pulse	21
Position error pulse	2345	□Hz□A□kW	pulse	The current position deviation pulse.	22
Torque current	48	□Hz□A□kW	%	Torque current command value or calculated torque current	23
Magnetic flux command	50	□Hz□A□kW	%	Magnetic flux command value (Available only under vector control)	24
Input watt-hour	10*0	□Hz□A□kW	kWh	$\text{Indicated value} = \frac{\text{Input watt-hour(kWh)}}{100}$	25

■ Illuminated, □ Not illuminated

E44	LED monitor (display when stopped)

E44 specifies whether the specified value (data = 0) or the output value (data = 1) will be displayed on the LED monitor of the keypad when the inverter is stopped. The monitored item depends on the E48 (LED monitor, Speed monitor item) setting as shown below.

E48 data	Monitored item	Inverter stopped	
		E44 = 0 Specified value	E44 = 1 Output value
0	Output frequency 1 (before slip compensation)	Reference frequency	Output frequency 1 (before slip compensation)
1	Output frequency 2 (after slip compensation)	Reference frequency	Output frequency 2 (after slip compensation)
2	Reference frequency	Reference frequency	Reference frequency
3	Motor rotation speed	Reference motor rotation speed	Motor rotation speed
4	Load rotation speed	Reference load rotation speed	Load rotation speed
5	Line speed	Reference line speed	Line speed
6	Transport time for specified length	Transport time for specified length setting	Transport time for specified length
7	Speed (%)	Reference display speed	Display Speed

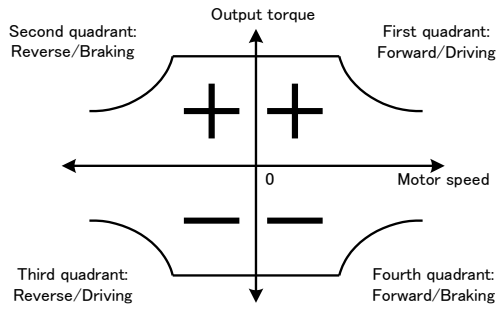
E48	LED monitor (speed monitor item) (refer to E43)

For details about LED Monitor (Speed monitor item), refer to the description of E43.

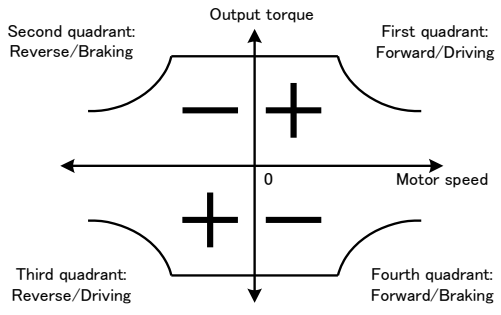
E49	Torque Command Monitor (Polarity selection)

The polarity of calculated torque value in v/f control or the torque command value in vector control is normally + for driving and – for braking. However in the case of hoisting load, when the motor rotation direction changes from forward direction to reverse direction, the torque polarity also changes from driving to braking. If it monitors the torque data by IMO-Loader, we cannot take the expected data around zero speed because the polarity changes. If E49 is set to 0, the torque monitor data becomes + for forward/driving and reverse/braking, - for forward/braking and reverse/driving. Therefore we can monitor the continuous torque data around zero speed.

E49 data	Torque monitor polarity
0	Torque polarity (+ for forward/driving and reverse braking, - for forward/braking and reverse/driving)
1 (Factory setting)	Plus for driving, Minus for braking



E49=0；Torque polarity



E49=1：+ for driving, - for braking

Related data is the following. These data are displayed and submitted with polarity. Judge the meaning of the polarity by E49 setting.

Torque data	Data	Related data
Keypad LED monitor	E43=8	Calculated torque
	E43=23	Torque current
Keypad drive monitor	*3_04*	Calculated torque
Keypad alarm information	*6_03*	Calculated torque when alarm
OPC-AIO	o90 = 4	Output torque (only o93=0:Bipolar)
Torque monitor function code	M02	Torque direction
	M03	Torque current direction
	M07	Output torque
	M08	Torque current
	M28	Torque direction when alarm
	M29	Torque current direction when alarm
	M33	Output torque when alarm
	M34	Torque current when alarm
	W07	Calculated torque
	W24	Torque current
	X23	Calculated torque when alarm
	X63	Calculated torque when alarm
	Z03	Calculated torque when alarm
	Z53	Calculated torque when alarm
	Z81	Output torque

E50 Display coefficient for speed monitor

E50 specifies the coefficient that is used when the load shaft speed or line speed is displayed on the LED monitor. (Refer to the description of E43.)

Load shaft speed [min^{-1}] = (E50: Display coefficient for speed monitor) × (Output frequency Hz)

Line speed [m/min] = (E50: Display coefficient for speed monitor) × (Output frequency Hz)

- Data setting range: 0.01 to 200.00

E51 Display coefficient for “Input watt-hour data”

E51 specifies a display coefficient (multiplication factor) for displaying the input watt-hour data (*5_10*) in a part of maintenance information on the keypad.

Input watt-hour data = Display coefficient (E51 data) × Input watt-hour (100kWh)

- Data setting range: 0.000 (cancel/reset) 0.001 to 9999

Note Setting E51 data to 0.000 clears the input watt-hour and its data to “0.” After clearing, be sure to restore E51 data to the previous value; otherwise, input watt-hour data will not be accumulated.

E52	Keypad (Menu display mode)

E52 provides a choice of three menu display modes for the standard keypad as listed below.

E52 data	Menu display mode	Menus to be displayed
0	Function code data editing mode	Menus #0, #1 and #7
1	Function code data check mode	Menus #2 and #7
2	Full-menu mode	Menus #0 through #7

E52 specifies the menus to be displayed on the standard keypad. There are eight menus as shown in the table below.

Menu #	LED monitor shows:	Function	Display content
0	*.fnc	Quick setup	Quick setup function code
1	!.f__	Data setting F to o	F to o group function code
2	".rep	Data check	Modified function code
3	#.ope	Operation monitor	Operation status indication
4	$.i_o	I/O check	DIO, AIO status indication
5	%.che	Maintenance	Maintenance information indication
6	&.al	Alarm information	Alarm information indication
7	'cpy	Data copy	Data copy function (only optional keypad)
8	(des	Destinations	Destinations setting

📖 For details of each menu item, refer to Chapter 3 “OPERATION USING THE KEYPAD.”

E54	Frequency detection 3 (level) (refer to E31)

For details, refer to the description of E31.

E55, E56	Current detection 3 (level and timer) (refer to E34)

For details, refer to the description of E34.

E59	Terminal [C1] function selection (C1 function//V2 function)

Specifies whether terminal [C1] is used with current input +4 to +20 mA/0 to 20 mA or voltage input 0 to +10 V. In addition, switch SW7 on the interface board must be switched.

E59 data	Input form	Switch SW7
0	Current input: 4 to 20 mA/0 to 20 mA (C1 function)	C1
1	Voltage input: 0 to 10 V (V2 function)	V2

Note When using terminal [C1] as a PTC thermistor input, specify E59 = 0.

For using terminal [C1] for the C1, V2 or PTC function, switching as shown below is necessary.

Terminal [C1]	SW3	SW4	E59	H26	C40
For use of C1 function (4 to 20 mA)	C1	AI	0	0	0,10
For use of C1 function (0 to 20 mA)	C1	AI	0	0	1, 11
For use of V2 function (0 to +10 V)	V2	AI	1	0	Does not matter
For use of PTC function	C1	PTC	Does not matter	1,2	Does not matter

For details about SW3 and SW4, refer to Chapter 2, Section 2.2.8.

⚠WARNING

Failure to correctly switch as shown above may cause a wrong analog input value, possibly leading to unexpected operation of the inverter.

Injuries may occur.

Failure may occur.

E61 to E63 Terminals [12], [C1] (C1 function), [C1] (V2 function) (extended function)

Select the functions of terminals [12], [C1] (C1 function) and [C1] (V2 function).

There is no need to set up these terminals if they are to be used for frequency command sources.

E61, E62, E63 data	Function	Description
0	None	—
1	Auxiliary frequency command 1	Auxiliary frequency input to be added to the reference frequency given by frequency setting 1 (F01). Will not be added to any other reference frequency given by frequency setting 2 and multistep frequency commands, etc. 100%/full scale
2	Auxiliary frequency command 2	Auxiliary frequency input to be added to all frequency commands. Will be added to frequency command 1, frequency command 2, multistep frequency commands, etc. 100%/full scale
3	PID process command	Inputs command sources such as temperature and pressure under PID control. You also need to set function code J02. 100%/full scale
5	PID feedback value	Inputs feedback values such as temperature and pressure under PID control. 100%/full scale
6	Ratio setting	Multiplies the final frequency command value by this value, for use in the constant line speed control by calculating the winder diameter or in ratio operation with multiple inverters. 100%/full scale
7	Analog torque limiter A	Used when analog inputs are used as torque limiters. (🕮 Function code F40) 200%/full scale
8	Analog torque limiter B	Used when analog inputs are used as torque limiters. (🕮 Function code F40) 200%/full scale
9	Torque bias	Used when analog inputs are used as torque bias. (🕮 Function code H154) 200%/full scale
10	Torque command	Analog inputs to be used as torque commands under torque control. (🕮 Function code H18 (Torque control).)
11	Torque current command	Analog inputs to be used as torque current commands under torque control. (🕮 Function code H18 (Torque control).)
17	Speed limit for forward rotation	Analog inputs to be used as speed limit FWD under torque control. (🕮 Function code H18 (Torque control).)
18	Speed limit for reverse rotation	Analog inputs to be used as speed limit REV under torque control. (🕮 Function code H18 (Torque control).)
20	Analog signal input monitor	By inputting analog signals from various sensors such as the temperature sensors in air conditioners to the inverter, you can monitor the state of external devices via the communications link. By using an appropriate display coefficient, you can also have various values to be converted into physical quantities such as temperature and pressure before they are displayed. 100%/full scale

Note If these terminals have been set up to have the same data, E61 is given priority. For E62 and E63, only the terminal selected with E59 is enabled.

E64 Saving of digital reference frequency

E64 specifies how to save the reference frequency specified in digital format by the ⌃/⌄ keys on the keypad as shown below.

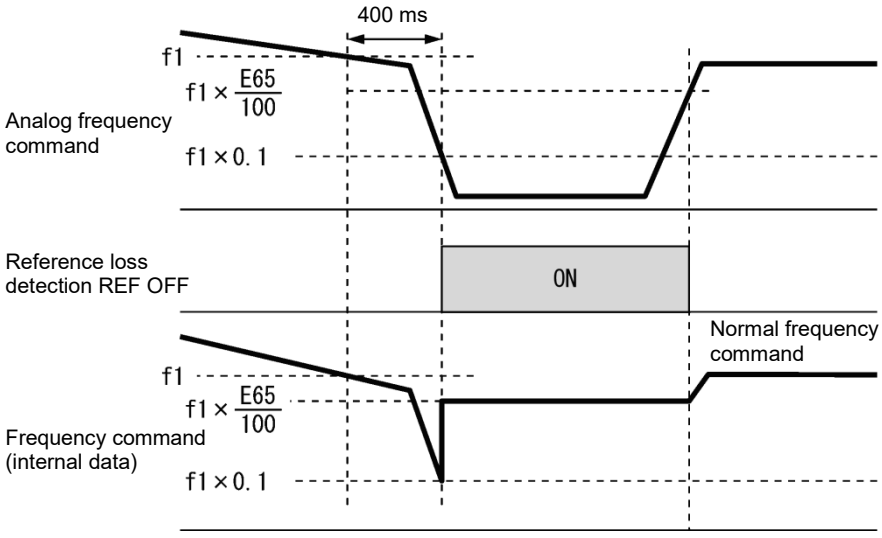
E64 data	Function
0	The reference frequency will be automatically saved when the main power is turned OFF. At the next power-on, the reference frequency at the time of the previous power-off applies.
1	Saving by pressing FUNC/DATA key. Pressing the FUNC/DATA key saves the reference frequency. If the control power is turned OFF without pressing the [image] key, the data will be lost. At the next power-ON, the inverter uses the reference frequency saved the FUNC/DATA key was pressed.

E65	Reference loss detection (continuous running frequency)

When the analog frequency command (setting through terminal [12], [C1] (C1 function) or [C1] (V2 function) has dropped below 10% of the reference frequency within 400 ms, the inverter presumes that the analog frequency command wire has been broken and continues its operation at the frequency determined by the ratio specified by E65 to the reference frequency. And “REF OFF” signal comes on.

(🕮 Function codes E20, E21 and E27, data = 33)

When the frequency command level (in voltage or current) returns to a level higher than that specified by E65, the inverter presumes that the broken wire has been fixed and continues to run following the frequency command.



In the diagram above, f1 is the level of the analog frequency command sampled at any given time. The sampling is repeated at regular intervals to continually monitor the wiring connection of the analog frequency command.

- Data setting range:0 (Decelerate to stop) 20 to 120 % 999 (Disable)

Note Avoid an abrupt voltage or current change for the analog frequency command. An abrupt change may be interpreted as a wire break.

Setting E65 data at “999” (Disable) allows the REF OFF signal (“Reference loss detected”) to be issued, but does not allow the reference frequency to change. (The inverter runs at the analog frequency command as specified.)

When E65 = “0” or “999,” the reference frequency level at which the broken wire is recognized as fixed is “f1 × 0.2.”

When E65 = “100” (%) or higher, the reference frequency level at which the wire is recognized as fixed is “f1 × 1.”

The reference loss detection is not affected by the setting of analog input adjustment (filter time constants: C33, C38, and C43).

E76	DC link bus low-voltage detection level

“U-EDC” signal comes ON when the DC intermediate voltage drops below E76 (DC link bus low-voltage detection level), and it goes OFF when the DC intermediate voltage exceeds E76.

(🕮 Function codes E20, E21 and E27, data = 77)

E78, E79 E80, E81	**Torque detection 1 (level and timer)** **Torque detection 2/low torque detection (level and timer)**

E78 specifies the operation level and E79 specifies the timer, for the output signal “TD1”. E80 specifies the operation level and E81 specifies the timer, for the output signal “TD2” or “U-TL”.

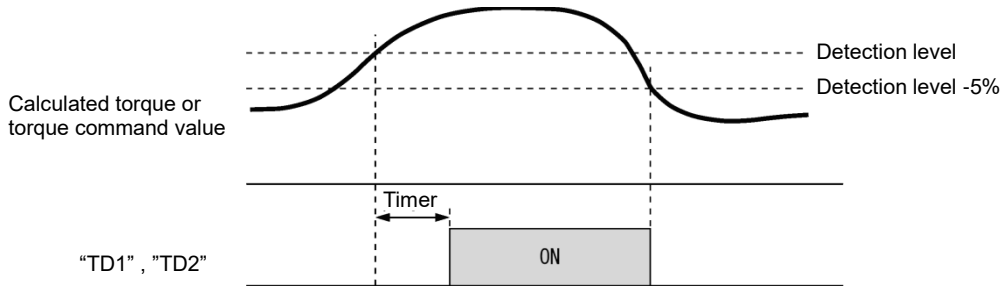
In the inverter’s low frequency operation, as a substantial error in torque calculation occurs, no low torque can be detected within the operation range at less than 20% of the base frequency (F04). (In this case, the result of recognition before entering this operation range is retained.) The U-TL signal goes off when the inverter is stopped.

Since the motor parameters are used in the calculation of torque, it is recommended that auto-tuning be applied by function code P04 to achieve higher accuracy.

Output signal	Assigned data	Detection level	Timer
		Range: 0 to 300%	Range: 0.01 to 600.00 s
“TD1”	46	E78	E79
“TD2”	47	E80	E81
“U-TL”	45	E80	E81

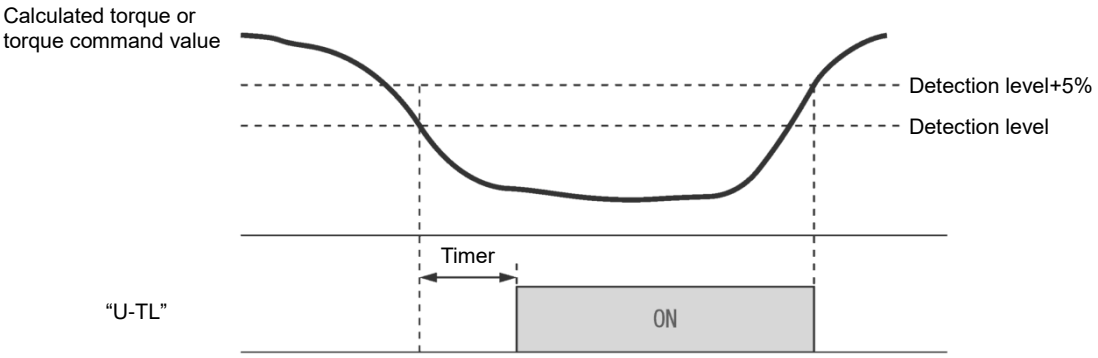
■ **Torque detected 1 – “TD1”, Torque detected 2 – “TD2”**

The output signal TD1 or TD2 comes ON when the torque value calculated by the inverter or torque command exceeds the level specified by E78 or E80 (Torque detection (Level)) for the period specified by E79 or E81 (Torque detection (Timer)), respectively. The signal turns OFF when the calculated torque drops below “the level specified by E78 or E80 minus 5% of the motor rated torque.” (The minimum ON-duration is 100 ms.)



■ **Low torque detected – “U-TL”**

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Low torque detection (Level)) for the period specified by E81 (Low torque detection (Timer)). The signal turns OFF when the calculated torque exceeds “the level specified by E78 or E80 plus 5% of the motor rated torque.” (The minimum ON-duration is 100 ms.)



E98, E99	**Terminal [FWD] function, Terminal [REV] function (refer to E01 to E05)**

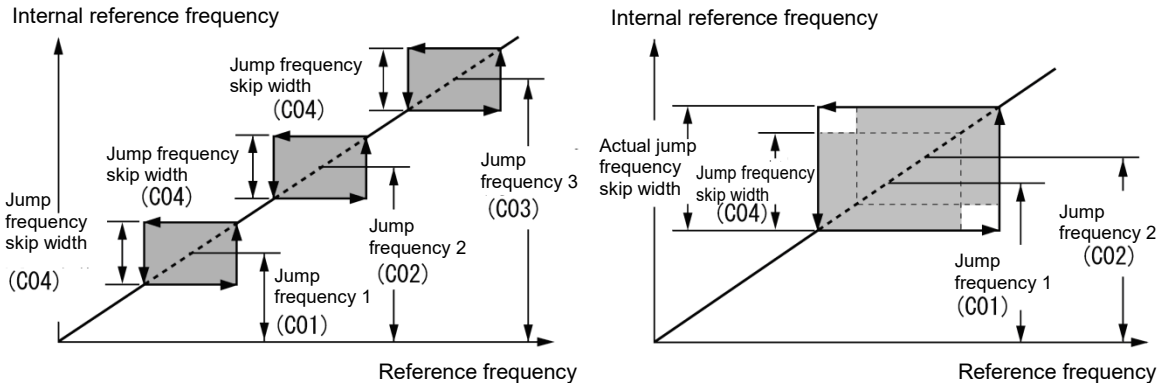
For details, refer to the descriptions of E01 to E05.

5.3.3 C codes (Control functions)

C01 to C04	Jump frequency 1, 2 and 3, Jump frequency (Skip width)

These function codes enable the inverter to jump over three different points on the output frequency in order to skip resonance caused by the motor speed and natural frequency of the driven machinery (load).

- While increasing the reference frequency, the moment the reference frequency reaches the bottom of the jump frequency band, the inverter keeps the output at that bottom frequency. When the reference frequency exceeds the upper limit of the jump frequency band, the internal reference frequency takes on the value of the reference frequency. When decreasing the reference frequency, the situation will be reversed. Refer to the left figure below.
- When more than two jump frequency bands overlap, the inverter actually takes the lowest frequency within the overlapped bands as the bottom frequency and the highest as the upper limit. Refer to the right figure below.



■ Jump frequency 1, 2 and 3 (C01, C02 and C03)

Specify the center of the jump frequency band.

- Data setting range: 0.0 to 500.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

■ Jump frequency skip width (C04)

Specify the jump frequency skip width.

- Data setting range: 0.0 to 30.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

C05 to C19	Multistep frequency 1 to 15

■ **These function codes specify 15 frequencies required for driving the motor at frequencies 1 to 15.**

Turning terminal commands “SS1”, “SS2”, “SS4” and “SS8” ON/OFF selectively switches the reference frequency of the inverter in 15 steps. To use this features, you need to assign “SS1”, “SS2”, “SS4” and “SS8” (“Select multistep frequency”) to the digital input terminals with E01 to E05 (data = 0, 1, 2, and 3).

■ **Multistep frequency 1 to 15 (C05 through C19)**

- Data setting range: 0.00 to 500.0 (Hz)

The combination of “SS1”, “SS2”, “SS4” and “SS8” and the selected frequencies is as follows.

“SS8”	“SS4”	“SS2”	“SS1”	Selected frequency command
OFF	OFF	OFF	OFF	Other than multistep frequency*
OFF	OFF	OFF	ON	C05 (Multistep frequency 1)
OFF	OFF	ON	OFF	C06 (Multistep frequency 2)
OFF	OFF	ON	ON	C07 (Multistep frequency 3)
OFF	ON	OFF	OFF	C08 (Multistep frequency 4)
OFF	ON	OFF	ON	C09 (Multistep frequency 5)
OFF	ON	ON	OFF	C10 (Multistep frequency 6)
OFF	ON	ON	ON	C11 (Multistep frequency 7)
ON	OFF	OFF	OFF	C12 (Multistep frequency 8)
ON	OFF	OFF	ON	C13 (Multistep frequency 9)
ON	OFF	ON	OFF	C14 (Multistep frequency 10)
ON	OFF	ON	ON	C15 (Multistep frequency 11)
ON	ON	OFF	OFF	C16 (Multistep frequency 12)
ON	ON	OFF	ON	C17 (Multistep frequency 13)
ON	ON	ON	OFF	C18 (Multistep frequency 14)
ON	ON	ON	ON	C19 (Multistep frequency 15)

* “Other than multistep frequency” includes frequency setting 1 (F01), frequency setting 2 (C30) and other frequency command sources except multistep frequency commands.

C20	Jogging frequency Related function codes: H54 and H55 Acceleration/Deceleration time (Jogging) H54 and H55 Acceleration/Deceleration time (jogging)

C20 specifies the operating condition (frequency) to apply in jogging operation.

Function code		Data setting range	Description
C20	Jogging frequency	0.00 to 500.00 (Hz)	Reference frequency for jogging operation
H54	Acceleration time (Jogging)	0.00 to 6000 s	Acceleration time for jogging operation
H55	Deceleration time (Jogging)	0.00 to 6000 s	Deceleration time for jogging operation

📖 For details about jogging operation, refer to Chapter 3 “3.3.6 Jogging operation.”

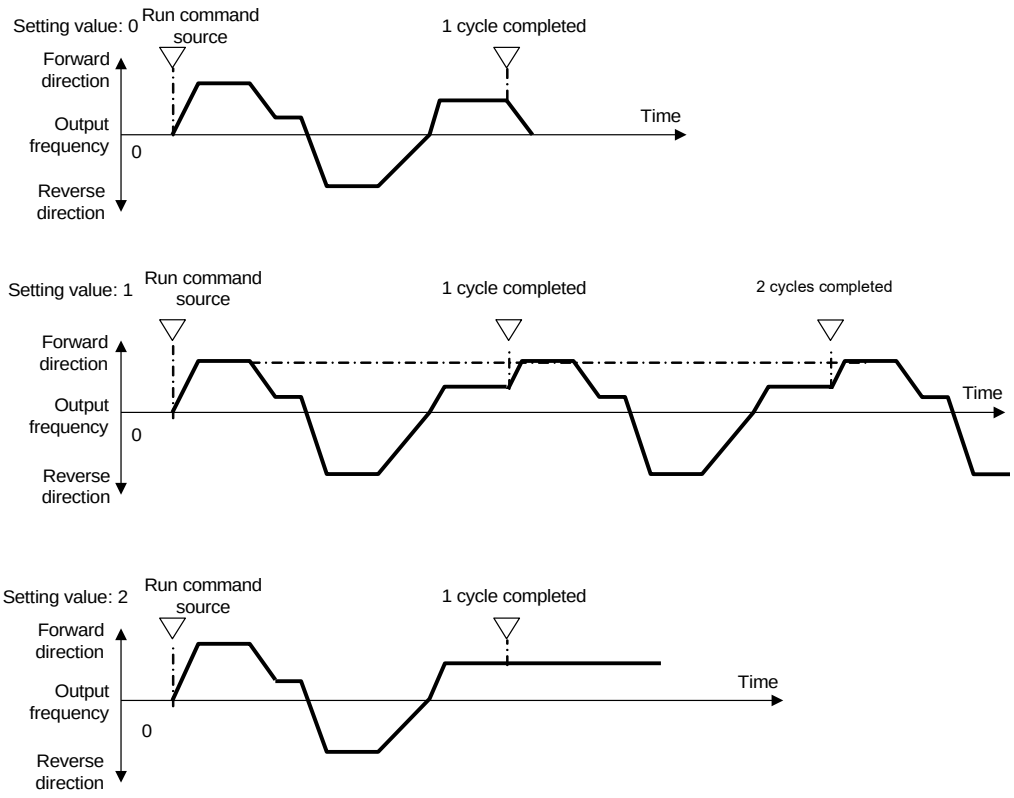
C21 C22 to C28	**Pattern operation mode selection Stage 1 to 7 / Timed operation**

Pattern operation is a function of automatic operation according to the predefined run time, rotational direction, and acceleration/deceleration time and reference frequency.

When using this function, set the frequency setting (F01) to 10 (pattern operation).

The following operation patterns are available:

C21:Setting	Operation pattern
0	Pattern operation performed for one cycle and stopped after the cycle.
1	Pattern operation repeatedly performed and immediately stopped with a stop command
2	Pattern operation performed for one cycle and operation continued at the reference frequency after the cycle.
3	Timed operation



■ **C22 to C28 Stage 1 to Stage 7**

Specify the run time for Stage 1 to Stage 7.

Press the FUNC DATA key three times for each function code to set the following three data.

Setting	Description
1st	Specifies the run time between 0.0 and 6000 s.
2nd	2nd: Specifies the rotational direction F (forward) or r (reverse)
3rd	3rd: Specifies the acceleration/deceleration time between 1 and 4. 1: F07/F08 2: E10/E11 3: E12/E13 4: E14/E15

If the PRG RESET key is pressed to exit the function code before the three data are specified by pressing the FUNC DATA key three times, no data are updated.

For any unused stage, specify 0.0 as the run time. The stage is skipped and the next stage becomes ready for setting.

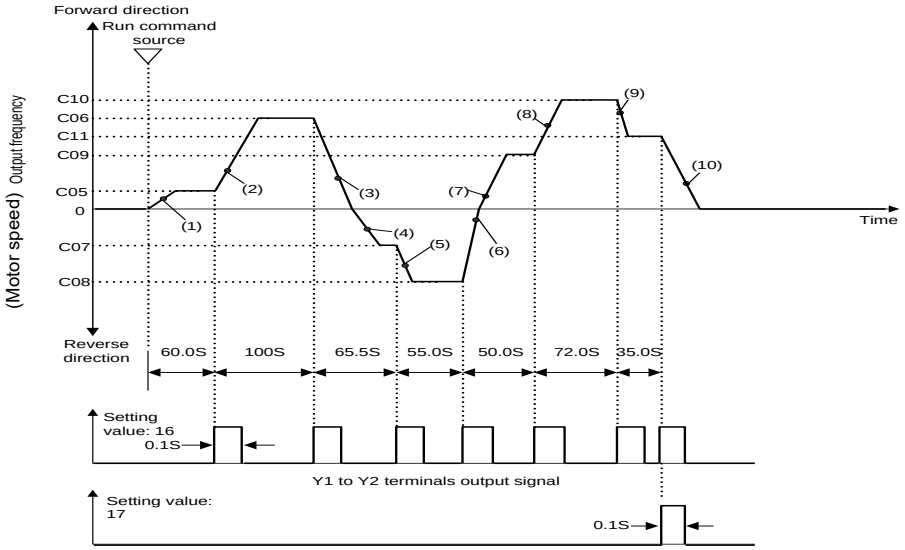
■ **Reference frequency**

Multistep frequencies 1 to 7 are assigned to the reference frequency of Stage 1 to 7.

■ **Example of pattern operation setting**

C21 (Mode selection)	Stage No.	Run time	Rotational direction	Acceleration/deceleration time	Operation (reference) frequency
		Setting value	Setting value	Setting value	
0	Stage 1	60.0	F	2	C05 Multistep frequency 1
	Stage 2	100	F	1	C06 Multistep frequency 2
	Stage 3	65.5	r	4	C07 Multistep frequency 3
	Stage 4	55.0	r	3	C08 Multistep frequency 4
	Stage 5	50.0	F	2	C09 Multistep frequency 5
	Stage 6	72.0	F	4	C10 Multistep frequency 6
	Stage 7	35.0	F	2	C11 Multistep frequency 7

The figure below illustrates the operation.



Set according to (1) to (10) Acceleration time or deceleration time

(1)	Acceleration time: E10
(2)	Acceleration time: F07
(3)	Deceleration time: E15
(4)	Acceleration time: E14
(5)	Acceleration time: E12
(6)	Deceleration time: E11
(7)	Acceleration time: E10
(8)	Acceleration time: E14
(9)	Deceleration time: E11
(10)	Deceleration time: F08

F08 Deceleration time 1 setting is used as deceleration time for deceleration to stop after the completion of one cycle.

◆ To run or stop, use input from the RUN key of the keypad or by switching the control terminal. When using the keypad, press the RUN key to run. Press the STOP key to suspend the progression of stages. Press the RUN key again to resume operation according to the stages from the point where it was suspended. For alarm stop, press the PRG/RESET key to reset the inverter protective functions. Then press the RUN key. The suspended progression of the cycle resumes. If a need arises for operation from the first stage “C22 (Stage 1 runtime)” and “C82 (Stage 1 rotational direction and acceleration/deceleration time)” during operation, input a stop command and press the PRG/RESET key.

When operation from the first stage is necessary after an alarm stop, press the PRG/RESET key for resetting the protective functions and press the PRG/RESET key again. For operation with input terminals, use of the “RST” terminal (set “8 (Active ON)” or “1008 (Active OFF)” for any of E01 to E05) function the same way.

Tip

- Pattern operation can be started by either a forward run command (specify F02 = 2 and press the RUN key, or specify F02 = 1 and turn the FWD terminal ON) or reverse run command (specify F02 = 3 and press the RUN key, or specify F02 = 1 and turn the REV terminal ON). However, the rotational direction is as specified by C82 to C88 regardless the operation is started by a forward run command or reverse run command.
- If using FWD or REV terminal, please use the alternate-type switch because it is not self-holding.

⚠CAUTION

When pattern operation is started by specifying C21 = 0 and turning the FWD (REV) terminal ON, the motor stops after the completion of the last stage even if the FWD (REV) terminal is kept turned ON.
In this case, modifying the value for F01 or C30 or switching the control terminal “Hz2/Hz1” ON/OFF without turning the FWD (REV) terminal OFF causes the operation to be immediately resumed according to the reference frequency after the change.

An accident or physical injury may result.

■ Timed operation (C21 = 3)

Select this for timed operation, in which simply specifying the run time and inputting a run command starts motor operation and stops the operation after the specified period has elapsed.

Tip
- To stop the timed operation, press the STOP key during timer countdown.
- When the timer period is 0, pressing the RUN key does not start operation if C21 = 3.
- An external signal (FWD or REV) can also be used to start operation.

Example of timed operation

Preconfiguration

- To indicate the timer value on the LED monitor, set the data for E43 (LED monitor) to “13” (timer vaule) and data for C21 to “3.”
- Specify the reference frequency for timed operation. When the reference frequency is specified by keypad operation and the timer value is indicated, press the FUNC/DATA key to switch to speed monitor display and modify the reference frequency.

Timed operation (to start operation with the RUN key)

(1) While checking the timer value on the LED monitor, press the ▲/▼ key to specify the timer period (in seconds). (The timer value is indicated as an integer without a decimal point on the LED monitor.)

(2) Press the RUN key to start motor operation. The timer period counts counted down. After the timer period has elapsed, the operation stops without the need for pressing the STOP key. (Timed operation is possible even when the LED monitor indication is not the timer value.)

Note For operation by turning the FWD terminal ON, the indication alternates between “end” and LED monitor display (0 for timer value) when the timed operation has been completed with deceleration to stop. Turning FWD OFF brings back the LED monitor display.

C30	Frequency setting 2	(refer to F01)

For details of frequency setting 2, refer to the description of F01.

C31 to C35	**Analog input adjustment (terminal [12])** **(offset, gain, filter time constant, gain base point, polarity)**
C36 to C40	**Analog input adjustment (terminal [C1] C1 function)** **(offset, gain, filter time constant, gain base point, range/polarity)**
C41 to C45	**Analog input adjustment (terminal [C1] V2 function)** **(offset, gain, filter time constant, gain base point, polarity)** **(refer to F01 for frequency setting)**

C55, C56	**Bias (for PID, frequency command 2 (terminal [12])) (bias, bias base point) (refer to F01)**
C61, C62	**Bias (for PID, frequency command 2 (terminal [C1]) (C1 function))** **(bias, bias base point)(refer to F01)**
C67, C68	**Bias (for PID, frequency command 2 (terminal [C1]) (V2 function))** **(bias, bias base point)(refer to F01)**

You can adjust the gain, bias, polarity, filter time constant and offset which are applied to analog inputs (voltage inputs to terminals [12] and [C1] (V2 function) and current input to terminal [C1] (C1 function)).

Adjustable items for analog inputs (excluding those for frequency command 1)

Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset
		Bias	Base point	Gain	Base point			
[12]	0 to +10 V, -10 to +10 V	C55	C56	C32	C34	C35	C33	C31
[C1] (C1)	4 to 20 mA, 0 to 20 mA	C61	C62	C37	C39	C40	C38	C36
[C1] (V2)	0 to +10 V	C67	C68	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input.

- Data setting range: -5.0 to +5.0 (%)

■ Filter time constant (C33, C38, C43)

C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. The larger the time constant, the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

- Data setting range: 0.00 to 5.00 (s)

■ Polarity Terminal [12] (C35)

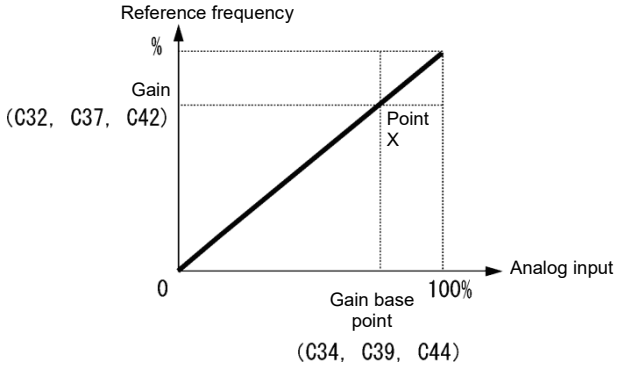
C35 and C45 configure the input range for analog input voltage.

C35 data	Modes for terminal inputs
0	-10 to +10 V
1	0 to +10 V (negative value of voltage is regarded as 0 V)

■ Polarity [C1] (V2 function) (C45)

C45 data	Modes for terminal inputs
0	0 to +10 V When the bias is specified to be a negative value, makes a point lower than 0 effective as a negative value.
1	0 to +10 V (factory default) When the bias is specified to be a negative value, limits a point lower than 0 to 0.

■ **Gain**



Note To input bipolar analog voltage (0 to ±10 VDC) to terminal [12], set C35 data to “0.” Setting C35 data to “1” enables only the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.

■ **Terminal [C1] (C1 function) range / polarity selection(C40)**

Selects the range of current input terminal [C1](C1 function).

C40 data	Terminal input range	When specified bias is negative
0	4 to 20 mA (factory default)	Limits a point lower than 0 to 0.
1	0 to 20 mA	
10	4 to 20 mA	Makes a point lower than 0 effective as a negative value.
11	0 to 20mA	

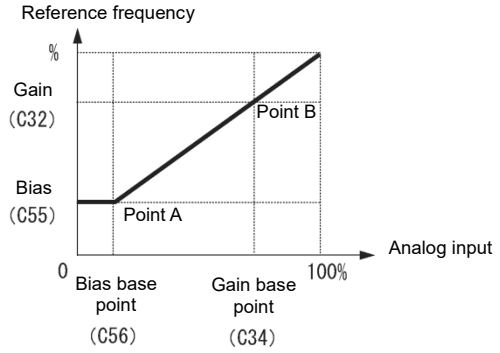
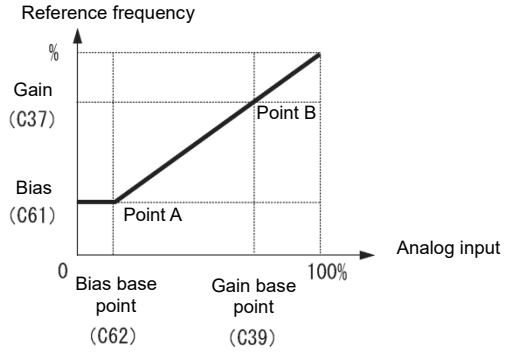
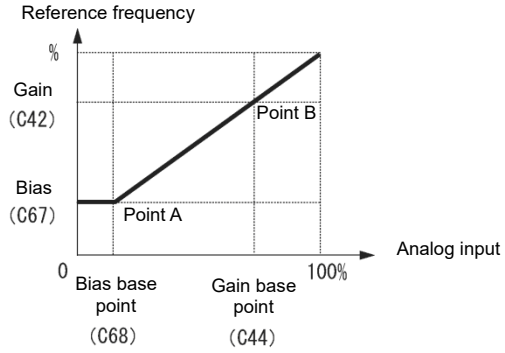
For using terminal [C1] for the C1, V2 or PTC function, it is necessary to make the settings as shown below.

Terminal [C1]	SW3	SW4	E59	H26	C40
For use of C1 function (4 to 20 mA)	C1	AI	0	0	0, 10
For use of C1 function (0 to 20 mA)	C1	AI	0	0	1, 11
For use of V2 function (0 to +10V)	V2	AI	1	0	Does not matter
For use of PTC function	C1	PTC	Does not matter	1, 2	Does not matter

For details about SW3 and SW4, refer to Chapter 2, Section 2.2.8.

Expected operation may not be obtained if the settings above are not switched correctly. Use sufficient caution.

■ **Gain/bias**

Terminal	PID command, feedback, analog monitor
[12]	
[C1] (C1 function)	
[C1] (V2 function)	

These are biases and bias base points used for PID command, PID feedback, frequency command 2 and analog monitor. For details, refer to the description of F01 and J01.

Bias (C55, C61, C67)

- Data setting range: -100.00 to 100.00 (%)

Bias base point (C56, C62, C68)

- Data setting range: 0.00 to 100.00 (%)

Specifying the bias as a negative value allows an input to be specified as bipolar for a unipolar analog input. By setting C40 data to 10 or 11 for terminal [C1] (C1 function) or C45 data to 1 for terminal [C1] (V2 function), an input value for an analog input equal to or lower than 0 point is specified to have negative polarity.

C50	Bias (Frequency setting 1) (Bias base point) (refer to F01)

Refer to the description of F01.

C53	Selection of normal/inverse operation (frequency setting 1)

Switches between the between normal and inverse operation of frequency setting 1 (F01) .

For details, refer to E01 through E05 (data = 21) for the terminal command IVS (“■ Switch normal/inverse operation – “IVS””).

C58	**Analog input adjustment (for analog monitor (terminal [12])) (Display unit)**
C64	**Analog input adjustment (for analog monitor (terminal [C1])) (C1 function) (Display unit)**
C70	**Analog input adjustment (for analog monitor (terminal [C1])) (V2 function) (Display unit)**

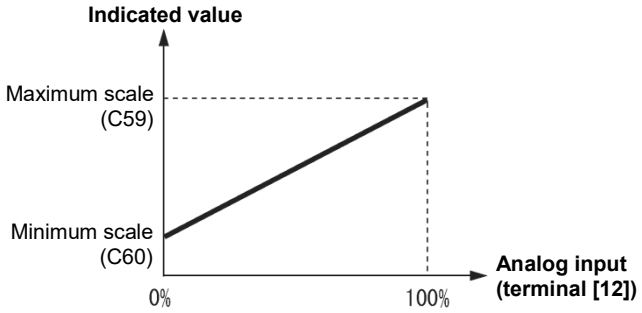
The units for the respective analog inputs can be displayed when a multi-function keypad (TP-A1-E2C) is used. Set these codes to use for command and feedback values of the PID control and the analog input monitor. Use the multi-function keypad to display the SV and PV values of the PID control and the analog input monitor on the main and sub-monitors. Indications are given in the specified units.

C58, C64, C70	Unit	C58, C64, C70	Unit	C58, C64, C70	Unit
—	—	23	L/s (flowrate)	45	mmHg (pressure)
1	No unit	24	L/min (flowrate)	46	Psi (pressure)
2	%	25	L/h (flowrate)	47	mWG (pressure)
4	r/min	40	Pa (pressure)	48	inWG (pressure)
7	kW	41	kPa (pressure)	60	K (temperature)
20	m^3/s (flowrate)	42	MPa (pressure)	61	°C (temperature)
21	m^3/min (flowrate)	43	mbar (pressure)	62	°F (temperature)
22	m^3/h (flowrate)	44	bar (pressure)	80	ppm (concentration)

C59, C60	**Analog input adjustment (terminal [12]) (Maximum scale, Minimum scale)**
C65, C66	**Analog input adjustment (terminal [C1] (C1 function)) (Maximum scale, Minimum scale)**
C71, C72	**Analog input adjustment (terminal [C1] (V2 function)) (Maximum scale, Minimum scale)**

Values of the analog input monitor (terminals [12] and [C1] (C1 and V2 functions) can be converted into easily recognizable physical quantities for display. This function can also be used for PID feedback and PID command values.

- Data setting range: (maximum scale and minimum scale) -999.00 to 0.00 to 9990.00



5.3.4 P codes (Motor 1 parameters)

To use the integrated automatic control functions such as auto torque boost, torque calculation monitoring, auto energy saving operation, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, vector control without speed sensor (torque vector), droop control, and overload stop, it is necessary to build a motor model in the inverter by specifying proper motor parameters including the motor capacity and rated current.

The IMO Jaguar VXT, provides built-in motor parameters for standard motors. To use these motors, it is enough to specify motor parameters for P99 (Motor 1 selection). If the cabling between the inverter and the motor is long (generally, 20 m (66 ft) or longer) or a reactor is inserted between the motor and the inverter, however, the apparent motor parameters are different from the actual ones, so auto-tuning or other adjustments are necessary.

For the auto-tuning procedure, refer to the IMO Jaguar VXT Instruction Manual, Chapter 4 “TEST RUN PROCEDURE.”

P01	**Motor 1 (No. of poles)**

P01 specifies the number of poles of the motor. Enter the value given on the nameplate of the motor. This setting is used to display the motor speed on the LED monitor and to control the speed (refer to E43). The following expression is used for the conversion.

Motor rotational speed (min^{-1}) = 120/No.of poles x Frequency (Hz)

- Data setting range: 2 to 22 (poles)

P02	**Motor 1 (Rated capacity)**

P02 specifies the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.

P02 data	Unit	Function
0.01 to 1000	kW	When P99 (Motor 1 selection) = 0, 4, 20 or 21
	HP	When P99 (Motor 1 selection) = 1

When accessing P02 with the keypad, take into account that the P02 data automatically updates data of P03, P06 through P13, P53 and H46.

P03	**Motor 1 (Rated current)**

P03 specifies the rated current of the motor. Enter the rated value given on the nameplate of the motor.

- Data setting range: 0.00 to 2000 (A)

P04	Motor 1 (Auto-tuning)

The inverter automatically detects the motor parameters and saves them in its internal memory.

There are two types of auto-tuning as listed below. Select the appropriate one considering the limitations in your equipment and control mode.

P04 data	Auto-tuning	Action	Motor parameters to be tuned	
0	Disable	—	—	
1	Tune the motor while it is stopped	Tunes while the motor is stopped.	IM	Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12) %X correction factors 1 (P53)
			PM	Armature resistance (P60) d-axis inductance (P61) q-axis inductance (P62) Reserved (P84, P88)
2	Tune the motor while it is rotating.	After tuning the motor in a stopped state, retunes it running at 50% of the base frequency.	IM	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12) %X correction factor 1 (P53) Magnetic saturation factors 1 to 5 (P16 to P20)
			PM	Armature resistance (P60) d-axis inductance (P61) q-axis inductance (P62) Induced voltage (P63) Reserved (P84, P88)
5	Tune the motor while it is stopped	Tunes while the motor is stopped.	IM	Primary resistance (%R1) (P07) Leakage reactance (%X) (P08)

For details of auto-tuning, refer to the IMO Jaguar VXT Instruction Manual, Chapter 4 “TEST RUN PROCEDURE.”

Note In any of the following cases, perform auto-tuning since the motor parameters are different from those of standard motors so that the best performance cannot be obtained under some conditions.

- The motor to be driven is a non-standard motor.
- Cabling between the motor and the inverter is long. (Generally, 20 m (66 ft) or longer)
- A reactor is inserted between the motor and the inverter.

Other applicable cases

■ **Functions whose performance is affected by the motor parameters**

Function	Related function codes (representative)
Auto torque boost	F37
Output torque monitor	F31, F35
Load factor monitor	F31, F35
Auto energy saving operation	F37
Torque limit control	F40
Anti-regenerative control (Automatic deceleration)	H69
Auto search	H09
Slip compensation	F42
V/f control with speed sensor and auto torque boost	F42
Droop control	H28
Torque detection	E78 to E81
Brake Signal (Brake-release torque)	J95
Vector control with speed sensor	F42

P05	Motor 1 (Online tuning)

When vector control without speed sensor (dynamic torque vector) or slip compensation control is used for long-time operation, the motor parameters change along with motor temperature rise.

If motor parameters change, the amount of speed compensation may change to cause the motor speed to be different from the initial speed.

Enabling auto-tuning allows the identification of the motor parameters that match the change in the motor temperature, which minimizes the motor speed variation.

To use this function, specify “2” for auto-tuning (P04).

Note Online tuning is enabled only when F42 = 1 (Vector control without speed sensor) or F42 = 2 (V/f control with slip compensation active) and F37 = 2, 5 (auto torque boost).

P06 to P08	Motor 1 (No-load current, %R1 and %X)

P06 through P08 specify no-load current, %R1 and %X, respectively. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

- No-load current: Input the value obtained from the motor manufacturer.
- %R1: Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + \text{Cable } R1}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

R1: Primary resistance of the motor (Ω)

Cable R1: Resistance of the output cable (Ω)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

- %X: Enter the value calculated by the following expression.

$$\%X = \frac{X1 + X2 \times XM / (X2 + XM) + \text{Cable } X}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

X1: Primary leakage reactance of the motor (Ω)

X2: Secondary leakage reactance of the motor (converted to primary) (Ω)

XM: Exciting reactance of the motor (Ω)

Cable X: Reactance of the output cable (Ω)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

Note For reactance, use the value at the base frequency (F04).

P09 to P11	Motor 1 (slip compensation gain for driving, slip compensation response time and slip compensation gain for braking)

P09 and P11 determine the slip compensation amount in % for driving and braking individually and adjust the slip amount from internal calculation. Mode of 100% fully compensates for the rated slip of the motor. Excessive compensation (100% or more) may cause hunting (undesirable oscillation of the system), so carefully check the operation on the actual machine.

P10 determines the response time for slip compensation. Basically, there is no need to modify the default setting. If you need to modify it, consult your IMO Drives representatives.

Function code		Operation (slip compensation)
P09	Slip compensation gain for driving	Adjust the slip compensation amount for driving. Slip compensation amount for driving = Rated slip × Slip compensation gain for driving
P11	Slip compensation gain for braking	Adjust the slip compensation amount for braking. Slip compensation amount for braking = Rated slip × Slip compensation gain for braking
P10	Slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the setting.

For details about slip compensation control, refer to the description of F42.

P12	Motor 1 (rated slip frequency)

P12 specifies rated slip frequency. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

- Rated slip frequency: Convert the value obtained from the motor manufacturer to Hz using the following expression and enter the converted value.

  (Note: The motor rated value on the nameplate sometimes shows a larger value.)

$$\text{Rated slip frequency (Hz)} = \frac{(\text{Synchronous speed} - \text{Rated speed})}{\text{Synchronous speed}} \times \text{Base frequency}$$

For details about slip compensation control, refer to the description of F42.

P13	Motor 1 (iron loss factor 1)

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value. Basically, there is no need to modify the setting.

P16 to P20	Motor 1 (Magnetic saturation factors 1 to 5)

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value. Performing auto-tuning while the motor is rotating (P04 = 2) sets the value of these factors automatically.

P30	**PMSM drive Motor 1 (Magnetic pole position detection mode)** **Related function codes:** **P74:PMSM Motor 1 (Reference current at starting)** **P87:PMSM Motor 1 (Reference current for polarity discrimination)**

P30 specifies the magnetic pole position detection mode. Select the appropriate mode that matches the PMSM to be used.

Data for P30	Function	Remarks
0: Pull-in by current	No magnet pole position detection is made. At the start of driving the motor, the inverter supplies current specified by P74 to pull in the magnetic pole position. In this position detection mode, the motor may rotate slightly in the direction opposite to the commanded direction depending upon the current motor shaft position.	—
1: For IPMSM (Interior permanent magnet synchronous motor)	The inverter starts the motor with the magnetic pole position detection suitable for IPMSM. The reference current for polarity discrimination specified by P87 applies. Usually it is not necessary to change the factory default.	—
2: For SPMSM (Surface permanent magnet synchronous motor)	The inverter starts the motor with the magnetic pole position detection suitable for SPMSM.	—
3: Pull-in by current for IPMSM (Interior permanent magnet synchronous motor)	The inverter starts the motor with the magnetic pole position detection suitable for IPMSM causing no magnetic saturation. In this position detection mode, the motor may rotate slightly in the direction opposite to the commanded direction depending upon the current motor shaft position.	—

Tip The reference current for polarity discrimination specified by P87 applies. Usually it is not necessary to change the factory default.

Note During the magnetic pole position pull-in operation or the magnetic pole position detection, the motor cannot generate enough torque. When applying to the application which needs torque at start, engage the mechanical brake by using brake signal ***BRKS*** until magnetic pole position pull-in operation is completed. (🕮 Function code E20)

P53	**Motor 1 (%X correction factor 1)**

This is a factor for correcting the variation of leakage reactance %X. Basically, there is no need to modify the setting.

P55 P56	**Motor 1 (Torque current under vector control)** **Motor 1 (Induced voltage factor under vector control)**

P55 specifies the rated torque current; P56 specifies the induced voltage factor under vector control with speed sensor.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value.

Basically, there is no need to modify the setting.

P60 to P64	**PMSM Motor 1 (Armature resistance, d-axis inductance, q-axis inductance, Induced voltage, and Iron loss)**

P60 through P64 specify the armature resistance, d-axis inductance, q-axis inductance, induced voltage and iron loss of the motor, respectively.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value.

Basically, there is no need to modify the setting.

P65, P85	PMSM Motor 1 (d-axis inductance magnetic saturation correction, Flux limitation value)

These are the control parameter for PMSMs. Normally, it is not necessary to change the data of these function codes.

P74	PMSM Motor 1 (Reference current at starting)

Refer to P30.

P83, P84, P86, P88, P89	PMSM Motor 1 (Reserved)

These function codes are displayed, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

P90	PMSM Motor 1 (Overcurrent protection level)

A PMSM has a current limit to prevent demagnetization of permanent magnet. If a current exceeding that limit flows through the motor, it weakens the magnet force of permanent magnet so that the motor does not get the desired characteristics.

To prevent it, P90 specifies the overcurrent protection level. If a current flows exceeding the level, the inverter causes an overcurrent protection alarm *0c1*, *0c2* or *0c3*.

P99	Motor 1 selection

P99 specifies the motor type to be used.

P99 data	Function
0	Motor characteristics 0 (KW Rated IM)
1	Motor characteristics 1 (HP rated IM)
4	Other IMs
20	Other PMSMs
21	Motor characteristics PM

To select the motor drive control or to run the inverter with the integrated automatic control functions such as auto torque boost and torque calculation monitoring, it is necessary to specify the motor parameters correctly.

First select the motor type with P99 from KW Rated, set P02 (capacity) and then initialize the motor parameters with H03. This process automatically configures the related motor parameters (P01, P03, P06 through P13,P53 and H46).
The data of F09 (Torque boost 1), H13 (Restart mode after momentary power failure (Restart time)), and F11 (Electronic thermal overload protection for motor 1 (Overload detection level)) depends on the motor capacity, but the process stated above does not change them. Specify and adjust the data during a test run if needed.

5.3.5 H codes (High performance functions)

H02, H03	Data initialization (Method, Target) Related function codes: H193,H194 User initialization data (Save, Protect)

Initialize all function code data to the factory defaults. The motor parameters are also initialized.
To change the H02/ H03 data, it is necessary to press the STOP + ∧/∨ keys (simultaneous keying).

H03 data	Function
0	Disable initialization (Settings manually made by the user will be retained.)
1	Initialize all function codes (initialization in accordance with function code H02 setting)
2	Initialize motor 1 parameters in accordance with F42(Drive control selection 1), P02 (Rated capacity) and P99 (Motor 1 selection)
3	Initialize motor 2 parameters in accordance with A16 (Rated capacity) and A39 (Motor 2 selection)
11	Limited initialization (initialization other than communications function codes): Communication can be continued after initialization.
12	Limited initialization (initialization of customizable logic function U codes only)

- When all function codes are initialized, select the initialization method in advance with function code H02.

Selection of H02		Initialization method when 1 is set to H03
Data=0	Asian standard initial value	Initialize all function codes with the Asian standard factory defaults.
Data=1	User initial value	Initialize the value with the user setting value saved by H194. If the user initial value is not saved, initialize it with Asian standard initial value (H02=0).

For saving the user initial value, refer to items in function codes H193 and H194.

- To initialize the motor parameters, set the related function codes as follows.

Step	Item	Data	Function code	
			1st motor	2nd motor
(1)	Motor selection	Selects the motor type	P99	A39
(2)	Motor (rated capacity)	Sets the motor capacity (kW)	P02	A16
(3)	Data initialization	Initialize motor parameters	H03 = 2	H03 = 3
Function code data to be initialized Please refer to the F42 when using PMSM drive (F42=15)			P01, P03, P05 to P20, P30, P53 to P56, P60 to P65, P74,P83 to P90, H46	A15, A17, A20 to A27, A30 to A34,A53 to A56

- Upon completion of the initialization, the H03 data reverts to “0” (factory default).
- If P02/A16 data is set to a value other than the standard nominal applied motor rating, data initialization with H03 internally converts the specified value parameters values to the standard nominal applied motor rating. (See “5.2.4 Motor constant.”)
- Motor parameters to be initialized are for motors listed below under V/f control. When the base frequency, rated voltage, and the number of poles are different from those of the listed motors, or when or non-standard motors are used, change the rated current data to that printed on the motor nameplate.

Motor selection		V/f control data
Data = 0 or 4	KW rated standard motors,	4 poles 200 V/50 Hz, 400 V/50 Hz
Data = 1	HP rated motors	4 poles 230 V/60 Hz, 460 V/60 Hz

Note When accessing P02 with the keypad, take into account that the P02 data automatically updates data of P03, P06 through P13, P53 and H46. Also, when accessing function code A16 for the 2nd motor, data of related function codes for each are automatically updated.

H193, H194	**User initial value (save, protection)** **Relevant function code: Initialization of H02 and H03 data (initial value selection and target)**

The value can be saved in the non-volatile memory in the inverter so that customers may use the setting value changed from the IMO Jaguar standard factory default value as the initial value for inverter initialization.

The setting value saved and protected here can be selected as the user initial value for initialization with function code H03. When this function is used, set H02 data=1.

If initialization is performed without saved/protected setting data, it is initialized to the IMO Jaguar standard factory default regardless of the H02 value.

For data initialization, refer to function codes H02 and H03.

To change the data of function codes H02, H193 and H194, it is necessary to operate double keys "STOP key + ∧/∨ key".

To save the user setting value, set 1 (saved as the user initial value) to function code H02 in advance. In addition, function code H194 must be set to 0 (save enable).

H02 data	H194 data	Function when 1 is set to H193
0	Optional	User setting value is not saved.
1	0：Save enable	User setting value is saved.
	1：Protected (save disable)	User setting value is not saved.

User initial value save procedures

(1) Set all function codes and determine the user setting value for initialization.

(2) Set H02=1 and H194=0.

(3) Set H193=1. The user setting value is saved.

(4) Set H194=1. The user setting value is protected.

Note When the setting value of the function code has already saved by H193 and the step of H193 is repeated again, the saved data is overwritten. Be careful for error operation. To prevent overwriting by error, it is recommended to protect the data with H194 data=1 after saving.

H04, H05	Auto-reset (Times and reset interval)

H04 and H05 specify the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart without issuing an alarm output (for any alarm) even if any protective function subject to reset is activated and the inverter enters the forced-to-stop state (tripped state). If the protective function is activated in excess of the times specified by H04, the inverter will issue an alarm output (for any alarm) and not attempt to auto-reset the tripped state.

Listed below are the protective functions subject to auto-reset.

Protective function	LED monitor displays:	Protective function	LED monitor displays:
Overcurrent protection	*0c1*, *0c2*, *0c3*	Motor overheat	*0h4*
Overvoltage protection	*0u1*, *0u2*, *0u3*	Braking resistor overheat	*dbh*
Heat sink overheat	*0h1*	Motor overload	*0l1*, *0l2*
Inverter internal overheat	*0h3*	Inverter overload	*0lu*

■ Number of reset times (H04)

H04 specifies the number of reset times for the inverter to automatically attempt to escape the tripped state. When H04 = 0, the auto-reset function will not be activated.

- Data setting range: 0 (Disable), 1 to 20 (times)

⚠CAUTION

If the “auto-reset” function has been specified, the inverter may automatically restart and run the motor stopped due to a trip fault, depending on the cause of the tripping. Design the machinery so that human body and peripheral equipment safety is ensured even when the auto-resetting succeeds.

Otherwise an accident could occur.

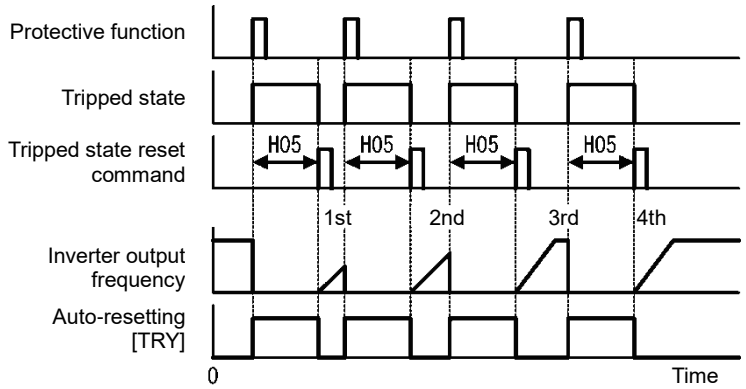
■ Reset interval (H05)

- Data setting range: 0.5 to 20.0 (s)

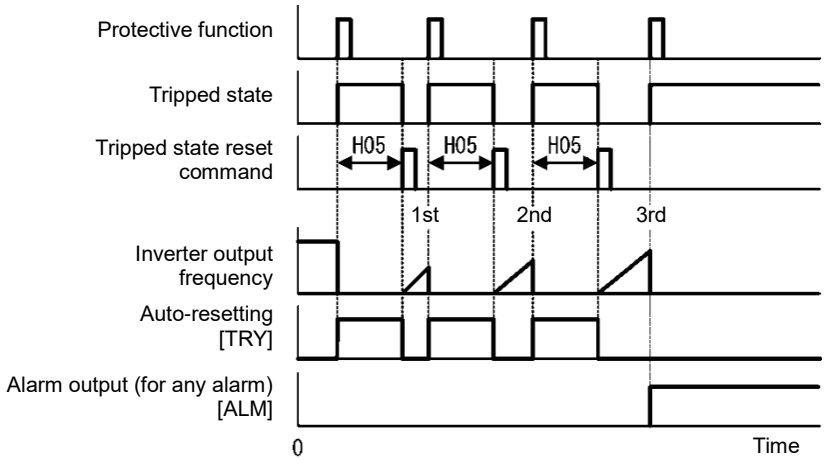
H05 specifies the reset interval time between the time when the inverter enters the tripped state and the time when it issues the reset command to attempt to auto-reset the state. Refer to “Operation timing scheme” below.

<Operation timing scheme>

- In the figure below, normal operation restarts in the 4-th retry.



- In the figure below, the inverter failed to restart normal operation within the number of reset times specified by H04 (in this case, 3 times (H04 = 3)), and issued the alarm output (for any alarm) ALM.



- The auto-reset operation can be monitored from the external equipment by assigning the digital output signal TRY to any of the programmable, output terminals [Y1], [Y2] or [30A/B/C] by setting E20, E21 or E27 respectively (data = 26).

H06	Cooling fan ON/OFF control

To prolong the service life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level while the inverter stops. However, since frequent switching of the cooling fan shortens its service life, the cooling fan keeps running for at least 10 minutes once started.

H06 specifies whether to keep running the cooling fan all the time or to enable ON/OFF control.

H06 data	Function
0	Disable (Always in operation)
1	Enable (ON/OFF controllable)

■ Cooling fan in operation -- FAN (E20, E21 and E27, data = 25)

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control

H07	Curve acceleration/ deceleration (refer to F07)

For details, refer to the description of F07.

H08	Rotational direction limitation

H08 inhibits the motor from running in an unexpected rotational direction due to miss-operation of run commands, miss-polarization of frequency commands, or other mistakes.

H08 data	Function
0	Disable
1	Enable (Reverse rotation inhibited)
2	Enable (Forward rotation inhibited)

H09, d67	Starting mode (Auto search) Related function codes: H49 (Starting mode, auto search delay time 1) H46 (Starting mode, auto search delay time 2)

Specify the mode for auto search without stopping the idling motor. The mode can be specified for each restart after momentary power failure and each start of normal operation. The starting mode can be switched by assigning “STM” to a general-purpose digital input signal. If it is not assigned, “STM” is regarded to be OFF. (Data = 26)

■ **H09/d67 (Starting mode, auto search) and terminal command “STM” (“Enable auto search for idling motor speed at starting”)**

The combination of H09 data and the “STM” status determines whether to perform the auto search as listed below.

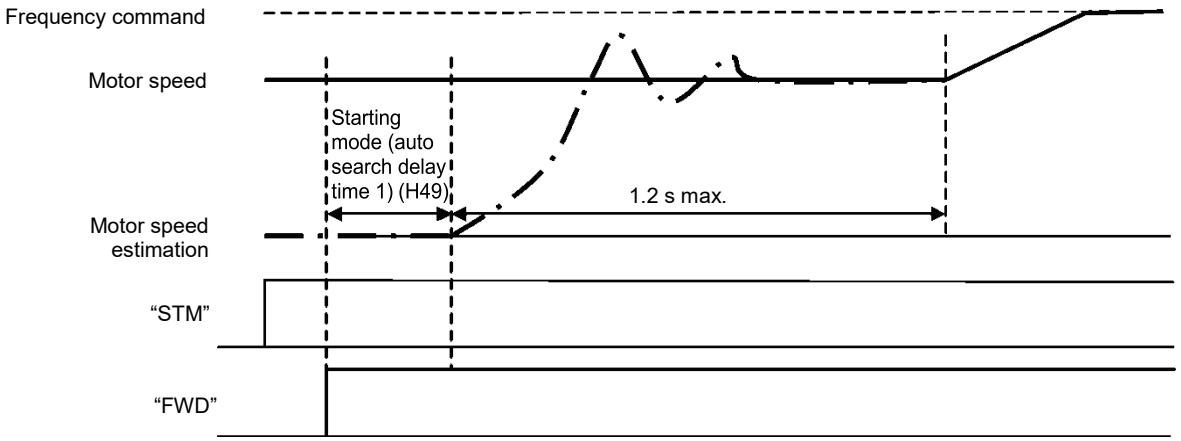
Function code	Drive control	Factory default
H09	V/f control (F42 = 0 to 2)	0: Disable
d67	Vector control for synchronous motor without pole position sensor nor speed sensor (F42 = 15)	2: Enable

H09/d67 data	Enable auto search for idling motor speed at starting “STM”	Auto search for idling motor speed at starting	
		Restart mode after momentary power failure (F14 = 3 to 5)	For normal startup
0: Disable	OFF	Disable	Disable
1: Enable	OFF	Enable	Disable
2: Enable	OFF	Enable	Enable
—	ON	Enable	Enable

When “STM” is ON, auto search for idling motor speed at starting is enabled regardless of the H09/d67 setting.
(🕮 Function codes E01 to E05, data =26)

Auto search for idling motor speed to follow

Starting the inverter (with a run command ON, BX OFF, auto-reset, etc.) with STM being ON searches for the idling motor speed for a maximum of 1.2 seconds to run the idling motor without stopping it. After completion of the auto search, the inverter accelerates the motor up to the reference frequency according to the frequency command and the preset acceleration time.



■ Starting mode (auto search delay time 1) (H49)

- Data setting range: 0.0 to 10.0 (s)

Auto search does not function normally when performed with the residual voltage remaining in the motor.

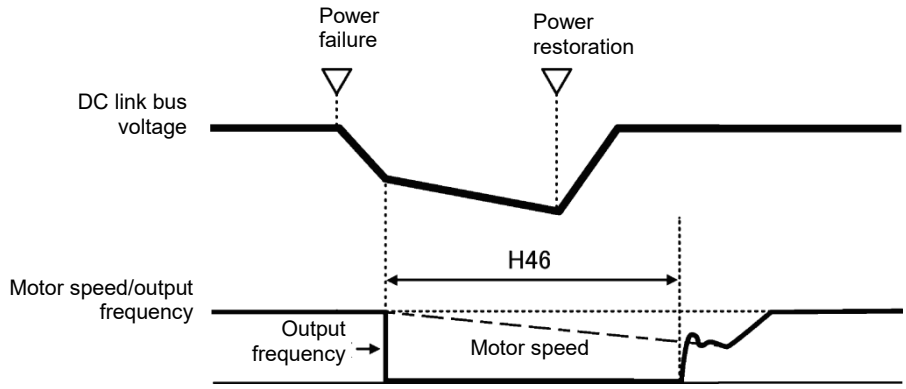
Accordingly, time to allow the residual voltage to disappear must be ensured.

When operation is started by turning a run command ON, auto search is started after the period specified with the starting mode (auto search delay time 1) (H49) has elapsed. When switching between two inverters for controlling one motor and if the motor is coasting to stop at the time of switching to start by auto search, by specifying H49 eliminates the need for timing the run command.

■ Starting mode (auto search delay time 2) (H46)

- Data setting range: 0.1 to 20.0 (s)

At the restart after a momentary power failure, at the start by turning the terminal command “BX” (“Coast to a stop”) OFF and ON, or at the restart by auto-reset, the inverter applies the delay time specified by H46. The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied. The inverter starts after the auto search delay time has elapsed.



Under auto search control, the inverter searches the motor speed with the voltage applied at the motor start and the current flowing in the motor, based on the model built with the motor parameters. Therefore, the search is greatly influenced by the residual voltage in the motor.

H46 is available for motor 1 only. At factory shipment, H46 data is preset to a correct value according to the motor capacity for the general-purpose motor, and basically there is no need to modify the data.

Depending on the motor characteristics, however, it may take time for residual voltage to disappear (due to the secondary thermal time constant of the motor). In such a case, the inverter starts the motor with the residual voltage remaining, which will cause an error in the speed search and may result in occurrence of an inrush current or an overvoltage alarm.

If it happens, increase the value of H46 data and remove the influence of residual voltage.
(If possible, it is recommended to set the value around two times as large as the factory default value allowing a margin.)

Note
- Be sure to auto-tune the inverter preceding the start of auto search for the idling motor speed.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.
- During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.
- Perform auto search at 60 Hz or below.

Note Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.

H11	Deceleration mode

H11 specifies the deceleration mode to be applied when a run command is turned OFF.

H11 data	Action
0	Normal deceleration
1	The inverter immediately shuts down its output, so the motor stops according to the inertia of the motor and machinery (load) and their kinetic energy losses.

Note When reducing the reference frequency, the inverter decelerates the motor according to the deceleration commands even if H11 = 1 (Coast-to-stop).

H12	Instantaneous overcurrent limiting (Mode selection) (refer to F43)

Refer to the descriptions of F43 and F44.

H13, H14 H15, H16	Restart mode after momentary power failure (Restart time, frequency fall rate) Restart mode after momentary power failure (Continue to run level, allowable momentary power failure time) (refer to F14)

For how to set these function codes (Restart time, Frequency fall rate, Continue to run level and Allowable momentary power failure time), refer to the description of F14.

H18	**Torque control (Mode selection)** **Related functions: d32, d33 (Speed limits / Over speed level 1 and 2)** **d35 (Over speed detection level)**

When vector control with speed sensor is selected, the inverter can control the motor-generating torque according to a torque command sent from external sources.

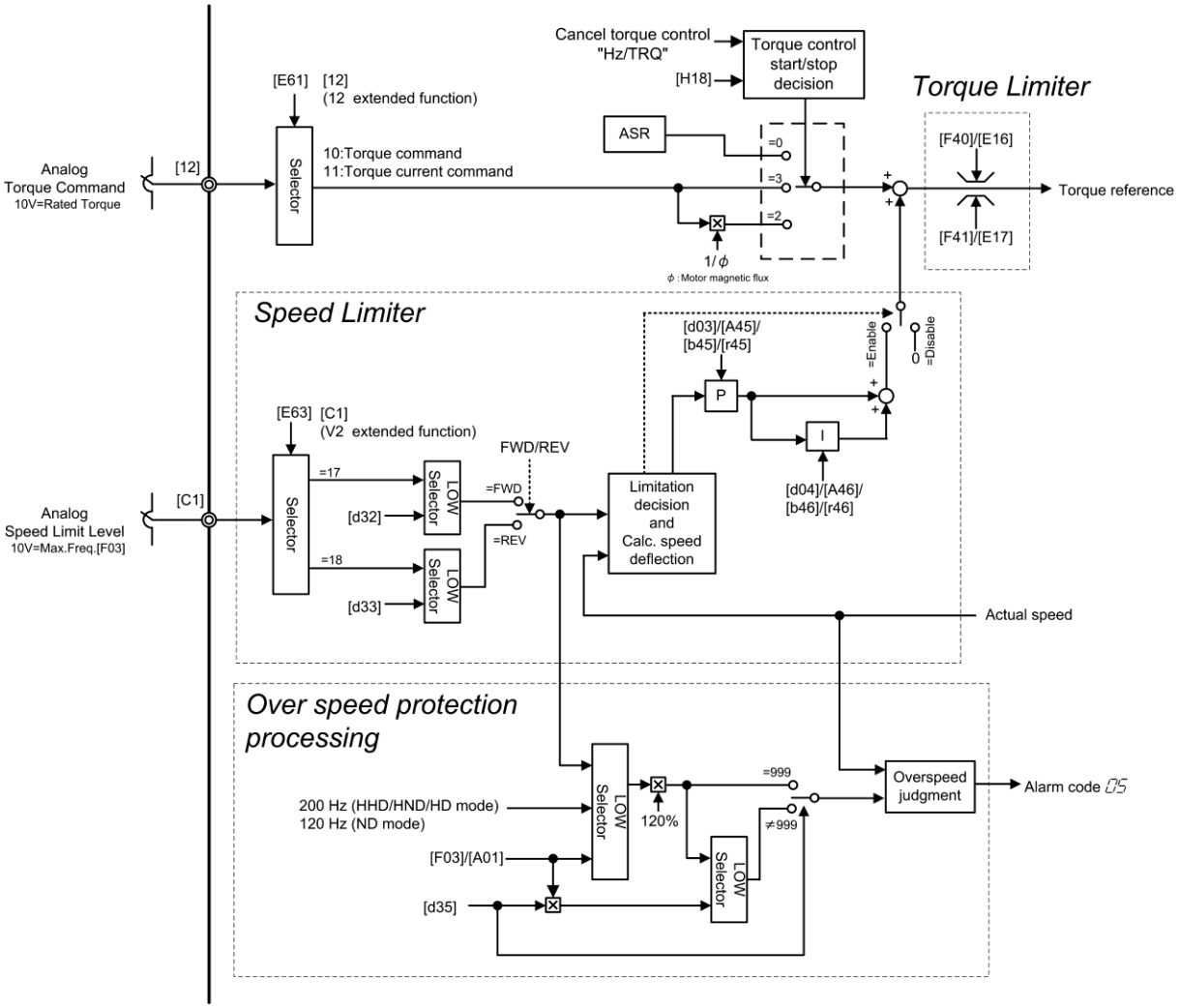


Figure 5.3-11 Block Diagram of Torque Control

■ **Torque control (Mode selection) (H18)**

H18 specifies whether to enable or disable the torque control. Enabling the torque control offers two choices: with torque current command and with torque command.

Data for H18	Available control
0	Disable (Speed control)
2	Enable (Torque control with torque current command)
3	Enable (Torque control with torque command)

■ Torque Commands

Torque commands can be given as analog voltage input (via terminals [12] and [C1](V2 function)) or analog current input (via terminal [C1](C1 function)), or via the communications link (communication-dedicated function codes S02 and S03). To use analog voltage/current inputs, it is necessary to set E61 (for terminal [12]), E62 (for terminal [C1](V2 function)), or E63 (for terminal [C1](V2 function)) data to “10” or “11.”

Input	Command form	Function code setting	Specifications
Terminal [12] (-10 V to 10 V)	Torque command	E61 = 10	Motor rated torque ±200% / ±10 V
	Torque current command	E61 = 11	Motor rated torque current ±200% / ±10V
Terminal [C1] (V2 function) (0 V to 10 V)	Torque command	E63 = 10	Motor rated torque 200% / 10V
	Torque current command	E63 = 11	Motor rated torque current 200% / 10V
Terminal [C1] (C1 function) (0/4 to 20 mA)	Torque command	E62 = 10	Motor rated torque 200% / 20 mA
	Torque current command	E62 = 11	Motor rated torque current 200% / 20 mA
S02 (-327.68 to 327.67%)	Torque command	—	Motor rated torque / ±100.00%
S03 (-327.68 to 327.67%)	Torque current command	—	Motor rated torque current / ±100.00%

■ Polarity of Torque Commands

The polarity of a torque command switches according to the combination of the polarity of an external torque command and a run command on terminal [FWD] or [REV], as listed below.

Polarity of torque command	Run command (ON)	Torque polarity
Positive	**“FWD”**	Positive torque (Forward driving/Reverse braking)
	“REV”	Negative torque (Forward braking/Reverse driving)
Negative	**“FWD”**	Negative torque (Forward braking/Reverse driving)
	“REV”	Positive torque (Forward driving/Reverse braking)

■ Cancel torque control -- “Hz/TRQ” (E01 to E05, data = 23)

When torque control is enabled (H18 = 2 or 3), assigning the terminal command ***Hz/TRQ*** (“Cancel torque control”) to any of the general-purpose digital input terminals (data = 23) enables switching between speed control and torque control.

Cancel torque control signal “**Hz/TRQ**”	Operation
ON	Cancel torque control (Enable speed control)
OFF	Enable torque control

■ Speed limits 1 and 2 (d32, d33)

Torque control mode controls the motor-generating torque directly, not the speed. The speed is determined secondarily by torque of the load, inertia of the machinery, and other factors. To prevent a dangerous situation, therefore, the speed limit functions (d32 and d33) are provided inside the inverter.

The speed limit levels can be set to forward or reverse individually.

- Forward speed limit level = Maximum frequency 1 (F03) × Speed limit 1 (d32) (%)
- Reverse speed limit level = Maximum frequency 1 (F03) × Speed limit 2 (d33) (%)

■ Speed limit value by analog input (E61, E62 and E63)

You can also enter from the analog input the speed limit value. Refer to E61, E62 and E63.

- Forward speed limit level = Maximum frequency 1 (F03) × FWD speed limit value (analog input) (%)
- Reverse speed limit level = Maximum frequency 1 (F03) × REV speed limit value (analog input) (%)

■ Over speed detection level (120% of the specified speed limit levels)

If a regenerative load (which is not generated usually) is generated under droop control or function codes are incorrectly configured, then the motor may rotate at an unintended high speed. To protect the machinery, it is possible to specify the overspeed level with d32 and d33 as follows.

- Forward overspeed level = Maximum frequency 1 (F03) × Speed limit 1 (d32) × 120 (%)
- Reverse overspeed level = Maximum frequency 1 (F03) × Speed limit 2 (d33) × 120 (%)

■ Over speed detection level (d35)

Setting d35 data to “999(factory default)” causes the inverter to issue an over speed alarm if either of the above conditions are satisfied.

or

Motor speed = 200 Hz (120Hz at [ND] mode) × (d32 or d33) × 120(%)

d35 specifies the over speed detection level by percentage of the maximum frequency (F03/A01).

- Over speed level = Maximum frequency 1 (F03/A01) × d35

Note

Running/stopping the motor

Under torque control, the inverter does not control the speed, so it does not perform acceleration or deceleration by soft-start and stop (acceleration/deceleration time) at the time of startup and stop. Turning ON a run command starts the inverter to run and output the commanded torque. Turning it OFF stops the inverter so that the motor coasts to a stop.

H26, H27 Thermistor (for motor) (Mode selection and level)

These function codes specify the PTC (Positive Temperature Coefficient) thermistor embedded in the motor. The thermistor is used to protect the motor from overheating or output an alarm signal.

■ Thermistor (for motor) (mode selection) (H26)

H26 selects the function operation mode (protection or alarm) for the PTC thermistor as shown below.

H26 data	Action
0	Disable
1	When the voltage sensed by PTC thermistor exceeds the detection level, motor protective function (alarm 0h4) is triggered, causing the inverter to enter an alarm stop state.
2	When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. You need to assign the “Motor overheat detected by thermistor” signal (“THM”) to one of the digital output terminals beforehand, by which a temperature alarm condition is indicated to the peripheral equipment (E20, E21 and E27, data = 56).

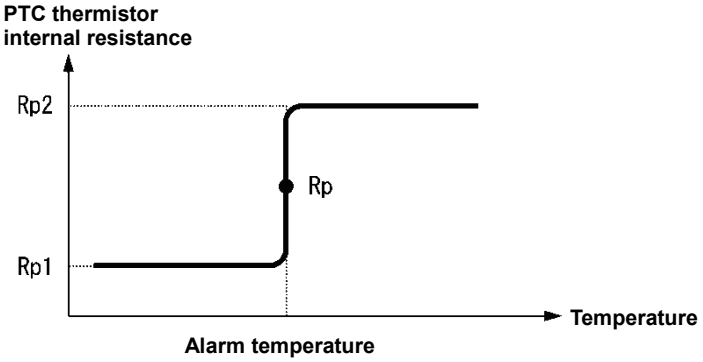
If H26 data is set to “1” or “2” (PTC thermistor), the inverter monitors the voltage sensed by PTC thermistor and protects the motor even when the 2nd motor is selected.

■ Thermistor (for motor) (level) (H27)

H27 specifies the detection level (expressed in voltage) for the temperature sensed by the PTC thermistor.

- Data setting range: 0.00 to 5.00 (V)

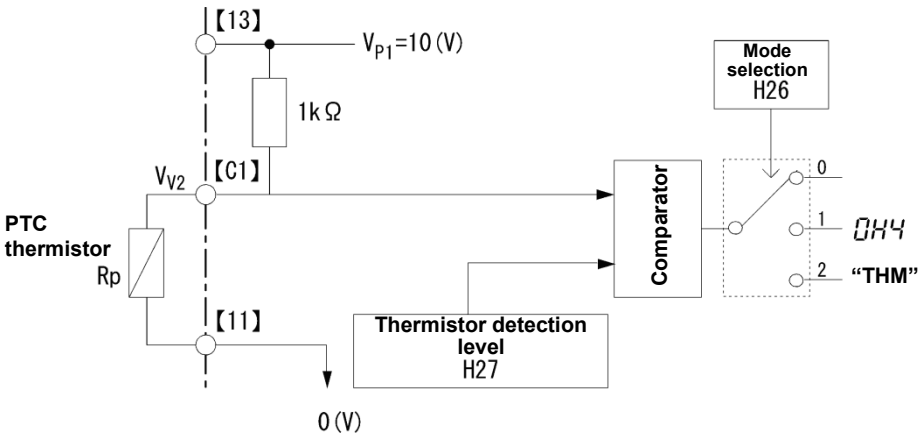
The alarm temperature at which the overheat protection becomes activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of the internal resistance.



Suppose that the internal resistance of the PTC thermistor at the alarm temperature is Rp, the detection level (voltage) V_{v2} is calculated by the expression below. Set the value of V_{v2} to function code H27.

$$V_{V2} = \frac{R_p}{1000 + 5 \times R_p} \times 10.5(V)$$

Connect the PTC thermistor as shown below. The voltage obtained by dividing the input voltage on terminal [C1] with a set of internal resistors is compared with the detection level voltage specified by H27.

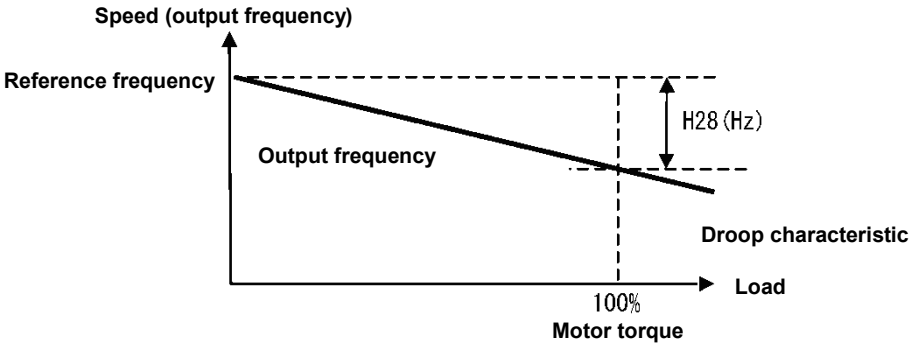


Note When using the terminal [C1] for PTC thermistor input, also set SW4 on the control printed circuit board to the PTC side. For details, refer to Chapter 2, Section 2.2.8.

H28	Droop control

In a system in which two or more motors drive single machinery, any speed gap between inverter-driven motors results in some load unbalance between motors. Droop control allows each inverter to drive the motor with the speed droop characteristic for increasing its load, eliminating such kind of load unbalance.

- Data setting range: -60.0 to 0.0 (Hz), (0.0: Disable)



■ **Select droop control – "DROOP" (E01 to E05, data = 76)**

The terminal command "DROOP" toggles droop control on and off.

The terminal command "DROOP"	Droop control
ON	Enable
OFF	Disable

Note To use droop control, be sure to auto-tune the inverter for the motor.

Under V/f control, to prevent the inverter from tripping even at an abrupt change in load, droop control applies the acceleration/deceleration time to the frequency obtained as a result of droop control. This may delay reflection of the frequency compensated during droop control on the motor speed, thereby running the inverter as if droop control is disabled.

H30	Communication link function (Mode selection) Related function codes: y98 bus link function (mode selection)

Using the RS-485 communications link, built-in CAN communications link or fieldbus (option) allows you to issue frequency commands and run commands from a computer or PLC at a remote location, as well as monitor the inverter running information and the function code data. It is possible to sets the source that specifies the frequency and run commands with H30 and y98. H30 and y98 set the sources that specify RS-485 communications and fieldbus respectively.

When the built-in CAN communications link is enabled with y33 = 1, the fieldbus in the figure below is replaced with the built-in CAN communications link.

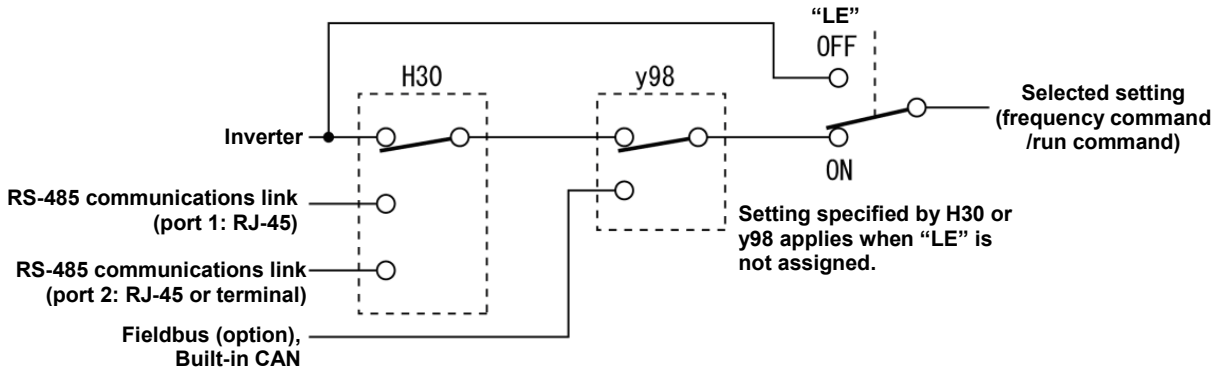


Table 5.3-11 Command sources selectable

Command sources	Data
Inverter itself	Sources except RS-485 communications link and fieldbus Frequency setting source: Specified by F01/C30, or multistep frequency command Operation method source: Via the keypad or digital input terminals selected by F02
Via RS-485 communications link (port 1)	Via the standard RJ-45 port used for connecting a keypad
Via RS-485 communications link (port 2)	GB model and C model (for China):Via the terminals DX+, DX- and SD GA model Via RJ-45 connector
Via fieldbus(option) or built-in CAN	Via fieldbus (DeviceNet, PROFIBUS DP, etc.) Via built-in CAN communications link

* C model (for China) and GB model is not equipped with the CAN communications link.

Table 5.3-12 Command sources specified by H30 (Communications link function, Mode selection)

H30 data	Frequency command	Run command source
0	Inverter itself (F01/C30)	Inverter itself (F02)
1	RS-485 communications link (port 1)	Inverter itself (F02)
2	Inverter itself (F01/C30)	RS-485 communications link (port 1)
3	RS-485 communications link (port 1)	RS-485 communications link (port 1)
4	RS-485 communications link (port 2)	Inverter itself (F02)
5	RS-485 communications link (port 2)	RS-485 communications link (port 1)
6	Inverter itself (F01/C30)	RS-485 communications link (port 2)
7	RS-485 communications link (port 1)	RS-485 communications link (port 2)
8	RS-485 communications link (port 2)	RS-485 communications link (port 2)

Table 5.3-13 Command sources specified by y98 (Bus link function, Mode selection)

y98 data	Frequency command	Run command source
0	Follow H30 data	Follow H30 data
1	Via fieldbus (option), built-in CANopen	Follow H30 data
2	Follow H30 data	Via fieldbus (option), built-in CANopen
3	Via fieldbus (option), built-in CANopen	Via fieldbus (option), built-in CANopen

Table 5.3-14 H30 and y98 settings by combination of sources

		Frequency command			
		Inverter itself	Via RS-485 communications link port 1	Via RS-485 communications link port 2	Via fieldbus (option) and built in CAN
Run command source	Inverter itself	H30 = 0 y98 = 0	H30 = 1 y98 = 0	H30 = 4 y98 = 0	H30 = 0 (1, 4) y98 = 1
	Via RS-485 communications link (port 1)	H30 = 2 y98 = 0	H30 = 3 y98 = 0	H30 = 5 y98 = 0	H30 = 2 (3, 5) y98 = 1
	Via RS-485 communications link (port 2)	H30 = 6 y98 = 0	H30 = 7 y98 = 0	H30 = 8 y98 = 0	H30 = 6 (7, 8) y98 = 1
	Via fieldbus (option and built-in CAN)	H30 = 0 (2, 6) y98 = 2	H30 = 1 (3, 7) y98 = 2	H30 = 4 (5, 8) y98 = 2	H30 = 0 (1 to 8) y98 = 3

For details, refer to the RS-485 Communication User's Manual, the Field Bus (Option) Instruction Manual or Chapter 9.

- When the terminal command "LE" ("Select link operation (RS-485, BUS option)") is assigned to a digital input terminal, turning "LE" ON makes the settings of H30 and y98 enabled. When LE is OFF, those settings are disabled so that both frequency commands and run commands specified from the inverter itself take control. (Function codes E01 to E05, data = 24)
  No "LE" assignment is functionally equivalent to the "LE" being ON.

H42, H43, H48	**Capacitance of DC link bus capacitor, Cumulative run time of cooling fan Cumulative run time of capacitors on printed circuit boards** **Related function codes: H47 Initial capacitance of DC link bus capacitor H98 Protection/maintenance function**

■ **Life prediction function**

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LED monitor and judge whether those parts are approaching the end of their service life. The life prediction function can also issue early warning signals if the lifetime alarm command LIFE is assigned to any of the digital output terminals by any of E20, E21 and E27.

The predicted values should be used only as a guide since the actual service life is influenced by the surrounding temperature and other usage environments.

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	On the LED monitor
DC link bus capacitor	Calculating the capacitance of DC link bus capacitor Measures the discharging time of the DC link bus capacitor when the main power is shut down and calculates the capacitance.	85% or lower of the initial capacitance at shipment (See "[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment" on page 5-175.)	At periodic inspection H98 bit3 = 0	*5_05* (Capacitance)
		85% or lower of the reference capacitance under ordinary operating conditions at the user site (See "[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions at power shutdown" on page 5-176.)	During ordinary operation H98 bit3 = 1	*5_05* (Capacitance)
	ON-time counting of DC link bus capacitor Counts the time elapsed when the voltage is applied to the DC link bus capacitor, while correcting it according to the capacitance measured above.	Exceeding 87,600 hours (10 years) (ND mode: 61,320 hours (7 years))	During ordinary operation	*5_26* (Elapsed time) *5_27* (Remaining hours)
Electrolytic capacitors on printed circuit boards	Counts the time elapsed when the voltage is applied to the capacitors, while correcting it according to the surrounding temperature.	Exceeding 87,600 hours (10 years) (ND mode: 61,320 hours (7 years))	During ordinary operation	*5_06* (Cumulative run time)
Cooling fans	Counts the run time of the cooling fans.	Exceeding 87,600 hours (10 years) (ND mode: 61,320 hours (7 years))	During ordinary operation	*5_07* (Cumulative run time)

■ **Capacitance of DC link bus capacitor (H42)**

Calculating the capacitance of DC link bus capacitor

- The discharging time of the DC link bus capacitor depends largely on the inverter's internal load conditions, e.g. options attached or ON/OFF of digital I/O signals. If actual load conditions are so different from the ones at which the initial/reference capacitance is measured that the measurement result falls out of the accuracy level required, then the inverter does not perform measuring.
- The capacitance measuring conditions at shipment are extremely restricted, e.g., all input terminals being OFF in order to stabilize the load and measure the capacitance accurately. Those conditions are, therefore, different from the actual operating conditions in almost all cases. If the actual operating conditions are the same as those at shipment, shutting down the inverter power automatically measures the discharging time; however, if they are different, no automatic measurement is performed. To perform it, put those conditions back to the factory default ones and shut down the inverter. For the measuring procedure, see "[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment" on page 5-175.
- To measure the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF, it is necessary to set up the load conditions for ordinary operation and measure the reference capacitance (initial setting) when the inverter is introduced. For the reference capacitance setup procedure, see "[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions at power shutdown" on page 5-176. Performing the setup procedure automatically detects and saves the measuring conditions of the DC link bus capacitor.

  Setting bit 3 of H98 data to 0 restores the inverter to the measurement in comparison with the initial capacitance measured at shipment.

Note When the inverter uses an auxiliary control power input, the load conditions widely differ so that the discharging time cannot be accurately measured. In this case, measuring of the discharging time can be disabled with the function code H98 (Bit 4 = 0) for preventing unintended measuring. (For details, refer to H98.)

ON-time counting of DC link bus capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. For such an inverter, the ON-time counting is provided. If the capacitance measurement is made, the inverter corrects the ON-time according to the capacitance measured. The ON-time counting result can be represented as "elapsed time" and "remaining time" before the end of life.

[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

When bit 3 of H98 data is 0, the measuring procedure given below measures the capacitance of DC link bus capacitor in comparison with initial one at shipment when the power is turned OFF. The measuring result can be displayed on the keypad as a ratio (%) to the initial capacitance.

----------Capacitance measuring procedure----------

1) To ensure validity in the comparative measurement, put the condition of the inverter back to the state at factory shipment.
   - Remove the option card (if already in use) from the inverter.
   - In case another inverter is connected via the DC link bus to the P(+) and N(-) terminals of the main circuit, disconnect the wires. (You do not need to disconnect a DC reactor (optional), if any.)
   - Disconnect power wires for the auxiliary input to the control circuit (R0, T0).
   - In case the standard keypad has been replaced with an optional multi-function keypad TP-A1-E2C after the purchase, put back the original standard keypad.
   - Turn OFF all the digital input signals fed to terminals [FWD], [REV], and [X1] through [X5] of the control circuit
   - If a potentiometer is connected to terminal [13], disconnect it.
   - If an external apparatus is attached to terminal [PLC], disconnect it.
   - Ensure that transistor output signals ([Y1] and [Y2]) and relay output signals ([30A/B/C]) will not be turned ON.
   - Disable the RS-485 and built-in CAN communications links.

     Note If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. Specify positive logic for them.

   - Keep the surrounding temperature within 25 ±10℃.
2) Turn ON the main circuit power.
3) Confirm that the cooling fan is rotating and the inverter is in stopped state.
4) Turn OFF the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor. Make sure that " . . . . " appears on the LED monitor.

   Note If " . . . . " does not appear on the LED monitor, the measurement has not started. Check the conditions listed in 1).

6) After " . . . . " has disappeared from the LED monitor, turn ON the main circuit power again.
7) Select Menu #5 "Maintenance Information" in Programming mode and note the reading (relative capacitance (%) of the DC link bus capacitor).

---

[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions at power shutdown

When bit 3 of H98 data is 1, the inverter automatically measures the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF. This measurement requires setting up the load conditions for ordinary operation and measuring the reference capacitance when the inverter is introduced to the practical operation, using the setup procedure given below.

Function code	Name	Data
H42	Capacitance of DC link bus capacitor	• Capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (0000) • Measurement failure (0001)
H47	Initial capacitance of DC link bus capacitor	• Initial capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (0000) • Measurement failure (0001)

When replacing parts, clear or modify the H42 and H47 data. For details, refer to the maintenance related documents.

----------Reference capacitance setup procedure----------

1) Set function code H98 (Protection/maintenance function) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor (Bit 3 = 1) (refer to function code H98).
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set both function codes H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) to “0000”.
5) Turn OFF the inverter, and the following operations are automatically performed.
   The inverter measures the discharging time of the DC link bus capacitor and saves the result in function code H47 (Initial capacitance of DC link bus capacitor).
   The conditions under which the measurement has been conducted will be automatically collected and saved.
   During the measurement, “ . . . . ” will appear on the LED monitor.
6) Turn ON the inverter again.
   Confirm that H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) hold right values. Shift to Menu #5 “Maintenance Information” and confirm that the relative capacitance (ratio to full capacitance) is 100%.

Note If the measurement has failed, “0001” is entered into both H42 and H47. Remove the factor of the failure and conduct the measurement again.

Hereafter, each time the inverter is turned OFF, it automatically measures the discharging time of the DC link bus capacitor if the above conditions are met. Periodically check the relative capacitance of the DC link bus capacitor (%) with Menu #5 “Maintenance Information” in Programming mode.

Note The condition given above tends to produce a rather large measurement error. If this mode gives you a lifetime alarm, set H98 (Protection/maintenance function) back to the default setting (Bit 3 (Select life judgment threshold of DC link bus capacitor) = 0) and conduct the measurement under the condition at the time of factory shipment.

■ **Cumulative run time of capacitors on printed circuit boards (H48)**

Function code	Name	Data
H48	Cumulative run time of capacitors on printed circuit boards	Displays the cumulative run time of capacitor on the printed circuit board in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours)

When replacing capacitors on printed circuit boards, clearing or modifying H48 data is required. For details, refer to the maintenance related documents.

■ **Cumulative run time of cooling fan (H43)**

Function code	Name	Data
H43	Cumulative run time of cooling fan	Displays the cumulative run time of cooling fan in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours)

When replacing the cooling fan, clearing or modifying H43 data is required. For details, refer to the maintenance related documents.

H44	**Startup count for motor 1**

H44 counts the number of inverter startups and displays it in hexadecimal format. Check the displayed number on the maintenance screen of the keypad, and use it as a guide for maintenance timing for parts such as belts. To start the counting over again, e.g. after a belt replacement, set the H44 data to “0000.”

H45	**Mock alarm** **Related function codes: H97 (Clear alarm data)**

H45 causes the inverter to generate a mock alarm in order to check whether external sequences function correctly at the time of machine setup. Setting the H45 data to “1” displays mock alarm *err* on the LED monitor. It also issues alarm output (for any alarm) “ALM” (if assigned to a digital output terminal by any of E20, E21 and E27).

Accessing the H45 data requires simultaneous keying of the STOP key + ⌃ key. After that, the H45 data automatically reverts to “0,” allowing you to reset the alarm.

Same as other alarms that could occur when running the inverter, the inverter saves mock alarm data, enabling you to confirm the mock alarm status.

To clear the mock alarm data, use H97. (Accessing the H97 data requires simultaneous keying of the STOP key + ⌃ key.) H97 data automatically returns to “0” after clearing the alarm data.

Tip A mock alarm can be issued also by simultaneous keying of the STOP key + FUNC/DATA key on the keypad for 5 seconds or more.

H46	**Starting mode (Auto search delay time 2) (refer to H09)**

For details, refer to the description of H09.

H47, H48	**Initial capacitance of DC link bus capacitor, Cumulative run time of capacitors on printed circuit boards (refer to H42)**

For details, refer to the description of H42.

H49	Starting mode (Auto search delay time 1) (refer to H09)

For details, refer to the description of H09.

H50, H51 H52, H53	Non-linear V/f 1 (Frequency and voltage) (refer to F04) Non-linear V/f 2 (Frequency and voltage)

For details, refer to the description of F04.

H54, H55 H56 H57 to H60	Acceleration/Deceleration time (Jogging) (refer to F07) Deceleration time for forced stop 1st/2nd S-curve acceleration/deceleration range

For details, refer to the description of F07.

H61	UP/DOWN control (Initial frequency setting) (refer to F01)

For details, refer to the description of F01.

H63	Low limiter (Mode selection) (refer to F15)

For details, refer to the description of F15.

H64	Low limiter (Lower limiting frequency)

H64 specifies the lower limit of frequency to be applied when the current limiter, torque limiter, or overload prevention control is activated. Normally, it is not necessary to change this data.

- Data setting range: 0.0 to 60.0 (Hz)

H65, H66	Non-linear V/f 3 (Frequency and voltage) (refer to F04)

For details, refer to the description of F04.

H68	Slip compensation 1 (Operating conditions) (refer to F42)

For details, refer to the description of F42.

H69	**Anti-regenerative control (Mode selection)** **Related function codes: H76 (Torque limiter) (Frequency rising limit for braking)**

Enable the automatic deceleration (anti-regenerative control) with this function code. In the inverter not equipped with a PWM converter or braking unit, if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs. Turning digital input "AR-CCL" ON cancels anti-regenerative control.

(📖 Function codes E01 to E05, data =82)

If anti-regenerative control is selected, the output frequency is controlled to suppress the regenerative energy for avoiding an overvoltage trip.

H69	Function		AR-CCL
	Control mode	Force-to-stop with actual deceleration time exceeding three times the specified one	
0	Disable automatic deceleration	—	OFF
2	Torque limit control	Enable	OFF
3	DC link bus voltage control	Enable	OFF
4	Torque limit control	Disable	OFF
5	DC link bus voltage control	Disable	OFF
—	Disable automatic deceleration	—	ON

IMO Jaguar VXT is equipped with two control modes: torque limiter and DC link bus voltage control. Understand the features of the respective modes and select the appropriate one.

Control mode	Control operation	Operation mode	Characteristics
Torque limiter (H69 = 2, 4)	Controls the output frequency so that the braking torque is approximately 0.	Enabled during acceleration, constant speed operation and deceleration.	Features high response and makes less prone to overvoltage trips under impact load.
DC link bus voltage control (H69 = 3, 5)	Controls the output frequency so that the DC link bus voltage is decreased when it exceeds the limit level.	Enabled only during deceleration Disabled during constant speed operation	Regenerative capability of the inverter will be maximum use. Deceleration time will be shorter than the torque limit control.

■ **Torque limiter (Frequency rising limit for braking) (H76)**

- Data setting range: 0.0 to 500.0 (Hz)

With the torque limiter, the inverter increases the output frequency to limit the output torque. Excessive increase of the output frequency may cause danger, and therefore the frequency increment limit for braking (H76) is provided. This prevents the output frequency from increasing to exceed the "reference frequency + H76." If the limit is reached, however, anti-regenerative control is restricted and an overvoltage trip may occur. Increasing the frequency increment limit for braking improves the anti-regenerative capability.

If a run command is turned OFF, the anti-regenerative control causes the frequency to increase and operation may not stop depending on the load conditions. For safety, a function is provided in which the anti-regenerative control is forced to be disabled if the actual deceleration time becomes three times the deceleration time currently selected forcing the operation to stop. The function can be enabled/disabled by the setting of H69.

Note

- The deceleration time may be automatically increased by anti-regenerative control.
- Disable the anti-regenerative control when a braking unit is connected. Otherwise, the anti-regenerative control may be activated at the same time as the operation of the braking unit, resulting in a deceleration time not in accordance with the setting.
- An excessively short deceleration time causes the DC link bus voltage of the inverter to rise too fast for the anti-regenerative control to function. In that case, specify a longer deceleration time.

H70	Overload prevention control

Specifies the rate of decrease of the output frequency of overload prevention control. Before the inverter generates a heat sink overheat or overload trip (alarm *0h1* or *0lu*), the output frequency of the inverter is decreased for avoiding a trip. This is applied when operation is required to continue in a system in which the load decreases as the output frequency decreases, such as a pump.

H70 data	Function
0.00	Uses the deceleration time currently selected (F08, E11, E13, E15, etc.).
0.01 to 100.0	Decelerates at a deceleration rate of 0.01 to 100.0 (Hz/s).
999	Cancel overload prevention control

■ Overload prevention controlling – "OLP" (E20, E21 and E27, data = 36)

Outputs "OLP", which is a signal that turns ON during overload prevention control, in order to inform that the overload prevention control has been activated and the output frequency has changed.

Note No effect can be expected in a system in which the load does not decrease even if the output frequency decreases. Do not use this function.

H71	Deceleration characteristic

Enable hard braking control with this function code.

During motor deceleration, if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs. When hard braking control is selected, the motor loss is increased and the deceleration torque is increased during motor deceleration.

H71 data	Function
0	Disable
1	Action

Note This function suppresses the torque during deceleration and is not effective if braking load is applied. When anti-regenerative control of the torque limiter is enabled (H69 = 2, 4), the deceleration characteristic is disabled.

H72	Main power shutdown detection (Mode selection)

This function monitors the AC input power supply of the inverter to see if the AC input power supply (main circuit power) is established and prevents inverter operation when the main circuit power is not established.

Available VXT-88A-2/VXT-59A-4 or above.

H72 data	Function
0	Disables main circuit power cutoff detection
1	Enables main circuit power cutoff detection

With power supply via a PWM converter or DC link bus, there is no AC input. When the data for H72 is "1," the inverter cannot operate. Change the data for H72 to "0."

Note For single-phase supply, consult your IMO Drives representatives.

H74	Torque limiter (Control target)

Refer to F40, F41.

H76	Torque limiter (Braking) (Frequency rising limiter for braking) (refer to H69)

For details, refer to the description of H69.

H77	Service life of DC link bus capacitor (Remaining time)

Indicates the time remaining (in units of ten hours) before the end of service life of the DC link bus capacitor.
Transfer the DC link bus capacitor life data when replacing the printed circuit board.

- Data setting range: 0 to 8760 (in units of 10 hours 0 to 87,600 hours)

H78 H94	Maintenance interval (M1) Cumulative motor run time 1

Specify the maintenance interval in hours with the maintenance interval (M1) (H78).
Specify in units of 10 hours. Up to 9999 x 10 hours can be specified.

- Data setting range: 0 (disable), 1 to 9999 (in units of 10 hours)

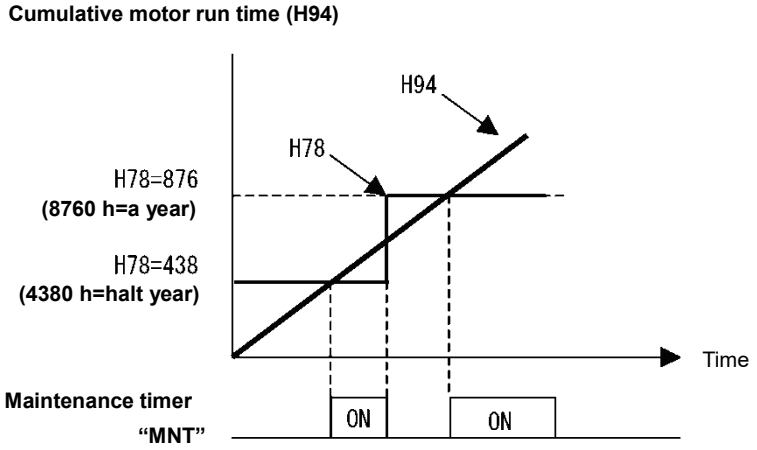
■ Maintenance timer counted up – “MNT” (E20, E21 and E27, data = 84)

When the cumulative motor run time 1 (H94) reaches the value specified by the maintenance interval (H78), the inverter outputs the maintenance timer signal “MNT”.

■ Cumulative motor run time 1 (H94)

The cumulative run time of the motor can be indicated by keypad operation. It can be used for management of the machinery or maintenance. Specifying an arbitrary time for the cumulative motor run time 1 (H94) allows an arbitrary value to be specified for the cumulative motor run time. It can be replaced with the initial data to use as a guide for the replacement of machine parts or inverter. Setting “0” allows the cumulative motor run time to be reset.

<For half yearly maintenance>



Note If the maintenance interval is reached, set a new value in H78 and press the FUNC/DATA key to reset the output signal and restart measurement.

This function is exclusively applied to the 1st motor.

■ **Count the run time of commercial power-driven motor 1, 2 – "CRUN-M1, 2" (E01 to E05, data = 72, 73)**

Even when a motor is driven by commercial power, not by the inverter, it is possible to count the cumulative motor run time 1, 2 (H94, A51) by detecting the ON/OFF state of the auxiliary contact of the magnetic contactor for switching to the commercial power line.

Note Check the cumulative motor run time with *5_23* on Menu #5 "Maintenance Information" of the keypad.

H79	Preset startup count for maintenance (M1) Related function codes: H44 Startup count for motor 1

H79 specifies the number of inverter startup times to determine the next maintenance timing, e.g., for replacement of a belt.

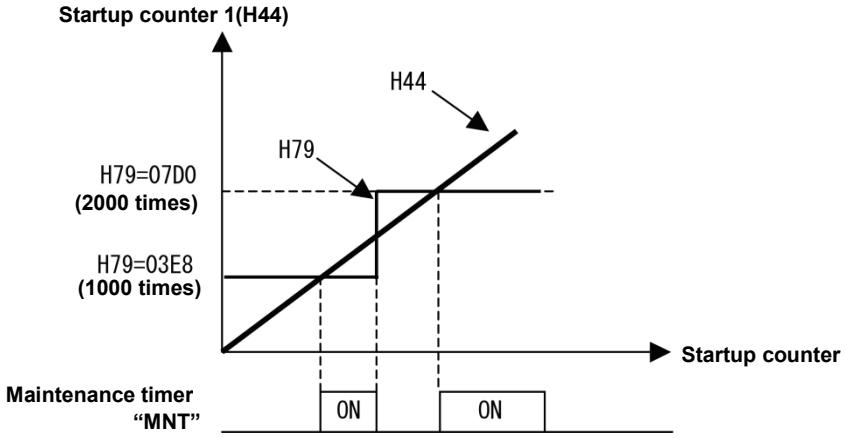
Set the H79 and H44 data in hexadecimal. The maximum setting count is 65,535 (FFFF in hexadecimal.)

- Data setting range: OFF (disable), 0001 to FFFF (hexadecimal)

■ **Maintenance timer counted up – "MNT" (E20, E21 and E27, data = 84)**

When the startup counter for motor 1 (H44) reaches the number specified by H79 (Preset startup count for maintenance (M1)), the inverter outputs the maintenance timer signal "MNT" (if assigned to any digital terminal with any to E20 to E24 and E27) to inform the user of the need of the maintenance of the machinery.

< Maintenance every 1,000 times of startups >



Note If the startup counter reaches the specified value, set a new value for the next maintenance in H79 and press the (F/C DATA) key to reset the output signal and restart counting.

This function is exclusively applied to the 1st motor.

H80	Output current fluctuation damping gain for motor 1

The inverter output current driving the motor may fluctuate due to the motor characteristics and/or backlash in the machinery (load). Modifying the H80 data adjusts the controls in order to suppress such fluctuation. However, as incorrect setting of this gain may cause larger current fluctuation, do not modify the default setting unless it is necessary.

- Data setting range: 0.00 to 1.00

H81, H82	Light alarm selection 1 and 2

If the inverter detects a minor abnormal state “light alarm”, it can continue the current operation without tripping while displaying the “light alarm” indication */-al* on the LED monitor. In addition to the indication l-al, the inverter blinks the KEYPAD CONTROL LED. Function codes H81 and H82 specify which alarms should be categorized as “light alarm.”

The table below lists alarms selectable as “light alarm.”

Code	Name	Description
0h1	Heat sink overheat	Heat sink temperature increased to the trip level.
0h2	Enable external alarm trip	An error that has occurred in peripheral equipment turned the external alarm signal THR ON.
0h3	Inverter internal overheat	The temperature inside the inverter abnormally has increased.
dbh	Braking resistor overheat	Estimated temperature of the coil in the braking resistor exceeded the allowable level.
0l1 to *0l2*	Overload of motor 1 to 2	Motor temperature calculated with the inverter output current reached the trip level.
er4	Option communications error	Communications error between the inverter and an option.
er5	Option error	An option judged that an error occurred.
ert	Built-in CAN communications link error	Error generated in built-in CAN communications link
er8 *erp*	RS-485 communications error (COM port 1, 2)	RS-485 communications error in COM ports 1 or 2.
cof	PID feedback wire break	The PID feedback signal wire(s) is broken.
fal	Detect DC fan lock	Failure of the air circulation DC fan inside the inverter
0l	Motor overload early warning	Early warning before a motor overload
0h	Heat sink overheat early warning	Early warning before a heat sink overheat trip
lif	Lifetime alarm	It is judged that the service life of any one of the capacitors (DC link bus capacitors or electrolytic capacitors on the printed circuit boards) or cooling fan has expired. Or, failure of the air circulation DC fan inside the inverter.
ref	Reference loss	Analog frequency command was lost.
pid	PID alarm	Warning related to PID control (absolute-value alarm or deviation alarm)
uTl	Low output torque detection	Output torque drops below the low torque detection level for the specified period.
pTc	PTC thermistor activated	The PTC thermistor on the motor detected a high temperature.
rTe	Inverter life (Cumulative run time)	The motor cumulative run time reached the specified level.
cnT	Inverter life (Number of startups)	Number of startups reached the specified level.

Set data for selecting “light alarms” in hexadecimal. For details on how to select the codes, see the next page.

- Data setting range: 0000 to FFFF (hexadecimal)

■ **Selecting light alarm factors**

To set and display the light alarm factors in hexadecimal format, each light alarm factor has been assigned to bits 0 to 15 as listed in Table 5.3-15 and Table 5.3-16. Set the bit that corresponds to the desired light alarm factor to "1." Table 5.3-17 shows the relationship between each of the light alarm factor assignments and the LED monitor display.

Table 5.3-18 gives the conversion table from 4-bit binary to hexadecimal.

Table 5.3-15 Light Alarm Selection 1 (H81), Bit Assignment of Selectable Factors

Bit	Code	Data	Bit	Code	Data
15	*0h6*	Charging resistor overheat	7	—	—
14	*ert*	Built-in CAN communications link error	6	*0l2*	Overload of motor 2
13	*erp*	RS-485 communications error (COM port 2)	5	*0l1*	Overload of motor 1
12	*er8*	RS-485 communications error (COM port 1)	4	*dbh*	Braking resistor overheat
11	*er5*	Option error	3	—	—
10	*er4*	Option communications error	2	*0h3*	Inverter internal overheat
9	—	—	1	*0h2*	External alarm
8	—	—	0	*0h1*	Heat sink overheat

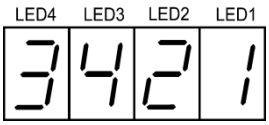
Table 5.3-16 Light Alarm Selection 2 (H82), Bit Assignment of Selectable Factors

Bit	Code	Data	Bit	Code	Data
15	—	—	7	*lif*	Lifetime alarm
14	—	—	6	*0h*	Heat sink overheat early warning
13	*cnT*	Inverter life (Number of startups)	5	*0l*	Motor overload early warning
12	*rTe*	Inverter life (Cumulative run time)	4	*fal*	Detect DC fan lock
11	*pTc*	PTC thermistor activated	3	*cof*	PID feedback wire break
10	*uTl*	Low output torque detection	2	*ero*	Positioning error
9	*pid*	PID alarm	1	—	—
8	*ref*	Reference loss	0	—	—

Table 5.3-17 Display of Light Alarm Factor

(Example) Light alarm factors "RS-485 communications error (COM port 2)," "RS-485 communications error (COM port 1)," "Option communications error," "Overload of motor 1" and "Heat sink overheat" are selected by H81.

LED No.		LED 4				LED 3				LED 2				LED 1			
Bit		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code		—	—	*erp*	*er8*	*er5*	*er4*	—	—	—	*0l2*	*O0l1*	*dbh*	—	*0h3*	*O0h2*	*O0h1*
Sample indication	Binary	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1
	Hexadecimal * Refer to Table 5.3-18	*3*				*4*				*2*				*1*			

	Hexadecimal on the LED monitor	

■ **Hexadecimal expression**

A 4-bit binary number can be expressed in hexadecimal format (hexadecimal digit). The table below shows the correspondence between the two notations.

Table 5.3-18 Binary and Hexadecimal Conversion

Binary				Hexadecimal	Binary				Hexadecimal
0	0	0	0	*0*	1	0	0	0	*8*
0	0	0	1	*1*	1	0	0	1	*9*
0	0	1	0	*2*	1	0	1	0	*a*
0	0	1	1	*3*	1	0	1	1	*b*
0	1	0	0	*4*	1	1	0	0	*c*
0	1	0	1	*5*	1	1	0	1	*d*
0	1	1	0	*6*	1	1	1	0	*e*
0	1	1	1	*7*	1	1	1	1	*f*

Note When H26 = 1 (PTC (The inverter immediately trips with *0h4* displayed)), if the PTC thermistor is activated, the inverter stops without displaying l-al, blinking the KEYPAD CONTROL LED, or outputting L-ALM signal, regardless of the assignment of bit 11 (PTC thermistor activated) by H82 (Light Alarm Selection 2).

■ **Light alarm – "L-ALM" (E20, E21 and E27, data = 98)**

This output signal "L-ALM" comes ON when a light alarm occurs.

H84, H85 Pre-excitation (Initial level, Time)

A motor generates torque with magnetic flux and torque current. Lag elements of the rising edge of magnetic flux causes a phenomenon in which enough torque is not generated at the moment of the motor start. To obtain enough torque even at the moment of motor start, enable the pre-excitation with H84 and H85 so that magnetic flux is established before a motor start.

■ **Pre-excitation (Initial level) (H84)**

H84 specifies the forcing function for the pre-excitation. It is used to shorten the pre-excitation time. Basically, there is no need to modify the default setting. If the inverter determines that the magnetic flux is established, then excitation level will return to 100 percent.

- Data setting range: 100 to 400 (%) (exciting current level in percentage)

■ **Pre-excitation (Time) (H85)**

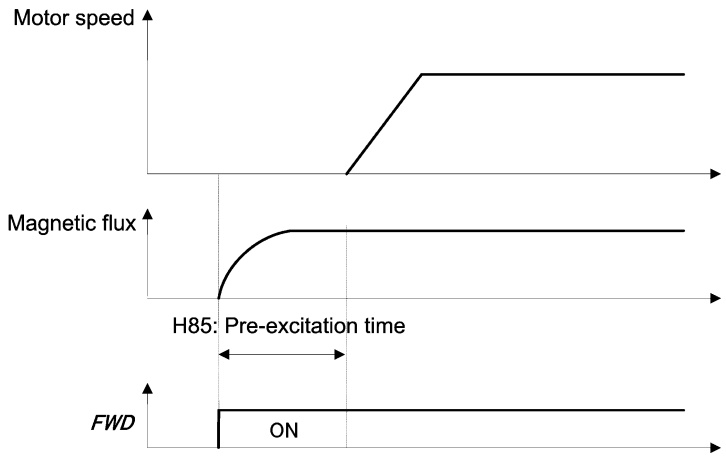
H85 specifies the pre-excitation time before starting operation.

- Data setting range: 0.00 (Disable), 0.01 to 30.00 (s)

When a run command is inputted, the pre-excitation starts.

After the pre-excitation time specified by H85 has elapsed, the inverter judges magnetic flux to have been established and starts acceleration.

Specify H85 data so that enough time is secured for establishing magnetic flux. The appropriate value for H85 data depends on the motor capacity. Use the default setting value of H13 data as a guide.

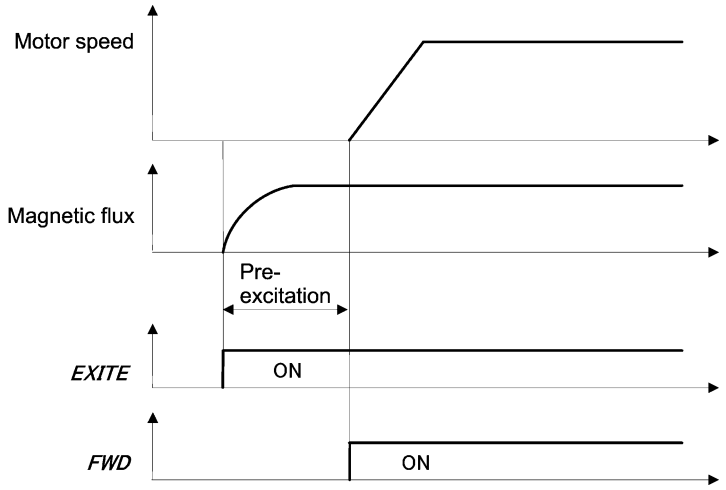


■ **Pre-excite --*EXITE* (E01 to E07, data = 32)**

Turning this input signal ON starts pre-excitation.

After the delay time for establishing magnetic flux has elapsed, a run command is inputted. Inputting the run command terminates pre-excitation and starts acceleration.

Use an external sequence to control the time for establishing magnetic flux.



Note Under V/f control (including auto torque boost and torque vector), pre-excitation is disabled, so use DC braking or hold the starting frequency instead.

Note A transient phenomenon, which may occur when the losses of the machinery (load) are small, may make the motor rotate during pre-excitation. If the motor rotation during pre-excitation is not allowed in your system, install a mechanical brake or other mechanism to stop the motor.

⚠WARNING
Even if the motor stops due to pre-excitation, voltage is output to inverter's output terminals [U], [V], and [W]. **An electric shock may occur.**

H89	Electronic thermal overload protection for motor – data retention

When the electronic thermal overload protection for motor is used, whether to clear the cumulative value of the thermal by inverter power-off or retain the value after power-off can be specified.

Data for H89	Function
0	Clears cumulative value of thermal by inverter power-off.
1	Retains cumulative value of thermal after inverter power-off (factory default).

H86, H90	Reserved for particular manufacturers

H86 and H90 are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

H91	PID feedback wire break detection

Using the terminal [C1] (C1 function) (current input) for PID feedback signal enables wire break detection and alarm (*cof*) issuance. H91 specifies whether the wire break detection is enabled, or the duration of detection. (The inverter judges an input current to the terminal [C1] below 2 mA as a wire break.)

This function does not work unless C40 is set to 0.

- Data setting range: 0.0 (Disable wire break detection)
  0.1 to 60.0 s (Detect wire break and issue *cof* alarm within the time)

H92, H93	Continuous running at the momentary power failure (P, I) (refer to F14)

Refer to the description of F14.

H94	Cumulative motor run time 1 (refer to H78)

Refer to the description of H78.

H95	DC braking (Braking response mode) (refer to F20 to F22)

Refer to the descriptions of F20 through F22.

H96	STOP key priority/Start check function

H96 specifies a functional combination of "STOP key priority" and "Start check function" as listed below.

H96 data	STOP key priority	Start check function
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

■ **STOP key priority**

Even when run commands are entered from the digital input terminals or via the RS-485 communications link (link operation), pressing the STOP key forces the inverter to decelerate and stop the motor. After that, *er6* appears on the LED monitor.

■ **Start check function**

For safety, this function checks whether any run command has been turned ON or not in each of the following situations. If one has been turned ON, the inverter does not start up but displays alarm code *er6* on the LED monitor.

- When the power to the inverter is turned ON.
- When the PRG/RESET key is pressed to release an alarm status or when the digital input terminal command "RST" ("Reset alarm") is turned ON.
- When the run command source is switched by a digital input terminal command such as "LE" ("Enable communications link via RS-485 or fieldbus") or "LOC" ("Select local (keypad) operation").

H97	Clear alarm data **Related function codes: H45 Mock alarm**

H97 clears alarm data (alarm history and relevant information) stored in the inverter.

To clear alarm data, simultaneous keying of "STOP key + ∧ key" is required.

H97 data	Function
0	Disable
1	Enable (Setting "1" clears alarm data and then returns to "0.")

H98	Protection/Maintenance function (Mode selection)

H98 specifies whether to enable or disable automatic lowering of carrier frequency, input phase loss protection, output phase loss protection, judgment threshold on the life of DC link bus capacitor, judgment on the life of DC link bus capacitor, DC fan lock detection and braking transistor error detection by setting a bit combination.

Automatic lowering of carrier frequency (Bit 0)

This function should be used for critical machinery that requires keeping the inverter running. Even if a heat sink overheat or overload occurs due to excessive load, abnormal surrounding temperature, or cooling system failure, enabling this function lowers the carrier frequency to avoid tripping (*0h1*, *0h3* or *0lu*). Note that enabling this function results in increased motor noise.

Input phase loss protection (*lin*) (Bit 1)

This function detects the voltage unbalance between the phases and phase loss of 3-phase power supply. And an alarm displays *lin* to stop the inverter when it detects.

Note In configurations where only a light load is driven or a DC reactor is connected, phase loss or line-to-line voltage unbalance may not be detected because of the relatively small stress on the apparatus connected to the main circuit.

Output phase loss protection (*0pl*) (Bit 2)

Upon detection of output phase loss while the inverter is running, this feature stops the inverter and displays an alarm *0pl*.

Note Where a magnetic contactor is installed in the inverter output circuit, if the magnetic contactor goes OFF during operation, all the phases will be lost. In such a case, this protection function does not work.

Judgment threshold on the life of DC link bus capacitor (Bit 3)

Bit 3 is used to select the threshold for judging the life of the DC link bus capacitor between the factory default setting and a user-defined setting.

Note Before specifying a user-defined threshold, measure and confirm the reference level in advance.
(🕮 Function code H42)

Judgment on the life of DC link bus capacitor (Bit 4)

Whether the DC link bus capacitor has reached its life is judged by measuring the discharging time after power OFF. The discharging time is determined by the capacitance of the DC link bus capacitor and the load inside the inverter. Therefore, if the load inside the inverter fluctuates significantly, the discharging time cannot be accurately measured. As a result, it may be mistakenly determined that the DC link bus capacitor has reached the end of its life. To avoid such an error, you can disable the judgment based on the discharging time. (Even if it is disabled, the judgment based on the “ON-time counting” while the voltage is applied to the DC link bus capacitor is performed.)

🕮 For details about the life prediction function, refer to H42.

Since load may fluctuate significantly in the cases described below, disable the judgment on the life during operation even in user-defined setting mode. During periodical maintenance, either conduct the measurement with the judgment enabled under appropriate conditions or conduct the measurement under the operating conditions matching the actual ones.

- Auxiliary input for control power is used.
- An option card is used.
- Another inverter or equipment such as a PWM converter is connected to terminals of the DC link bus.

DC fan lock detection (bit 5) (400 V class: VXT-203A-4 or above)

The inverter may be equipped with the internal air circulation DC fan depending on the capacity. When the inverter detects that the DC fan is locked by a failure or other cause, you can select between continuing the inverter operation or making the inverter enter into the alarm state.

Entering alarm state: The inverter issues the alarm *0h1* and allows the motor to coast to a stop.

Continuing operation: The inverter does not enter the alarm state and continues to run the motor.

Note that, however, the inverter turns ON the “OH” and “LIFE” signals on the transistor output terminals whenever the DC fan lock is detected regardless of your selection.

Note If the ON/OFF control of the cooling fan is enabled (H06 = 1), the cooling fan may stop depending on the operating condition of the inverter. In this case, the DC fan lock detection feature is considered normal (e.g., the cooling fan is normally stopped by the stop fan command.) so that the inverter may turn OFF the LIFE or OH signal output, or enable to cancel the alarm *0h1* , even if the internal air circulation DC fan is locked due to a failure etc. (When you start the inverter in this state, it automatically issues the run fan command. Then the inverter detects the DC fan lock state, and turns ON the “LIFE” or “OH” output or enters the alarm *0h1* state.)

Note that, operating the inverter with the DC fan being locked for a long time may shorten the service life of electrolytic capacitors on the PCBs due to local high temperature inside the inverter. Be sure to check with the “LIFE” signal etc., and replace the broken fan as soon as possible.

Braking transistor error detection (Bit 6)
(*dba* VXT-72A-4 or below, VXT-115A-2 or below, VXT-12A-1 or below)

Upon detection of a built-in braking transistor error, this feature stops the inverter and displays an alarm *dba*. Set data of this bit to “0” when the inverter does not use a braking transistor and there is no need of entering an alarm state.

To set data of function code H98, assign the setting of each function to each bit and then convert the 8-bit binary to the decimal number. Refer to the assignment of each function to each bit and a conversion example below.

Bit	Function	Data = 0	Data = 1	Factory default
Bit 0	Lower the carrier frequency automatically	Disable	Enable	1: Enable
Bit 1	Detect input phase loss	Continue to run	Enter alarm processing	1: Enter alarm processing
Bit 2	Detect output phase loss	Continue to run	Enter alarm processing	0: Continue to run
Bit 3	Select life judgment threshold of DC link bus capacitor	Factory default	User-defined setting	0: Factory default
Bit 4	Judge the life of DC link bus capacitor	Disable	Enable	1: Enable
Bit 5	Detect DC fan lock	Enter alarm processing	Continue to run	0: Enter alarm processing
Bit 6	Detect braking transistor breakdown	Continue to run	Enter alarm processing	0: Continue to run

Decimal and binary conversion

Decimal = Bit 6 × 2^6 + Bit 5 × 2^5 + Bit 4 × 2^4 + Bit 3 × 2^3 + Bit 2 × 2^2 + Bit 1 × 2^1 + Bit 0 × 2^0
= Bit 7 × 128 + Bit 6 × 64 + Bit 5 × 32 + Bit 4 × 16 + Bit 3 × 8 + Bit 2 × 4 + Bit 1 × 2 + Bit 0 × 1
= 64 + 0 × 32 + 1 × 16 + 0 × 8 + 0 × 4 + 1 × 2 + 1 × 1
= 16 + 2 + 1
= 19

H99, **H197, H198** **H199**	**Password 2 setting/check** **User password 1 (selection of protective operation, setting check)** **User password protection valid**

The password function is the function to hide the function code entirely/partially which is set for the inverter. When this function is used, perform correct settings after familiarizing yourself with the following details. If incorrect settings are made, the function code cannot be changed or checked. An alarm may also occur and the inverter may stop. Perform the operation carefully.

Tip If the objective is to prevent inadvertent rewriting of the setting value from the touch panel, it is recommended to use the data protective function with function code F00 rather than the password function. For details of the data protection, refer to the items in F00.

Note If a password is inadvertently set, the setting values cannot be changed from the remote touch panel, multi-function touch panel or external device using the link function. Be careful for setting.

Note If an incorrect password setting value is entered and you failed to decode the password, the password protection state cannot be released. In addition, failure to decode the password consecutively 5 times results in minor failure */-al*.

Note To prevent the password decoding by an ill-disposed third party, failure to decode the password for the specified number of times results in */ok* alarm, which disables the inverter operation. Therefore, it is recommended to decode the password during stop of the system. If it is necessary to decode the password during operation, perform decoding carefully.

Note We are not able to know the passwords set by customers. If you have forgotten the password setting value, the only way to decode the password is initialization of the function code. Set and control the password carefully.

■ **Password 1 (Rewrite disable protection)**

Function code setting values excluding some codes can be protected as rewrite disable.

Select the target function code which is protected by H197 and set the password (hexadecimal 4 digits) with function code H198. When function code H199 is set to 1, password 1 protective status (rewrite disable protection) is active.

■ **Temporary decoding of password 1 (rewrite disable protection)**

When password 1 protective status is shown and the same value as the password set for function code H198 is entered in H198, password 1 protective status is temporarily released and the function code setting value can be rewritten.

If password 2 is set at the same time, it is necessary to decode password 2 with H99 in advance.

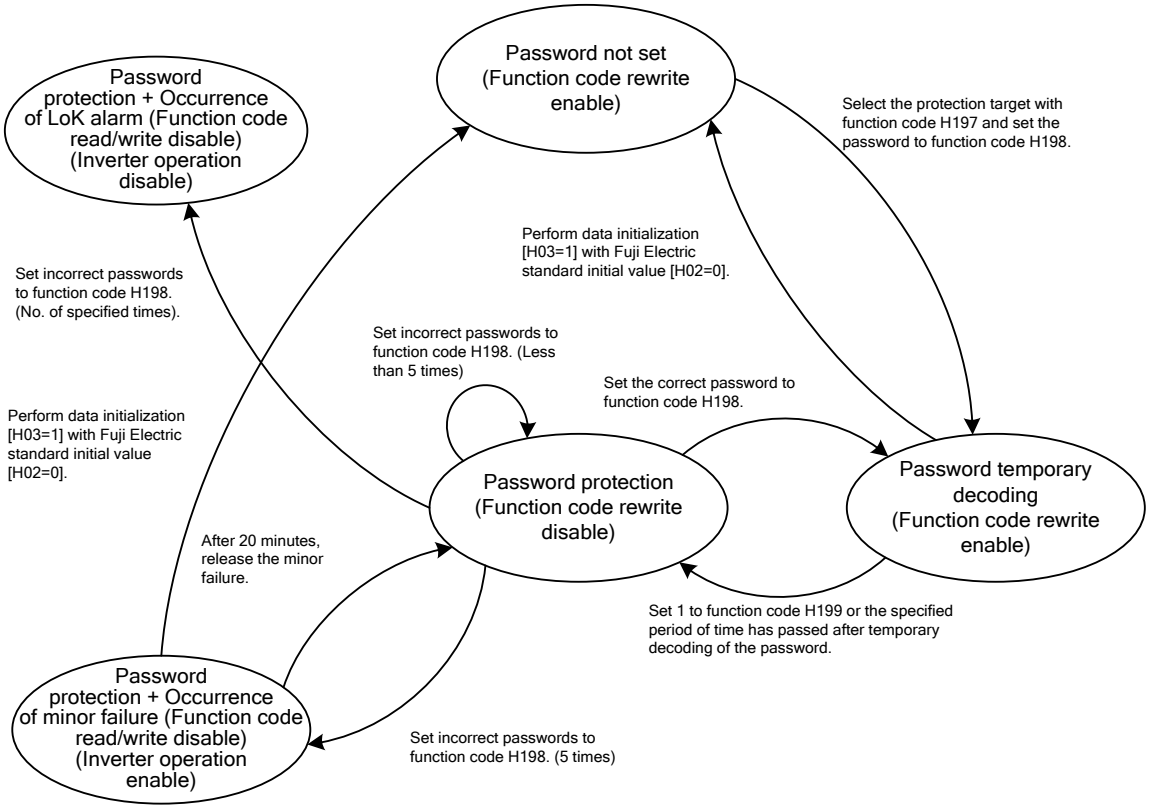


Figure 5.3-12 Relation chart of password 1 protection status

■ **Password 2 (Read/write disable protection)**

Setting values of all function codes not by selecting function code H197 can be protected as read disable and rewrite disable. (Exceptionally, partial function codes are not protected.)

Set the password with function code H99 and set function code H199 to 1. Password 2 protective status (read/write disable protection) is active.

The function code of read/write disable does not allow writing of the setting value to the inverter with a remote touch panel, multi-function touch panel or external device using serial communication, or reading of the setting value.

■ **Temporary decoding of password 2 (read/write disable protection)**

When password 2 protective status is shown and the same value as the password (hexadecimal 4 digits) set for function code H99 is entered in H99, password 2 protective status is temporarily decoded and the function code value can be read and it can be displayed on the touch panel.

If password 1 protection (rewrite disable protection) is also set, the function code can be rewritten by temporarily decoding password 1 protective status continuously.

■ **Failure of temporary decoding of passwords 1 and 2**

In password 1 protective status or password 2 protective status, if the password value entered in function code H198 or H99 is incorrect when trying to temporarily cancel the protective status, temporary decoding is disabled.

In both function codes H198 and H99, 5 consecutive failures of password input result in minor failure */-al*.

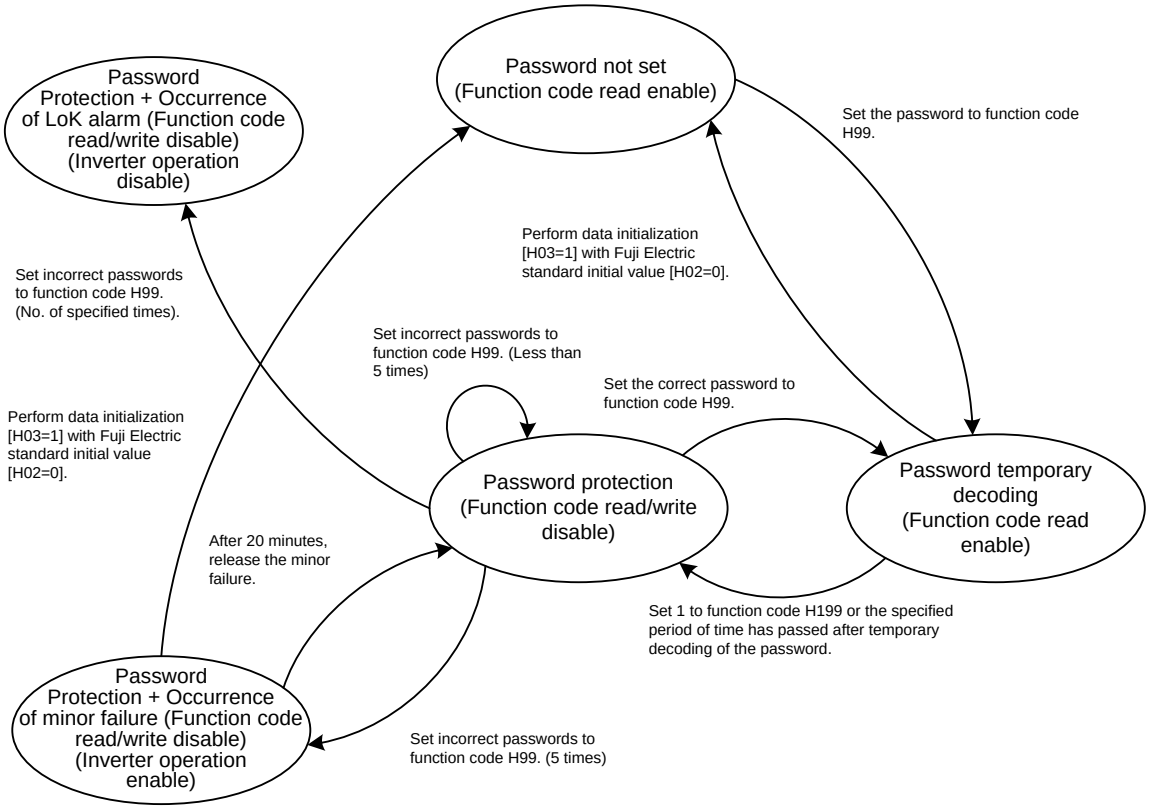


Figure 5.3-13 Relation chart of password 2 protection status

Note In our factory default status, passwords are not provided excluding special products. Therefore, if the password set for H198 or H99 is unknown or forgotten, we do not answer or inform you of the password or its decoding method from protective status.

For this reason, set and control the password at your own risk. If a password is set at the delivery of the product and its decoding is required, please contact the dealer you purchased or the unit manufacturer. (We are not able to know the passwords set by customers.)

■ **Setting passwords 1 and 2 with multi-function touch panel and temporary decoding**

Setting or temporary decoding of passwords 1 and 2 using the multi-function touch panel is performed by the special menu on the multi-function touch panel. Therefore, function codes H99, H198 and H199 are not displayed on the function code list of the function code setting menu or function code check menu on the multi-function touch panel (H197 is displayed).

📖 For the special password menu of the multi-function touch panel, refer to the instruction manual of the multi-function touch panel.

H101	Destination

Refer to Chapter 4 “4.4 Destination Setting”.

H111	UPS operation Level

Refer to the description of “■UPS operation” in E01 to E05.

- Data setting range: 120 to 220 VDC: (200 V class), 240 to 440 VDC: (400 V class)

H114	Anti-regenerative control (Level)	Related function code: H69

Allows the adjustment of the level when anti-regenerative control by torque limiter is performed with H69 = 2, 4. Basically, there is no need to modify the setting.

Data for H114	Function
0.0 to 50.0%	Adjusted level: Increasing the value increases the frequency operation.
999	Standard level

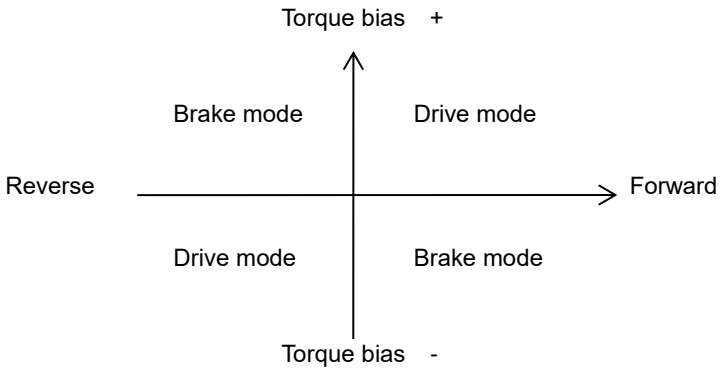
H147	Speed control (Jogging) (FF Gain)

Refer to the description of d01 to d08.

H154	Torque bias (Mode selection)
H155 to H157	Torque bias (Level 1 to 3)
H158	Torque bias (Mechanical loss compensation)
H159	Torque bias (Startup timer)
H161	Torque bias (Shutdown timer)
H162	Torque bias (Limiter)

Torque bias value is added to the torque command (the output of ASR) before the torque limiter value. The torque bias level can be selected from the analog input value or the three fixed values which are specified with function codes and switched by the digital input signals “TB1” and “TB2”. For block diagram for control logic, refer to Chapter 8, Figure 8.6-5.

The direction of run command and the polarity of the torque bias determine the mode of drive operation (driving/braking). Refer to the figure below.



■ **Modes select (H154)**

This function allows to select the method of torque bias input.

H154 data	Function
0	Disable torque bias (factory default)
1	Enable levels 1,2 and 3 selected by digital inputs “TB1”, “TB2”.
2	Enable analog input value.

■ **Set level 1, 2 and 3 (H155 to H157); Select torque bias 1, 2 -- “TB1”, “TB2” (E01 toE05 data = 61, 62)**

The combination of the ON/OFF states of digital input signals “TB1” and “TB2” selects one of 3 different torque-bias levels defined beforehand by the 3 function codes H155 to H157 (Torque-bias level 1, level 2 and level 3). These functions cannot be changed during running.

Set level 1, 2 and 3 data setting range: -300.00 to 300.00 (%)

input signals		Torque-bias to be selected
“TB2”	“TB1”	
OFF	OFF	Disable torque-bias
OFF	ON	H155 Torque-bias level 1
ON	OFF	H155 Torque-bias level 2
ON	ON	H155 Torque-bias level 3

■ **Mechanical loss compensation (H158)**

Use this function compensate the amount of the mechanical loss of a load.

- Data setting range: 0 to 300.00 (%) of a motor rated torque

■ **Torque-bias hold command -- “H-TB” (E01 to E05 data = 62)**

Turning this terminal command ON enables a torque-bias hold command. This command directs to preserve the torque-bias data supplied via an analog input.

■ **Startup timer (H159)**

H159 is the time to increase the bias torque from 0 to 100% of the motor rated torque.
Use this function for adjusting the release timing of the mechanical brake control at zero speed.
If this function code is set to “0.00”, the torque bias is activated immediately.

- Data setting range: 0.00 (Factory default) to 1.00 (s)

■ **Shutdown timer (H161)**

H161 is the time which is defined to decrease the bias torque from 100 to 0% of the motor rated torque.
Use this function for adjusting the apply timing of the mechanical brake control at zero speed.

- Data setting range: 0.00(factory default) to 1.00 (s)

■ **Limiter (H162)**

This function code can be applied to limit the torque bias for protection when the load sensor has failed. The absolute value of the torque bias is limited by setting the value of the function code H162.

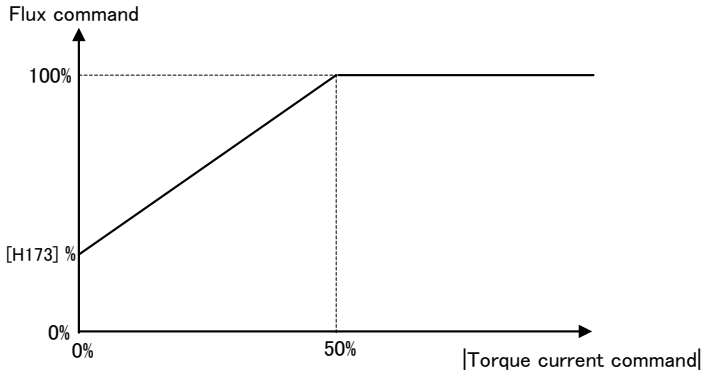
- Data setting range: 0 to 200 (%) (Factory default)

H173	Magnetic flux level at light load

This function decreases the motor magnetic flux at light load and can reduce the motor noise. It is only available under vector control with speed sensor.

The motor magnetic flux command is controlled in proportion to torque current command that is less than 50%. H173 specifies the minimum value of the flux command. Refer to the figure below.

- Data setting range: 10 to 100(%) (factory default)



H180	Brake control signal (Check-timer for brake operation) Related function code: J68 to J72

Refer to the description of J68.

H195	DC braking (Braking timer at the startup) Related function code: F21

DC braking can be activated at startup. For details, refer to the description of F21.

5.3.6 A codes (Motor 2 parameters)

IMO Jaguar VXT allows to switch between 2 motors for operation using the same inverter.

Function code	“M2”	Motor to drive	Remarks
F/E/P and other codes	OFF	Motor 1	Including function codes commonly applied to motors 1 to 2.
A codes	ON	Motor 2	Induction motor control only.

Note This manual describes function codes applied to motor 1 only. For ones applied to motor 2, refer to the corresponding function codes for motor 1 in Table 5.3-19.

It turned ON M2 accidentally while driving a PMSM, it will be driven as induction motor. There is a risk of an accident.

When motor switching is specified, the function codes in Table 5.3-19 are switched. Note that the functions listed in Table 5.3-20 are for motor 1 only and not available when the motor 2 is selected. However, they can be enabled with A98.

Table 5.3-19 Function Codes to be Switched

Name	Function code	
	1st motor	2nd motor
Maximum frequency	F03	A01
Base frequency	F04	A02
Rated voltage at base frequency	F05	A03
Maximum output voltage	F06	A04
Torque boost	F09	A05
Electronic thermal overload protection for motor (Select motor characteristics)	F10	A06
(Overload detection level)	F11	A07
(Thermal time constant)	F12	A08
DC braking (Braking starting frequency)	F20	A09
(Braking level)	F21	A10
(Braking time)	F22	A11
Starting frequency	F23	A12
Load selection / Auto torque boost/ Auto energy saving operation	F37	A13
Drive control selection	F42	A14
Motor parameters (No. of poles)	P01	A15
(Rated capacity)	P02	A16
(Rated current)	P03	A17
(Auto-tuning)	P04	A18
(Online tuning)	P05	A19
(No-load current)	P06	A20
(%R1)	P07	A21
(%X)	P08	A22
(Slip compensation gain for driving)	P09	A23
(Slip compensation response time)	P10	A24
(Slip compensation gain for braking)	P11	A25
(Rated slip frequency)	P12	A26

Table 5.3-19 Function Codes to be Switched (cont'd)

Name		Function code	
		1st motor	2nd motor
	(Iron loss factor 1)	P13	A27
	(Magnetic saturation factor 1 to 5)	P16 to P20	A30 to A34
	(%X correction factor 1)	P53	A53
	(Torque current under vector control)	P55	A55
	(induced voltage factor under vector control)	P56	A56
Speed control	(Speed command filter)	d01	A43
	(Speed detection filter)	d02	A44
	(P Gain)	d03	A45
	(Integral time)	d04	A46
	(FF Gain)	d05	A47
	(Notch filter resonance frequency)	d07	A49
	(Notch filter attenuation level)	d08	A50
Motor selection		P99	A39
Slip compensation (Operating conditions)		H68	A40
Output current fluctuation damping gain for motor		H80	A41
Cumulative motor run time		H94	A51
Startup count for motor		H44	A52
Reserved for particular manufacturers		d51	d52

Table 5.3-20 Function Codes not available for the Motor 2

Data	Function codes	2nd motor operation
Non-linear V/f pattern	H50 to H53, H65, H66	Disabled
Starting frequency 1 (Holding time)	F24	Disabled
Stop frequency (Holding time)	F39	Disabled
Motor overload early warning	E34, E35	Disabled
Droop control	H28	Disabled
UP/DOWN control	H61	Fixed at the initial setting (0 Hz)
PID control	J01 to J06, J08 to J13, J15 to J19 J56 to J62, J105 to J138, H91	Disabled
Brake signal	J68 to J72, J95, J96	Disabled
Current limiter	F43, F44	Disabled
Rotational direction limitation	H08	Disabled
Maintenance Interval/ Preset startup count for maintenance	H78, H79	Disabled
DC braking (Braking timer at the startup)	H195	Disabled
PMSM drive	F42	Disabled

A98	Motor 2 (Function selection)

Setting range: 0000 to FFFF (hexadecimal)

Among the functions disabled for motor 2 shown in Table 5.3-20, function A98 allows to enable the functions below.

Bit	Function	Data = 0	Data = 1	Factory default
Bit 0	Current limitation	Disabled	Enabled	0: Disabled
Bit 1	Rotational direction limitation	Disabled	Enabled	0: Disabled
Bit 2	Non-linear V/f	Disabled	Enabled	0: Disabled
Bit 3	PID control	Disabled	Enabled	0: Disabled
Bit 4	Brake signal	Disabled	Enabled	0: Disabled
Bit 5	DC braking at start-up	Disabled	Enabled	0: Disabled
Bit 6 to 15	No function assigned	—	—	—

5.3.7 b, r codes (Speed control 3 and 4 parameters)

IMO Jaguar VXT has four sets of speed control parameter. They can be selected by “MPRM1”, “MPRM2” signals. For the description of speed control parameters, refer to function code d01.

Name		Speed control parameter sets			
		set1	set2	set3	set4
Speed control	(Speed command filter)	d01	A43	b43	r43
	(Speed detection filter)	d02	A44	b44	r44
	(P gain)	d03	A45	b45	r45
	(Integral time)	d04	A46	b46	r46
	(FF Gain)	d05	A47	b47	r47
	(Notch filter resonance frequency)	d07	A49	b49	r49
	(Notch filter attenuation level)	d08	A50	b50	r50

■ **Select speed control parameter 1, 2 -- “MPRM1”, “MPRM2” (E01 to E05 data = 78, 79)**

The combination of the ON/OFF states of digital input signals “MPRM1” and “MPRM2” selects one among 4 different speed control parameter sets .

input signals		Selected speed control parameter set
“MPRM2”	“MPRM1”	
OFF	OFF	d01 to d08 speed control parameter set1
OFF	ON	A43 to A50 speed control parameter set2
ON	OFF	b43 to b50 speed control parameter set3
ON	ON	r43 to r50 speed control parameter set4

5.3.8 J codes (Applied functions)

J01	PID control (Mode selection)

Under PID control, the inverter detects the state of a control target object with a sensor or similar device and compares it with the commanded value (e.g., temperature control command). If there is any deviation between them, PID control operates so as to minimize it. That is, it is a closed loop feedback system that matches a controlled variable (feedback amount).

PID control expands the application area of the inverter to process control (e.g., flow control, pressure control, and temperature control) and speed control (e.g., dancer control).

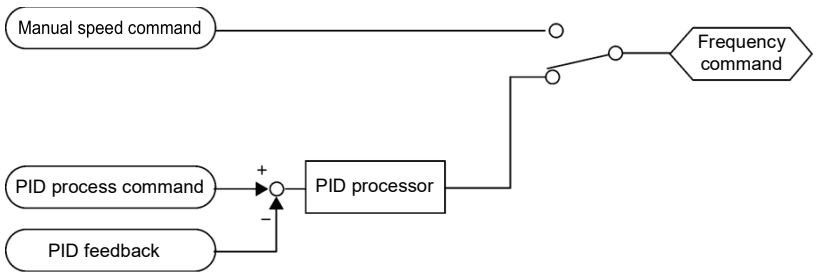
If PID control is enabled (J01 = 1, 2 or 3), the frequency control of the inverter is switched from the drive frequency command generator block to the PID command generator block.

■ **Mode Selection (J01)**

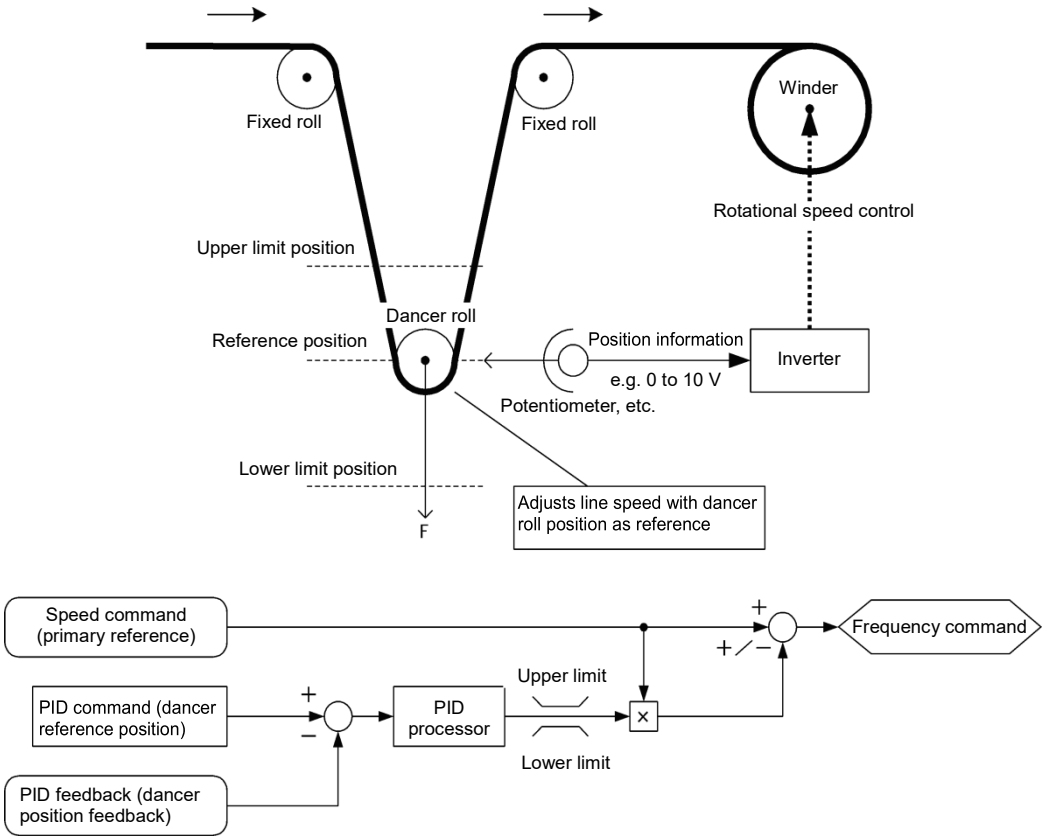
J01 selects the PID control mode.

J01 data	Function
0	Disable
1	Process control (normal operation)
2	Process control (inverse operation)
3	Speed control (dancer control)

<PID process control block diagram>



<PID dancer control block diagram>



- Using J01 allows switching between normal and inverse operations for the PID control output, so you can specify an increase/decrease of the motor rotating speed depending on the difference (error component) between the commanded (input) and feedback amounts, making it possible to apply the inverter to air conditioners. The terminal command IVS can also switch operation between normal and inverse.

For details about the switching of normal/inverse operation, refer to the description of "■ Switch normal/inverse operation – "IVS"" (E01 to E05, data = 21).

J02	**PID Control (Remote command)** **Related function code** **J105: PID control (Display unit)** **J106: PID control (Maximum scale)** **J107: PID control (Minimum scale)** **J136 to J138: PID control multistep command 1 to 3**

J02 sets the source that specifies the command value (SV) under PID control.

J02 data	Function
0	Keypad Specify the PID command by using the ⌃ / ⌄ keys on the keypad.
1	PID command 1 (Analog input: Terminals [12], [C1] (C1 function), [C1] (V2 function)) Voltage input to the terminal [12] (0 to ±10 VDC, 100% PID command/ ±10 VDC) Current input to the terminal [C1] (C1 function) (4 to 20 mA DC, 100% PID command/ 20 mA DC) Voltage input to the terminal [C1] (V2 function) (0 to +10 VDC, 100% PID command/ +10 VDC)
3	Terminal command UP/DOWN Using the "UP" or "DOWN" command in conjunction with PID minimum scale to maximum scale (specified by J106 and J107) with which the command value is converted into a physical quantity, etc., you can specify 0 to 100% of the PID command (± 100% for PID dancer control).
4	Command via communications link Use function code S13 to specify the PID command by communications. The transmission data of 20000d (decimal) is equal to 100% (maximum set point value) of the PID command.

[1] PID command with the ⌃ / ⌄ keys on the keypad (J02 = 0, factory default)

Using the ⌃ / ⌄ keys on the keypad in conjunction with PID minimum / maximum scale (specified by J106 and J107), you can specify 0 to 100% of the PID command (±100% for PID dancer control) in an easy-to-understand, converted command format.

For details of operation, refer to Chapter 3 "3.3.5 Setting up PID commands from the keypad."

[2] PID command by analog inputs (J02 = 1)

When any analog input (voltage input to terminals [12] and [C1] (V2 function), or current input to terminal [C1] (C1 function)) for PID command 1 (J02 = 1) is used, it is possible to arbitrary specify the PID command by multiplying by the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted. In addition to J02 setting, it is necessary to select PID process command 1 for analog input (specified by any of E61 to E63, function code data = 3). For details, refer to the descriptions of E61 to E63.

Table 5.3-21 Adjustable elements of PID command

Input terminal	Input range	Bias		Gain		Polarity	Filter	Offset
		Bias	Base point	Gain	Base point			
[12]	0 to +10V, -10 to +10V	C55	C56	C32	C34	C35	C33	C31
[C1] (C1)	4 to 20mA, 0 to 20mA	C61	C62	C37	C39	C40	C38	C36
[C1] (V2)	0 to +10V	C67	C68	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

C31, C36 or C41 configure the offset for an analog voltage/current input.

■ Filter (C33, C38, C43)

C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. The larger the setting of time constant is, the slower the response is. Specify the proper filter time constant taking into account the response speed of the machine (load). If an analog input signal fluctuates due to line noises, increase the filter time constant.

■ Polarity selection for terminal [12] (C35)

C35 configures the input range for analog input voltage of terminal [12].

C35 data	Modes for terminal inputs
0	-10 to +10V
1	0 to +10 V(negative value of voltage is regarded as 0 V)

■ Range / polarity selection for terminal [C1] (C1 function) (C40)

C40 configures the input range for analog input current of terminal [C1] (C1 function).

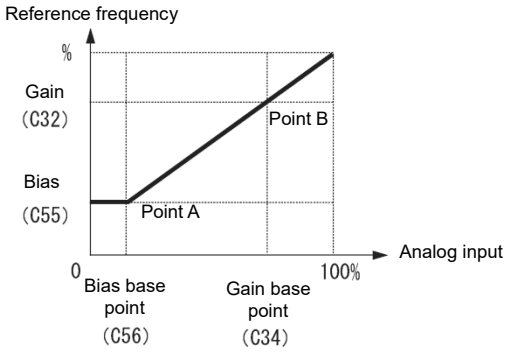
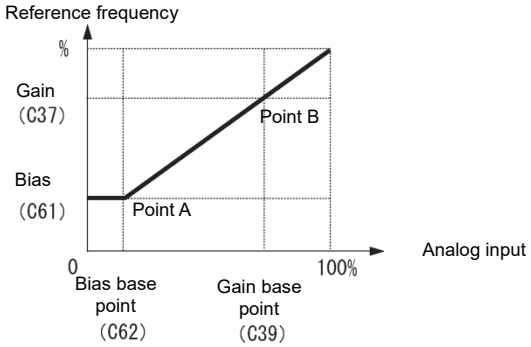
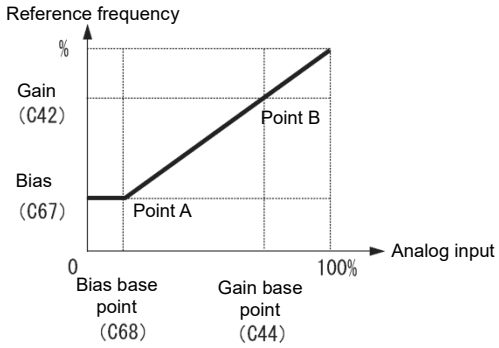
C40 data	Range of terminal inputs	Handling when a bias value is configured as minus
0	4 to 20 mA (Factory default)	Limits any value lower than 0 to 0.
1	0 to 20 mA	
10	4 to 20 mA	Enables any value lower than 0 as minus value.
11	0 to 20 mA	

■ Polarity selection for terminal [C1] (V2 function) (C45)

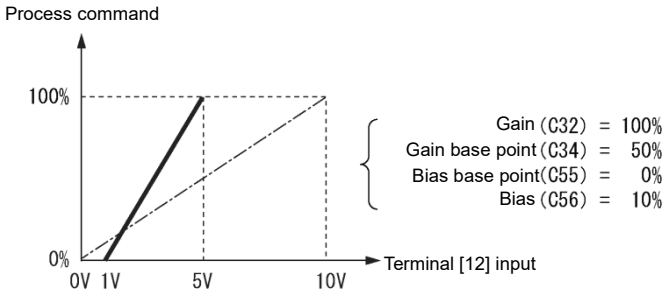
C45 configures the input range for analog input voltage of terminal [C1] (V2 function).

C45 data	Modes for terminal inputs	When bias is specified to be negative
0	0 to +10V	Makes a value lower than 0 effective as a negative value.
1	0 to +10V (factory default)	Limits a value lower than 0 to 0.

■ **Gain and bias**

Terminal	Data
[12]	
[C1] (C1) function	
[C1] (V2 function)	

(Example) In order to allocate for the range of 0 to 100% to the range of 1 to 5 V at terminal [12], set as follows.



[3] PID command with UP/DOWN control (J02 = 3)

When UP/DOWN control is selected as a PID speed command, turning the terminal command “UP” or “DOWN” ON causes the PID set point value to change within the range from minimum scale to maximum scale.

The PID set point value can be specified in physical quantity units (such as temperature or pressure) with the minimum scale (J106) and maximum scale (J107).

To select UP/DOWN control as a PID set point value, the “UP” and “DOWN” should be assigned to the digital input terminals [X1] to [X5]. (🕮 Function codes E01 to E05 data = 17, 18)

“UP” Data = 17	“DOWN” Data = 18	Action
OFF	OFF	Retain PID set point value.
ON	OFF	Increase PID set point value at a rate between 0.1%/0.1 s and 1%/0.1 s.
OFF	ON	Decrease PID set point value at a rate between 0.1%/0.1 s and 1%/0.1 s.
ON	ON	Retain PID set point value.

Note The inverter internally holds the PID command value set by UP/DOWN control and applies the held value at the next restart (including powering ON).

[4] PID command via communications link (J02 = 4)

Use function code S13 to specify the PID command by communications. The transmission data of 20000 (decimal) is equivalent to 100% (maximum set point value) of the PID command. For details of the communications format, refer to the RS-485 Communication User’s Manual.

Note
- Other than the remote command selection by J02, the PID multistep commands 1, 2 or 3 (specified by J106, J137 or J138, respectively) selected by the PID multistep commands “PID-SS1” and “PID-SS2” can also be used as preset set point values for the PID command.
- In dancer control (J01 = 3), the setting command from the keypad is in conjunction with the function code J57 (PID control: Dancer position set point), and it is saved as function code data.

Selecting Feedback Terminals

For feedback control, determine the connection terminal according to the type of the sensor output.

- If the sensor is a current output type, use the current input terminal [C1] (C1 function) of the inverter.
- If the sensor is a voltage output type, use the voltage input terminal [12] of the inverter, or switch over the terminal [C1] (V2 function) to the voltage input terminal and use it.

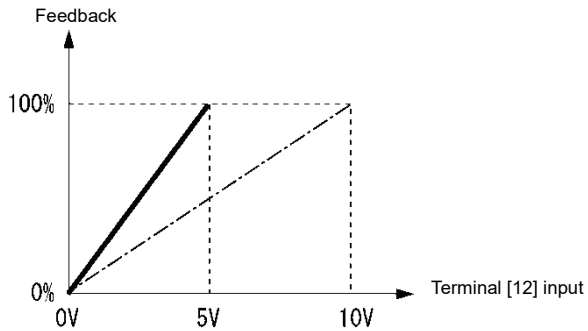
🕮 For details, refer to the descriptions of E61 to E63.

<Application example: Process control> (for air conditioners, fans and pumps)

The operating range for PID process control is internally controlled as 0% through 100%. For the given feedback input, determine the operating range to be controlled by means of gain adjustment.

Example: When the external sensor has the output range of 1 to 5 V:

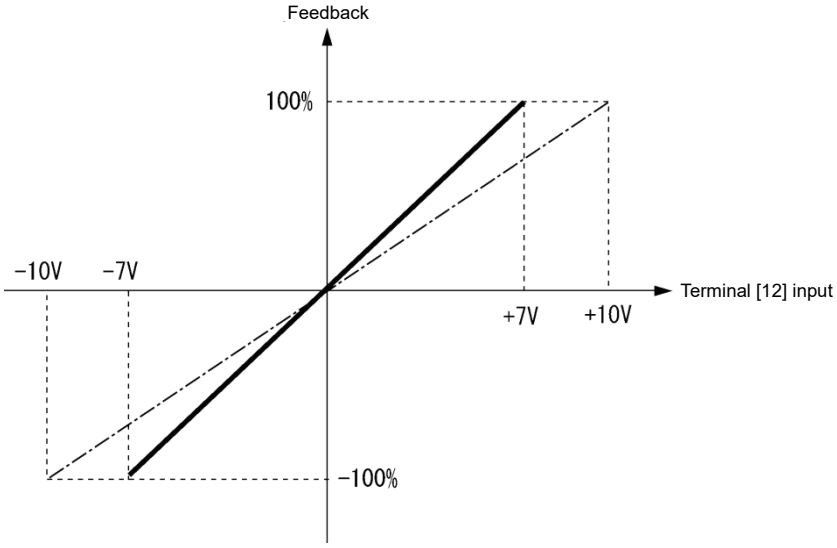
- Use terminal [12] as the input terminal in voltage.
- Set the gain (C32 for analog input adjustment) to 200% in order to make 5V of the maximum output of the external sensor to be 100% of input scale.
  For the input specification of terminal 12, 0-10V is equivalent to 0-100%.Therefore the gain has to be set 200% (= 10 V / 5 V *100). Note also that any bias setting does not apply to feedback control.



<Application examples: Dancer control> (for winders)

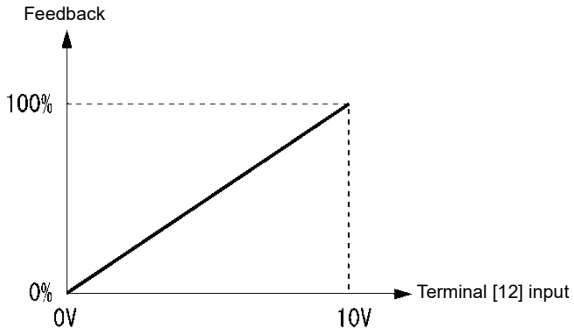
Example 1: When an external sensor has the output range of -7 to +7 VDC:

- Use terminal [12] as the input terminal in voltage.
- When the external sensor has ±7 VDC of bipolar output, inside the inverter ±7 VDC should be equivalent to ±100%. To convert ±7 VDC from the output of an external sensor to ±100%, the gain (C32 for analog input adjustment) has to be set 143% (≈10 V / 7 V *100).



Example 2: When an external sensor has the output range of 0 to 10 VDC:

- Use terminal [12] as the input terminal in voltage.
- When the external sensor has unipolar output, inside the inverter it is controlled within the range of 0 to 100%.



In this example, it is recommended that the dancer reference position is set around the 5 V (50%) point.

PID display coefficient and Monitoring

To monitor the PID command and its feedback value, set the scale to convert the values into easy-to-understand physical quantities such as temperature. The display unit is invalid on the standard keypad (TP-M2). The display unit is used with the multi-function keypad (TP-A1-E2C).

	Display unit	Maximum scale	Minimum scale
Terminal [12]	C58	C59	C60
Terminal [C1] (C1)	C64	C65	C66
Terminal [C1] (V2)	C70	C71	C72

🕮 Refer to function codes C59, C60, C65, C66, C71 and C72 for details on scales, and to E43 for details on monitoring.

■ **Display unit (J105)**

J105 can select the display units for monitoring PID feedback value with the multi-function keypad (TP-A1-E2C).

Setting “0” selects the factory default unit for the PID feedback value.

J105	Display unit	J105	Display unit	J105	Display unit
0	* (Factory default)	23	L/s (flow)	45	mmHg (pressure)
1	No unit	24	L/min (flow)	46	Psi (pressure)
2	%	25	L/h (flow)	47	mWG (pressure)
4	r/min	40	Pa (pressure)	48	inWG (pressure)
7	kW	41	kPa (pressure)	60	K (temperature)
20	m^3/s (flow)	42	MPa (pressure)	61	°C (temperature)
21	m^3/min (flow)	43	mbar (pressure)	62	°F (temperature)
22	m^3/h (flow)	44	bar (pressure)	80	ppm (density)

* The unit and scale for feedback values are used.

■ **Maximum scale/minimum scale (J106, J107)**

The PID control values can be converted to a physical quantity that is easy to recognize and displayed accordingly. Set the maximum scale “PID command value/ display for 100% of a PID feedback value” with J106 and the minimum scale “PID command value/ display for 0% of a PID feedback value” with J107

The displayed value is determined as follows:

Display value = (PID command value (%)) / 100 * (Max. scale - Min. scale) + Min. scale

- Data setting range: (Max. scale and min. scale) -999.00 to 0.00 to 9990.00

■ **PID multistep command 1 to 3 (J136, J137 and J138)**

A PID command value can be given by the PID multistep command and selected by digital inputs programmed with “PID-SS1” and “PID-SS2” functions. Assign the digital input terminals with “PID-SS1” and “PID-SS2” (📖Function codes E01 to E05, data =171 and 172 respectively).

PID-SS2	PID-SS1	PID multistep command
OFF	OFF	Not selected
OFF	ON	J136: PID multistep command 1 setting range: -999.0 to 0.00 to 9990
ON	OFF	J137: PID multistep command 2 setting range: -999.0 to 0.00 to 9990
ON	ON	J138: PID multistep command 3 setting range: -999.0 to 0.00 to 9990

J03 to J06	PID Control P (Gain), I (Integral time), D (Differential time), Feedback filter

■ P gain (J03)

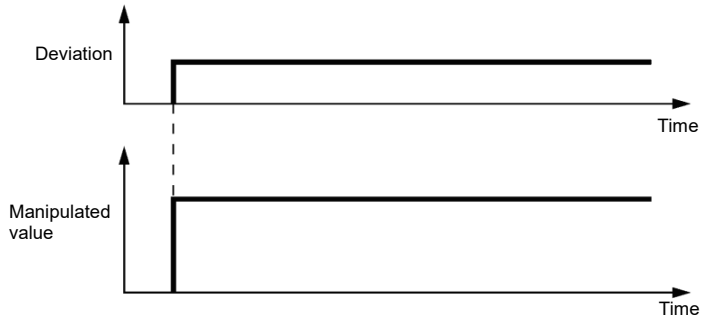
J03 specifies the proportional gain for the PID processor.

- Data setting range: 0.000 to 30.000 (times)

P (Proportional) action

An operation in which the MV (manipulated value: output frequency) is proportional to the deviation is called P action, which outputs the MV in proportion to deviation. However, P action alone cannot eliminate deviation.

Gain is data that determines the system response level against the deviation in P action. An increase in gain speeds up response, but an excessive gain may oscillate the inverter output. A decrease in gain delays response, but it stabilizes the inverter output.



■ I integral time (J04)

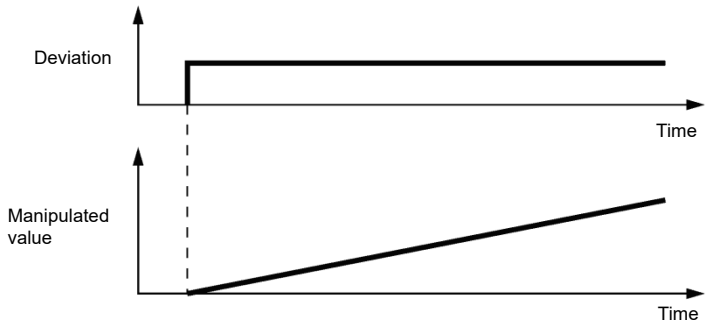
J04 specifies the integral time for the PID processor.

- Data setting range: 0.0 to 3600.0 (s)
  0.0 indicates that the integral component is ineffective

I (Integral) action

An operation in which the change rate of the MV (manipulated value: output frequency) is proportional to the integral value of deviation is called I action, which outputs the MV that integrates the deviation. Therefore, I action is effective in bringing the feedback value close to the commanded value. For the system whose deviation rapidly changes, however, this action cannot make it respond quickly.

The effectiveness of I action is expressed by integral time as parameter, that is J04 data. The longer the integral time, the slower the response. The reaction to the external disturbance also becomes slow. The shorter the integral time, the faster the response. Setting too short integral time, however, makes the inverter output tend to oscillate against the external disturbance.



■ D differential time (J05)

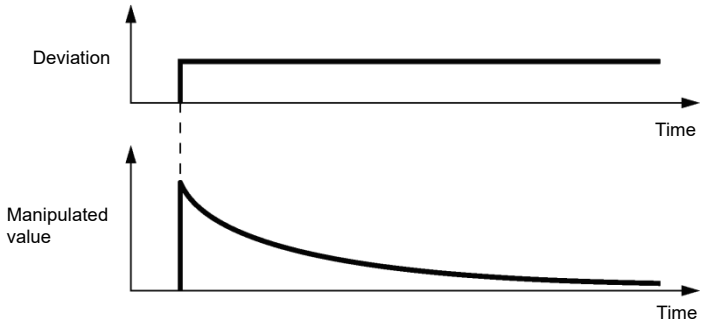
J05 specifies the differential time for the PID processor.

- Data setting range: 0.00 to 600.00 (s)
  0.00 indicates that the differential component is ineffective.

D (Differential) action

An operation in which the MV (manipulated value: output frequency) is proportional to the differential value of the deviation is called D action, which outputs the MV that differentiates the deviation. D action makes the inverter quickly respond to a rapid change of deviation.

The effectiveness of D action is expressed by differential time as parameter, that is J05 data. Setting a long differential time will quickly suppress oscillation caused by P action when a deviation occurs. Too long differential time makes the inverter output oscillation more. Setting short differential time will weakens the suppression effect when the deviation occurs.



The combined uses of P, I, and D actions are described below.

(1) PI control

PI control, which is a combination of P and I actions, is generally used to minimize the remaining deviation caused by P action. PI control always acts to minimize the deviation even if a commanded value changes or external disturbance steadily occurs. However, the longer the integral time of I action, the slower the system response to quick-changed control. P action can be used alone for loads with very large part of integral components.

(2) PD control

In PD control, the moment that a deviation occurs, the control rapidly generates greater MV (manipulated value: output frequency) than that generated by D action alone, to suppress the deviation increase. When the deviation becomes small, the behavior of P action becomes small. A load including the integral component in the controlled system may oscillate due to the action of the integral component if P action alone is applied. In such a case, use PD control to reduce the oscillation caused by P action, for keeping the system stable. That is, PD control is applied to a system that does not contain any damping actions in its process.

(3) PID control

PID control is implemented by combining P action with the deviation suppression of I action and the oscillation suppression of D action. PID control features minimal control deviation, high precision and high stability. In particular, PID control is effective to a system that has a long response time to the occurrence of deviation.

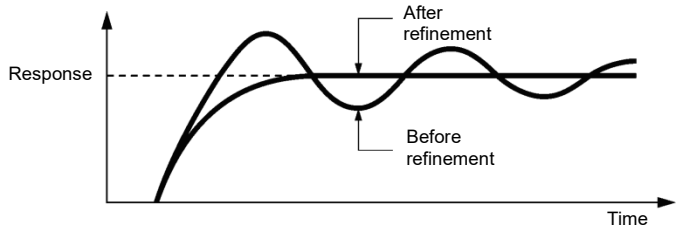
Follow the procedure below to set data to PID control function codes.

It is highly recommended that you adjust the PID control value while monitoring the system response waveform of the PID feedback with an oscilloscope or equivalent. Repeat the following procedure to determine the optimal solution for each system.

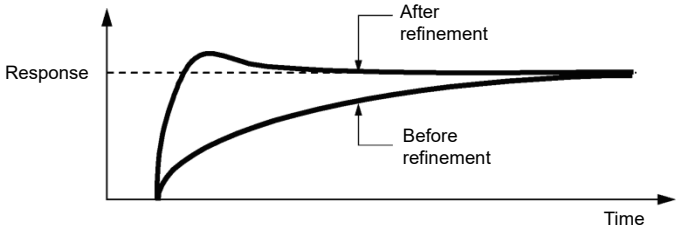
- Increase the data of J03 (PID control P (Gain)) within the range where the feedback signal does not oscillate.
- Decrease the data of J04 (PID control I (Integral time)) within the range where the feedback signal does not oscillate.
- Increase the data of J05 (PID control D (Differential time)) within the range where the feedback signal does not oscillate.

The method for refining the system response from the waveforms is shown below.

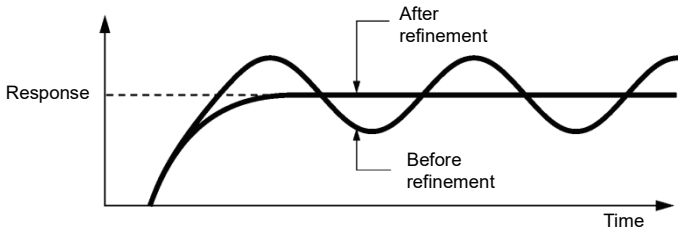
1) Suppressing overshoot
Increase the data of J04 (Integral time) and decrease that of J05 (Differential time).



2) Quick stabilizing (Moderate overshoot is allowable.)
Decrease the data of J03 (Gain) and increase that of J05 (Differential time).



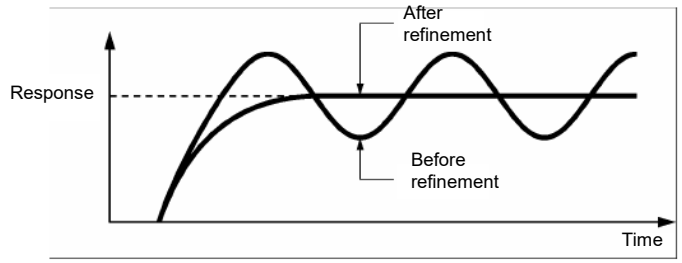
3) Suppressing oscillation whose period is longer than the integral time specified by J04
Increase the data of J04 (Integral time).



4) Suppressing oscillation whose period is approximately the same as the time specified by J05 (Differential time)

Decrease the data of J05 (Differential time).

Decrease the data of J03 (Gain), if the oscillation cannot be suppressed even though the differential time is set at 0 sec.



■ Feedback filter (J06)

J06 specifies the time constant of the filter for feedback signals under PID control.

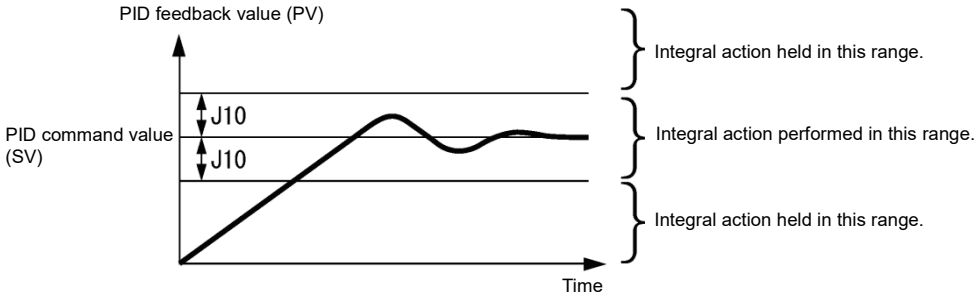
- Data setting range: 0.0 to 900.0 (s)
- This setting is used to stabilize the PID control loop. Setting a too long time constant makes the system response slow.

Note Under PID dancer control, the filter time constant setting of up to 0.1 s is recommended. To specify the filter time constant more finely, apply filter time constants for analog input (C33, C38 and C43) with J06 = 0.0.

J10	PID Control (Anti-reset windup)

J10 suppresses overshoot in control with the PID processor. As long as the error between the feedback and the PID command is beyond the preset range, the integrator holds its value and does not perform integration operation.

- Data setting range: 0 to 200 (%)



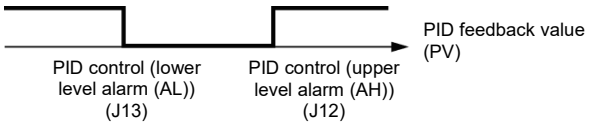
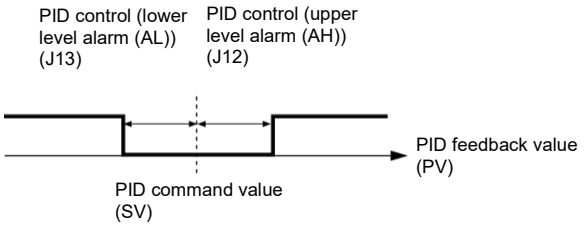
J11 to J13	PID Control (Select warning output, Upper limit of warning (AH) and Lower limit of warning (AL))

The inverter can output two types of warning signals (caused by process command value or PID error value) associated with PID control if the digital output signal “PID-ALM” is assigned to any of the programmable, output terminals with any of E20, E21 and E27 (data = 42).

J11 specifies the warning output types. J12 and J13 each specify the upper and lower limits for warnings.

■ PID Control (Select warning output) (J11)

J11 specifies one of the following alarms available.

J11 data	Alarm	Data
0	Warning caused by process command value	While PV < AL or AH < PV, “PID-ALM” is ON 
1	Warning caused by process command value with hold	Same as above (with Hold)
2	Warning caused by process command value with latch	Same as above (with Latch)
3	Warning caused by process command value with hold and latch	Same as above (with Hold and Latch)
4	Warning caused by PID error value	While PV < SV - AL or SV + AH < PV, “PID-ALM” is ON. 
5	Warning caused by PID error value with hold	Same as above (with Hold)
6	Warning caused by PID error value with latch	Same as above (with Latch)
7	Warning caused by PID error value with hold and latch	Same as above (with Hold and Latch)

Hold: During the power-on sequence, the alarm output is kept OFF (disabled) even when the monitored quantity is within the alarm range. Once it goes out of the alarm range, and comes into the alarm range again, the alarm is enabled.

Latch: Once the monitored quantity comes into the alarm range and the alarm is turned ON, the alarm will remain ON even if it goes out of the alarm range. To release the latch, perform a reset by using the PRG/RESET key on keypad or turning the terminal command RST ON. Resetting can be done by the same way as resetting an alarm.

■ PID Control (Upper limit of warning (AH)) (J12)

J12 specifies the upper limit of warning (AH) in percentage (%) of the feedback value.

■ **PID Control (Lower limit of warning (AL)) (J13)**

J13 specifies the lower limit of warning (AL) in percentage (%) of the feedback value.

Note The value displayed (%) is the ratio of the upper/lower limit to the full scale (10 V or 20 mA) of the feedback amount (in the case of a gain of 100%).

Upper limit of warning (AH) and lower limit of warning (AL) also apply to the following alarms.

Alarm	Data	How to handle the warning	
		Select warning output (J11)	Data setting
Upper limit (process command)	ON when AH < PV	Warning caused by process command	AL = 0
Lower limit (process command)	ON when PV < AL		AH = 100%
Upper limit (PID error value)	ON when SV + AH < PV	Warning caused by PID error value	AL = 100%
Lower limit (PID error value)	ON when PV < SV - AL		AH = 100%
Upper/lower limit (PID error value)	ON when |SV - PV| > AL		AL = AH
Upper/lower range limit (PID error value)	ON when SV - AL < PV < SV + AL	Warning caused by PID error value	A negative logic signal should be assigned to "PID-ALM".
Upper/lower range limit (process command)	ON when AL < PV < AH	Warning caused by process command	
Upper/lower range limit (PID error value)	ON when SV - AL < PV < SV + AH	Warning caused by PID error value	

J15	**PID control (Sleep frequency)**
J16	**PID control (Sleep timer)**
J17	**PID control (Wakeup frequency)**
J23	**PID control (Wakeup level of PID error)**
J24	**PID control (Wakeup timer)**

Sleep function (J15 to J17, J23, J24)

J15 to J17 configure the sleep function in pump control, a function that stops the inverter when the discharge pressure increases, causing the volume of water to decrease.

When the discharge pressure has increased, decreasing the reference frequency (output of the PID processor) below the sleep level (J15) for the period specified sleep timer (J16), the inverter decelerates to stop, while PID control itself continues to operate. When the discharge pressure decreases, increasing the reference frequency (output of the PID processor) above the wakeup frequency (J17), the inverter resumes operation.

The restarting conditions can be adjusted with J23 and J24.

■ PID control (Sleep frequency) (J15)

J15 specifies the frequency which triggers slow flowrate stop of inverter.

■ PID control (Sleep timer) (J16)

J16 specifies the period from when the PID output drops below the frequency specified by J15 until the inverter starts deceleration to stop.

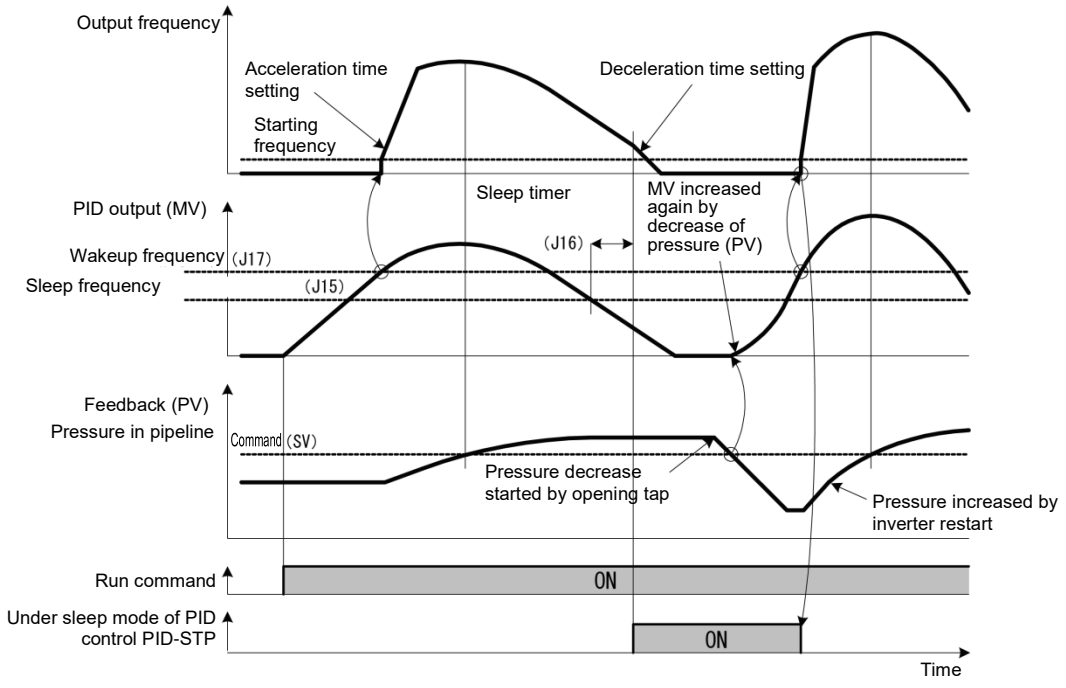
■ PID control (Wakeup frequency) (J17)

J17 specifies the wakeup frequency. Set J17 to a frequency higher than the sleep frequency (J15). If the specified wakeup frequency is lower than the sleep frequency, the sleep frequency is ignored; the sleep function is triggered when the output of the PID processor drops below the specified wakeup frequency.

■ Assignment of "PID-STP" ("Under sleep mode of PID control") (E20, E21 and E27, data = 44)

"PID-STP" ("Under sleep mode of PID control") is ON when the inverter is in a stopped state due to the sleep function under PID control. PID-STP should be assigned if it is necessary to output a signal to indicate that the inverter is stopped.

For the sleep function, see the chart below.



■ **PID control (Wakeup level of PID error) (J23)**

■ **PID control (Wakeup timer) (J24)**

When both of the two conditions below are satisfied (AND), the inverter is restarted.

- The discharge pressure has decreased, increasing the frequency (output of the PID processor) to or above the wakeup frequency (J17) and the wakeup timer (J24) has elapsed.
- The absolute error of the PV (feedback value) against to the SV (command value) is equal to or higher than the wakeup level of PID error (J23), and the wakeup time (J24) has elapsed.

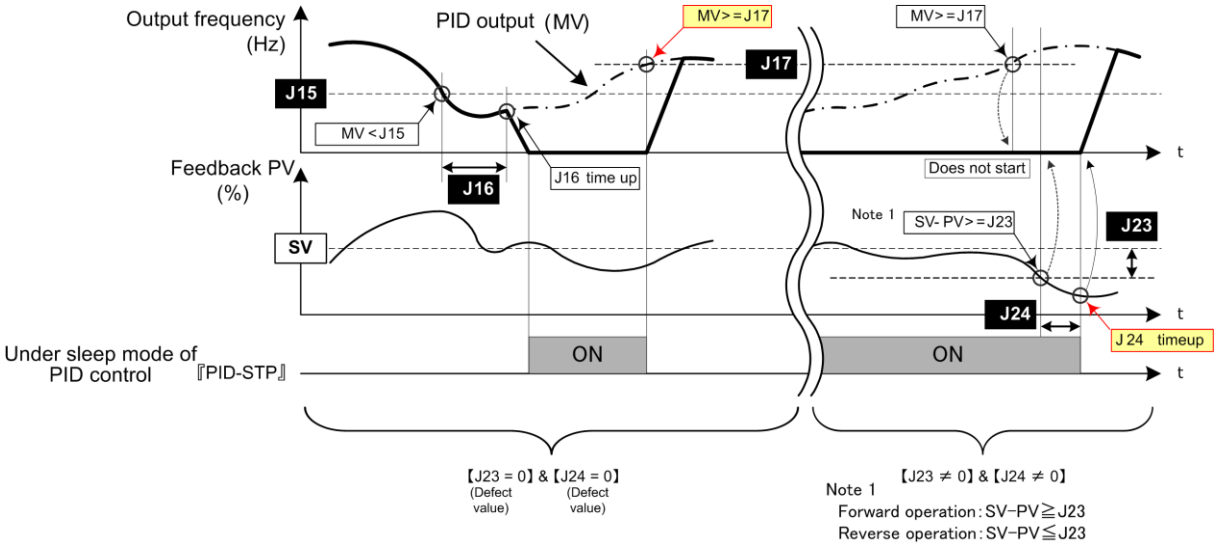


Figure 5.3-14

J18, J19	PID Control (Upper limit of PID process output, Lower limit of PID process output)

The upper and lower limiters can be specified to the PID output, exclusively used for PID control. The settings are ignored when PID cancel “Hz/PID” is enabled and the inverter is operated at the reference frequency previously specified. (🕮 Function codes E01 to E05 data = 20)

■ **PID Control (Upper limit of PID process output) (J18)**

J18 specifies the upper limit of the PID processor output limiter in %. If the value of “999” is specified to J18, the setting of the frequency limiter (Upper) (F15) will serve as the upper limit.

■ **PID Control (Lower limit of PID process output) (J19)**

J19 specifies the lower limit of the PID processor output limiter in %. If the value of “999” is specified to J19, the setting of the frequency limiter (Lower) (F16) will serve as the lower limit.

J57	PID Control (Dancer position set point)

J57 specifies the dancer position set point in the range of -100% to +100% for dancer control. If J02 = 0 (keypad) is selected, this function code is applied for the dancer position set point.

It is also possible to modify the set point (PID command) with the ⌃ / ⌄ keys on a keypad. If it is modified, the new set point value is stored as J57 data automatically.

For the setting procedure of the set point (PID command), refer to Chapter 3 “3.3.5 Setting up PID commands from the keypad.”

J58 J59 to J61	PID Control (Detection width of dancer position error) PID Control(P (Gain) 2, I (Integral time) 2 and D (Differential time) 2)

When the feedback value of dancer roll position comes into the range of “Detection width of dancer position error (J58)” the inverter switches PID constants from the combination of J03, J04 and J05 to that of J59, J60 and J61, respectively in its PID processor. Giving a boost to the system response by raising the P gain may improve the system performance in the dancer roll positioning accuracy.

■ **PID Control (Detection width of dancer position error) (J58)**

J58 specifies the bandwidth in the range of 1 to 100%. Specifying “0” does not switch PID constants.

■ **PID Control (P (Gain) 2) (J59)**

■ **PID Control (I (Integral time) 2) (J60)**

■ **PID Control (D (Differential time) 2) (J61)**

Descriptions for J59, J60, and J61 are the same as those of PID control P (Gain) (J03), I (Integral time) (J04), and D (Differential time) (J05), respectively.

J62	PID Control (PID control block selection)

For speed control (PID dancer control), the output of the PID processor is the compensating value for the primary speed command.

It is possible to switch the polarity of the PID error to the PID dancer processor with bit 0 of J62, and also switch the output in percentage (%) of the primary speed command or in percentage (%) of the maximum frequency with bit 1 of J62.

J62 data			Block selection	
Decimal	Bit 1	Bit 0	Select the compensating value (the PID processor output) format for the primary speed command	Select the polarity of the PID error
0	0	0	In % of the primary speed command	Plus(+)
1	0	1	In % of the primary speed command	Minus(-)
2	1	0	In % of the maximum frequency	Plus(+)
3	1	1	In % of the maximum frequency	Minus(-)

[5] Overload stop function

J63 **J64** **J65** **J66** **J67**	**Overload stop function (Item selection)** **(Detection level)** **(Mode selection)** **(Operation mode)** **(Timer)**

Detects an overload status and if it exceeds the specified detection level (J64) for the specified timer duration (J67), the operation is stopped based on the selected action (J65). It is used to protect the system when an unacceptable overload is applied or to lock the motor shaft by mechanically hitting it to the stopper.

■ Item selection (J63)

Select a target (detected item) to monitor the load status.

J63 data	Detected value	Function overview
0	Torque	Select the driving torque as the target. To improve the accuracy of calculated torque, perform auto-tuning.
1	Current	Select the driving current as the target. The no-load current always flows to the motor. Specify J64 (Detection level) correctly considering the no-load current of the applied motor.

■ Detection Level (J64)

Set the value for overload detection level in percentage (%) of the motor rated torque or current.

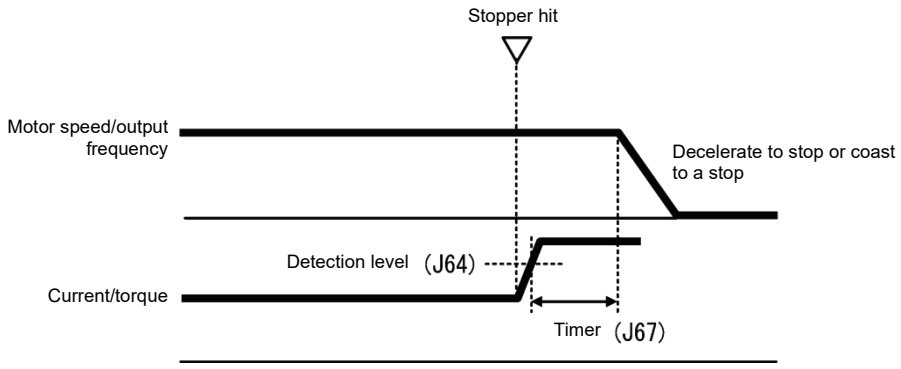
■ Mode Selection (J65)

Select an operation when the load exceeds the value specified in J64.

J65 data	Action	Function overview
0	Disable	Overload stop function operation cancellation
1	Decelerate to stop	Decelerates to stop the motor, as specified in deceleration time.
2	Coast to stop	Immediately shuts down the inverter, allowing the motor to coast to a stop.

Note
- When the overload stop facility is enabled and an overload is detected, the inverter turns the run command OFF depending on data of the function code J65. To restart the inverter operation, turn the run command OFF, and turns it ON again.
- This function does not work with 10% speed or less when driving PMSM.

<Mode selection J65=1, 2>



■ **Operation Mode (J66)**

J66 specifies the inverter's operation condition under which the overload stop function is activated.

Carefully make this setting so as not to activate the overload stop function when it is not necessary.

J66 data	Operation mode
0	Enabled during constant speed and deceleration time.
1	Enabled during constant speed
2	Enabled always

■ **Timer (J67)**

Apply the timer (J67) to prevent the start of the overload stop function due to the instantaneous, unintended load fluctuation. The overload stop function is activated when the operation condition has continued for specified timer J67. (if J65=1, 2).

■ **Enable overload stop - "OLS" (E01 to E05 = 46)**

Turning this terminal command ON enables the overload stop function; turning it OFF disables the function. If "OLS" is not assigned to any terminal, the overload stop function is always valid.

[6] Brake control signal

J68 to J70	**Brake control signal (Brake-release current, Brake-release frequency/speed and Brake-release timer)**
J71, J72	**Brake control signal (Brake-apply frequency/speed and Brake-apply timer)**
J95, J96	**Brake control signal (Brake-release torque, Brake-apply conditions)**
	Related function code: A98: Motor 2 (Function selection)

The brake (release/apply) control signal is useful for lift application such as a hoist. This signal is adjustable with these function codes.

It is possible to set the release and apply conditions based of these signals (current, torque and frequency/speed) so that a hoisted load does not fall down at the start or stop of the operation, or so that the load applied to the brake is reduced.

■ **Brake control "BRKS" (E20, E21 and E27, data = 57)**

This signal outputs a brake control command that releases or applies the brake.

Releasing the Brake

When the inverter output current and output frequency exceeds the specified level for the brake control signal (J68/J69/J95) for the period specified by J70 (Brake control signal (Brake-release timer)), the inverter judges that required motor torque is generated and turns the signal BRKS ON for releasing the brake.

This prevents a hoisted load from falling down due to an insufficient torque when the brake is released.

Function code	Name	Data setting range	Remarks
J68	Brake-release current	0.00 to 300.00%:	Set the value in percentage (%) of the inverter rated current.
J69	Brake-release frequency/speed	0.0 to 25.0 Hz	
J70	Brake-release timer	0.00 to 5.00s	
J95	Brake-release torque	0.00 to 300.00%	Only available under vector control with speed sensor.

Note: Resolution of each function code is different from the IMO Jaguar VXG and VXR series.

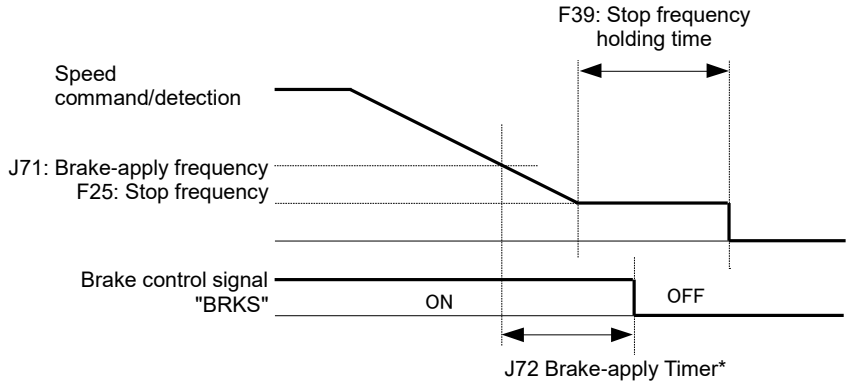
Applying the brake

When the run command is OFF and the output frequency drops below the level specified by J71 (Brake control signal (Brake-applied frequency/speed)) and stays below the level for the period specified by J72 (Brake control signal (Brake-applied timer)), the inverter judges that the motor rotation is below a certain level and turns the signal “BRKS” OFF for activating (applying) the brake.

This operation reduces the load applied to the brake, extending lifetime of the brake.

Function code	Name	Data setting range	Remarks
J71	Brake-apply frequency/speed	0.0 to 25.0 Hz	
J72	Brake-apply timer	0.00 to 5.00s	
J96	Brake-apply conditions (Only available when using vector control with speed sensor)	0 to 31 (in decimal) Criteria of speed condition for Brake-apply (Bit 0) 0: Detected speed (default) 1: Reference speed	Specifies the criteria of speed to be used for Brake-apply condition.
		Condition of brake-apply control signal (Bit 4) 0: Regardless of run command status (ON or OFF) (default) 1: Only when run command is OFF.”	Specifies whether to turn off a brake control signal independent of a run command ON/OFF or only when a run command is OFF. When forward and reverse operations are switched, Brake-applied conditions may be met in the vicinity of zero speed. For such a case, select “Only when a run command is OFF” (Bit 4 = 1).

Note: Resolution of each function code is different from the IMO Jaguar VXG and VXR.



* If inverter output was turned off before the timer counts up, then the brake is applied.

Figure 5.3-15 Time chart

Note
- The brake control signal applies by default to the 1st motor. When the 2nd motor is selected, switch the brake control signal to this motor by setting the corresponding bit of function code A98.
- When the inverter is shut down due to an alarm status or coast-to-stop command, the brake control signal is immediately applied.
- The stop is determined after the output frequency exceeds “F25 stop frequency + E30 frequency arrival hysteresis width”, and then the output frequency falls below F25.
  To inch the motor (repeatedly turn ON and OFF the run command in a short time), adjust F25 and E30.

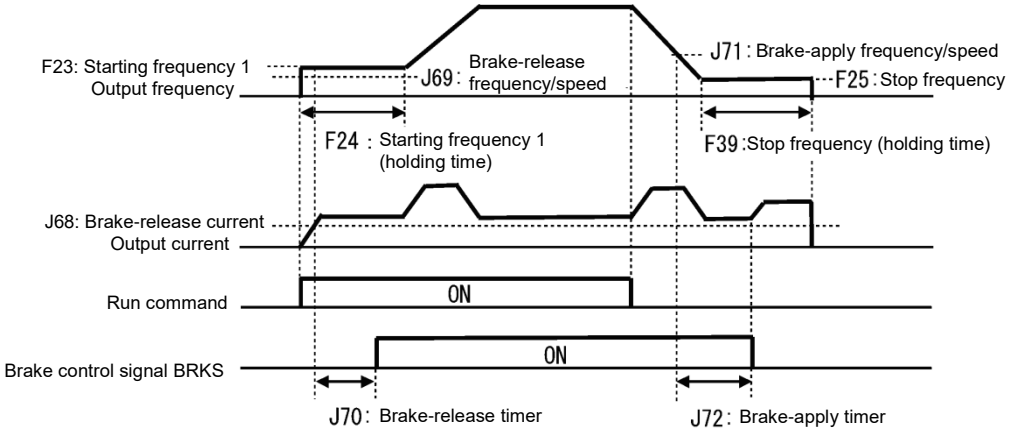


Figure 5.3-16 Operation time chart under v/f control

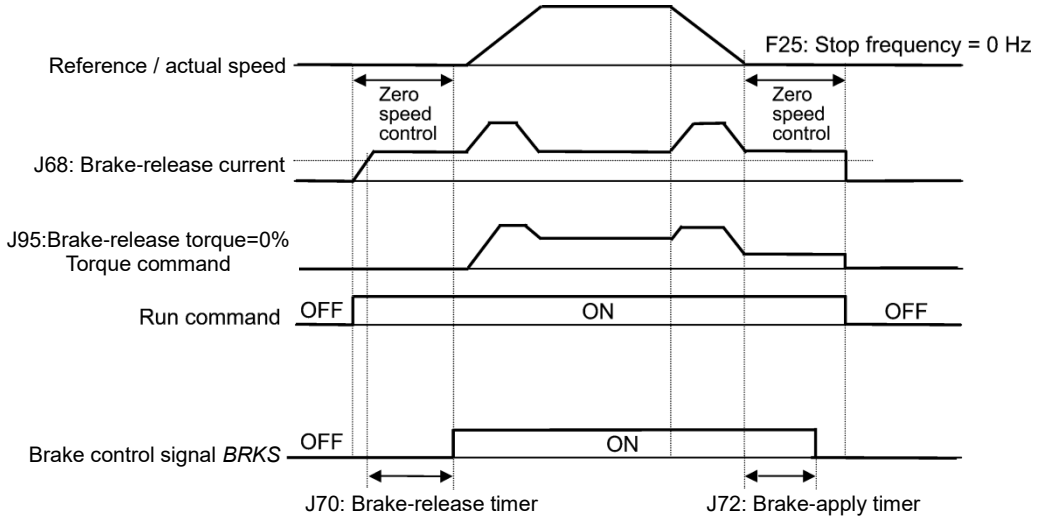


Figure 5.3-17 Operation time chart under vector control with speed sensor

Note

- Set 0% to J95 (Brake-release torque) excluding brake-release at zero speed.
- If releasing the brake at zero speed is needed under vector control with speed sensor, please use the torque bias function.
- After releasing the brake (BRKS ON), operating for a while, and then applying the brake (BRKS OFF) to stop the motor, if it is required to release the brake again (BRKS ON), turn the inverter's run command OFF and then ON.
- The brake is not released during auto-tuning (stop mode).

■ Check brake "BRKE" (E01 toE05 data = 65)

If the status of the brake control signal BRKS fails to agree with the status of the brake check signal BRKE during inverter operation, the inverter occurs alarm to stop with *er6*.

This signal is used as a feedback signal for the brake control signal BRKS. When the mechanical brake does not operate, it causes the inverter to trip, applying the mechanical brake. The response delay time for BRKS and BRKE can be adjusted with H180: Check-timer for brake operation.

(🕮 Function code H180: Brake control signal (Check-timer for brake operation) range 0.00s to 10.00s

[7] Positioning control with pulse counter

J73 to J88	Positioning control parameters

This function allows simple positioning control with pulse counter and requires the PG interface card.

The inverter internally counts the feedback pulses and controls the motor so that the control object moves from the previously specified start point, decelerates and switches to the creep speed operation to arrive at the specified stop position.

■ Function Code List

Table 5.3-22 lists the function codes to be used for positioning control.

Table 5.3-22 Function Codes to be used for positioning control

Code	Name	Data setting range	Unit	Default setting	Change when running
E01 to E05, E98, E99	Terminal [Xn] Function	42 (1042): Activate the limit switch at start point, "**LS**" 43 (1043): Start/reset, "**S**/**R**" 44 (1044): Switch to the serial pulse receiving mode, "**SPRM**" 45 (1045): Enter the return mode, "**RTN**"	—	—	N
E20, E21, E27	Terminal [Y1] Function Terminal [Y2] Function Terminal [30A/B/C] Function	80 (1080): Stop position override alarm, "**OT**" 81 (1081): Under positioning, "**TO**" 82 (1082): Positioning completed, "**PSET**" 83 (1083): Current position count overflowed, "**POF**"	—	—	N
J73	Positioning Control (Start timer)	0.0: Disable 0.1 to 1000.0: Preset time	s	0.0	Y
J74	(Start point, upper digits)	-999 to 999	—	0	Y
J75	(Start point, lower digits)	[P], 0 to 9999 *1	p	0	Y
J76	(Preset point, upper digits)	-999 to 999	—	0	Y
J77	(Preset point, lower digits)	[P], 0 to 9999 *1	p	0	Y
J78	(Creep speed switch point, upper digits)	0 to 999	p	0	Y
J79	(Creep speed switch point, lower digits)	0 to 9999	p	0	Y
J80	(Creep speed)	0 to 500	Hz	0	Y
J81	(End point, upper digits)	-999 to 999	p	0	Y
J82	(End point, lower digits)	0 to 9999	p	0	Y
J83	(Completion range)	0 to 9999	p	0	Y
J84	(End timer)	0.0: Disable. 0.1 to 1000.0: Preset time	s	0.0	Y
J85	(Coasting compensation)	0 to 9999	p	0	Y
J86	(End point, serial pulse input format)	0: Direction and pulse 1: Forward and reverse pulse	—	0	Y
J87	(Preset positioning requirement)	0: Allow to preset at the forward rotation only 1: Allow to preset at the reverse rotation only 2: Allow to preset at any rotation direction	—	0	N
J88	*2 (Direction of detected position)	0: Does not switch the direction of detected position 1: Switch the direction of detected position (Multiply by "-1" the detected position)	—	0	N

*1 [P]: Current position (Absolute position) Switching between "0" and [P] requires the simultaneous keying: STOP + ⌄ keys from "0" to [P] and STOP + ⌃ keys from [P] to "0."

*2 In case of wrong wiring of the PG, inverts the position detection; direction, using J88 it is to possible correct the direction without rewiring.

■ **Description of the Control**

The PG interface card allows the inverter to internally count feedback pulses issued from the encoder (PG) and control the motor so that the control object starts moving from the previously specified start point (S point), decelerates and switches to the creep speed operation to arrive at the specified stop position (E point).

Turning the run command ON with “Start/reset” command ***S/R*** being ON starts the positioning control.

See Figure 5.3-18 “Positioning Control Behaviour” and Table 5.3-23.

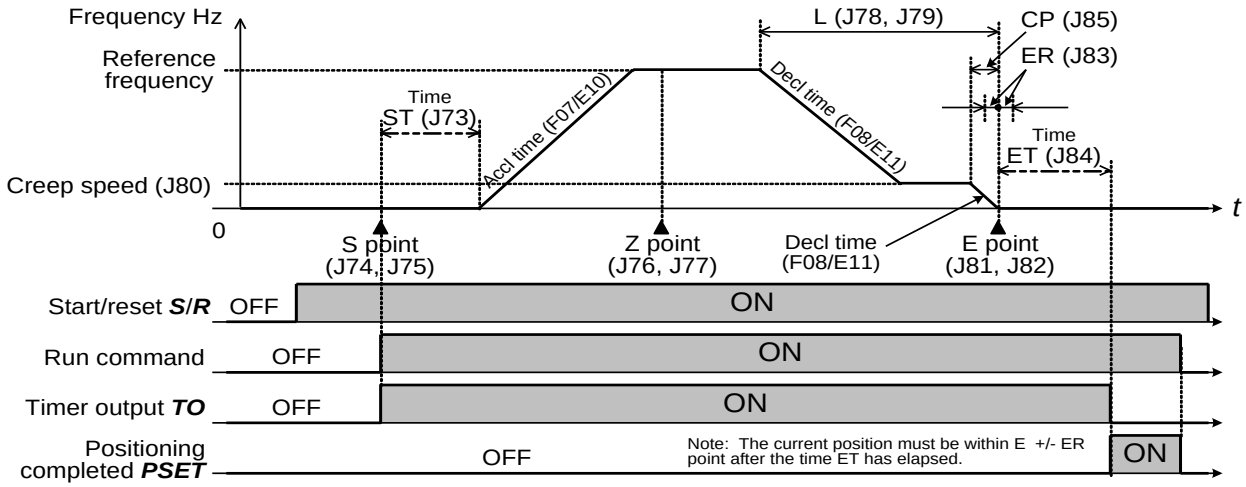


Figure 5.3-18 Positioning Control Behaviour

Note
- The positioning control applies to motor 1 only.
- During jogging (inching) operation or when the PID control is enabled (J01 ≠ 0), the positioning control is disabled.
- An undervoltage alarm that occurs in positioning control triggers the alarm *ero*; however, the inverter does not enter the restart mode (specified by F14).
- Enabling the positioning control disables the auto-reset function specified by H04 and H05.

Tip The operation status in positioning control can be displayed on the keypad by using Menu #3 “Drive Monitoring.” For details, refer to “Monitoring.” Refer to Chapter 3, see the description of function code E52.

■ **Symbols**

Table 5.3-23 lists the meanings of symbols used in Figure 5.3-18.

Table 5.3-23 Symbols Meaning

Symbol	Name	Function code	Descriptions
S point	Start point	J74, J75	This specifies the start position data for the positioning control. It can be the current position [P] (absolute position) or numerical value (relative position). Specification of an absolute position and that of a relative position produce different results as described below. **[Absolute position]** Specifying [P] regards the current position as a start point. When starting the positioning control, the inverter applies the current position pulse count as start point data. (Example) Suppose that the current position pulse count = 10,000, the start point data = [P], and the stop point (E point) pulse count = 20,000. Then, when starting the positioning control, the inverter moves the control object from the current position (10,000, as start point data) to the E point (20,000). Accordingly, the object moving pulse count is 10,000 (20,000 - 10,000). **[Relative position]** Specifying “a” (numerical value) substitutes “a” for the current position data. When starting the positioning control, the inverter applies “a” pulses as start point data. (Example) Suppose that the current position pulse count = 10,000, start point data “a” = 4,000, and the stop position (E point) pulse count = 20,000. Then, when starting the positioning control, the inverter moves the control object from the start point pulse count “a” (4,000) instead of the current position data (10,000) to the E point (20,000). Accordingly, the object moving pulse count is 16,000 (20,000 - 4,000).
ST	Start timer	J73	This specifies the waiting time from when a run command comes ON with the “**S**/**R**” terminal command being ON until the inverter starts running the motor. (This covers the delay of brake release.) If the output frequency has not been zero (inverter running), turning the terminal command “**S**/**R**” ON does not start the timer count. (During deceleration triggered by turning the run command OFF, the start timer does not start neither.)
Z point	Preset position	J76, J77	When the inverter detects that the Z signal is turned from Low to High first after the “**LS**” terminal command is turned from OFF to ON, it corrects the current position data for the preset position data (Z point). This is functionally equivalent to a mechanical position correction or origin point reset. Specifying [P] to the preset position does not perform the Z point correction. It is also possible to restrict the application of the Z point correction with the “**LS**” to the motor rotational direction specified by function code J87.
L	Creep speed switch point	J78, J79	These parameters specify the deceleration start point towards the creep speed (specified by J80) as an absolute position.
CP	Coasting correction	J85	These parameters specify the deceleration start point that follows the end of creep speed operation as a pulse count (relative position) from the E point. Take into account the inertia produced when the control object decelerates to stop.
E point	End point	J81, J82	This specifies a target stop position.
ER	Completion range	J83	This specifies the positioning completion range at the E point, that is, “Actual stop position - E point position.” After the end timer counts up: If “| Actual stop point - E point |” ≤ ER, the inverter issues the “Positioning completed” signal “**PSET**”. If “| Actual stop point - E point |” > ER, the inverter issues the “Stop point alarm” signal “**OT**”.
ET	End timer	J84	This specifies the waiting time from when the control object stops at E point until the inverter can receive the next positioning control signal. After completion of positioning, when this waiting time has elapsed or when 0.5 second has elapsed if ET < 0.5 second, the inverter issues the “Positioning completed” signal **“PSET”** or “Stop point alarm” signal **“OT”**. Turning the run command OFF when the ET is counting interrupts the counting, so the inverter does not issue **“PSET”** or **“OT”**. The inverter ensures that **“PSET”** and **“OT”** signals are kept ON for at least 100 ms.

■ **Input/output terminal functions**

Table 5.3-24 Input Terminal Functions

Terminal function	Terminal command	Description
Activate the limit switch at start point	**"LS"**	This is used when the inverter corrects the current position data from the preset position data (Z point) specified by function codes J76 and J77. When the inverter detects that the Z signal is turned from Low to High first after the **"LS"** terminal command is turned from OFF to ON, it triggers the Z point correction. In any other conditions, the **"LS"** terminal command does not produce any effect.
Start/reset	**"S/R"**	This enables or disables the positioning control. ON: Enable OFF: Disable
Switch to the serial pulse receiving mode	**"SPRM"**	This enables or disables the serial pulse receiving mode. When the serial pulse input shares an input terminal with other functional pulse inputs (when the positioning control is concurrently enabled with frequency control with pulse rate input and/or speed control with PG) by function code setting, the inverter counts input pulses from the PG to determine the stop position only when the **"SPRM"** terminal command is ON. ON: Enable OFF: Disable However, If the serial pulse receiving is exclusively assigned to the digital input terminal for the PG input, the inverter counts the input pulses for the stop position, regardless of the **"SPRM"** status. Turning the **"SPRM"** ON resets to zero the pulse count (E point data previously specified by J81 and J82).
Enter the return mode	**"RTN"**	Starting the positioning control with the **"RTN"** terminal command being ON enables the return mode in which the inverter moves the control object in the reverse direction while keeping the S and E point data. Using the **"RTN"** enables the reciprocal positioning control; moving from S to E points and returning from E to S points. ON: Enable OFF: Disable

Note The resets to zero function of the received pulse count (E point specified by J81 and J82), which can be triggered by turning the SPRM from OFF to ON, is always enabled. Take care not to reset to zero the E point mistakenly.

Tip When the positioning control is enabled concurrently with the speed control with PG or frequency control with pulse rate input, the specifications of terminals [XA], [XB], [XZ], [YA], [YB], and [YZ] differ from the ones listed above. For details, refer to Table 5.3-30 of "■ Assignment of PG Terminals When Shared."

Table 5.3-25 Output Terminal Functions

Terminal function	Symbol	Description
Stop position override alarm	"OT"	ON conditions • The ET time has elapsed (or after 0.5 second if ET < 0.5 s) or • "Actual stop position – E-point" > ER data. OFF conditions Except the above ON conditions.
Timer output	"TO"	ON conditions Until the ET time has elapsed after the start timer (J73) starts. OFF conditions Except the above ON conditions. When the ET is cancelled, the output frequency becomes 0 Hz, turning this signal OFF..
Positioning completed	"PSET"	ON conditions • The ET time has elapsed (or after 0.5 second if ET < 0.5 s) or • "Actual stop position – E-point" > ER data. OFF conditions Except the above ON conditions.
Current position count overflowed	"POF"	ON conditions The current position pulse count goes out of the range from -9,999,999 to +9,999,999, regardless of the ON/OFF state of the **"S/R"** terminal command. OFF conditions • The position count comes within the specified range after going out of the range, • Any run command is turned ON with the **"S/R"** being ON, or • A Z point correction is performed.

■ **Monitoring**

The positioning control status and the pulse count can be displayed on the keypad by using E43 or Menu #3 "Drive Monitoring" as described in this section.

Table 5.3-26 Monitoring items: Function Code E43 (LED Monitor, Item selection)

Data for E43	Monitor items	Unit	Descriptions	Refer to:
21	Current position pulse	p	Displays the current position pulse count.	Table 5.3-28
22	Position error pulse	p	Displays the pulse count error between the current position and the E point.	

Table 5.3-27 Keypad menu #3 "Drive Monitoring"

LED monitor shows:	Monitor items	Unit	Descriptions	Refer to:
3_17	E point pulse count	p	Displays the E point of positioning control in the pulse count. Turning "RTN" OFF displays E point (J81 and J82); turning it ON displays S point (J74 and J75).	Table 5.3-28
3_18	Current position pulse count	p	Displays the current position pulse count.	
3_19	Position deviation pulse count	p	Displays the pulse count deviation between the current position and E point.	
3_20	Positioning control status	—	Displays the position control status shown in Figure 5.3-19 "Positioning Control Status Transition Model."	Figure 5.3-19

■ Displaying system on the LED monitor

The positioning control handles the pulse count ranging from -9,999,999 to +9,999,999. To display it, the 4-digit LED monitor shows alternately the upper and lower four digits for one second and three seconds, respectively. The lower four digits are followed by a decimal point.

Table 5.3-28 Displaying System for Pulse Count

Pulse count	• Running status in Running mode and running info in Programming mode on the standard keypad • Running status in Running mode on the multi-function keypad		Remarks
	Upper 4 digits	Lower 4 digits	
+9,999,999	+999	9999.	Maximum display value
+19,999	+1	9999.	The lower digits are not zero-suppressed.
+10,000	+1	0000.	
+9,999	+0	9999.	
+10	+0	0010.	
0	0	0000.	
-10	-0	0010.	
-9,999	-0	9999.	
-10,000	-1	0000.	
-19,999	-1	9999.	
-9,999,999	-999	9999.	Minimum display value

■ Positioning control status

In positioning control, the keypad can display the current control status. Figure 5.3-19 shows a control status transition model and Table 5.3-29 lists details of the status.

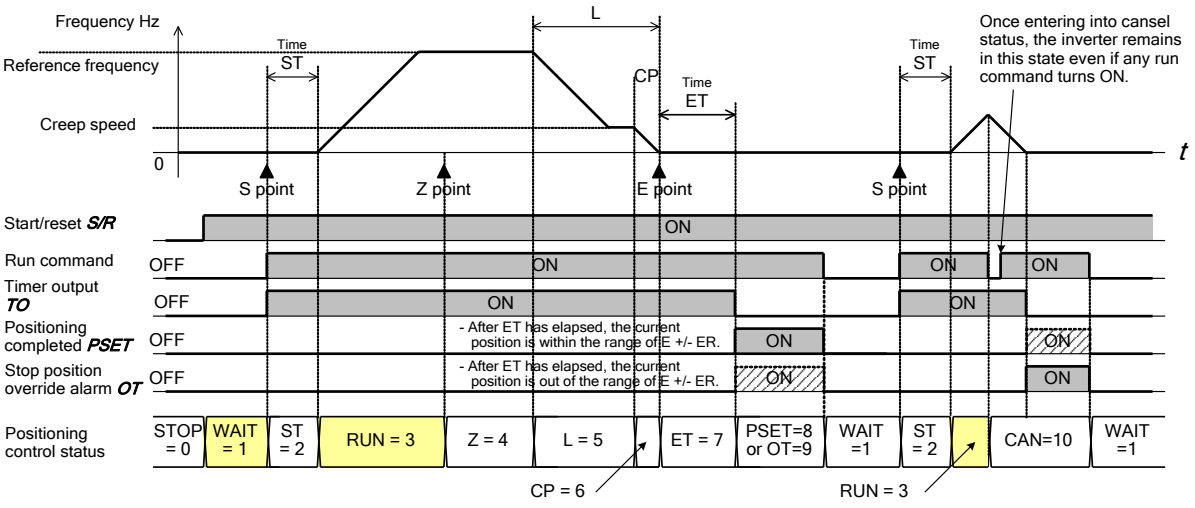


Figure 5.3-19 Positioning Control Status Transition Model

Table 5.3-29 Status Name and Number in Positioning Control

Positioning control status	Status name *1	Status number *2	Descriptions
Positioning control stopped	STOP	0	Status where "**S/R**" is OFF. Turning "**S/R**" ON shifts to "WAIT = 1" where the inverter waits for a run command. If the inverter output frequency is other than 0 Hz (Gate output) when "**S/R**" is turned ON, it shifts to "RUN = 3" since the start timer does not count.
Waiting for run command	WAIT	1	Status where "**S/R**" is ON and a run command is OFF. Turning a run command ON in this status shifts to "ST = 2." If the start timer (J73 data) is 0.0 s, the status shifts from "WAIT = 1" to "RUN = 3."
Start timer counting	ST	2	Status where "**S/R**" and run command are ON and the start timer is counting. Upon completion of timer count, the status shifts to "RUN = 3."
Running	RUN	3	Status until the inverter enters into a control zone "Current position ≥ (E point - L point)" in forward operation or "Current position ≤ (E point + L point)" in returning operation, or until Z point correction occurs.
Z point correction completed	Z	4	If Z point correction occurs in "RUN = 3," the inverter shifts to this status.
Running in creep speed	L	5	Status where the inverter is decelerating down to the creep speed (J80) or is running at the creep speed.
Coasting	CP	6	Status where the inverter is decelerating to a stop after entering the control zone "Current position ≥ (E point - CP point)" in forward operation or "Current position ≤ (E point + CP point)" in returning operation.
End timer counting	ET	7	Status where the end timer is counting.
Positioning control completed	PSET	8	Status where the positioning control is completed and the inverter is issuing "**PSET**".
Stop position override alarm	OT	9	Status where the inverter is issuing a stop position override alarm "**OT**".
Stopped by cancellation	CAN	10	If any inverter operation under positioning control is canceled during any status of "ST = 2" to "ET = 7," the inverter enters "CAN = 10." After that, the inverter turns the "Timer output" "**TO**" OFF and issues the "Positioning completed" "**PSET**" or "Stop position override alarm" "**OT**". Once the inverter enters "CAN = 10", the inverter remains in this status and keeps the reference frequency at 0 Hz as long as the run command is not turned OFF.

*1: The status name can be displayed in "Drive Monitoring" menu on the LCD monitor of the multi-function keypad.

*2: The status number can be displayed in Menu #3 "Drive Monitoring," Display item *3_20* on the standard keypad or on the LCD monitor of the multi-function keypad.

■ Serial Pulse Receiving Function

When the **"S/R"** terminal command is assigned to any digital input terminals [X] and the serial pulse receiving function is enabled, the pulse train input from host equipment can specify the stop position (E point). Function codes J81 and J82 (Stop position) save the input pulse count.

Function code J86 specifies the pulse input mode for the serial pulse train input.

Note When the serial pulse receiving input shares an input terminal with other function input (e.g. Table 5.3-30), the inverter counts the PG input pulse train as the serial pulse receiving input for E point pulse count only when **"SPRM"** is ON. On the contrary, if the serial pulse receiving input terminal is exclusively assigned, the inverter counts the input for E point data independently the ON/OFF status of **"SPRM"**.

■ Assignment of PG Terminals When Shared

Table 5.3-30 lists input assignments for terminals [XA], [XB], [XZ], [YA], [YB] and [YZ] when the positioning control, speed control with PG and speed control with pulse rate input share the PG terminals

The specifications of those terminals when shared differ from the ones when not shared.

Table 5.3-30 Function Assignments of PG Terminals

Pulse train input, F01/C30 data is 12.	Speed control with PG, F42/A14 data is 3 or 4.	Positioning control, ***S***/***R*** is assigned.	Normal mode (Except the right column mode)	Serial pulse receiving mode, ***SPRM*** is ON
No	No	No	X: Pulse monitor	
			Y: Pulse monitor	
		Yes	X: Serial pulse (J86)	
			Y: Positioning control	
	Yes	No	X: Pulse monitor	
			Y: Speed control	
		Yes	X: Positioning control	X: Serial pulse (J86)
			Y: Speed control	
Yes	No	No	X: Pulse train input	
			Y: Pulse monitor	
		Yes	X: Pulse train input	X: Serial pulse (J86)
			Y: Positioning control	
	Yes	No	X: Pulse train input	
			Y: Speed control	
		Yes	X: Pulse train input	X: Serial pulse (J86)
			Y: Speed and positioning control	

Symbol "X" in the above table stands for PG terminals [XA], [XB] and [XZ].

Symbol "Y" stands for PG terminals [YA], [YB] and [YZ].

The positioning control is invalid when F42=6 and 15.

Switching to the serial pulse receiving mode with **"SPRM"** involves switching of the input mode, so the idle time insertion is required for a stable switching as listed Table 5.3-31.

Table 5.3-31 Idle Time Required for Stable Mode Switching by **"SPRM"**

Function switching	When "**SPRM**" is turned from OFF to ON:	When "**SPRM**" is turned from ON to OFF:	Remarks
Positioning control to/from serial pulse receiving	Insert a minimum of 100 ms idle time before the start of the serial pulse receiving input after "**SPRM**" is turned ON.	Do not input the serial pulse within 100 ms before or after "**SPRM**" is turned OFF.	—
Pulse train input to/from serial pulse receiving		Stop the serial pulse receiving input before a minimum of 100 ms before "**SPRM**" is turned OFF. Start the pulse train input within 100 ms after "**SPRM**" is turned OFF.	During the "serial pulse receiving mode ("**SPRM**" being ON) + 100 ms," the inverter holds the pulse train input count applied when "**SPRM**" is turned ON.

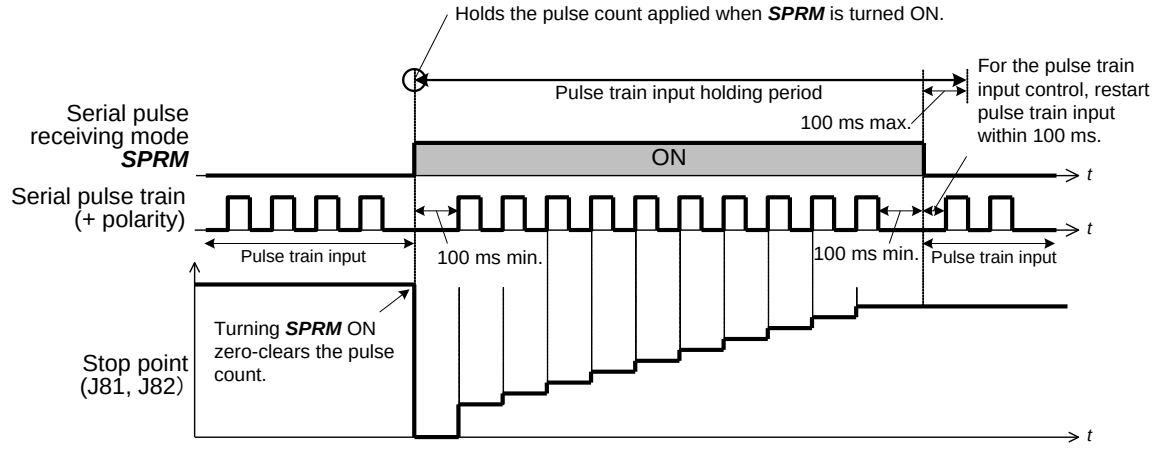


Figure 5.3-20 Switching the Input Mode between the Pulse Train Input and Serial Pulse Receiving Mode

[8] Servo lock

J97 to J99	Servo lock (Gain, Completion timer, Completion range)

■ Servo lock

The servo lock function is available only at vector control with speed sensor (F42=6). This function holds the motor within the positioning completion range specified by J99 for the period specified by J98 even if an external force applies to the motor.

Note Do not apply the frequent servo lock because the protection function for power cycle life may operate.

■ Startup conditions of servo lock

	Servo lock control starts when the following conditions are met:	
	F38 = 0 (Use actual speed as a decision criteria)	F38 = 1 (Use reference speed as a decision criteria)
1	Run command OFF, or Reference frequency < Stop frequency (F25)	
2	"LOCK" ("Servo lock command") ON (Assignment of "LOCK" (E01 to E05 data = 47))	
3	The actual speed is less than the stop frequency (F25).	The reference speed is less than the stop frequency (F25).

■ Operation examples

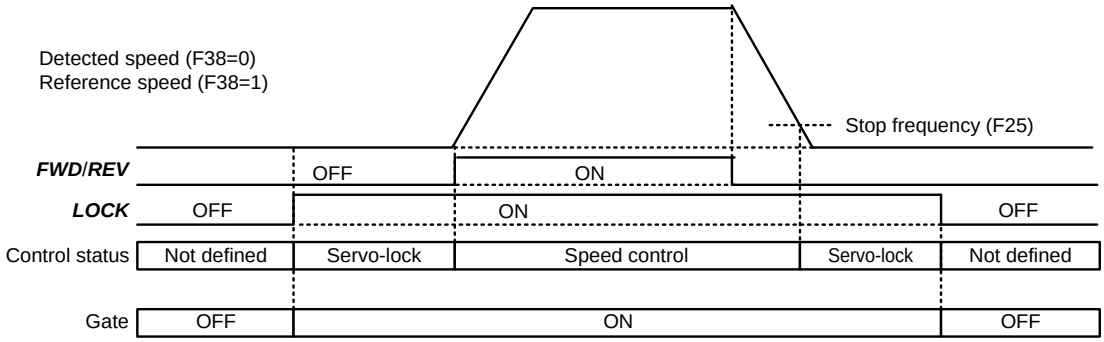


Figure 5.3-21 Typical Control Sequence of servo lock

⚠WARNING

When the servo lock command is ON, the inverter keeps on outputting voltage on output terminals [U], [V] and [W] even if a run command is OFF and the motor seems to be in stop state.

An electric shock may occur.

■ Specifying servo lock control

Positioning completed signal -- "PSET" (E20, E21 and E27 data = 82), Servo lock (Completion timer) (J98), and Servo lock (Completion range) (J99)

This output signal comes ON when the inverter has been servo locked so that the motor is held within the positioning completion pulse counts specified by J99 and the timer specified with J98 has counted up.

- Data setting range J98: 0.000 to 1.000 (s) (Factory default is 0.100)
- Data setting range J99: 0 to 9999 (pulses) (Factory default is 10)

■ **Servo lock (Gain) (J97)**

J97 specifies the gain of the servo lock positioning to adjust the stop behavior and shaft holding torque against an external force. If the mechanical stiffness is not high, J97 is difficult to set larger.

J97	Small	↔	Large
Stop behavior	Response slow, but smooth	↔	Response quick, but hunting might occur.
Shaft holding torque	Small	↔	Large

- Data setting range: 0.000 to 9.999 (times) (Factory default is 0.010)

Note: Resolution of J97 and factory default value is different from the IMO Jaguar VXG series.

■ **Notes for using servo lock**

(1) Positioning control error *ero*

If a positioning error exceeds the value equivalent to four rotations of the motor shaft when the inverter is servo locked, the inverter issues a positioning control error signal *ero*.

(2) Stop frequency (F25) under servo lock

Since servo lock starts when the output frequency is below the stop frequency (F25), it is necessary to specify such F25 data that does not trigger *ero* (that is, specify the value equivalent to less than 4 rotations of the motor shaft).

Stop frequency (F25) $<$ (4 $\times$ Gain (J97) $\times$ Maximum frequency)

(Example) When Gain (J97) = 0.01 and Maximum frequency (F03) = 60 Hz, specify F25 data $<$ 2.4 Hz.

(3) The following functions are ignored in the servo lock mode:

- Frequency/speed control specified with the stop frequency
- Rotation direction limitation

J105 to J107 **PID control (Display unit, Maximum scale, Minimum scale)**

Refer to the description of J02.

J136 to J138 **PID control 1 (PID multistep command 1 to 3)**

For details, refer to the description of J02.

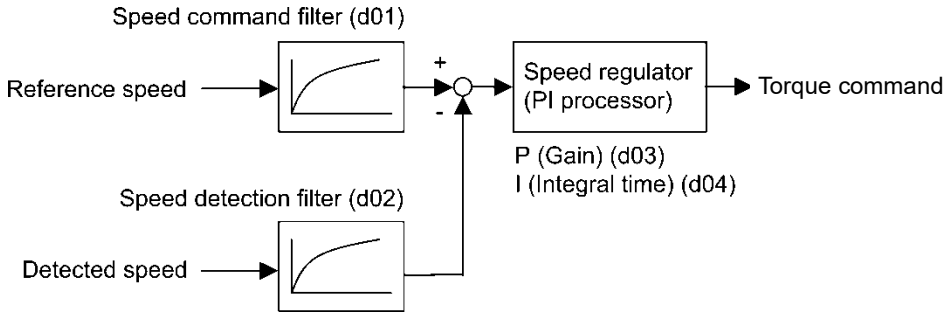
5.3.9 d codes (Applied functions 2)

[1] Speed control

d01/A43/b43/r43	**Speed control 1, 2, 3 and 4 (Speed command filter)**
d02/A44/b44/r44	**(Speed detection filter)**
d03/A45/b45/r45	**P (Gain)**
d04/A46/b46/r46	**I (Integral time)**
d05/A47/b47/r47	**FF(Gain)**
d07/A49/b49/r49	**(Notch filter resonance frequency)**
d08/A50/b50/r50	**(Notch filter attenuation level)**
	Related function code: d25:ASR switching time

These function codes are used to set up the speed control during normal operation.

■ **Block diagram of the speed control algorithm**



■ **Speed command filter (d01/A43/b43/r43)**

d01 specifies the time constant determining the first order delay of the speed command filter.

- Data setting range: 0.000 to 5.000 (s)

Modify this data when an excessive overshoot occurs against the change of the reference speed.

Increasing the filter time constant stabilizes the reference speed and reduces overshoot against the change of the reference speed, but it slows the response speed of the inverter.

■ **Speed detection filter (d02/A44/b44/r44)**

d02 specifies the time constant determining the first order delay of the speed detection filter.

- Data setting range: 0.000 to 0.100 (s)

Modify this data when the control target (machinery) is oscillatory due to deflection of a drive belt or other causes so that ripples (oscillatory components) are superimposed on the detected speed, causing hunting (undesirable oscillation of the system) and blocking the PI processor gain from increasing (resulting in a slow response speed of the inverter). In addition, if a low encoder (PG) resolution makes the system oscillatory, try to modify this data.

Increasing the time constant stabilizes the detected speed and allows to raise the PI processor gain even with ripples superimposed on the detected speed. However, speed detection itself is delayed, resulting in a slower speed response, larger overshoot, or hunting.

■ P(Gain) (d03/A45/b45/r45), I(integral time) (d04/A46/b46/r46)

d03 and d04 specify the gain and integral time of the speed regulator (PI processor), respectively.

- Data setting range: (d03) 0.1 to 200.0 (times)
  (d04) 0.001 to 9.999 (s), 999 (Cancel integral term)

P(Gain)

Definition of “P gain = 1.0” is that the torque command is 100% (100% torque output of each inverter capacity) when the speed deviation (reference speed – detected speed) is 100% (equivalent to the maximum speed).

Determine the P gain according to moment of inertia of machinery loaded to the motor output shaft. Larger moment of inertia needs larger P gain to keep the flat response during whole operation.

Specifying a larger P gain improves the quickness of control response, but may cause a motor speed overshooting or hunting (undesirable oscillation of the system). Moreover, mechanical resonance or vibration sound on the machine or motor could occur due to excessively amplified noise. If it happens, decreasing P gain will reduce the amplitude of the resonance/vibration. A too small P gain results in a slow inverter response and a speed fluctuation in low frequency, which may prolong the time required for stabilizing the motor speed.

I(Integral time)

Specifying a shorter integral time shortens the time needed to compensate the speed deviation, resulting in quick response in speed. Specify a short integral time if quick arrival to the target speed is necessary and a slight overshooting in the control is allowed; specify a long time if any overshooting is not allowed and taking longer time is allowed.

If a mechanical resonance occurs and the sound from the motor or gears is abnormal, setting a longer integral time can transfer the resonance point to the low frequency zone and suppress the resonance in the high frequency zone.

■ FF(Gain) (d05/A47/b47/r47)

The inverter operates the feed forward (FF) control that adds the acceleration torque calculated from the variation of speed command to torque command directly.

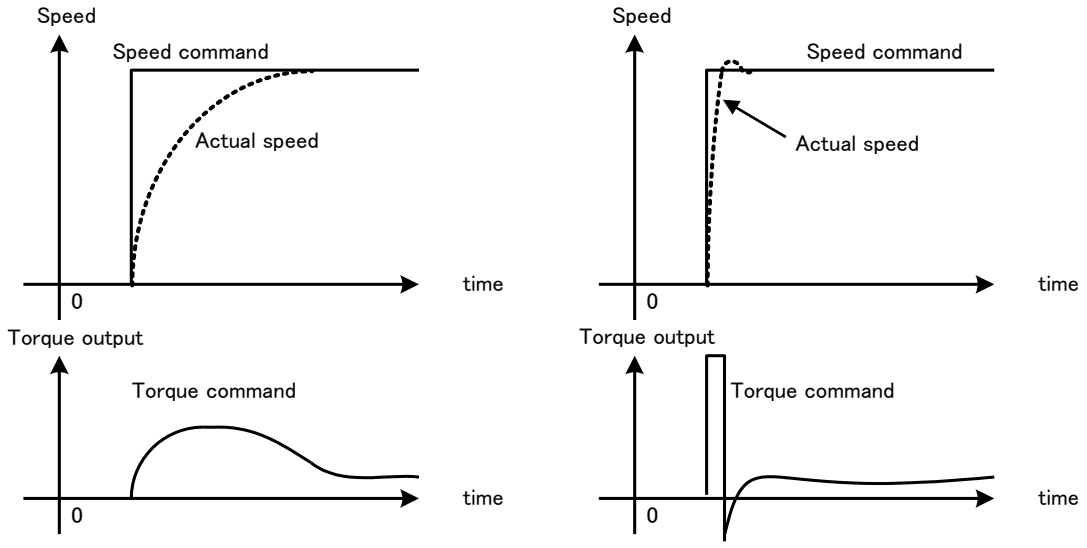
The PI control of ASR is feed back control and it makes the compensation operation against the result (actual speed detection value). Therefore it can control against the disturbance or the uncertain characteristic of controlled object also. However it becomes a follow-up control even if the variation of speed command is already-known.

The feed forward control can calculate the torque command related to the already-known variation of speed command.

This is the function code that can make the feed forward control.

- Data setting range: 0.00 to 99.99s

When the moment of inertia is known, this function can be used effectively. Conceptually, as it is shown in the following figure, the follow-up speed behaviour against the actual speed command is clearly different between feed forward control valid and invalid. However, to get the maximum effect, it is necessary to adjust this function code setting and the PI control settings value of the ASR.



The above mentioned effect can be obtained by setting the P gain of ASR higher. However the response of the system becomes faster in this setting and there is the possibility that it affects negatively due to generation of vibration.

■ **Notch filter resonance frequency (d07/A49/b49/r49), Notch filter attenuation level (d08/A50/b50/r50)**

These function codes specify speed control using notch filters. The notch filters make it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points, suppressing the mechanical resonance.

The notch filters are available only under “vector control with speed sensor.”

Setting the speed loop gain at a high level in order to obtain quicker speed response may cause mechanical resonance. If it happens, decreasing the speed loop gain the speed response will be slower in the whole operating range. In such a case, using the notch filter makes it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points and set the speed loop gain at a high level in other operating points, enabling a quicker speed response in the whole operating range.

The following four types of notch filters can be specified.

Function code	Name	Data setting range	Unit	Default setting
d07/A49/b49/r49	Speed control 1, 2, 3, 4 (Notch filter resonance frequency)	1 to 200	Hz	200
d08/A50/b50/r50	Speed control 1, 2, 3, 4 (Notch filter attenuation level)	0 to 20	dB	0 (Disable)

Setting the notch filter attenuation level to “0” (dB) disables the corresponding notch filter.

■ **Select speed control parameter 1, 2 -- “MPRM1”, “MPRM2” (E01 toE05 data = 78, 79)**

The combination of the ON/OFF states of digital input signals “MPRM1” and “MPRM2” selects one between 4 different speed control parameter sets.

Refer to “5.3.7 b, r codes (Speed control 3 and 4 parameters)”

■ **ASR switching time (d25)**

Speed control parameters switching by “MPRM1” and “MPRM2” signals is possible even during motor drive operation. For example, speed control P (Gain) and I (Integral time) listed can be switched. Switching these parameters during operation may cause an abrupt change of torque and result in a mechanical shock, depending on the driving condition of the load. To reduce such a mechanical shock, the inverter decreases the abrupt torque change using the ramp function of ASR switching time (d25).

- Data setting range: 0.000 to 1.000 (s)

d09, d10 d11, d12 H147	**Speed control (Jogging) (Speed command filter and Speed detection filter) (P (Gain) and I (Integral time), FF(Gain)) (Refer to d01.)**

These function codes are used to set up the speed control during jogging operation.

The block diagrams and function codes related to jogging operation are the same as for normal operation.

Since this speed control setting is exclusive to jogging operations, specify these function codes to obtain higher speed response to obtain smooth jogging operation.

For details, refer to the corresponding descriptions (d01 to d05) about the speed control sequence for normal operation.

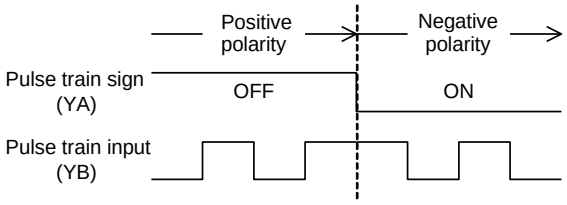
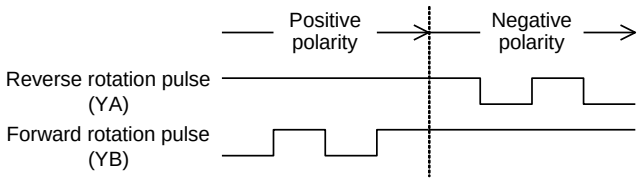
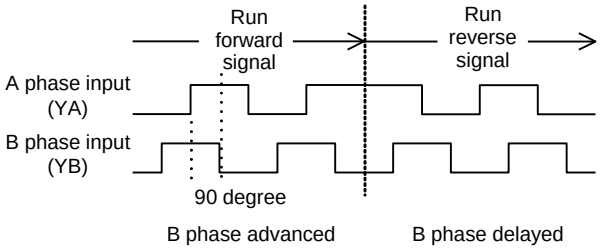
Speed control parameters	Jogging operation	Normal operation
Speed command filter	d09	d01
Speed detection filter	d10	d02
P (Gain)	d11	d03
I (Integral time)	d12	d04
FF(Gain)	H147	d05

d14 to d17	Feedback Input (Pulse input format, Encoder pulse resolution, Pulse scaling factor 1 and Pulse scaling factor 2)

These function codes specify the speed feedback input under vector control with speed sensor.

■ Feedback Input, Pulse input format (d14)

d14 specifies the speed feedback input format.

Data for d14	Pulse input mode	Remarks
0	Frequency and direction	
1	Forward and reverse pulse	
2	Quadrature A/B signal (B phase lead)	
3	Quadrature A/B signal (A phase lead)	This setting is the inversion of d14 = 2. (Lead phase A Forward rotation) In case that YA and YB are reversely connected to the specified terminals, setting “3” to this function code can reverse the polarity of detected speed (position) without changing the connection.

■ Feedback Input, Encoder pulse resolution (d15)

d15 specifies the pulse resolution (P/R) of the speed feedback encoder.

- Data setting range: 20 to 60000 (P/R), Set by standard keypad using hexadecimal format (0x0014 to 0xEA60)

■ **Feedback Input, Pulse scaling factor 1 (d16) and Pulse scaling factor 2 (d17)**

d16 and d17 specify the factors to convert the speed feedback input pulse rate into the motor shaft speed (min^{-1}).

- Data setting range:1 to 9999

Specify the data according to the transmission ratios of the pulley and gear train as shown below.

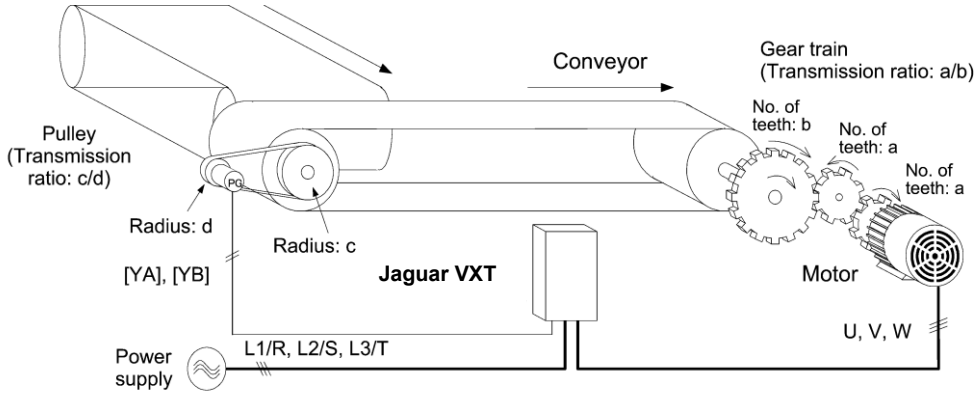


Figure 5.3-22 An Example of a Closed Loop Speed Control System (Conveyor)

Listed below are expressions for conversion between the speed feedback input pulse rate and the motor shaft speed.

$$\text{Motor shaft speed} = \frac{\text{Pulse scaling factor 2 (d17)}}{\text{Pulse scaling factor 1 (d16)}} \times \text{Encoder shaft speed}$$

$$\frac{\text{Pulse scaling factor 2 (d17)}}{\text{Pulse scaling factor 1 (d16)}} = \frac{b}{a} \times \frac{d}{c}$$

$$\text{Pulse scaling factor 1 (d16)} = a \times c$$

$$\text{Pulse scaling factor 2 (d17)} = b \times d$$

Note When driving the motor under the vector control with speed sensor, mount the sensor encoder to the motor shaft directly, or to a shaft with the rigidity equivalent to the motor shaft. A backlash, slip or deflection being on the mounting shaft could interfere with normal control.

Please be sure that the encoder wiring is done correctly. Otherwise an accident could occur.

d21, d22 d23	**Speed agreement/PG error (Hysteresis width and detection timer)** **PG error processing**

These function codes specify the detection levels of the speed agreement signal **"DSAG"** and PG error detected signal **"PG-ERR".**

Speed agreement signal "DSAG" (E20 , E21 and E27, data = 71)

■ **Speed agreement/PG error (Hysteresis width (d21) and detection timer (d22))**

- Data setting range: (d21) 0.0 to 50.0 (%), in (%) of the maximum speed
  (d22) 0.00 to 10.00 (s)

If the speed regulator's deviation (between the reference speed and detected one) is within the specified range (d21), the signal **"DSAG"** turns ON. If the deviation is out of the specified range (d21) for the specified period (d22), the signal turns OFF. This signal allows the user to check whether the speed regulator works properly or not.

PG error detected signal *PG-ERR* (E20 to E21 and E27, data = 76)

■ **Speed agreement/PG error (Hysteresis width (d21), Detection timer (d22) and PG error processing (d23))**

- Data setting range: (d21) 0.0 to 50.0 (%), in (%) of the maximum speed
  (d22) 0.00 to 10.00 (s)
  (d23) 0 to 5

If the speed regulator's deviation (between the reference speed and detected one) is out of the specified range (d21) for the period specified by d22, the inverter judges it as a PG error.

d23 defines the detection condition (and exception), processing after error detection, and hysteresis width as listed below.

<table>
<tr><th>d23</th><th>Function</th><th>Detection condition (and exception)</th><th>Processing after error detection</th><th>Hysteresis width for error detection</th></tr>
<tr><td>0</td><td>Continue to run 1</td><td rowspan="3">When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a PG error.</td><td>The inverter outputs the PG error detected signal "PG-ERR" and continues to run.</td><td rowspan="3">Hysteresis width = d21, which is constant, even if the speed command is above the base frequency (F04).</td></tr>
<tr><td>1</td><td>Stop running with alarm 1</td><td rowspan="2">The inverter initiates a motor coast to stop, with the ere alarm.
It also outputs the PG error detected signal "PG-ERR".</td></tr>
<tr><td>2</td><td>Stop running with alarm 2</td><td>No exception.</td></tr>
<tr><td>3</td><td>Continue to run 2</td><td rowspan="3">When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a PG error.</td><td>The inverter outputs the PG error detected signal "PG-ERR" and continues to run.</td><td>If the speed command is below the base frequency (F04), hysteresis width = d21, which is constant.
If it is above the base frequency, hysteresis width = d21*Speed command*Maximum frequency/Base frequency (F04).</td></tr>
<tr><td>4</td><td>Stop running with alarm 3</td><td rowspan="2">The inverter initiates a motor coast to stop, with the ere alarm.
It also outputs the PG error detected signal "PG-ERR".</td></tr>
<tr><td>5</td><td>Stop running with alarm 4</td><td>No exception.</td></tr>
</table>

Note Enabling an operation limiting function such as the torque limit and droop control will increase the deviation caused by a huge gap between the reference speed and detected one. In this case, the inverter may trip interpreting this situation as a PG error, depending on the running state. To avoid this incident, set the d23 data to "0" (Continue to run) to prevent the inverter from tripping even if any of those limiting functions is activated.

d24	Zero speed control (Refer to F23)

Refer to the description of F23.

d25	ASR switching time (Refer to d01)

Refer to the description of d01.

d32, d33	Speed limits / Over speed level 1 and 2 (Refer to H18)

Under speed control, the over speed detection levels are specified with 120% of these function codes.
The other hand, these function codes specifies the speed limit value under torque control.
Refer to the description of H18.

d35	Over speed detection level (Refer to H18)

Refer to the description of H18.

d41	Application specific function selection

d41 selects/deselects line speed control or master-follower operation (immediate synchronization mode at the start or follow-up mode during acceleration).
Line speed control suppresses an increase in line speed resulting from the increasing radius of the take-up roll in a winder system.
Master-follower operation drives two or more shafts of a conveyer while keeping their positions in synchronization.

■ **Application specific function selection (d41)**

Data for d41	Function
0	Invalid
1	Line speed control with speed sensor **Note:** This control is valid only when “V/f control with speed sensor” or “Vector control with speed sensor (with auto torque boost)” is selected with F42, A14, b14, or r14 (data = 3 or 4).
2	Master-follower operation(Immediate synchronization mode at the start, without Z phase)
3	Master-follower operation(Follow-up mode during acceleration)
4	Master-follower operation(Immediate synchronization mode at the start, with Z phase)

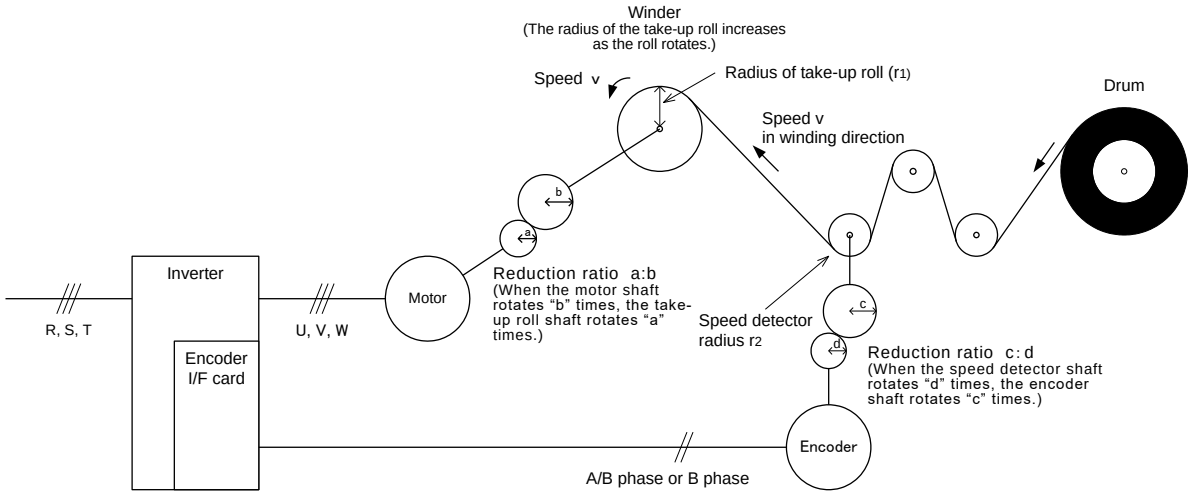
Line speed control

In a winder system (e.g., roving frames, wiredrawing machines), if the inverter continues to run the motor at a constant speed, the take-up roll gets bigger with materials (roving, wire, etc.) and its radius increases so that the winding speed of the take-up roll increases.

To keep the line speed (winding speed) constant, the inverter detects the winding speed using a speed sensor (encoder) and controls the motor rotation according to the encoder feedback.

Machinery configuration of winder system and function code settings

Shown below is a machinery configuration of a winder system for which it is necessary to configure the function codes as listed below.



- Speed reduction ratio between motor shaft and take-up roll shaft a : b
- Speed reduction ratio between speed detector shaft and encoder shaft c : d
- Radius of take-up roll before winding r_1
- Radius of speed detector r_2

Table 5.3-32 Setting the Reduction Ratio

Function code	Name	Settings
d15	Encoder pulse resolution	Encoder pulse resolution (P/R)
d16	Pulse scaling factor 1	Speed reduction ratio of the whole machinery (load) $\frac{K_2}{K_1} = \frac{r_2}{r_1} \times \frac{b}{a} \times \frac{d}{c}$ = d17/d16 d16: Denominator factor for the speed reduction ratio (K1 = r1 × a × c) d17: Numerator factor for the speed reduction ratio (K2 = r2 × b × d)
d17	Pulse scaling factor 2	

■ **Line speed command**

Under line speed control, speed commands should be given as line speed commands.

Setting with digital inputs

To digitally specify a line speed in m/min, make the following settings.

Function code	Name	Settings
E48	LED monitor (Speed monitor item)	5: Line speed
E50	Display coefficient for speed monitor	$K_s = \frac{240\pi \times a \times r_1}{p \times b}$ Ks: Display coefficient for transport time (E50) p: Number of motor poles a, b: Components of speed reduction ratio between motor shaft and take-up roll shaft (When the motor shaft rotates "b" times, the take-up roll shaft rotates "a" times.) r1: Radius of take-up roll before winding (initial value) in m

Setting with analog inputs

To specify a line speed using analog inputs, set an analog input (0 to 100%) based on the following equation.

$$\text{Analog input (\%)} = \frac{p \times b \times 100}{240\pi \times r1 \times a \times f_{max}} \times V$$

Where

V: Line speed in m/min

f_{max}: Maximum frequency 1 (F03)

■ **Adjustment**

Like usual speed controls, it is necessary to adjust the speed command filter, speed detection filter, P gain, and integral time in the speed control sequence that controls the line speed at a constant level.

Function code	Name	Key points
d01	Speed control (Speed command filter)	If an excessive overshoot occurs for a speed command change, increase the filter constant.
d02	Speed control (Speed detection filter)	If ripples are superimposed on the speed detection signal so that the speed control gain cannot be increased, increase the filter constant to obtain a larger gain.
d03	Speed control P (Gain)	If hunting is caused in the motor speed control, decrease the gain. If the motor response is slow, increase the gain.
d04	Speed control I (Integral time)	If the motor response is slow, decrease the integral time.

■ **Cancel line speed control -- "Hz/LSC" (Function code E01 to E05, data = 70)**

Turning ON **"Hz/LSC"** cancels line speed control. This disables the frequency compensation of PI processor, resulting in no compensation for a take-up roll getting bigger and an increase in the winding speed.

Use this signal to temporarily interrupt the control for repairing a thread break, for example.

"**Hz/LSC**"	Function
OFF	Enable line speed control (depending on d41 setting)
ON	Cancel line speed control (V/f control, without compensation for a take-up roll getting bigger)

■ **Hold line speed control frequency in the memory -- "LSC-HLD" (Function code E01 to E05, data = 71)**

If **"LSC-HLD"** is turned ON under line speed control, stopping the inverter (including an occurrence of an alarm and a coast-to-stop command) or turning **"Hz/LSC"** ON saves the current frequency command compensating for a take-up roll getting bigger, in the memory. At the time of restart, the saved frequency command applies and the inverter keeps the line speed constant.

"LSC-HLD"	Function
OFF	Disable (No saving operation)
ON	Enable (Saving the frequency command compensating for a take-up roll getting bigger)

Note Shutting down the inverter power during operation stop loses the frequency compensation data saved in the memory. At the time of restart, therefore, the inverter runs at the frequency without compensation so that a large overshoot may occur.

d51, d52 d55, d69, d79, d88 d91 to d97	**Reserved for particular manufacturers**

These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

d60	**Command (Pulse train input) (Encoder pulse resolution)**

d60 specifies the pulse resolution (P/R) of the command pulse.

- Data setting range: 20 to 3600 (P/R), Set by standard keypad in hexadecimal format (0x0014 to 0x0E10)

d61 to d63	**Command (Pulse train input) (Filter time constant, Pulse scaling factor 1 and Pulse scaling factor 2) (Refer to F01.)**

Refer to the description of the function code F01 for details on the pulse rate input.

d67	**PMSM starting mode (Auto search)**

Refer to the description of the function code H09 for details on the PMSM starting mode.

[2] Master-follower operation

d71 to d78	Master-follower operation

These function codes specify various parameters required for master-follower operation.

■ Application-Defined Control (d41)

Data for d41	Function
2	Immediate synchronization mode at the start, without Z phase
3	Start after synchronization mode
4	Immediate synchronization mode at the start, with Z phase

The master-follower operation control enables the follower inverter to detect the master motor rotation with PG signals and synchronize the follower motor with the master motor in rotation speed and position.

The master-follower operation is available in three modes: Immediate synchronization mode at the start, with Z phase (d41 = 4) and without Z phase (d41 = 2) and Start after synchronization mode (d41 = 3).

PG signals from master motor should be fed to terminals XA, XB, and XZ, and follower motor's ones, to terminals YA, YB, and YZ.

Table 5.3-33 Specifications of Master-follower operation

	Item	Specifications	Remarks
Control	Speed control range under V/f control with speed sensor	1:100	4-pole motors and PGs with 1024 P/R Speed reduction ratio = 1:1 During running at constant speed
	Speed control range under vector control with speed sensor	1:1500	
	Position control accuracy	±2°	
Electrical requirements	Input pulse rate	10 p/s to 100 kp/s *	Maximum wiring length: 100 m (328 ft) * When using quadrature encoders

* For PGs with an open collector output, the input pulse rate is 30 kp/s or below and the maximum wiring length is 20 m (66 ft).

■ **Immediate synchronization mode at the start**

In immediate synchronization mode at the start (d41 = 2 or 4), the inverter controls the rotation speed and position of the follower motor to maintain the difference between the master and follower motors (hereafter called deviation) at the time when the single motor drive operation is switched to the master-follower operation. That is, it keeps the deviation between the integrated position pulses of the master and follower motors at zero.

If the deviation falls below the synchronization completion detection angle (specified by d77), the inverter issues an **"SY"** synchronization completion signal. If synchronization is lost so that the position error exceeds 10 times of the excessive error setting (specified by d78), the inverter shuts down its output with the *ero* alarm.

When d41 = 4 (Immediate synchronization mode at the start, with Z phase), if any incorrect count due to electrical noise or other factors is found in the integrated count of A/B phases, the inverter corrects the error based on the Z phase difference.

When a run command for the follower motor is turned ON, the inverter continues to monitor the motor positions even if the master motor stops as long as the master-follower operation is not switched to the single motor drive operation. When the master motor starts running again, the inverter restarts to control the follower motor to maintain the Z phase difference between the master and follower motors.

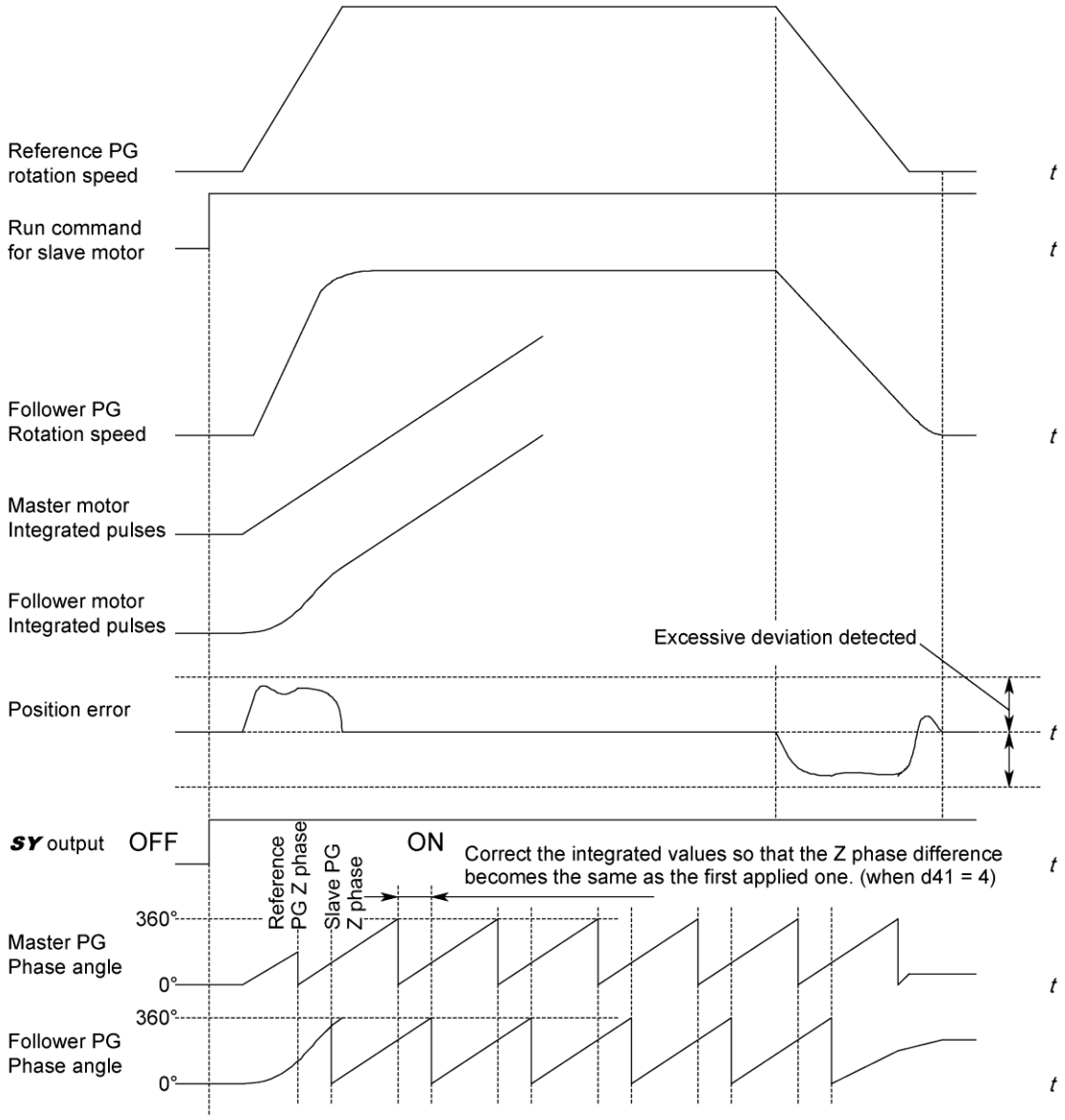


Figure 5.3-23

■ **Start after synchronization mode**

In Start after synchronization mode (d41 = 3), the inverter controls the follower motor to synchronize its Z phase with the master motor's Z phase, based on the first detected Z phases (positions) of those two motors after the start of master-follower operation. The follower motor could cause a single cycle delay at a maximum (on standby) at the start of operation.

Once the follower motor starts running after standby, it will never go standby unless the master-follower operation is cancelled (see Note 1 below).

The Z phase synchronization angles of the master and follower motors can be adjusted with d76.

The inverter integrates the position pulses for each of the master and follower motors and controls the follower motor's rotation speed and position to keep the deviation between those two motors at zero.

If any incorrect count due to electrical noise or other factors is found in the integrated count of A/B phases, the inverter corrects the error based on the Z phase difference.

If the deviation between those two motors falls below the synchronization completion detection angle (specified by d77), the inverter issues an **"SY"** synchronization completion signal. If synchronization is lost so that the position error exceeds 10 times of the excessive error setting (specified by d78), the inverter shuts down its output with the *ero* alarm.

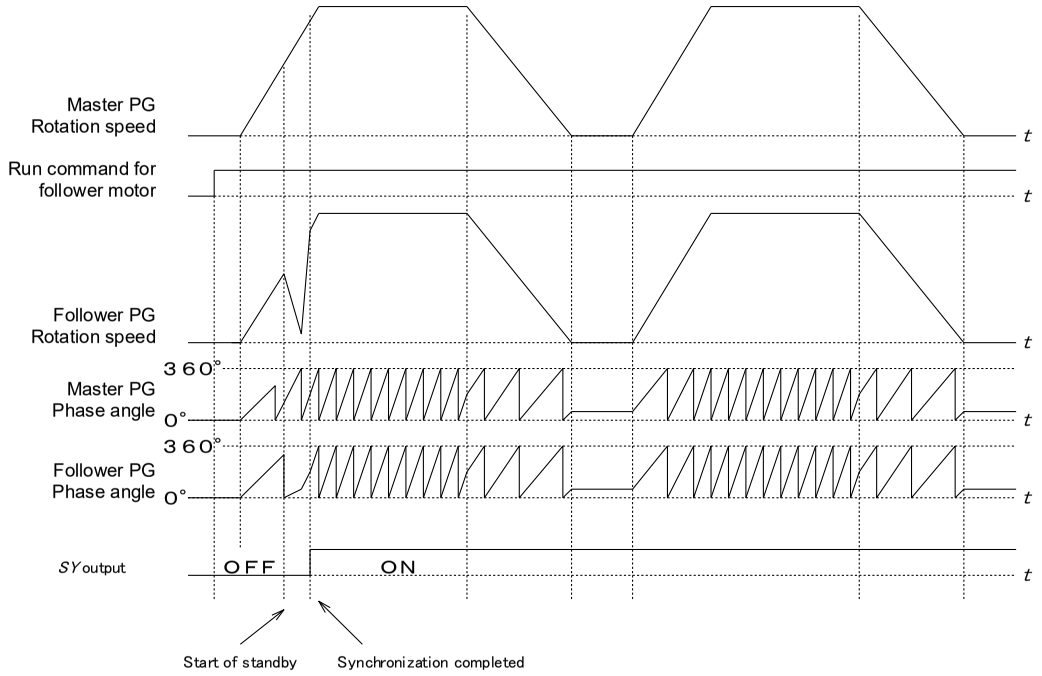


Figure 5.3-24

Note 1: Master-follower operation cancellation conditions

In any of the following cases, the master-follower operation is canceled.

- The run command for the follower motor is turned OFF.
- Terminal command **"BX"** ("Coast to a stop") or **"STOP"** ("Force to stop") is turned ON.
- Any alarm occurs.
- The inverter switches to a single motor drive. (Assign terminal command "**Hz2/Hz1**" and switch the frequency setting source with F01/C30.)
- Under torque control or when the inverter is driven by commercial power.

Block Diagrams

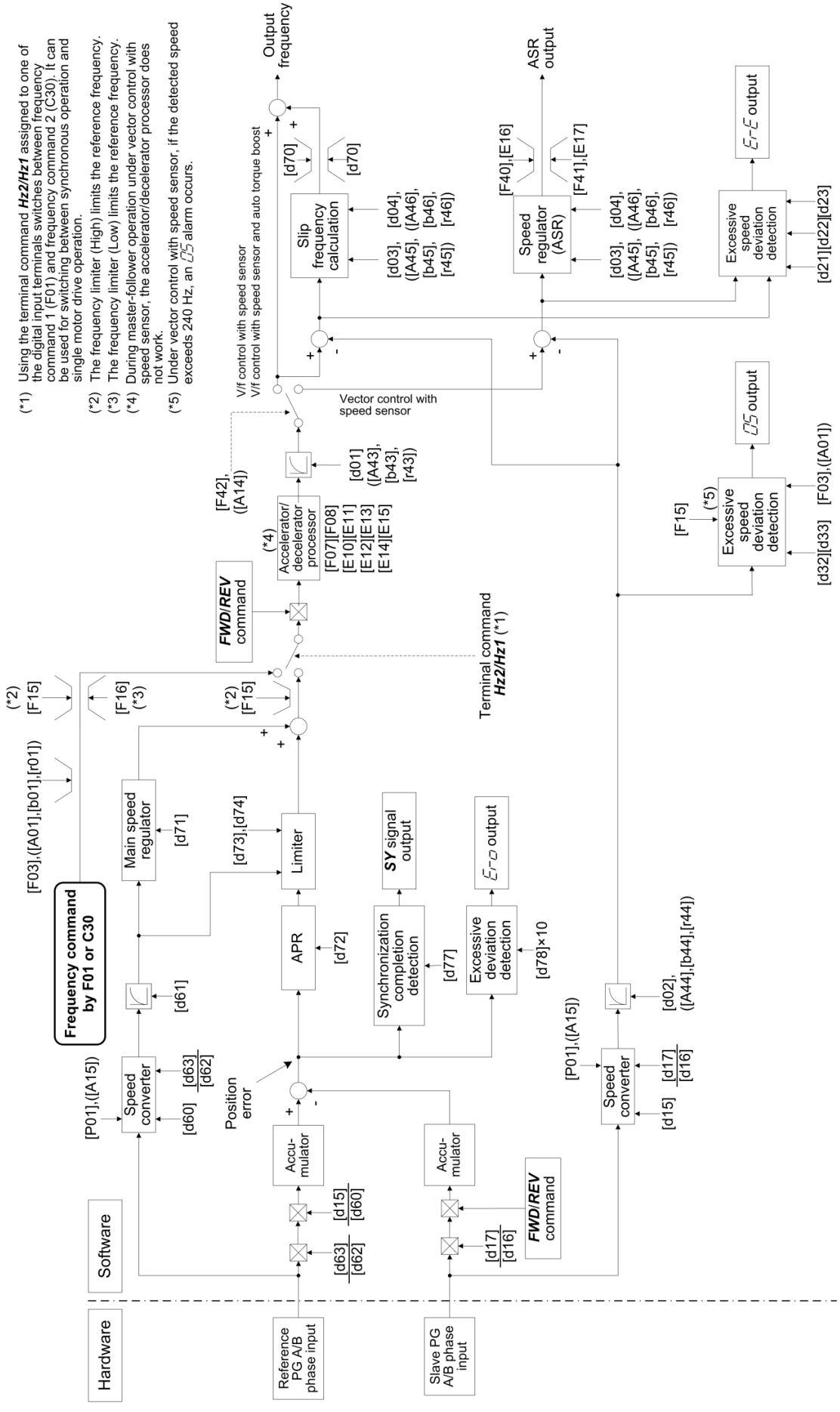


Figure 5.3-25 Block Diagram for Master-follower operation without Z Phase Compensation (d41 = 2)

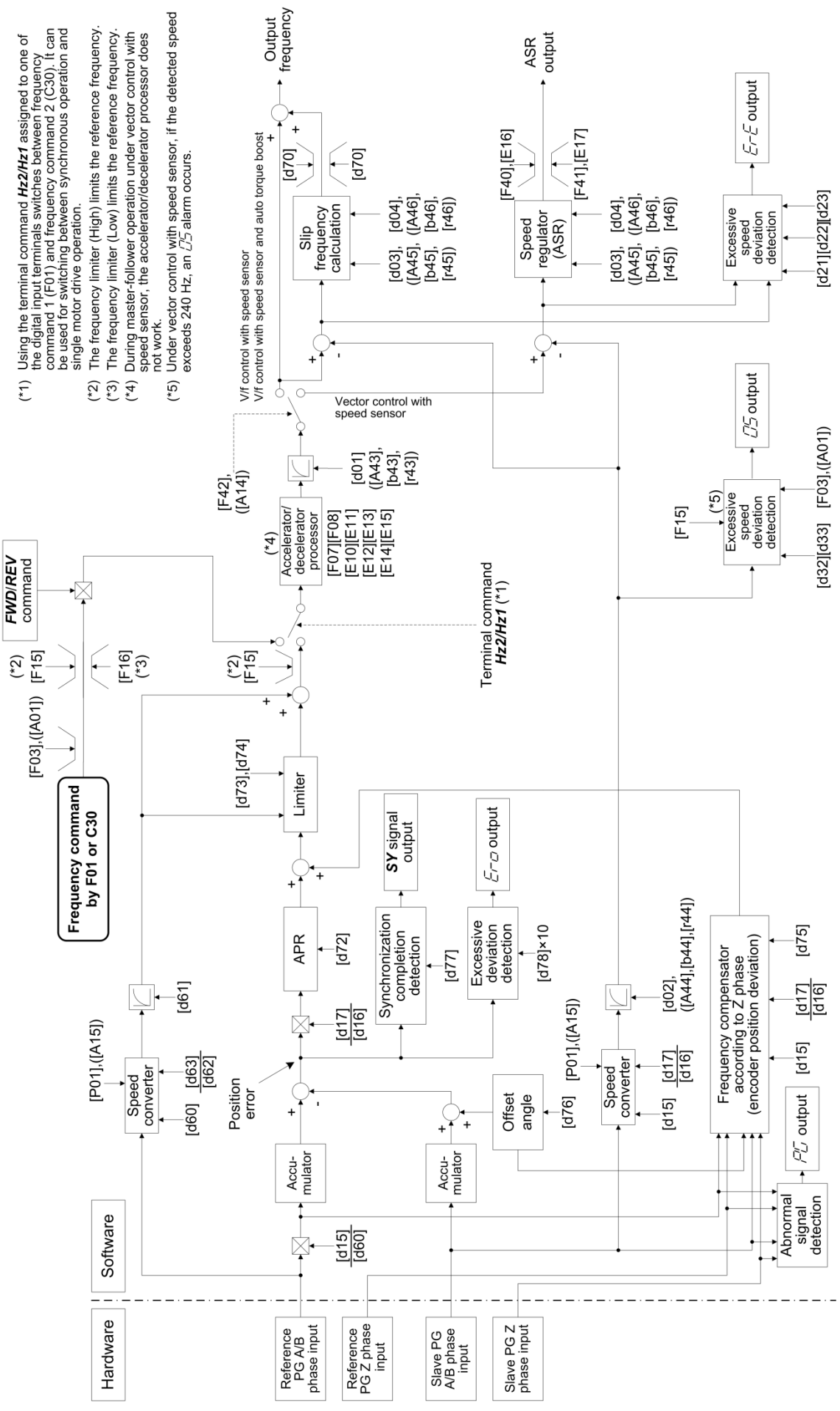


Figure 5.3-26 Block Diagram for Master-follower operation with Z Phase Compensation (d41 = 3 or 4)

■ **Unavailable Function Codes**

During master-follower operation, the following functions are not available.

F16	Frequency Limiter (Low)
C30	C01 to C04:Jump Frequency

Selecting “Vector control for induction motor with speed sensor” (F42 = 6) disables the settings of the following functions during master-follower operation, as well as making the above functions unavailable.

F07, F08	Acceleration Time 1/Deceleration Time 1
E10, E11	Acceleration Time 2/Deceleration Time 2
E12, E13	Acceleration Time 3/Deceleration Time 3
E14, E15	Acceleration Time 4/Deceleration Time 4
F24	Starting frequency (Holding time)
F39	Stop frequency (Holding time)

During master-follower operation, the following control should be disabled (H18 = 0, J01 = 0).

H18	Torque control
J01	PID control

Configuring Function Codes

To perform master-follower operation, be sure to select a control mode with speed sensor (F42 = 3, 4 or 6) and configure the function codes given in this section.

■ **Data setting for master-follower operation**

F01	Frequency setting 1
C30	Frequency setting 2

Select the pulse train input (F01/C30 = 12) as a reference command source.

Switching between master-follower operation and individual operation is possible using the “**Hz2/Hz1**” terminal command (see Figure 5.3-25 and Figure 5.3-26). The switching example is given below.

(Example) Turning terminal [X1] ON for individual operation during which a digital frequency command drives the inverter

Set F01 and C30 data to “12” and “0”, respectively. And set E01 data to “11” to assign the “**Hz2/Hz1**” command to terminal [X1].

It is recommended to perform switching between master-follower operation and individual operation when the inverter is stopped. Switching when the inverter is running may activate the protective function. To avoid it, decrease the difference between the output frequency and the reference frequency to apply after switching.

F07/E10/E12/E14	Acceleration Time
F08/E11/E13/E15	Deceleration Time

Also in master-follower operation, the inverter controls the output frequency according to the acceleration /deceleration time as usual. Set the acceleration/deceleration time as short as possible. Be careful that, setting the acceleration/deceleration time longer than that of the reference inverter loses the following capability of the follower motor.

Tip Selecting “Vector control for induction motor with speed sensor” (F42 = 6) ignores the acceleration /deceleration times specified by the function codes, running the motor with the acceleration/deceleration time 0.0 s.

F23, F24	Starting frequency, Starting frequency (Holding time)
F25, F39	Stop frequency, Stop frequency (Holding Time)

Set the starting frequency and stop frequency as low as possible to the extent that the motor can generate enough torque.

During master-follower operation, basically set the holding times for the starting frequency and stop frequency at 0.0 s.

Running at a frequency lower than the stop frequency or starting frequency the master cannot be followed.

Be careful that specifying the holding time deteriorates the following capability at the time of startup or stop.

Tip Selecting “Vector control for induction motor with speed sensor” (F42 = 6) ignores the starting/stop frequencies specified by the function codes, running the motor with the holding time 0.0 s.

F42	Drive Control Selection 1

To perform master-follower operation, select a control mode with speed sensor (F42 = 3, 4 or 6).

Usually, select “V/f control with speed sensor” (F42 = 3).

d01 to d05	Speed Control (Speed command filter, Speed detection filter, P (Gain), I (Integral time), FF(Gain))

These function codes set up the speed control response. Refer to d01.

d14 to d17	Feedback Input (Pulse input format, Encoder pulse resolution, Pulse scaling factor 1, Pulse scaling factor 2)

These function codes specify the speed feedback input under vector control with speed sensor (F42 = 3, 4 or 6).

Refer to d14 to d17

d59, d60 **d62, d63**	Command (Pulse train Input) (Pulse input format, Encoder pulse resolution, Pulse scaling factor 1, Pulse scaling factor 2)

These function codes specify the command frequency to apply to the inverter. The setting items are the same as for feedback input (d14 to d17).

Refer to F01.

d61	Command (Pulse train Input) (Filter time constant)

d61 specifies a filter time constant for pulse train input. Choose an appropriate value for the time constant taking into account the response speed of the machinery system since a large time constant slows down the response. When the reference frequency fluctuates due to small number of pulses, specify a larger time constant.

d71	Master follower operation (Main speed regulator gain)

d71 adjusts the main speed regulator gain to control the response and the steady-state deviation. Usually, it is not necessary to change the factory default.

Selecting simultaneous start synchronization without Z phase compensation (d41 = 2) only enables the setting made with d71.

d72	Master follower operation (APR gain)

d72 determines the response of the automatic position regulator (APR). (See Figure 5.3-25 and Figure 5.3-26)

If the APR output comes to be a single rotation of the encoder shaft per second when the phase angle error (position deviation) between the master and follower PGs becomes equal to a single rotation of the encoder shaft, that gain is assumed to be 1.0.

Setting a too large value to the gain data easily causes hunting, and setting a too small value results in a large steady-state deviation.

Adjust the gain, referring to Figure 5.3-27 as a guide. If the d72 setting is adjusted, it is recommended to adjust also the d02 setting as shown in Figure 5.3-27.

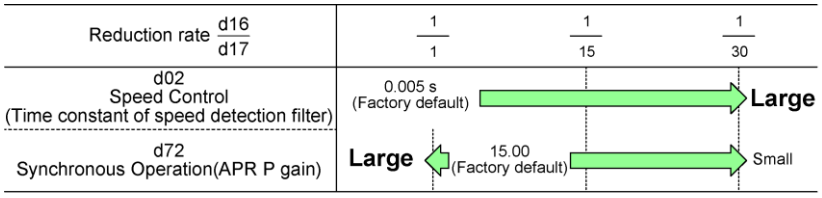


Figure 5.3-27 d72 Setting Guide

d73	Master follower operation (APR positive output limiter)
d74	Master follower operation (APR negative output limiter)

These function codes specify the limits of APR output relative to the master motor speed. (See Figure 5.3-25 and Figure 5.3-26)

Specification of “999” disables the limiter.

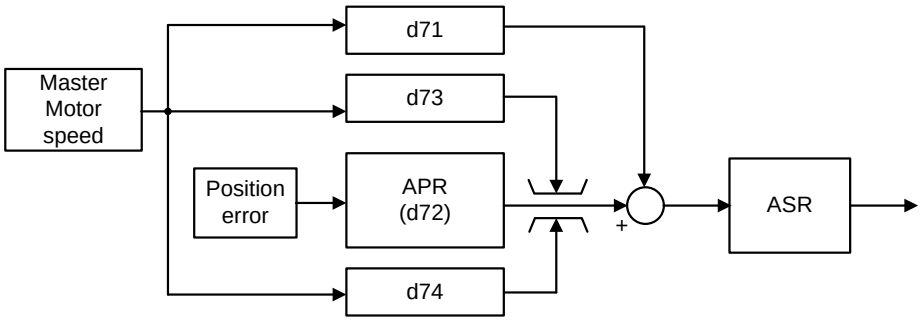


Figure 5.3-28 Operation of APR output limiter

d75	Master follower operation (Z phase alignment gain)

If the APR output reaches the maximum frequency when the phase angle error between the master and follower PGs (position deviation) becomes 10% of the pulse rate at the maximum frequency, that gain is assumed to be 1.0.

Usually, it is not necessary to change the factory default. If the reduction ratio is small and the encoder pulse count is low, it is necessary to decrease the Z phase alignment gain relative to the factory default.

d76	Master follower operation (Offset angle between master and follower)

In follow-up mode during acceleration, the follower inverter delays starting to synchronize the Z phase with that of the master motor by the offset angle specified by this function code.

d77 Master follower operation (Synchronization completion detection angle)

d77 specifies the synchronization completion detection angle.

If the absolute value of the phase angle error (position deviation) between the master and follower PGs becomes equal to or below the synchronization completion detection angle specified by d77, the inverter issues a synchronization completed signal **"SY"**, provided that the E20, E21 or E27 data (Terminal function) is set to "29" (Synchronization completed).

Once turned ON, the synchronization completed signal **"SY"** is kept ON for 100 ms.

360 degree of the detected angle is equivalent to 4 times d15.

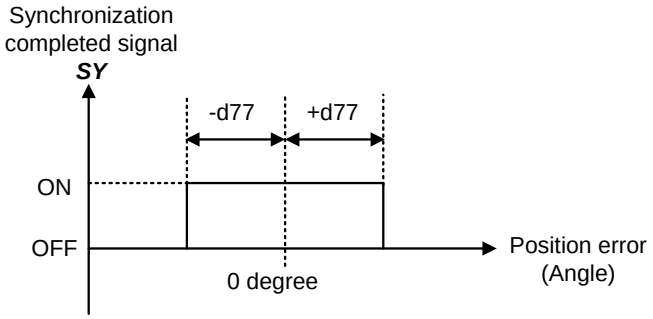


Figure 5.3-29 Synchronization Completion Detection Signal **"SY"**

d78 Master follower control (Excessive error detection level)

d78 specifies the detection level for excessive error alarm (*ero*).

If the absolute value of the phase angle deviation (position deviation) between the master and follower PGs exceeds 10 times the d78 setting, the inverter issues an alarm *ero* and shuts down its output.

During master-follower operation, the inverter always monitors an excessive deviation. The d78 setting should be made taking into account that the deviation temporarily increases immediately after the start of running.

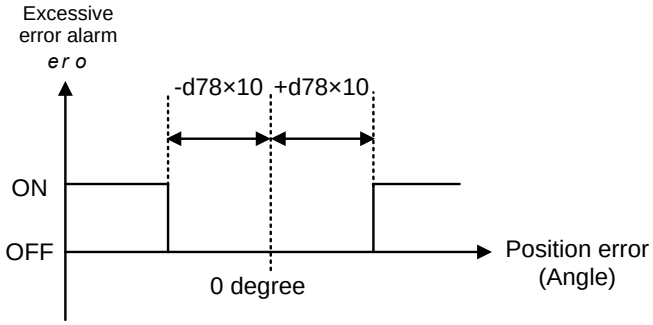


Figure 5.3-30 Excessive error alarm *ero*

d70	Speed control limiter

d70 specifies a limiter for the PI value output calculated in speed control sequence under “V/f control with speed sensor” or “dynamic torque vector control with speed sensor.”

A PI value output is within the “slip frequency × maximum torque (%)” in a normally controlled state.

If an abnormal state such as a temporary overload arises, the PI value output greatly fluctuates and it may take a long time for the PI value output to return to the normal level. Limiting the PI value output with d70 suppresses such abnormal operation.

- Data setting range: 0 to 100 (%) (assuming the maximum frequency as 100%)

d90	Magnetic flux level during deceleration under vector control for IM

d90 specifies the magnetic flux level to be applied during deceleration under vector control for Induction motor by percentage of the rated motor magnetic flux (determined by P06/A20).

d90 data takes effect only when H71 = 1 (Deceleration Characteristics enabled) and F42/A14 = 6 (Vector control for induction motor with speed sensor).

Increasing the d90 setting can reduce the deceleration time but increases the inverter output current and the motor temperature rise. In applications repeating frequent start/stop drive, an overload may apply to the inverter or motor.

Adjust the d90 setting so that the inverter output current (RMS equivalent) comes to be smaller than the motor rated current.

Use the default setting “150%” as long as there is no problem.

d99	Extended function 1

To enable the jogging operation “***JOG***” from communication, set bit 3=1 for this function.



Other bits than bit 3 of this function code are for manufacturers. Do not change these bits.

To change the d99 data, it is necessary to press the STOP + ▲/▼ keys (simultaneous keying).

5.3.10 U codes (Customizable logic operation)

The customizable logic function allows the user to form a logic or operation circuit for digital/analog input/output signals, customize those signals arbitrarily, and configure a simple relay sequence inside the inverter.

In the customizable logic, one step (component), depending on the type, is composed of:

(1) Digital 2 inputs, digital 1 output + logical operation (including timer)

(2) Analog 2 inputs, analog 1 output/digital 1 output + numerical operation

(3) Analog 1 input, digital 1 input, analog 1 output + numerical operation, logical operation

and a total of 200 steps can be used to configure a sequence.

■ **Modes**

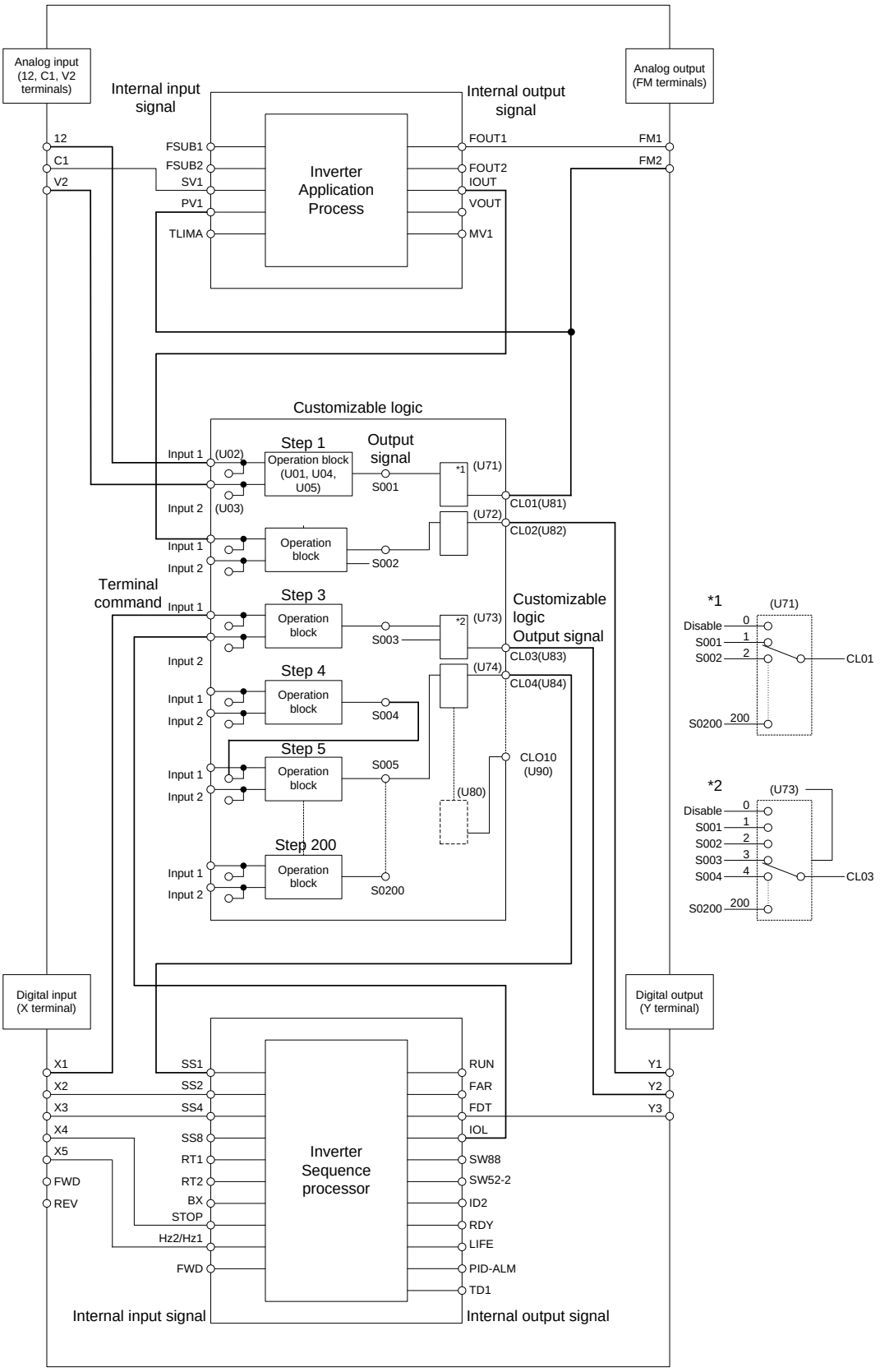
Item	Modes		
Terminal command	Digital 2 inputs	Analog 2 inputs	Analog 1 input Digital 1 input
Operation block	Logical operation, counter, etc.: 13 types Timer: 5 types	Numerical operation, comparator, limiter, etc.: 25 types	Selector, hold, etc.: 12 types
Output signal	Digital 1 output	Analog 1 output/ Digital 1 output	Analog 1 output
Number of steps	200 steps		
Customizable logic output signal	10 outputs		
Customizable logic processing time	2 ms (max. 10 steps), 5 ms (max. 50 steps), 10 ms (max. 100 steps), 20ms (max. 200 steps) Can be selected with a function code.		
Customizable logic cancellation command “CLC”	Allows to stop all the customizable logic operations by assigning “CLC” to a general-purpose input terminal and turning it ON. It is used when you want to deactivate the customizable logic temporarily.		
Customizable logic timer cancellation command “CLTC”	Resets the timer, counter and all the previous values used in customizable logic by assigning “CLTC” to a general-purpose input terminal and turning it ON. It is used when a customizable logic is changed or if you want to synchronize it with external sequence.		

Note If you use the customizable logic cancellation command and customizable logic timer cancellation command, the inverter can unintentionally start because the speed command is unmasked, depending on the structure of the customizable logic. Be sure to turn OFF the operation command to turn it ON.

A physical injury may result.

A damage may result.

■ **Block diagram**



Note Mode selection function codes for enabling customizable logic can be modified during operation but the customizable logic output may become temporarily unstable due to the setting modification. Therefore, since unexpected operation can be performed, change the settings if possible when the inverter is stopped.

A physical injury may result.

A damage may result.

U00	**Customizable logic (Mode selection)**
U01 to U70	**Customizable logic: Step 1 to 14 (Mode setting)**
U71 to U80	**Customizable logic: Output signal 1 to 10 (Output selection)**
U81 to U90	**Customizable logic: Output signal 1 to 10 (Function selection)**
U91	**Customizable logic: Timer monitor (Step selection)**
U92 to U97	**Customizable logic: The coefficients of the approximate formula**
U100	**Customizable logic: Task process cycle setting**
U101 to U106	**Customizable logic: Operating point 1 to 3**
U107	**Customizable logic: Auto calculation of the coefficients of the approximate formula**
U121 to U140	**Customizable logic: User parameter 1 to 20**
U171 to U175	**Customizable logic: Storage area 1 to 5**
U190 to U195	**Customizable logic: Step 15 to 200 setting**

■ Customizable Logic (Mode selection) (U00)

U00 specifies whether to enable the sequence configured with the customizable logic function or disable it to run the inverter only via its input terminals or others.

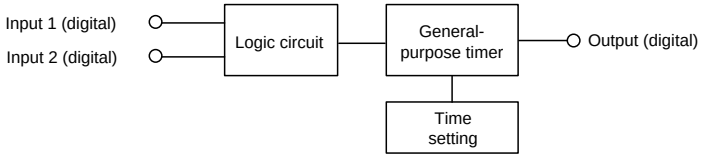
U00 data	Function
0	Disable
1	Enable (Customizable logic operation)

The *ec1* alarm occurs when changing U00 from 1 to 0 during operation.

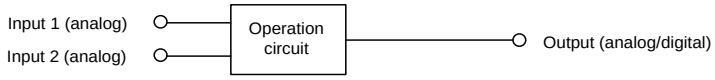
■ Customizable Logic (Mode Setting) (U01 to U70, U190 to U195)

In the customizable logic, the steps are categorized in the following three types:

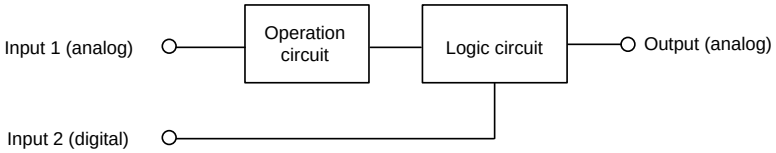
[Input: digital] Block selection (U01, U06, U11, etc.) = 1 to 1999



[Input: analog] Block selection (U01, U06, U11, etc.) = 2001 to 3999



[Input: digital, analog] Block selection (U01, U06, U11, etc.) = 4001 to 5999



The function code settings for each step are as follows:

- Step 1 to 14

Step No.	Block selection	Input 1	Input 2	Function 1	Function 2	Output Note)
Step 1	U01	U02	U03	U04	U05	“SO01”
	= 1 to 1999	Digital input 1	Digital input 2	Time setting	Not required	Digital output
	= 2001 to 3999	Analog input 1	Analog input 2	Value 1	Value 2	Analog/digital output
	= 4001 to 6999	Analog input 1	Digital input 2	Value 1	Value 2	Analog output
Step 2	U06	U07	U08	U09	U10	“SO02”
Step 3	U11	U12	U13	U14	U15	“SO03”
Step 4	U16	U17	U18	U19	U20	“SO04”
Step 5	U21	U22	U23	U24	U25	“SO05”
Step 6	U26	U27	U28	U29	U30	“SO06”
Step 7	U31	U32	U33	U34	U35	“SO07”
Step 8	U36	U37	U38	U39	U40	“SO08”
Step 9	U41	U42	U43	U44	U45	“SO09”
Step 10	U46	U47	U48	U49	U50	“SO10”
Step 11	U51	U52	U53	U54	U55`	“SO11”
Step 12	U56	U57	U58	U59	U60	“SO12”
Step 13	U61	U62	U63	U64	U65	“SO13”
Step 14	U66	U67	U68	U69	U70	“SO14”

Note) Output is not a function code. It indicates the output signal symbol.

- Step 15 to 200

Specify a step number in U190, and set the block selection, input 1, input 2, function 1, function 2 in U191 to U195 respectively.

Step No.	U190	Block selection	Input 1	Input 2	Function 1	Function 2	Output
Step 15	15	U191	U192	U193	U194	U195	“SO15”
Step 16	16						“SO16”
・・・	・・・						・・・
Step 199	199						“SO199”
Step 200	200						“SO200”

[Input: digital] Block function code setting

■ **Block selection (U01 etc.) (Digital)**

Any of the following items can be selected as a logic function block (with general-purpose timer):
The data can be logically inverted by adding 1000.

Data	Logic function block	Description
0	No function assigned	Output is always OFF.
10	Through output + General-purpose timer (No timer)	Only a general-purpose timer. No logic function block exists.
11	(On-delay timer)	Turning the input signal ON starts the on-delay timer. When the period specified by the timer has elapsed, the output signal turns ON. Turning the input signal OFF turns the output signal OFF.
12	(Off-delay timer)	Turning the input signal ON turns the output signal ON. Turning the input signal OFF starts the off-delay timer. When the period specified by the timer has elapsed, the output signal turns OFF.
13	(One-shot pulse output)	Turning the input signal ON issues a one-shot pulse whose length is specified by the timer.
14	(Retriggerable timer)	Turning the input signal ON issues a one-shot pulse whose length is specified by the timer. If the input signal is turned ON again during the preceding one-shot pulse length, however, the logic function block issues another one-shot pulse.
15	(Pulse train output)	If the input signal turns ON, the logic function block issues ON and OFF pulses (whose lengths are specified by the timer) alternately and repeatedly. This function is used to flash a luminescent device.
20 to 25	Logical AND + General-purpose timer	AND function with 2 inputs and 1 output, plus general-purpose timer.
30 to 35	Logical OR + General-purpose timer	OR function with 2 inputs and 1 output, plus general-purpose timer.
40 to 45	Logical XOR + General-purpose timer	XOR function with 2 inputs and 1 output, plus general-purpose timer.
50 to 55	Set priority flip-flop + General-purpose timer	Set priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
60 to 65	Reset priority flip-flop + General-purpose timer	Reset priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
70, 72, 73	Rising edge detector + General-purpose timer	Rising edge detector with 1 input and 1 output, plus general-purpose timer. This detects the rising edge of an input signal and outputs the ON signal for 5 ms (*1).
80, 82, 83	Falling edge detector + General-purpose timer	Falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects the falling edge of an input signal and outputs the ON signal for 5 ms (*1).
90, 92, 93	Rising & falling edges detector + General-purpose timer	Rising and falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects both the falling and rising edges of an input signal and outputs the ON signal for 5 ms (*1).

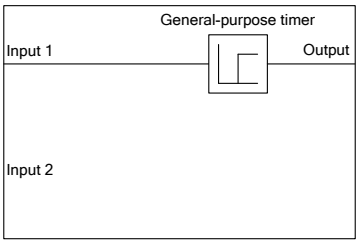
*1: Equals the task cycle: 2 ms for a task cycle of 2 ms, 5 ms for 5 ms, 10 ms for 10 ms, and 20 ms for 20 ms.

Data	Logic function block	Description
100 to 105	Hold + General-purpose timer	Hold function of previous values of 2 inputs and 1 output, plus general-purpose timer. If the hold control signal is OFF, the logic function block outputs input signals; if it is ON, the logic function block retains the previous values of input signals.
110	Increment counter	Increment counter with reset input. By the rising edge of the input signal, the logic function block increments the counter value by one. When the counter value reaches the target one, the output signal turns ON. Turning the reset signal ON resets the counter to zero.
120	Decrement counter	Decrement counter with reset input. By the rising edge of the input signal, the logic function block decrements the counter value by one. When the counter value reaches zero, the output signal turns ON. Turning the reset signal ON resets the counter to the initial value.
130	Timer with reset input	Timer output with reset input. If the input signal turns ON, the output signal turns ON and the timer starts. When the period specified by the timer has elapsed, the output signal turns OFF, regardless of the input signal state. Turning the reset signal ON resets the current timer value to zero and turns the output OFF.

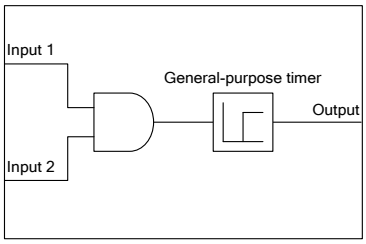
The data can be logically inverted by adding 1000.

The block diagrams for individual functions are given below.

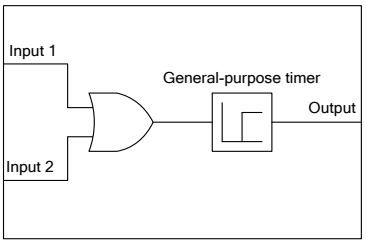
(Data=1□) Through output



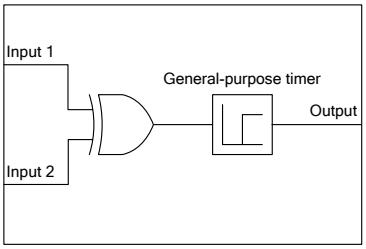
(Data=2□) Logical AND



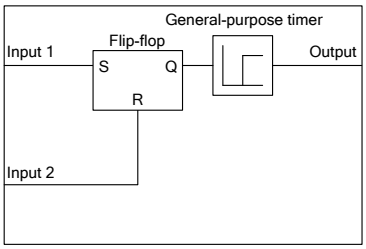
(Data=3□) Logical OR



(Data=4□) Logical XOR

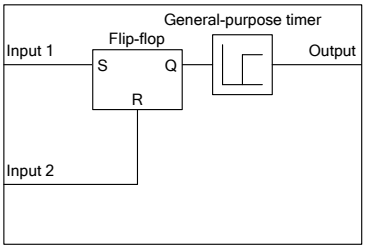


(Data=5□) Set priority flip-flop



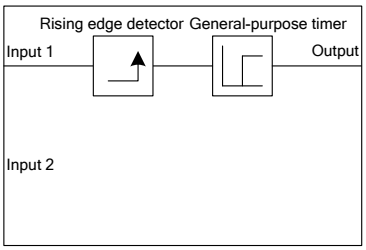
Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
	ON	–	OFF	
ON	–	–	ON	Set priority

(Data=6□) Reset priority flip-flop

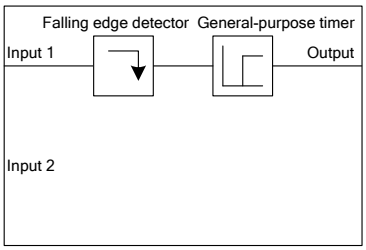


Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
–	ON	–	OFF	Reset priority
ON	OFF	–	ON	

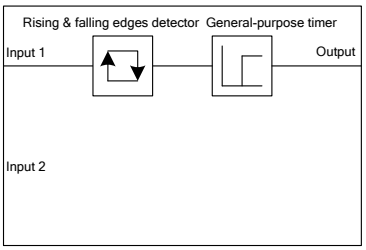
(Data=7□) Rising edge detector



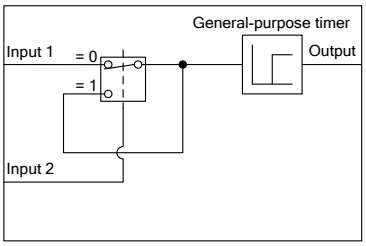
(Data=8□) Falling edge detector



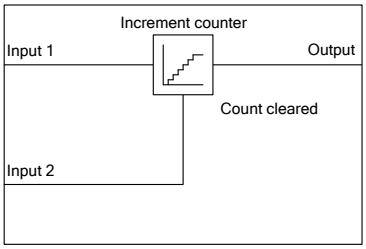
(Data=9□) Rising & falling edges detector



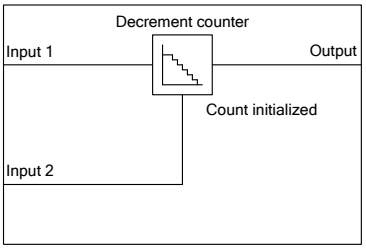
(Data=10□) Hold



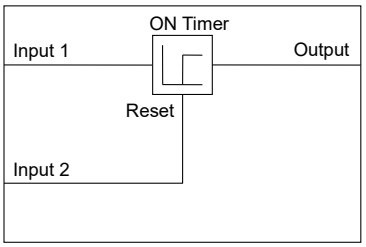
(Data=110) Increment counter

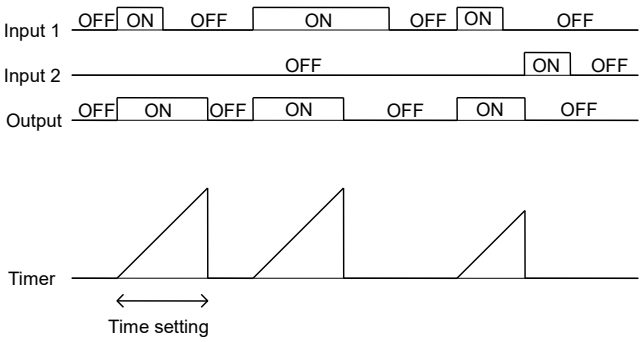


(Data=120) Decrement counter



(Data=130) Timer with reset input

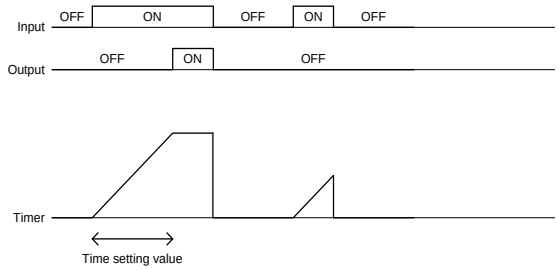




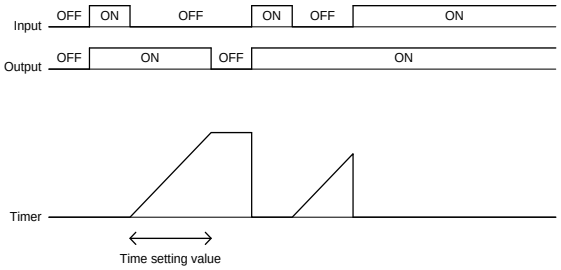
■ Operation of general-purpose timer(Digital)

The operation schemes for individual timers are shown below.

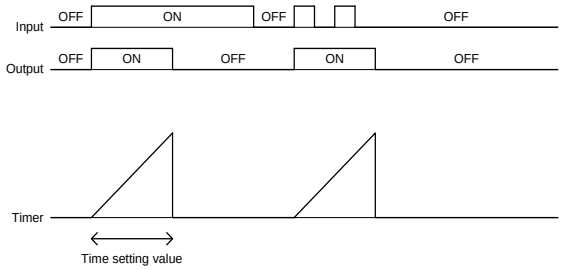
(End 1) On-delay timer



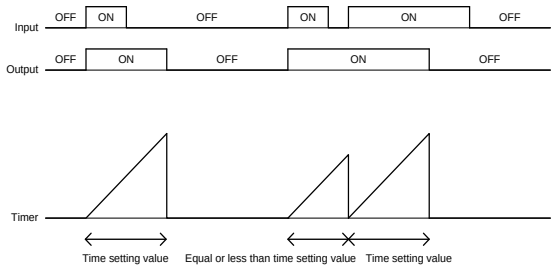
(End 2) Off-delay timer



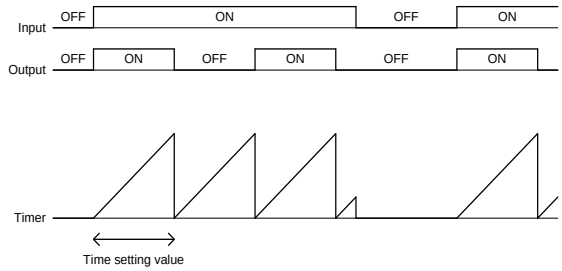
(End 3) One-shot pulse output



(End 4) Retriggerable timer



(End 5) Pulse train output



■ **Inputs 1 and 2 (U02, U03, etc.)(Digital)**

The following digital signals are available as input signals. Value in ( ) is in negative logic.

Data	Selectable Signals
0000 (1000) to 0105 (1105)	General-purpose output signals Same as the ones specified by E20, e.g., “RUN” (Inverter running), FAR (Frequency (speed) arrival signal), “FDT” (Frequency (speed) detected), “LU” (Undervoltage detected (Inverter stopped)), “B/D” (Torque polarity detected) Note: 27 (Universal DO) is not available. Note: Customizable logic output signals from 111 (1111) to 120 (1120) cannot be selected.
2001 (3001) to 2200 (3200)	Output of step 1 “SO01” to Output of step 200 “SO200”
4001 (5001)	Terminal X1 input signal “X1”
4002 (5002)	Terminal X2 input signal “X2”
4003 (5003)	Terminal X3 input signal “X3”
4004 (5004)	Terminal X4 input signal “X4”
4005 (5005)	Terminal X5 input signal “X5”
4010 (5010)	Terminal FWD input signal FWD
4011 (5011)	Terminal REV input signal REV
4021 (5021)	Terminal I1 input signal “I1” (on option card, OPC-DIO)
4022 (5022)	Terminal I2 input signal “I2” (on option card, OPC-DIO)
4023 (5023)	Terminal I3 input signal “I3” (on option card, OPC-DIO)
4024 (5024)	Terminal I4 input signal “I4” (on option card, OPC-DIO)
4025 (5025)	Terminal I5 input signal “I5” (on option card, OPC-DIO)
4026 (5026)	Terminal I6 input signal “I6” (on option card, OPC-DIO)
4027 (5027)	Terminal I7 input signal “I7” (on option card, OPC-DIO)
4028 (5028)	Terminal I8 input signal “I8” (on option card, OPC-DIO)
4029 (5029)	Terminal I9 input signal “I9” (on option card, OPC-DIO)
4030 (5010)	Terminal I10 input signal “I10” (on option card, OPC-DIO)
4031 (5011)	Terminal I11 input signal “I11” (on option card, OPC-DIO)
4032 (5012)	Terminal I12 input signal “I12” (on option card, OPC-DIO)
4033 (5013)	Terminal I13 input signal “I13” (on option card, OPC-DIO)
6000 (7000)	Final RUN command “FL_RUN” (ON when a run command is given)
6001 (7001)	Final FWD run command “FL_FWD” (ON when a run forward command is given)
6002 (7002)	Final REV run command “FL_REV” (ON when a run reverse command is given)
6003 (7003)	During acceleration “DACC” (ON during acceleration)
6004 (7004)	During deceleration “DDEC” (ON during deceleration)
6005 (7005)	Under anti-regenerative control “REGA” (ON under anti-regenerative control)
6006 (7006)	Within dancer reference position “DR_REF” (ON when the dancer position is within the reference range)
6007 (7007)	Alarm factor presence “ALM_ACT” (ON when there is no alarm factor)

■ **Function 1 (U04 etc.)(Digital)**

U05 and other related function codes specify the general-purpose timer period or the increment/decrement counter value.

Data	Function	Description
0.00 to +600.00	Timer	The period is specified in seconds.
	Counter value	The specified value is multiplied by 100 times. (If 0.01 is specified, it is converted to 1.)
-9990.00 to -0.01	—	The timer or counter value works as 0.00. (No timer)
+601.00 to +9990.00	Timer	The period is specified in seconds.

[Input: analog] Block function code setting

■ **Block selection, function 1, function 2 (U01, U04, U05, etc.)(Analog)**

The following items are available as operation function block.
Note that if the upper and lower limits have the same value, there are no upper and lower limits.

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
0	No function assigned	This function always outputs 0% (or logical “0: False”; OFF).	Not required	Not required
2001	Adder	Addition function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2002	Subtracter	Subtraction function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2003	Multiplier	Multiplication function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2004	Divider	Division function with two inputs (input 1 and input 2). Input 1 is dividend and input 2 is divisor. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2005	Limiter	Upper and lower limit functions of single input (input 1). The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2006	Absolute value of input	Absolute value function of single input (input 1). Negative input numbers become positive. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit

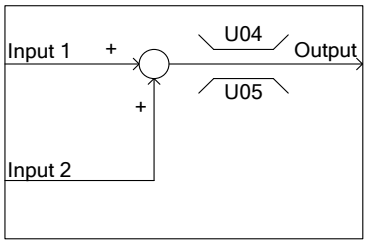
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
2007	Inverting adder	Inverting addition function with single input (input 1). This function subtracts the input 1 to the value specified with the 1st function code, inverts the result. And furthermore, the function adds the result to the value specified with the 2nd function code and outputs the result.	Subtraction value (former)	Addition value (latter)
2008	Variable limiter	Variable limit function of single input (input 1). Input 1 provides upper limit value and input 2 provides lower limit value.	Step number	Not required
2009	Linear function	Linear function of single input (input 1). This function receives single input (input 1), calculates pre-defined first-order polynomial, and outputs the result. The 1st and 2nd function codes provide the coefficients of the polynomial. The polynomial is represented by the following formula. $y = K_A \times \chi + K_B$ The output is limited within the range between -9990 and 9990 by the internal limiter.	Factor KA -9990.0 to +9990.0	Factor KB -9990.0 to +9990.0
2051	Comparator 1	Comparison function with hysteresis. This function compares the differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. If the differential value is (threshold value + hysteresis width) or bigger, this function outputs logical “1: True”. On the other hand, if the the differential value is (threshold value - hysteresis width) or smaller, this function outputs logical “0: False”.	Threshold value	Hysteresis width
2052	Comparator 2	Comparison function with hysteresis. This function compares the differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. If the differential value is bigger than (threshold value + hysteresis width), this function outputs logical “1: True”. On the other hand If the value is smaller than (threshold value - hysteresis width), the function outputs logical “0: False”.	Threshold value	Hysteresis width
2053	Comparator 3	Comparison function with hysteresis. This function compares the absolute differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. This function works like as comparator 1	Threshold value	Hysteresis width
2054	Comparator 4	Comparison function with hysteresis. This function compares the absolute differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. This function works like as comparator 2	Threshold value	Hysteresis width

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
2055	Comparator 5	Comparison function with hysteresis. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides threshold value and the 2nd one provides hysteresis width. If input 1 is (threshold value) or bigger, this function outputs logical “1: True”. On the other hand If input 1 is smaller than (threshold value - hysteresis width), this function outputs logical “0: False”.	Threshold value	Hysteresis width
2056	Comparator 6	Comparison function with hysteresis. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides threshold value and the 2nd one provides hysteresis width. If input 1 is (threshold value) or smaller, this function outputs logical “1: True”. On the other hand If input 1 is bigger than (threshold value + hysteresis width), this function outputs logical “0: False”.	Threshold value	Hysteresis width
2071	Window comparator 1	Comparison function with limits. Whether the value of the input is within a preselected range specified with two function codes determines the status of the output. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides upper threshold value and the 2nd one provides lower threshold value. If input 1 is within the range (defined with two function codes), this function outputs logical “1: True”. On the other hand If input 1 is outside of this range, this function outputs logical “0: False”.	Upper threshold	Lower threshold
2072	Window comparator 2	Comparison function with limit. This function has the inverting logic of “Window comparator 1”.	Upper threshold	Lower threshold
2101	High selector	High selector function. This function receives two inputs (input 1 and input 2), selects the higher one automatically, and outputs it. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit
2102	Low selector	Low selector function. This function receives two inputs (input 1 and input 2), selects the lower one automatically, and outputs it. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit
2103	Average of inputs	Average function. This function receives two inputs (input 1 and input 2), averages them, and outputs the result. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit

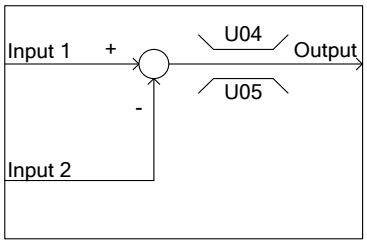
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
2151	Loading function from S13	Loading function from the function code S13 with scale conversion function. This function loads the setting value of the function code S13, maps the pre-selected range which is specified with two function codes, and outputs the result. The 1st function code provides the maximum scale value of the range and the 2nd one provides the minimum scale value of the range. The function code S13 is the PID process command value via communications in (%).	Maximum scale	Minimum scale
2201	Clip and map function	This function receives single input (input 1), clips a pre-selected range which is specified with two function codes from it, maps 0.00 to 100.00%, and outputs the result. The 1st function code provides the upper limit value of the range and the 2nd one provides the lower limit value of the range. This function can be connected to analog outputs (8000 to 8021) only, and only two of these functions can be used.	Upper limit	Lower limit
2202	Scale converter	Scale conversion function with single input (input 1). This function receives single input (input 1), maps an pre-selected range which is specified with two function codes, and outputs the result. The 1st function code provides the maximum scale value of the range and the 2nd one provides the minimum scale value of the range. This function can be connected to analog outputs (8000 to 8021) only, and only two of these functions can be used.	Maximum scale	Minimum scale
3001	Quadratic function	Quadratic function with limit. This function receives single input (input 1), calculates pre-defined second-order polynomial represented by the following formula, limits the value, and outputs the result.] $K_A \times (\text{Input } 1)^2 + K_B \times \text{input } 1 + K_C$ The 1st function code provides the upper limit value and the 2nd one provides the lower limit value. The coefficients of the polynomial are given by the function codes U92 to U97. Either (3001) or (3002) is available to use, and only one of these functions can be used.	Upper limit	Lower limit
3002	Square root function	Square root function with limit. This function receives single input (input 1), calculates pre-defined square root function represented by the following formula, limits the value, and outputs the result. $\sqrt{\frac{\text{Input } 1 + K_A}{K_B}} \times K_C$ The 1st function code provides the upper limit value and the 2nd one provides the lower limit value. The coefficients of the polynomial are given by the function codes U92 to U97. Either (3001) or (3002) is available to use, and only one of these functions can be used.	Upper limit	Lower limit

The block diagrams for each operation function block are given below. The setting value for functions 1 and 2 is indicated with U04 and U05.

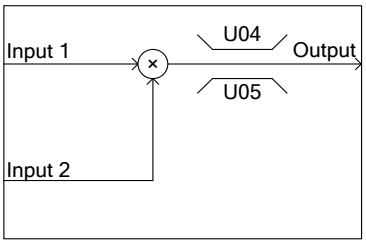
(2001) Adder



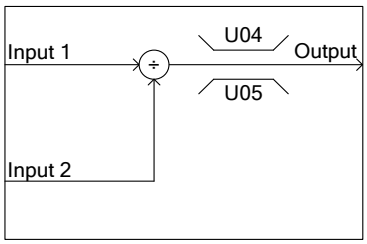
(2002) Subtracter



(2003) Multiplier



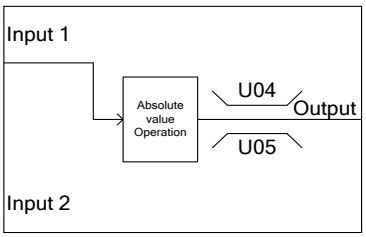
(2004) Divider



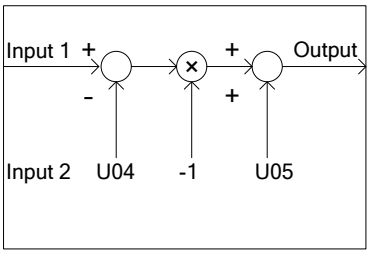
(2005) Limiter



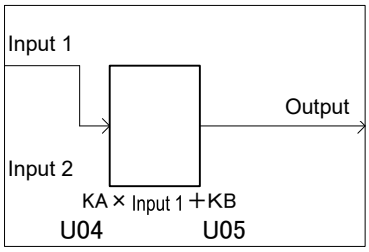
(2006) Absolute value of inputs



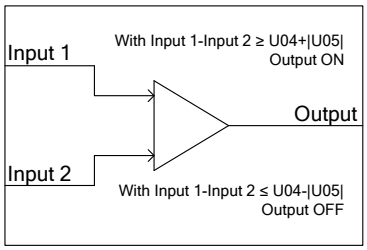
(2007) Inverting adder



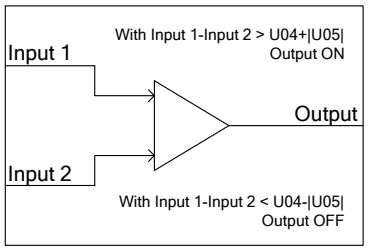
(2009) Linear function



(2051) Comparator 1

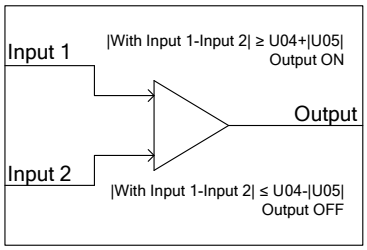


(2052) Comparator 2

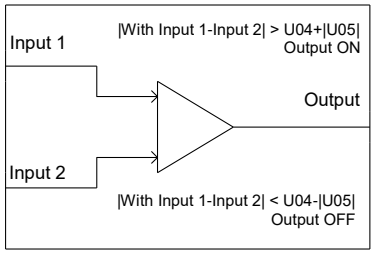


ON is prioritized when both conditions are satisfied.

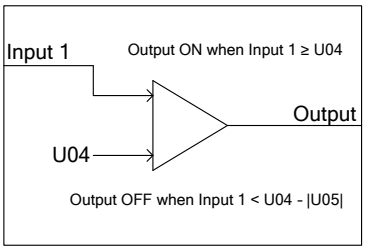
(2053) Comparator 3



(2054) Comparator 4

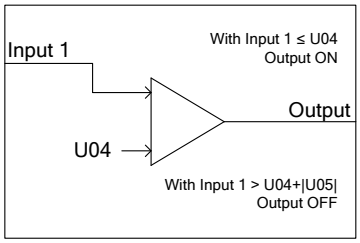


(2055) Comparator 5

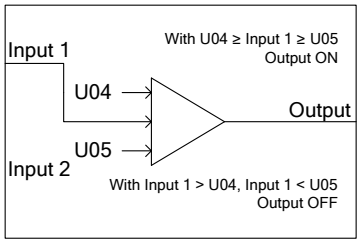


ON is prioritized when both conditions are satisfied.

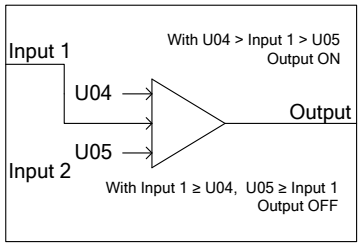
(2056) Comparator 6



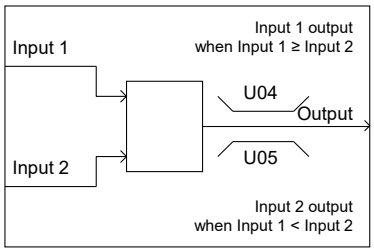
(2071) Window comparator 1



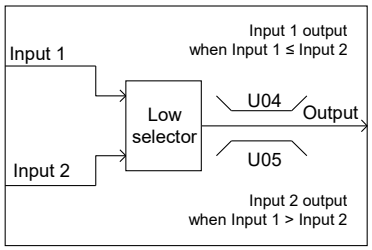
(2072) Window comparator 2



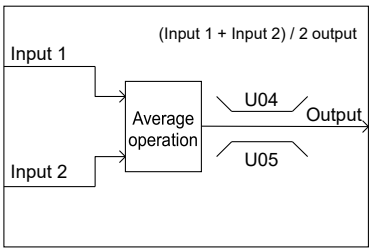
(2101) High selector



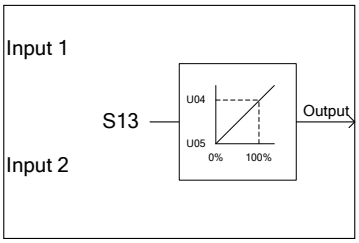
(2102) Low selector



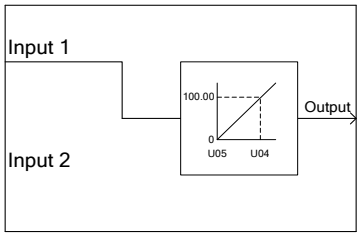
(2103) Average of inputs



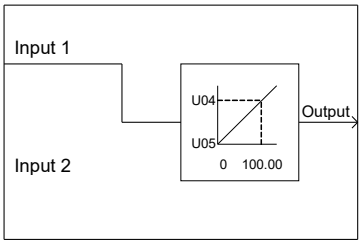
(2151) Loading function from S13



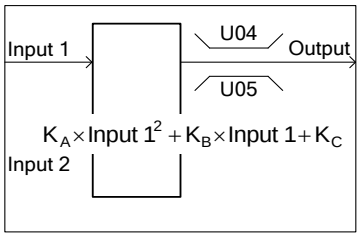
(2201) Clip and map function



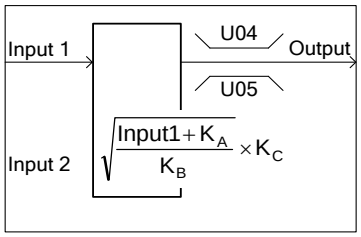
(2202) Scale converter



(3001) Quadratic function



(3002) Square root function



■ **Inputs 1 and 2 (U02, U03, etc.)(Analog)**

The following signals are available as analog input signals.

Data	Selectable Signals
8000 to 8021	General-purpose analog output signal (same as signals selected in F31 and F35: output frequency 1, output current, output torque, Input power, DC link bus voltage, etc.) Example: For output frequency 1, maximum frequency (100%) is input as 100.00. Example: For output current, 200% of the inverter rated current is input 100.00. Note: 10 (Universal AO) is not available.
2001 to 2200	Output of step 1 to 200 “SO01” to “SO200”
9001	Analog 12 terminal input signal [12]
9002	Analog C1 terminal input signal [C1] (C1 function)
9003	Analog C1 terminal input signal [C1] (V2 function)
9004	Analog 32 terminal input signal [32] (on option card, OPC-AIO)
9005	Analog C2 terminal input signal [C2] (on option card, OPC-AIO)

■ **Function 1, Function 2 (U04, U05, etc.)(Analog)**

Sets the upper limit and lower limit of operation function block.

Data	Function	Description
-9990.00 to 0.00 to +9990.00	Reference value Hysteresis width Upper limit Lower limit Upper threshold Lower threshold Setting value Maximum scale Minimum scale	Setting values for the operation of the function block (selected with the corresponding function code such as U01).

■ **The coefficients of the** conversion functions **(U92 to U97) (Analog)**

Sets the factor of conversions function (3001, 3002) of operation function block.

Function code	Name	Data setting range	Factory default
U92	Mantissa of K_A	Mantissa: -9.999 to 9.999	0.000
U93	Exponent part of K_A	Exponent part: -5 to 5	0
U94	Mantissa of K_B		0.000
U95	Exponent part of K_B		0
U96	Mantissa of K_c		0.000
U97	Exponent part of K_c		0

U92 to U97 can automatically be calculated based on measured data. For details, refer to the descriptions of U101 to U107 (page 5-277).

[Input: digital, analog] Block function code setting

■ **Lock selection, function 1, function 2 (U01, U04, U05, etc.) (digital,analog)**

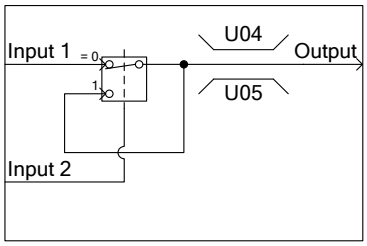
The following items are available as function block.

Note that if the upper and lower limits are identical, there are no upper and lower limits.

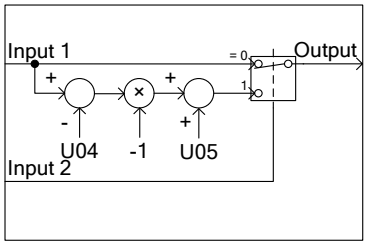
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
4001	Hold	Function to hold analog input 1 based on digital input 1.	Upper limit	Lower limit
4002	Inverting adder with enable	Function to reverse analog input 1 based on digital input 1.	Subtracted value (former)	Addition value (latter)
4003	Selector 1	Function to select analog input 1 and setting value based on digital input 1.	Setting value	Not required
4004	Selector 2	Function to select setting value 1/2 based on digital input 1.	Setting value 1	Setting value 2
4005	LPF (Low pass filter) with enable	Value of an analog input 1 is filtered through LPF (time constant U04) when the digital input 1 is “1”. When the digital input 1 is “0”, the analog input 1 is directly output. (LPF maintains the previous output value. Therefore, when the digital 1 input changes from 0 to 1, the output will be the value with the previous output value added as the initial value of LPF.) (No upper/lower limiter)	Time constant 0: No filter 0.01 to 5.00s	Fixed as 0
4006	Rate limiter with enable	Value of an analog input is limited with change rate specified in functions 1 and 2 when the digital input 1 is “1”. When the digital input 1 is “0”, the analog 1 input is directly output. When setting the initial value, carry out an operation with the initial value for input 1 and 0 applied to input 2. Then, reflect the result as the initial value (= previous output value) with 1 applied to input 2. During the initialization or when the CLC terminal is ON, the previous output value is cleared to 0.	Upward change rate Time taken to change 100% 0: No limit 0.01 to 600 s	Downward change rate Time taken to change 100% 0: The same change rate as function 1 0.01 to 600 s
5000	Selector 3	Function to select analog input 2 based on “SO01” to “SO200”.	Step No.	Not required
5100	Selector 4	Function to select analog input 1 and “SO01” to “SO200” based on digital input 1.	Step No.	Not required
6001	Reading function codes	Function to read the content of arbitrary function code. Use the 1st function code (such as U04) to specify a function code group, and the 2nd one (such as U05) to specify the last two digits of the function code number. For the function code settings, refer to “■ Configuration of function codes” in page 5-274. Both input 1 and input 2 are not used. Data formats that can be read correctly are as follows (the values are restricted between -9990 and 9990 and, for [29], 20000 is indicated as 100%): [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [12], [22], [24], [29], [35], [37], [45], [61], [67], [68], [74], [92] and [93] Data formats other than the above cannot be read correctly. Do not use any other format.	0 to 255	0 to 99

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
6002	Writing function codes	This function writes the value of input 1 to a function code (U171 to U175) on the volatile memory (RAM) when the input 2 becomes “1: True”. When the input 2 becomes “0: False”, this function stops to write to the function code (U171 to U175) and maintains the previous value. The value of input 1 is stored to the non-volatile memory (EEPROM) when the inverter detects undervoltage. Because the access arbitration from some steps at a time is not possible, only one step is allowed to access to the same function code in the customizable logic. If the access to the target function code from different steps at a time is executed, the alarm is displayed.	39	71 to 75
6003	Temporary change of function code	This function reflects the value of the specified function code on the volatile memory (RAM) when the input 2 becomes “0: False”. On the other hand when the input 2 does not become “0: False”, this function reflects the value of input 1 in the place of the function code. Refer to “■ Specific function codes” for the applicable function code on page 5-273. The value on the volatile memory (RAM) is cleared when the inverter is powered off. And the value is read from the non-volatile memory and restored when the inverter is powered on. Set the function code group (function type code) to the1st function code (U04, etc.). Set the lower 2 digits of the function code No. to the 2nd function (U05, etc.). If the specified function code (U04, U05, etc.) is not applicable one, this function outputs zero value. Because the access arbitration from some steps at a time is not possible, only one step is allowed with to access to the same function code in the customizable logic. When the function code is temporarily changed using 6003 during the customize logic operation and if the PC loader is read or copy to the touch panel is performed, the temporary changed data, not the non-volatile memory data, may be copied. Stop the customize logic before these operations.	0 to 255	0 to 99
6101	PID dancer output gain frequency	Circuit to switch either to calculate a frequency correction where 100% of PID output shall be the maximum frequency, or to calculate a frequency correction proportional to the line speed command. Use the input 1 to switch this circuit. Use the input 2 and gain ratio (1st function code) to set the frequency correction. Output: Frequency correction = (PID output) × (Line speed command) ••• (Input 2 OFF, U04≠0%) Frequency correction amount = (PID output×Gain ratio (U04)) × (Maximum output frequency) ••• (Input 2 ON, U04 ≠ 0%) Note that when the gain ratio is set to 0%, the following applies regardless of the input 2: Output: Frequency correction amount = (PID output) × (Line speed command) This circuit is used with the PID control.	Gain ratio 0 to 200%	Lower frequency limit 0 to 500Hz

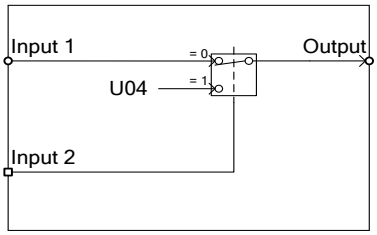
(4001) Hold



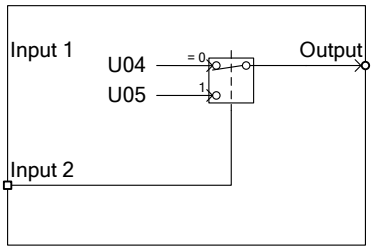
(4002) Inverting adder with enable



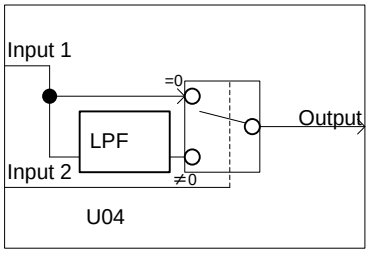
(4003) Selector 1



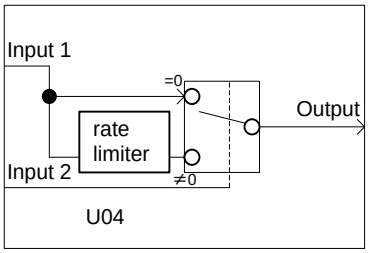
(4004) Selector 2



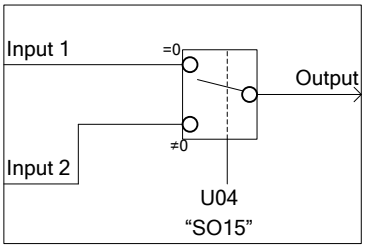
(4005) Low pass filter with enable



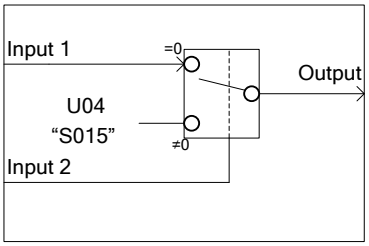
(4006) Rate limiter with enable



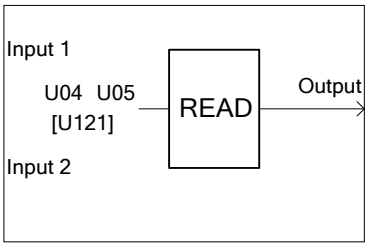
(5000) Selector 3



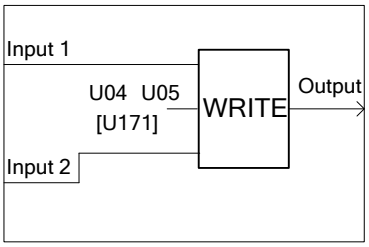
(5100) Selector 4



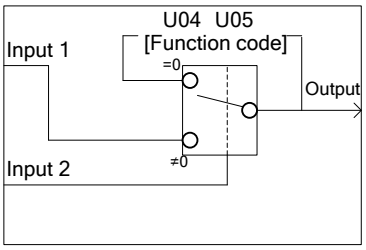
(6001) Reading function codes



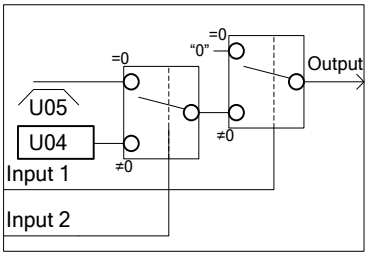
(6002) Writing function codes



(6003) Temporary change of function code



(6101) PID dancer output gain frequency



■ **Output signal (Digital,analog)**

In the customizable logic, outputs from steps 1 to 10 are issued to SO01 to SO200, respectively.

SO01 to SO200 differ in configuration depending upon the connection destination, as listed below. To relay those outputs to any function other than the customizable logic, route them via customizable logic outputs CL01 to CLO010.

Connection destination of each step output	Configuration	Function code
Input of customizable logic	Select one of the internal step output signals “SO01” to “SO200” in customizable logic input setting.	Such as U02 and U03
Input of inverter sequence processor (such as multistep speed “SS1” or operation command “FWD”)	Select one of the internal step output signals “SO01” to “SO200” to be connected to customizable logic output signals 1 to 10 (“CL01” to “CLO10”).	U71 to U80
	Select an inverter’s sequence processor input function to which one of the customizable logic output signals 1 to 10 (“CL01” to “CLO10”) is to be connected. (Same as in E01)	U81 to U90
Analog input (such as auxiliary frequency commands or PID process commands)	Select one of the internal step output signals “SO01” to “SO200” to be connected to customizable logic output signals 1 to 10 (“CL01” to “CLO10”).	U71 to U80
	Select an analog input function to which one of the customizable logic output signals 1 to 10 (“CL01” to “CLO10”) is to be connected. (Same as in E61)	U81 to U90
General-purpose digital output ([Y] terminals)	Select one of the internal step output signals “SO01” to “SO200” to be connected to customizable logic output signals 1 to 10 (“CL01” to “CLO10”).	U71 to U80
	To specify a general-purpose digital output function (on [Y] terminals) to which one of the customizable logic output signals 1 to 10 (“CL01” to “CLO10”) is to be connected, select one of “CLO1” to “CLO10” by specifying the general-purpose digital output function on any Y terminal.	E20, E21, E27
General-purpose analog output ([FM] terminals)	Select one of the internal step output signals “SO01” to “SO200” to be connected to customizable logic output signals 1 to 10 (“CL01” to “CLO10”).	U71 to U80
	To specify a general-purpose analog output function (on [FM] terminals) to which one of the customizable logic output signals 1 to 10 (“CL01” to “CLO10”) is to be connected, select one of “CLO1” to “CLO10” by specifying the general-purpose digital output function on any [FM] terminal.	F31, F35

Note General-purpose digital outputs (on [Y] terminals) are updated every 5 ms. To securely output a customizable logic signal via [Y] terminals, include on- or off-delay timers in the customizable logic. Otherwise, short ON or OFF signals may not be reflected on those terminals.

Function codes	Name	Data setting range	Factory default
U71	Customizable logic output signal 1 (Output selection)	0: Disable 1: Output of step 1, “SO01” 2: Output of step 2, “SO02” ••• 199: Output of step 199, “SO199” 200: Output of step 200, “SO200”	0
U72	Customizable logic output signal 2 (Output selection)		0
U73	Customizable logic output signal 3 (Output selection)		0
U74	Customizable logic output signal 4 (Output selection)		0
U75	Customizable logic output signal 5 (Output selection)		0
U76	Customizable logic output signal 6 (Output selection)		0
U77	Customizable logic output signal 7 (Output selection)		0
U78	Customizable logic output signal 8 (Output selection)		0
U79	Customizable logic output signal 9 (Output selection)		0
U80	Customizable logic output signal 10 (Output selection)		0
U81	Customizable logic output signal 1 (Function selection)	■ If a step output is digital The same value as E98 can be specified. 0(1000): Select multistep frequency (0 to 1 steps) “SS1” 1(1001): Select multistep frequency (0 to 3 steps) “SS2” 2(1002): Select multistep frequency (0 to 7 steps) “SS4” 3(1003): Select multistep frequency (0 to 15 steps) 4(1004): Select ACC/DEC time (2 steps) “RT1” 5(1005): Select ACC/DEC time (4 steps) “RT2” 6(1006): Enable 3-wire operation “HLD” 7(1007): Coast to a stop command “BX” 8(1008): Reset alarm “RST” 9(1009): Enable external alarm trip “THR” (9=Active OFF/1009=Active ON) and so on. ■ If a step output is analog 8001: Auxiliary frequency command 1 8002: Auxiliary frequency command 2 8003: PID process command 8005: PID feedback value 8006: Ratio setting 8007: Analog torque limit value A 8008: Analog torque limit value B 8009: Analog torque bias 8010: Analog torque command 8011: Analog torque current command 8017: Analog speed limit for forward rotation 8018: Analog speed limit for reverse rotation 8020: Analog monitor	100
U82	Customizable logic output signal 2 (Function selection)		100
U83	Customizable logic output signal 3 (Function selection)		100
U84	Customizable logic output signal 4 (Function selection)		100
U85	Customizable logic output signal 5 (Function selection)		100
U86	Customizable logic output signal 6 (Function selection)		100
U87	Customizable logic output signal 7 (Function selection)		100
U88	Customizable logic output signal 8 (Function selection)		100
U89	Customizable logic output signal 9 (Function selection)		100
U90	Customizable logic output signal 10 (Function selection)		100

■ **Specific function codes**

The following function codes can take values on memory by using the customizable logic “Function code switch (6003)”. Overwritten values are cleared with power off.

Code	Name	Code	Name
F07	Acceleration time 1	H66	Non-linear V/f 3 (Voltage)
F08	Deceleration time 1	H91	PID feedback wire break detection
F15	Frequency limiter (Upper)	J03	PID control P (Gain)
F16	Frequency limiter (Lower)	J04	PID control I (Integral time)
F21	DC braking 1 (Braking level)	J05	PID control D (Differential time)
F22	DC braking 1 (Braking time)	J06	PID control (Feedback filter)
F23	Starting frequency 1	J10	PID control (Anti-reset windup)
F24	Starting frequency 1 (Holding time)	J12	PID control (Upper limit of warning (AH))
F25	Stop frequency	J13	PID control (Lower limit of warning (AL))
F39	Stop frequency (Holding time)	J15	PID control (Sleep frequency)
F40	Torque limiter 1 (Driving)	J16	PID control (Sleep timer)
F41	Torque limiter 1 (Braking)	J17	PID control (Wakeup frequency)
F44	Current limiter (Level)	J18	PID control (Upper limit of PID process output)
E10	Acceleration time 2	J19	PID control (Lower limit of PID process output)
E11	Deceleration time 2	J58	PID control (Detection width of dancer position error)
E12	Acceleration time 3	J59	PID control P (Gain) 2
E13	Deceleration time 3	J60	PID control I (Integral time) 2
E14	Acceleration time 4	J61	PID control D (Differential time) 2
E15	Deceleration time 4	J62	PID control block selection
C05	Multistep frequency 1	J68	Brake control signal (Brake-release current)
C06	Multistep frequency 2	J69	Brake control signal (Brake-release frequency/speed)
C07	Multistep frequency 3	J70	Brake control signal (Brake-release timer)
C08	Multistep frequency 4	J71	Brake control signal (Brake-apply frequency/speed)
C09	Multistep frequency 5	J72	Brake control signal (Brake-apply timer)
H28	Droop control	J95	Brake control signal (Brake-release torque)
H50	Non-linear V/f 1 (Frequency)	J97	Servo lock (Gain)
H51	Non-linear V/f 1 (Voltage)	d01	Speed control 1 (Speed command filter)
H52	Non-linear V/f 2 (Frequency)	d02	Speed control 1 (Speed detection filter)
H53	Non-linear V/f 2 (Voltage)	d03	Speed control 1 (P (Gain))
H57	1st S-curve acceleration range (At starting)	d04	Speed control 1(I (Integral time))
H58	2nd S-curve acceleration range (At arrival)	d05	Speed control 1 (FF (Gain))
H59	1st S-curve deceleration range (At starting)	d07	Speed control 1 (Notch filter resonance frequency)
H60	2nd S-curve deceleration range (At arrival)	d08	Speed control 1 (Notch filter attenuation level)
H65	Non-linear V/f 3 (Frequency)		

■ **Function codes for the customizable logic**

Function code number	Name	Range	Minimum unit	Remarks
U121 to U140	User parameter 1 to 20	-9990.00 to 9990.00 Effective number are 3 digits.	0.01 to 10	
U171 to U175	Storage area 1 to 5	-9990.00 to 9990.00 Effective number are 3 digits.	0.01 to 10	Memorize the data when powered off.

■ **Configuration of function codes**

Set a function code group (code from the following table) to function 1 (such as U04) and set the last two digits of the function code number to function 2 (such as U05) to specify individual function codes.

Group	Code		Name	Group	Code		Name
F	0	00_H	Basic function	U1	39	27_H	For customizable logic
E	1	01_H	Terminal function	y	14	$0E_H$	Link function
C	2	02_H	Control function	K	28	$1A_H$	Touch panel function
P	3	03_H	Motor1	M	8	08_H	Monitor data
H	4	04_H	High performance function	o	6	06_H	Option function
H1	31	$1F_H$	High performance function 1	d	19	13_H	Applied function 2
A	5	05_H	Speed control 2	U	11	$0B_H$	Customizable logic
b	18	12_H	Speed control 3	W	15	$0F_H$	Monitor 2
r	10	$0A_H$	Speed control 4	X	16	10_H	Alarm 1
J	13	$0D_H$	Applied function 1	Z	17	11_H	Alarm 2
J1	48	30_H	Applied function 1				

■ **Task process cycle setting (U100)**

U100 data	Data
0	Automatically adjusts the task cycle from 2 ms to 10 ms depending on the number of used steps. This is the factory default. It is recommended to use this value.
2	2 ms: Up to 10 steps. If it exceeds 10 steps, the customizable logic does not work.
5	5 ms: Up to 50 steps. If it exceeds 50 steps, the customizable logic does not work.
10	10 ms: Up to 100 steps. If it exceeds 100 steps, the customizable logic does not work.
20	20 ms Up to 200 steps.

Note that if it exceeds the steps defined in 2, 5 or 10, the customizable logic does not work.

■ **Operating precautions**

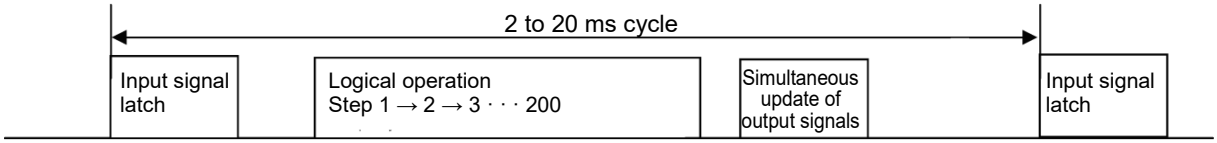
The customizable logics are executed within 2 ms to 20 ms (according to U100) and processed in the following procedure:

(1) First, latch the external input signals for all the customizable logics from step 1 to 200 to maintain synchronism.

(2) Perform logical operations sequentially from step 1 to 200.

(3) If an output of a step is an input to the next step, outputs of step with high priority can be used in the same process.

(4) The customizable logic simultaneously updates 10 output signals.



Note that if you do not consider the process order of customizable logic when configuring a function block, the expected output may not be obtained, the operation can be slower or a hazard signal can occur, because the output signal of a step is not available until the next cycle.

⚠CAUTION
Changing a functional code related to the customizable logic (U code etc.) or turning ON the customizable logic cancel signal “CLC” causes change in operation sequence depending on the setting, which may suddenly start an operation or start an unexpected action. Fully ensure it is safe before performing the operation. **An accident or physical injury may occur.**

■ **Customizable logic timer monitor (Step selection) (U91, X89 to X93)**

The monitor function codes can be used to monitor the I/O status or timer’s operation state in the customized logics.

Table 5.3-34 Selection of monitor timer

Function code	Function	Remarks
U91	0: Monitor not active (the monitor data is 0) 1 to 200: set the step No. to monitor	The setting value is cleared to 0 when powered off.

Table 5.3-35 Monitor method

Monitor method	Function code	Data
Communication	X89 customizable logic (digital I/O)	Digital I/O data for the step defined in U91 (only for monitoring)
	X90 customizable logic (timer monitor)	Data of the timer/counter value for the step defined in U91 (only for monitoring)
	X91 customizable logic (analog input 1)	Analog input 1 data for the step defined in U91 (only for monitoring)
	X92 customizable logic (analog input 2)	Analog input 2 data for the step defined in U91 (only for monitoring)
	X93 customizable logic (analog output)	Analog output data for the step defined in U91 (only for monitoring)

■ **Cancel customizable logic “CLC” (function codes E01 to E05 Data = 80)**

Customizable logic operations can temporarily be disabled so that the inverter can be operated without the customizable logic’s logical circuit and timer operation, for example during maintenance.

“CLC”	Function
OFF	Customizable logic enabled (according to U00 setting)
ON	Customizable logic disabled

Note If you turn ON the customizable logic cancellation signal “CLC”, a sequence by the customizable logic is cleared, which can suddenly start operation depending on the settings. Ensure the safety and check the operation before switching the signal.

■ **Clear all customizable logic timers “CLTC” (function codes E01 to E05 Data = 81)**

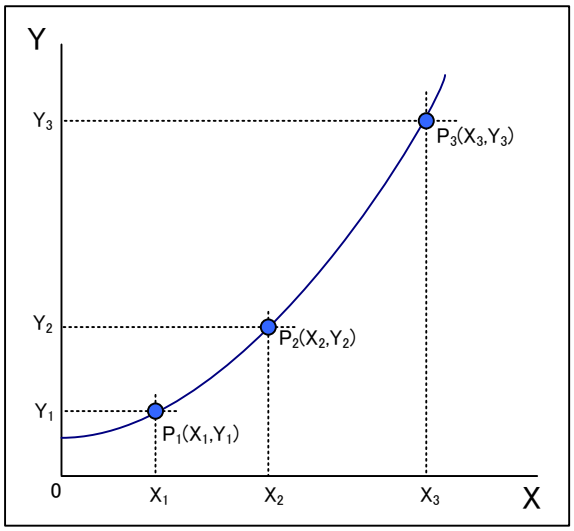
If the CLTC terminal function is assigned to a general-purpose input terminal and this input is turn ON, all the general-purpose timers and counters in the customizable logic are reset. It is used to reset and restart the system, when, for example, the timing of external sequence cannot be consistent with internal customizable logic due to a momentary power failure.

“CLTC”	Function
OFF	Normal operation
ON	Resets all the general-purpose timers and counters in the customizable logic. (To reactivate it, turn it OFF again.)

5.3.11 U1 codes (Customizable logic operation)

U101 to U106	**Customizable logic (Operating point 1 (X1, Y1), Operating point 2 (X2, Y2), Operating point 3 (X3, Y3))**

By using function block 3001, quadratic function $K_A \cdot x^2 + K_B \cdot x + K_C$ is calculated relative to the input signal x as shown in the following diagram, allowing the output to be obtained. Here, K_A, K_B, and K_C are coefficients, and they can be set with function codes.



Coefficients K_A, K_B, K_C

Coefficients K_A, K_B, K_C for quadratic function $K_A \cdot x^2 + K_B \cdot x + K_C$ can be set within the following ranges.

	Setting range
Coefficient KA	-9.999×105 to 9.999×105
Coefficient KB	-9.999×105 to 9.999×105
Coefficient KC	-9.999×105 to 9.999×105

These coefficients are set using function codes U92 to U97.

Function code	Name	Setting range
U92	Coefficient KA mantissa portion	-9.999 to 9.999
U93	Coefficient KA exponent portion	-5 to 5
U94	Coefficient KB mantissa portion	-9.999 to 9.999
U95	Coefficient KB exponent portion	-5 to 5
U96	Coefficient KC mantissa portion	-9.999 to 9.999
U97	Coefficient KC exponent portion	-5 to 5

Instead of setting the coefficients individually, they can be calculated and set automatically in function codes U92 to U97, by changing U107 from 0 to 1 after setting the arbitrary three sets of operating point data P_1 (X_1, Y_1), P_2 (X_2, Y_2), and P_3 (X_3, Y_3) from the above diagram in function codes U101 to U106.

Function code	Name	Setting range
U101	Operating point data P1 (X1)	-999.00 to 0.00 to 9990.00
U102	Operating point data P1 (Y1)	999.00 to 0.00 to 9990.00
U103	Operating point data P2 (X2)	999.00 to 0.00 to 9990.00
U104	Operating point data P2 (Y2)	999.00 to 0.00 to 9990.00
U105	Operating point data P3 (X3)	999.00 to 0.00 to 9990.00
U106	Operating point data P3 (Y3)	999.00 to 0.00 to 9990.00
U107	Automatic calculation	0: No calculation, 1: Calculation

U107	Auto calculation of the coefficients of the quadratic function

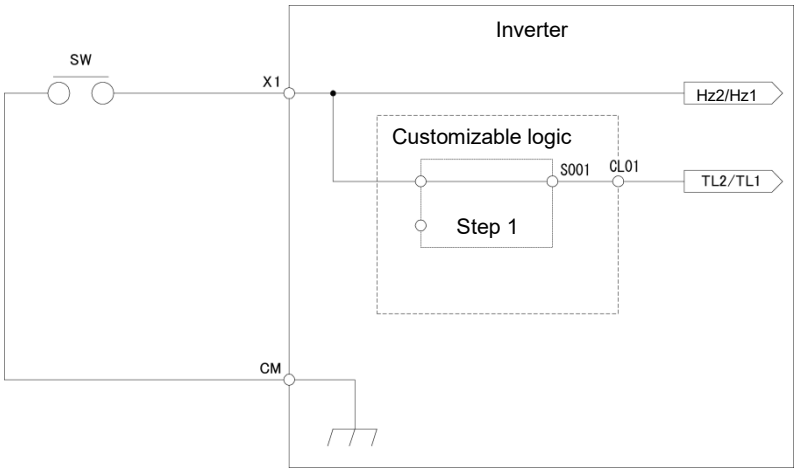
Set “1” to U107 in order to fit the approximate coefficients of the quadratic function (3001) ($K_A \times Input\,1^2 + K_B \times Input\,1 + K_C$) to a characteristic represented by three operating points which are given by function codes U101 to U106. Coefficients (K_A, K_B, K_C) of the polynomial are automatically calculated and the results are stored inside the function codes U92 to U97, and U107 reverts to “0”.

U107 data	Function
0	Invalid
1	Execute calculation (to get the coefficients (KA, KB, KC) of the following polynomial $K_A \times Input\,1^2 + K_B \times Input\,1 + K_C$)

■ **Setting examples of customizable logic**

Setting example 1: Use one switch to change multiple signals

If you use one switch to change the frequency setting 2/frequency setting 1 and torque limit 2/torque limit 1 simultaneously, replace an external circuit that is conventionally needed with a customizable logic reducing the general-purpose input terminals used to a single terminal.

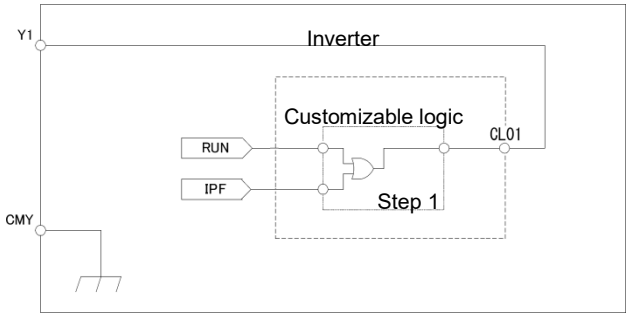


To configure this customizable logic, set the function codes as follows. (Timer selection) and (Timer setting) do not need to be modified if no change is made.

Function code			Setting value	Settings	Remarks
E01	Terminal [X1] function		11	Select frequency command 2/1 “Hz2/Hz1”	Can be used in parallel as general-purpose input terminals
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable logic: Step 1	(Block selection)	10	Through output + General-purpose timer	Mode selection
U02		(Input 1)	4001	Terminal [X1] input signal X1	
U71	Customizable logic: Output signal 1	(Output selection)	1	Output of step 1, “SO01”	
U81		(Function selection)	14	Select torque limiter level 2/1 “TL2/TL1”	

Setting example 2: Bring multiple output signals in a single signal

If the general-purpose RUN signal is kept ON at restart after momentary power failure, replace an external circuit that is conventionally needed with a customizable logic sequence to reduce the general-purpose output terminals and external relays.

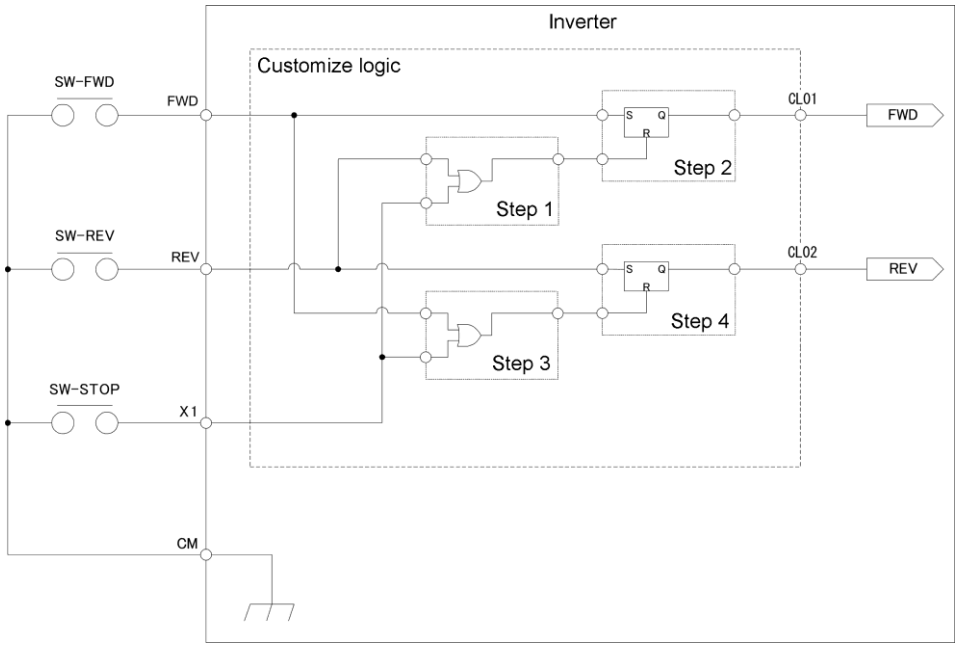


To configure this customizable logic, set the function codes as follows. (Timer selection) and (Timer setting) do not need to be modified if no change is made.

Function code			Setting value	Settings	Remarks
E20	Terminal [Y1] function		111	Customizable logic output signal 1 “CL01”	
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable logic: Step 1	(Block selection)	30	Logical OR + General-purpose timer	Mode selection
U02		(Input 1)	0	During operation “RUN”	
U03		(Input 2)	6	Auto-restarting after momentary power failure “IPF”	
U71	Customizable logic output signal 1	(Output selection)	1	Output of step 1, “SO01”	
U81		(Function selection)	100	No function assigned “NONE”	

Setting example 3: One-shot operation

The required operation is as follows: SW-FWD or SW-REV switch is short-circuited to start the operation and the SW-STOP switch is short-circuited to stop the operation (equivalent to FWD/REV keys/STOP key on keypad), if the above operation is required, replace an external circuit that is conventionally needed with customizable the customized logic.



To configure this customizable logic, set the function codes as follows. (Timer selection) and (Timer setting) do not need to be modified if no change is made.

Function code			Setting value	Settings	Remarks
F02	Operation method		1	External signal	
E01	Terminal [X1] function		100	No function assigned “NONE”	
E98	Terminal [FWD] function		100	No function assigned “NONE”	
E99	Terminal [REV] function		100	No function assigned “NONE”	
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable logic: Step 1	(Block selection)	30	Logical OR + General-purpose timer	Mode selection
U02		(Input 1)	4011	Terminal REV input signal “SW-REV”	
U03		(Input 2)	4001	Terminal X1 input signal “SW-STOP”	
U06	Customizable logic: Step 2	(Block selection)	60	Reset priority flip-flop + General-purpose timer	Mode selection
U07		(Input 1)	4010	Terminal FWD input signal “SW-FWD”	
U08		(Input 2)	2001	Output of step 1 “SO01”	
U11	Customizable logic: Step 3	(Block selection)	30	Logical OR + General-purpose timer	Mode selection
U12		(Input 1)	4010	Terminal FWD input signal “SW-FWD”	
U13		(Input 2)	4001	Terminal X1 input signal “SW-STOP”	
U16	Customizable logic: Step 4	(Block selection)	60	Reset priority flip-flop + General-purpose timer	Mode selection
U17		(Input 1)	4011	Terminal REV input signal “SW-REV”	
U18		(Input 2)	2003	Output of step 3 “SO03”	
U71	Customizable logic output signal 1	(Output selection)	2	Output of step 2 “SO02”	“FWD” command
U72	Customizable logic output signal 2		4	Output of step 4 “SO04”	“REV” command
U81	Customizable logic output signal 1	(Function selection)	98	Run forward/stop command “FWD”	
U82	Customizable logic output signal 2		99	Run reverse/stop command “REV”	

5.3.12 y codes (Link functions)

y01 to y20	RS-485 setting 1, RS-485 setting 2

In the RS-485 communication, two systems can be connected.

System	Connection method	Function code	Equipment that can be connected
First system	Via RS-485 communication link (port 1) (RJ-45 connector to connect keypad)	y01 to y10	Standard keypad Inverter supporting loader Host equipments (upper equipments)
Second systems	Via RS-485 communications link (port 2) GA model: RJ-45 (shared with CAN communication) GB model and C model (for China): Via digital input terminal blocks (DX+, DX-, SD)	y11 to y20	Host equipments (upper equipments) Inverter supporting loader

Overview of the equipments is given below.

(1) Standard keypad
Standard keypad can be connected to operate and monitor the inverter.
Regardless of the y code settings, standard keypad is available.

(2) Inverter supporting loader (IMO loader)
Inverter supporting (monitor, function code editing, test operation) can be performed by connecting a computer with the IMO loader installed.

For the y codes setting, refer to the function codes y01 to y10.

(3) Host equipments (upper equipments)
Host equipments (upper equipments) such as PLC and controller can be connected to control and monitor the inverter or Modbus RTU* protocol can be selected for communication.

*: Modbus RTU is a protocol defined by Modicon.

For details, refer to the RS-485 Communication User's Manual.

■ Station addresses (y01, y11)

Set the station addresses for the RS-485 communication. The setting range depends on the protocol.

Protocol	Range	Broadcast
Modbus RTU	1 to 247	0
Protocol for loader commands	1 to 255	—
Not used in Europe	1 to 31	99

- When specifying a value out of range, no response is returned.
- The settings to use inverter supporting loader should match with the computer's settings.

■ **Communications error processing (y02, y12)**

Select an operation when an error occurs in the RS-485 communication.

The RS-485 errors are logical errors such as address error, parity error and framing error, transmission errors and disconnection errors (the latter specified in y08 and y18). These errors occur only when the inverter is configured to receive the operation command or frequency command via the RS-485 communication. If the operation command or frequency command is not issued via the RS-485 communication, or when the inverter is stopped, the system does not determine an error.

y02, y12 data	Function
0	Displays the RS-485 communication error (*er8* for y02, *erp* for y12), and immediately stops the operation (trip by alarm).
1	Operates for a period specified in the error process timer (y03, y13), and then displays the RS-485 communication error (*er8* for y02, *erp* for y12), and stops the operation (trip by alarm).
2	Retries the communication for a period specified in the error process timer (y03, y13), and if the communication is recovered, the operation continues. Displays the RS-485 communication error (*er8* for y02, *erp* for y12) if the communication is not recovered, and immediately stops the operation (trip by alarm).
3	Continues the operation if a communication error occurs.

 For details, refer to the RS-485 Communication User's Manual.

■ **Error process timer (y03, y13)**

Sets the error process timer, as explained above for the communications error processing parameters (y02, y12). Refer also to the section of disconnection detection time (y08, y18).

- Data setting range: 0.0 to 60.0 (s)

■ **Baud rate (y04, y14)**

Sets the transmission baud rate.

- For inverter supporting loader (via RS-485): Match the value with the computer setting.

y04 and y14 data	Function
0	2400 bps
1	4800 bps
2	9600 bps
3	19200 bps
4	38400 bps

■ **Data length selection (y05, y15)**

Sets the character length.

- For inverter supporting loader (via RS-485): The value does not need to be set since it automatically becomes 8 bits. (It also applies to Modbus RTU.)

y05 and y15 data	Function
0	8 bits
1	7 bits

■ **Parity selection (y06, y16)**

Sets the parity.

- For inverter supporting loader (via RS-485): The value does not need to be set since it automatically becomes even parity.

y06 and y16 data	Function
0	No parity bit (2 bits of stop bit for Modbus RTU)
1	Even parity (1 bit of stop bit for Modbus RTU)
2	Odd parity (1 bit of stop bit for Modbus RTU)
3	No parity bit (1 bits of stop bit for Modbus RTU)

■ Stop bit selection (y07, y17)

Sets the stop bit.

- For inverter supporting loader (via RS-485):
  The value does not need to be set since it automatically becomes 1 bit.

  For Modbus RTU: The value does not need to be set since it is automatically determined in conjunction with the parity bit (function y06, y16).

y07 and y17 data	Function
0	2 bits
1	1 bit

■ Communication time-out detection timer (y08, y18)

Sets a period from the time when the system detects communication time-out (for any reason such as disconnection in equipment that periodically access to the station within a specific time) during the operation using the RS-485 communication, until the time when the system processes the communication errors.

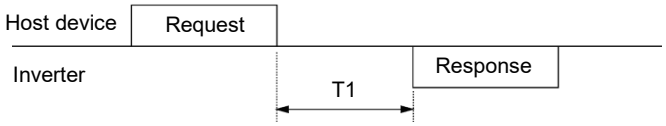
For details on processing communication errors, refer to y02 and y12.

y08 and y18 data	Function
0	Disconnection is not detected.
1 to 60	Detection time from 1 to 60 (s)

■ Response interval time (y09, y19)

Sets a period from the time when the system receives a request from host equipment (upper equipment such as computer or PLC) until the time when it returns a response. In case of the host equipments that are slow to process the task from completed transmission to completed reception preparation, a timing can be synchronized by setting a response interval time.

- Data setting range: 0.00 to 1.00 (s)



T1 = Response interval time + α

α: Processing time inside the inverter. It varies depending on the timing and command.

For details, refer to the RS-485 Communication User's Manual.

Note To set an inverter by the inverter supporting loader via the RS-485 communication, consider the performance and condition of the computer and converter (such as USB-RS-485 converter).
(Some converters monitor communication status and switch transmission and reception with timer.)

■ Protocol selection (y10, y20)

Selects a communication protocol.

y10 and y20 data	Function
0	Modbus RTU protocol
1	IMO Loader protocol
2	Not used in Europe

y21 to y36	Built-in CANopen communication setting

For details, refer to Chapter 9 “9.2 CANopen Communication.”

y95	Data clear processing for communications

If any of the communication error alarms (*er8*, *erp*, *er4*, *er5*, *ert*) occurs in RS-485, CANopen communication or bus option, the data of communication command function codes (S codes) can automatically be cleared.

Since the frequency and operation commands are also disabled when the data is cleared, the inverter does not start unintentionally when an alarm is released.

y95 data	Function
0	When a communication error alarm occurs, the function code Sxx data is not cleared (compatible with the conventional mode).
1	When a communication error alarm occurs, the function codes S01, S05 and S19 data is cleared.
2	When a communication error alarm occurs, the bits assigned in function code S06 for operation command is cleared.
3	Clear operations of 1 and 2 above are performed.

y97	Communication data storage selection

The inverter memory (non-volatile memory) has a limited rewritable times (100 thousand to 1 million times). If the count immoderately increases, the data cannot be modified or saved, causing a memory error.

If the data should frequently be overwritten via communication, it can be written in the temporary memory instead of the non-volatile memory. This allows to save rewritable times to the non-volatile memory, which can avoid a memory error.

If y97 is set to “2”, the data written in the temporary memory is stored (All Saved) in the non-volatile memory.

To change the y97 data, it is necessary to press the STOP + ∧/∨ keys (simultaneous keying).

y97 data	Function
0	Store into nonvolatile memory (Rewritable times are limited)
1	Write into temporary memory (Rewritable times are unlimited)
2	Store all data from temporary memory to nonvolatile memory (After storing all data, the y97 data return to 1)

y98	Bus function (Mode selection) (Refer to H30)

For details on setting the y98 bus function (mode selection), refer to the description of H30.

y99	Loader link function (Mode selection)

Function code to switch the links to the inverter supporting loader software (IMO Loader). Rewriting y99 with the inverter supporting loader software (IMO Loader) enables the frequency command and operation command from the inverter supporting loader software (IMO Loader). You do not need to use the keypad since the data is rewritten from the inverter supporting loader.

If the operation command is configured to be given from the inverter supporting loader software, and if the computer starts to go out of control during the operation and a stop command from the loader software is ignored, remove the communication cable connected to the computer that runs the inverter supporting loader software, and connect the keypad to set the y99 data to 0. By setting the y99 data to 0, the operation is isolated from the inverter supporting loader software's commands, switching to the commands of inverter's own settings (such as function code H30).

The y99 data is not saved in the inverter; the setting is lost and returned to 0 when powered off.

y99 data	Function	
	Frequency command	Run command source
0	From function codes H30 and y98	From function codes H30 and y98
1	Command issued from IMO loader	From function codes H30 and y98
2	From function codes H30 and y98	Command issued from IMO loader
3	Command issued from IMO loader	Command issued from IMO loader

Chapter 6 TROUBLESHOOTING

6.1 Protective Function

In order to prevent system down or to shorten a downtime, Jaguar VXT is provided with various protective functions shown in Table 6.1-1 below. The protective functions marked with an asterisk (*) in the table are disabled by factory default. Enable them according to your needs.
The protective functions include, for example, the “heavy alarm” detection function which, upon detection of an abnormal state, displays the alarm code on the LED monitor and causes the inverter to trip, the “light alarm” detection function which displays the alarm code but lets the inverter continue the current operation, and other warning signal output functions.
If any problem arises, understand the protective functions listed below and follow the procedures given in Sections 6.2 and onwards for troubleshooting.

Table 6.1-1 Abnormal States Detectable (“Heavy Alarm” and “Light Alarm” Objects)

Protective function	Description	Related function code
“Heavy alarm” detection	This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. See “Table 6.3-1 Various failure detections (Heavy failure objects)” for alarm codes. For details of each alarm code, see the corresponding item in the troubleshooting in the Jaguar VXT User's Manual, Section 6.3 . The inverter retains the last four alarm codes and their factors together with their running information applied when the alarm occurred, so it can display them.	H98
“Light alarm” detection*	This function detects an abnormal state categorized as a “light alarm,” displays *l-al* and lets the inverter continue the current operation without tripping. Details of light alarms are selectable. Selectable details (codes) are shown in “Table 6.3-1 Various failure detections (Heavy failure objects).” See the Jaguar VXT User's Manual, Section 6.4 for the confirming method and releasing method of the light alarms.	H81 H82
Stall prevention	When the output current exceeds the current limiter level (F44) during acceleration/ deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	F44
Overload prevention control*	Before the inverter trips due to a cooling fin overheat (*0h1*) or inverter overload (*0lu*), this function decreases the output frequency of the inverter to reduce the load.	H70
Anti-regenerative control*	If regenerative energy returned exceeds the inverter's braking capability, this function automatically increases the deceleration time or controls the output frequency to avoid an overvoltage trip.	H69
Deceleration characteristics* (Improvement of braking performance)	During deceleration, this function increases the motor energy loss and decreases the regenerative energy returned to avoid an overvoltage trip (*0u*).	H71
Reference loss detection*	This function detects a frequency reference loss (due to a broken wire, etc.), issues the alarm, and continues the inverter operation at the specified frequency.	E65
Automatic lowering of carrier frequency	Before the inverter trips due to an abnormal surrounding temperature or output current, this function automatically lowers the carrier frequency to avoid a trip.	H98
Motor overload early warning*	When the inverter output current has exceeded the specified level, this function issues the “Motor overload early warning” signal before the thermal overload protection function causes the inverter to trip for motor protection (Only for the 1st motor).	E34 E35
Retry*	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset and restart itself. The number of retries and the latency between stop and reset can be specified.	H04 H05
Forced stop*	Upon receipt of the “Force to stop” terminal command STOP, this function interrupts the run and other commands currently applied in order to forcedly decelerate the inverter to a stop state.	H56
Surge protection	This function protects the inverter from a surge voltage between main circuit power lines and the ground.	-
Momentary power failure protection*	• If a momentary power failure for 15 ms or longer occurs, a protective operation (inverter stop) is activated. • When momentary power failure restart is selected, the inverter restarts automatically after voltage restoration within a set-up time (momentary power failure permissible time).	F14

6.2 Before Proceeding with Troubleshooting

⚠WARNING

- If any of the protective functions has been activated, first remove the cause. Then, after checking that all run commands are set to OFF, release the alarm. If the alarm is released while any run command is set to ON, the inverter may supply the power to the motor, running the motor.

Injury may occur.

- Even though the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S, L3/T, L1/L and L2/N, voltage may be output to inverter output terminals U, V, and W.
- Turn OFF the power and wait for at least five minutes for inverters with a capacity of VX-T11A-1 / VXT-115A-2 / VXT-72A-4 or below, or at least ten minutes for inverters with a capacity of VXT-85A-4 or above. Make sure that the LED monitor or charging lamp are turned OFF. Further, make sure, using a multi-meter or a similar instrument, that the DC intermediate circuit voltage between the terminals P (+) and N (-) has dropped to the safe level (+25 VDC or below).

Electric shock may occur.

6.3 If an Alarm Code Appears on the LED Monitor

6.3.1 Alarm code list

When an alarm is detected, check the alarm code displayed on 7-segment LED of keypad.

When one alarm code has more than one cause, alarm subcodes are provided to make it easy to identify the cause. When there is only one cause, the alarm subcode is displayed as "-" and described as "-."

* See the Jaguar VXT User's Manual, Chapter 3 "3.4.6 Reading alarm information" for the method of checking the alarm codes.
* With regard to alarm details having alarm sub codes name "For manufacturer", inform the alarm sub codes, to IMO.

Table 6.3-1 Various failure detections (Heavy failure objects)

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name	Reference page
cof	PID feedback wire break	Y	Y	—	—	—	6-7
dba	Braking transistor broken	Y	—	—	—	—	6-7
dbh	Braking resistor overheat (VXT-115A-2 or below /VXT-11A-1 or below /VXT-72A-4 or below)	Y	Y	Y	0	DB resistor overheat	6-7
					1	For manufacturer	
ecf	EN circuit failure	Y	—	—	10	ASIC alarm for functional safety	6-8
			—	—	3000	Erroneous detection of STO input	
			—	—	Other than above	For manufacturer	
ec1	Customizable logic failure	Y	—	—	—	—	—
ef	Ground fault (VXT-85A-4 or above)	Y	—	—	—	—	6-8
er1	Memory error	Y	—	—	1 to 16	For manufacturer	6-8
er2	Keypad communications error	Y	—	—	1 to 2	For manufacturer	6-9
er3	CPU error	Y	—	—	1 to 9000	For manufacturer	6-9
er4	Option communications error	Y	Y	—	1	For manufacturer	6-9
er5	Option error	Y	Y	—	0	Time-out	6-9
					1 to 10	For manufacturer	
er6	Operation error	Y	—	—	1	STOP key priority/forced stop (STOP terminal)	6-10
					2	Start check function	
					3	Start check function (when operation is permitted)	
					4	Start check function (when reset is turned on)	
					5	Start check function (when the power recovers in powering on)	
					6	Start check function (TP connection)	
					8 to 14	For manufacturer	

Continuation of Table 6.3-1

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name	Reference page
er7	Tuning error	Y	—	—	7	Operation command OFF during motor tuning	6-10
					8	Forced stop during motor tuning	
					9	BX command during motor tuning	
					10	Hardware current limit during motor tuning	
					11	Occurrence of low voltage (LV) during motor tuning	
					12	Failure due to prevention of reverse rotation during motor tuning	
					13	Over upper limit frequency during motor tuning	
					14	Switching to commercial power during motor tuning	
					15	Occurrence of alarm during motor tuning	
					16	Change of run command source during motor tuning	
					18	Over acceleration time during motor tuning	
					24	EN terminal failure during motor tuning	
					5000 to 5065	Refer to Chapter 4 “4.8.2 Alarm Information”	
					Other than above	For manufacturer	
er8	RS-485 communications error (Communication port 1)	Y	Y	—	—	—	6-11
erd	Step-out detection	Y	—	—	5001 to 5008	For manufacturer	6-12
ere	Speed inconsistency/ excessive speed deviation	Y	Y	—	1	Signs of speed command and speed detection are inconsistent.	6-13
					3	In the case of excessive speed deviation (|detected speed|>|speed command|)	
					5	Detected speed remains 0Hz irrespective of speed command.	
					7	In the case of excessive speed deviation (|detected speed|<|speed command|)	
erf	Data saving error during undervoltage	Y	—	—	—	—	6-14
erh	Hardware error	Y	—	—	—	—	6-14
ero	Positioning control error	Y	Y	—	1 to 5	For manufacturer	6-14
erp	RS-485 communications error (Communication port 2)	Y	Y	—	—	—	6-12
err	Simulated failure	Y	—	—	—	—	6-15
ert	CAN communications failure	Y	—	—	1 to 2	For manufacturer	6-15
fUs	DC fuse-blowing	Y	—	—	—	—	6-15
lin	Input phase loss	Y	—	—	1-2	For manufacturer	6-16
lu	Undervoltage	Y	—	—	1	Occurrence of low voltage during gate ON (F14=0)	6-16
					2	Run command ON during low voltage (F14=0, 2)	
					3	LV trip on power recovery from a momentary power failure (F14=1)	
					4 to 5	For manufacturer	

Continuation of Table 6.3-1

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name	Reference page
0c1	Instantaneous overcurrent	Y	—	Y	1 to 5001	For manufacturer	6-17
0c2							
0c3							
0h1	Cooling fin overheat	Y	Y	Y	6	Detection of fan stop	6-18
					Other than above	For manufacturer	
0h2	External alarm	Y	Y	—	—	—	6-18
0h3	Inverter internal overheat	Y	Y	Y	0	Internal air overheat	6-18
					1	Charging resistor overheat	
					Other than above	For manufacturer	
0h4	Motor protection (PTC thermistor)	Y	—	Y	—	—	6-19
0h6	Charging resistor overheat	Y	Y	Y	—	—	6-19
0l1	Motor 1 overload	Y	Y	Y	—	—	6-20
0l2	Motor 2 overload	Y	Y	Y	—	—	
0lu	Inverter overload	Y	—	Y	1	IGBT protection	6-21
					2	Inverter overload	
					10	For manufacturer	
0pl	Output phase-failure detection	Y	—	—	1 to 10	For manufacturer	6-21
0s	Overspeed protection	Y	—	—	—	—	6-22
0u1	Overvoltage	Y	—	Y	1 to 12	For manufacturer	6-22
0u2							
0u3							
pbf	Charger circuit fault (VXT-203A-4 or above)	Y	—	—	1 to 2	For manufacturer	6-23
pg	PG wire break	Y	—	—	10 to 20	For manufacturer	6-23
cnT	Inverter life (Number of startups)	—	Y	—	—	—	6-24
fal	Detect DC fan lock	—	Y	—	—	—	
lif	Lifetime alarm	—	Y	—	—	—	
0h	Cooling fin overheat early warning	—	Y	—	—	—	
0l	Overload early warning	—	Y	—	—	—	
pid	PID alarm output	—	Y	—	—	—	
pTc	PTC thermistor activated	—	Y	—	—	—	
ref	Reference command loss detected	—	Y	—	—	—	
rTe	Machine life (Cumulative motor running hours)	—	Y	—	—	—	
uTl	Low torque detection	—	Y	—	—	—	

NB) • If a control power supply voltage drops to such a level that the operation of the inverter control circuit cannot be maintained, all protective functions are automatically reset.
• By OFF → ON operation of PRG/RESET key or X terminal (assigned to RST) the protection stop state can be released. In a state that an alarm cause is not removed, however, resetting operation is not effective.
• If two or more alarms are occurring, the resetting operation remains ineffective until all the alarm causes are removed. Alarm factors not removed can be checked from the keypad.
• When assigned to light alarms, “30A/B/C” do not work.

See page shows the page of the user's manual.

Chapter 7 MAINTENANCE AND INSPECTION

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time. When performing inspections, follow the instructions given in this chapter.

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, turn OFF the power and wait at least five minutes for inverters VXT-115A-2 / VXT-72A-4 / VXT-11A-1 or below, or at least ten minutes for inverters VXT-85A-4 or above. Make sure that the LED monitor / charging lamp are turned OFF. Further, make sure, using a multi-meter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

Electric shock may occur.

- Maintenance, inspection, and parts replacement should be made only by authorized persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
- Never modify the inverter.

Electric shock or injuries could occur.

7.1 Inspection Interval

Table 7.1-1 lists the inspection intervals and check items, as a guide.

Table 7.1-1 List of Inspections

Inspection type	Inspection interval	Check items
Daily inspection	Every day	See Section 7.2 .
Periodic inspection	Every year	See Section 7.3 .
Decennial inspection *1	Every 10 years *2	Replacement of cooling fans *3 Replacement of DC link bus capacitors and close checks

*1 The decennial inspection (except replacement of cooling fans) should be performed only by the persons who authorised by IMO. Contact IMO for further information.

*2 Every 7 years for ND-mode inverters.

*3 For the standard replacement interval of cooling fans, refer to “0

Note The replacement intervals are based on the inverter’s service life estimated at an ambient temperature of 40°C at 100% (HHD-mode inverters) or 80% (ND-/HD-/HND-mode inverters) of full load. In environments with an ambient temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

Standard replacement intervals mentioned above are only a guide for replacement, not a guaranteed service life.”

7.2 Daily Inspection

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is running or the power is ON.

Table 7.2-1 lists daily inspection items.

Table 7.2-1 Daily Inspection List

Check part	Check item	How to inspect	Evaluation criteria
Environment	1) Check the surrounding temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.	1) Check visually or measure using apparatus. 2) Visual inspection	1) The usage environment given in Chapter 1, Section 1.3.1 must be satisfied. 2) No foreign or dangerous objects are left.
External appearance and others	1) Check that the bolts securing the wires to the main circuit terminals and control circuit terminals are not loose before turning the power ON. 2) Check for traces of overheat, discoloration and other defects. 3) Check for abnormal noise, odor, or excessive vibration.	1) Retighten before turning the power ON. 2) Visual inspection 3) Auditory, visual, and olfactory inspection	1) No loose screws. If loose, retighten the screws. 2), 3) No abnormalities
Cooling fans	Check for abnormal noise or excessive vibration when the cooling fans are in operation.	Auditory and visual inspections	No abnormalities
Keypad	Check for alarm indication.	Visual inspection	If any alarm is displayed, refer to Chapter 6.
Performance	Check that the inverter provides the expected performance (as defined in the standard specifications).	Check the monitor items shown on the keypad.	No abnormalities in the output speed, current and voltage and other running data.

7.3 Periodic Inspection

7.3.1 Periodic inspection 1--Before the inverter is powered ON or after it stops running

Perform periodic inspections according to the items listed in Table 7.3-1. Before performing periodic inspection 1, shut down the power and then remove the front cover.

Even if the power has been shut down, it takes the time for the DC link bus capacitor to discharge. After the charging lamp is turned OFF, therefore, make sure that the DC link bus voltage has dropped to the safe level (+25 VDC or below) using a multi-meter or a similar instrument.

Table 7.3-1 Periodic Inspection List 1

Check part		Check item	How to inspect	Evaluation criteria
Structure such as frame and cover		Check for: 1) Loose bolts (at clamp sections). 2) Deformation and breakage 3) Discoloration caused by overheat 4) Contamination and accumulation of dust or dirt	1) Retighten. 2), 3), 4) Visual inspection	1), 2), 3), 4) No abnormalities (If any section is stained, clean it with a soft cloth.)
Main circuit	Common	1) Check that bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities (If any section is stained, clean it with a soft cloth.)
	Conductors and wires	1) Check conductors for discoloration and distortion caused by overheat. 2) Check the sheath of the wires for cracks and discoloration.	1), 2) Visual inspection	1), 2) No abnormalities
	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities
	DC link bus capacitor	1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing. 2) Check that the safety valve does not protrude remarkably.	1), 2) Visual inspection	1), 2) No abnormalities
	Braking resistor	1) Check for abnormal odor or cracks in insulators caused by overheat. 2) Check for wire breakage.	1) Olfactory and visual inspection 2) Check the wires visually, or disconnect either one of the wires and measure the conductivity with a multi-meter.	1) No abnormalities 2) Within ±10% of the resistance of the braking resistor
Control circuit	Printed circuit board	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Olfactory and visual inspection 3), 4) Visual inspection * Judgment on service life using “Menu #5 Maintenance Information” in the VXT User manual	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan	1) Check for engagement or abnormal vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheat.	1) Turn by hand. (Be sure to turn the power OFF beforehand.) 2) Retighten. 3) Visual inspection * Judgment on service life using “Menu #5 Maintenance Information” in the VXT User manual	1) Smooth rotation 2), 3) No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign materials.	Visual inspection	No clogging or accumulation of dust, dirt or foreign materials. Clean it, if any, with a vacuum cleaner.

7.3.2 Periodic inspection 2--When the inverter is ON or it is running

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is ON or it is running.

Perform periodic inspections according to the items listed in Table 7.3-2

Table 7.3-2 Periodic Inspection List 2

Check part		Check item	How to inspect	Evaluation criteria
Input voltage		Check that the input voltages of the main and control circuits are correct.	Measure the input voltages using a multi-meter or the like.	The standard specifications must be satisfied.
Structure such as chassis and covers		Check for abnormal noise or excessive vibration when the inverter is running.	Visual and auditory inspections	No abnormalities
Main circuit	Transformers and reactors	Check for abnormal roaring noise or odor when the inverter is running.	Auditory, visual, and olfactory inspections	No abnormalities
	Magnetic contactors and relays	Check for chatters when the inverter is running.	Auditory inspection	No abnormalities
	DC link bus capacitor	Measure the capacitance if necessary.	Judgment on service life using “Menu #5 Maintenance Information (*%che*)” in the VXT User manual	Capacitance ≥ Initial value x 0.85
Cooling fans		Check for abnormal noise or excessive vibration when the inverter is running.	Visual and auditory inspections	No abnormalities

Additional notes

(1) The inspection interval (every year) of check items given in Table 7.3-1 and Table 7.3-2 is merely a guide. Make the interval shorter depending on the usage environment.

(2) Store and organize the inspection results to utilize them as a guide for operation and maintenance of the equipment and service life estimation.

(3) At the time of an inspection, check the cumulative run times on the keypad to utilize them as a guide for replacement of parts. Refer to “7.4.1 Judgment on service life”.

(4) The inverter has cooling fans inside to ventilate itself for discharging the heat generated by the power converter section. This will accumulate dust or dirt on the heat sink depending on the ambient environment. In a dusty environment, the heat sink requires cleaning in a shorter interval than that specified in periodic inspection. Neglecting cleaning of the heat sink can rise its temperature, activating protective circuits to lead to an abrupt shutdown or causing the temperature rise of the surrounding electronic devices to adversely affect their service life.

7.4 List of Periodic Replacement Parts

Each part of the inverter has its own service life that will vary according to the environmental and operating conditions. It is recommended that the following parts be replaced at the specified intervals.

When the replacement is necessary, consult IMO.

Table 7.4-1 Replacement Parts

Part name	Standard replacement intervals (See **Note** below.)
DC link bus capacitor	10 years (7 years in the ND mode)
Electrolytic capacitors on printed circuit boards	10 years (7 years in the ND mode)
Cooling fans	10 years (7 years in the ND mode)
Fuses	10 years (7 years in the ND mode)

Note. These replacement intervals are based on the inverter’s service life estimated at a surrounding temperature

of 40°C at 100% (HHD-mode inverters) or 80% (ND-/HD-/HND-mode inverters) of full load. In environments with an ambient temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter. The condition for inverters of VXT-20A-2 / VXT-12A-4 / VXT-11A-1 or below capacity models is a load ratio of 80% even for HHD-mode.

Notes for periodic replacement of parts

(1) The replacement intervals listed above are a guide for almost preventing parts from failure if those parts are replaced with new ones at the intervals. They do not guarantee the completely fault-free operation.

(2) Table 7.4-1 does not apply to unused spare parts being kept in storage.
It applies only when they are stored under the temporary and long-term storage conditions given in Chapter 1 “1.3.2 Storage environment” and energized approximately once a year.

(3) Cooling fans can be replaced by users. Other components can be replaced only by IMO authorised personnel. For the purchase of spare cooling fans, contact IMO.

7.4.1 Judgment on service life

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LED monitor and judge whether those parts are approaching the end of their service life.

The life prediction function can also issue early warning signals if the life time alarm command ***LIFE*** is assigned to any of the digital output terminals. Refer to the VXT User manual Reading maintenance information “Maintenance Information: *%che* ””.

Table 7.4-2 lists the parts whose service life can be predicted and details the life prediction function. The predicted values should be used only as a guide since the actual service life is influenced by the ambient temperature and other usage environments.

Table 7.4-2 Life Prediction

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	“5: MAINTENANCE” on the LED monitor
DC link bus capacitor	Measurement of discharging time Measures the discharging time of the DC link bus capacitor when the main power is shut down and calculates the capacitance.	85% or lower of the initial capacitance at shipment	At periodic inspection (H98: Bit 3 = 0)	*5_05* (Capacity)
		85% or lower of the reference capacitance under ordinary operating conditions at the user site	During ordinary operation (H98: Bit 3 = 1)	*5_05* (Capacity)
	ON-time counting Counts the time elapsed when the voltage is applied to the DC link bus capacitor, while correcting it according to the capacitance measured above.	Exceeding 87,600 hours (10 years)	During ordinary operation	*5_26* (Elapsed time) *5_27* (Time remaining before the end of life)
Electrolytic capacitors on printed circuit boards	Counts the time elapsed when the voltage is applied to the capacitors, while correcting it according to the surrounding temperature.	Exceeding 87,600 hours (10 years)	During ordinary operation	*5_06* (Cumulative run time)
Cooling fans	Counts the run time of the cooling fans.	Exceeding 87,600 hours (10 years)	During ordinary operation	*5_07* (Cumulative run time)

The service life of the DC link bus capacitor can be judged by the “Measurement of discharging time of the DC link bus capacitor” or “ON-time counting of DC link bus capacitor.”

Measurement of discharging time of the DC link bus capacitor

- The discharging time of the DC link bus capacitor depends largely on the inverter's internal load conditions, e.g. options attached or ON/OFF status of digital I/O signals. If actual load conditions are so different from the ones at which the initial/reference capacitance is measured that the measurement result falls out of the accuracy level required, then the inverter does not measure.
  When the inverter is connected with a converter or with another inverter via DC common connection, it does not performs any measurement.
- The capacitance measuring conditions at shipment are drastically restricted, e.g., all input terminals being OFF in order to stabilize the load and measure the capacitance accurately. Those conditions are, therefore, different from the actual operating conditions in almost all cases. If the actual operating conditions are the same as those at shipment, shutting down the inverter power automatically measures the discharging time; however, if they are different, no automatic measurement is performed. To perform it, put those conditions back to the factory default ones and shut down the inverter. Refer to 7.4.1 [1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment on page 7-6.
- To measure the capacitance of the DC link bus capacitor *under ordinary operating conditions* when the power is turned OFF, it is necessary to set up the load conditions for ordinary operation and measure the reference capacitance (initial setting) when the inverter is introduced. For the reference capacitance setup procedure, see [2] on page7-7 Performing the setup procedure automatically detects and saves the measuring conditions of the DC link bus capacitor.

  Setting bit 3 of H98 data at "0" restores the inverter to the measurement in comparison with the initial capacitance measured at shipment.

Note When the inverter uses an auxiliary control power input, the load conditions widely differ so that the discharging time cannot be accurately measured. In this case, measuring of the discharging time can be disabled with the function code H98 (Bit 4 = 0) for preventing unintended measuring.

ON-time counting of DC link bus capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. For this case, the ON-time counting is provided. The ON-time counting result can be represented as "elapsed time" (*5_26*) and "time remaining before the end of life" (*5_27*) as shown in the "DC link bus capacitor" section in Table 7.4-2.

[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

The measuring procedure given below measures the capacitance of DC link bus capacitor in comparison with initial one at shipment when the power is turned OFF. The measuring result can be displayed on the keypad as a ratio (%) to the initial capacitance.

---------- **Capacitance measuring procedure** ----------

1) To ensure validity in the comparative measurement, put the condition of the inverter back to the state at factory shipment.
   - Remove the option card (if already in use) from the inverter.
   - In case another inverter is connected via the DC link bus to the P(+) and N(-) terminals of the main circuit, disconnect the wires. It is not required to disconnect the DC reactor (optional), if any.
   - Disconnect power wires for the auxiliary input to the control circuit (R0, T0).
   - Mount the keypad.
   - Turn OFF all the digital input signals fed to terminals [FWD], [REV], and [X1] through [X5] of the control circuit.
   - If an external speed command potentiometer is connected to terminal [13], disconnect it.
   - If an external apparatus is attached to terminal [PLC], disconnect it.
   - Ensure that transistor outputs [Y1] and [Y2] and Relay output terminals [30A/B/C] will not be turned ON.
   - Disable the RS-485 communications link and CANopen communications link.

     Note If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. Specify positive logic for them.
2) Turn ON the main circuit power.
3) Confirm that the DC cooling fan is rotating and the inverter is in stopped state. Disable the cooling fan ON/OFF control (H06 = 0).
4) Shut down the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor.

Note If " . . . . " does not appear on the LED monitor, the measurement has not started. Check the conditions listed in 1).

6) After " . . . . " has disappeared from the LED monitor, turn ON the main circuit power again.

7) Select Menu #5 "Maintenance Information" in Programming mode and check the capacitance (%) of the DC link bus capacitor (*5_05*).

---

[2] Measuring the capacitance of the DC link bus capacitor under ordinary operating conditions

The inverter automatically measures the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF. This measurement requires setting up the load conditions for ordinary operation and measuring the reference capacitance when the inverter is introduced to the practical operation, using the setup procedure given below

---------- Reference capacitance setup procedure ----------

1) Set bit 3 of function code H98 at "1" (User mode) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor.
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set each of function codes H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) at "*0000*."
5) Turn OFF the inverter, and the following operations are automatically performed.

   The inverter measures the discharging time of the DC link bus capacitor and saves the result in function code H47 (Initial capacitance of DC link bus capacitor).

   The conditions under which the measurement has been conducted will be automatically collected and saved.

6) Turn ON the inverter again.

   Confirm that H47 (Initial capacitance of DC link bus capacitor) holds right values. Switch to Menu #5 "Maintenance Information" in Programming mode and confirm that the main capacitor capacity is 100% (*5_05* = 100%).

   Note If the measurement has failed, "*0001* " is entered into each of H42 and H47. Remove the cause of the failure and conduct the measurement again.

Hereafter, each time the inverter is turned OFF, it automatically measures the discharging time of the DC link bus capacitor if the above conditions are met. Periodically check the capacitance (%) of the DC link bus capacitor (*5_05*) with Menu #5 "Maintenance Information" in Programming mode.

Note The condition given above produces a rather large measurement error. If this mode gives you a lifetime alarm, revert bit 3 of H98 (Main circuit capacitor life judgment selection) to the default setting (Bit 3 = 0) and conduct the measurement under the condition at the time of factory shipment.

[3] Early warning of lifetime alarm

For the components listed in Table 7.4-2, the inverter can issue an early warning of lifetime alarm LIFE at one of the transistor output terminals [Y1] and [Y2] and Relay output terminals [30A/B/C] as soon as any one of the levels specified in Table 7.4-2 has been exceeded.

The early warning signal is also turned ON when a lock condition on the internal air circulation DC fan (provided on VXT-203A-4 or above) has been detected.

7.5 Measurement of Electrical Amounts in Main Circuit

Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) contain harmonic components, the readings may vary with the type of the meter. Use meters indicated in Table 7.5-1 when measuring main circuit.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and use the following formula.

■ **Three-phase input**

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\sqrt{3} \times \text{Voltage (V)} \times \text{Current (A)}} \times 100\ \%$$

Table 7.5-1 Meters for Measurement of Main Circuit

Item	Input (primary) side			Output (secondary) side			DC link bus voltage (P(+)-N(-))
Waveform	Voltage / Current			Voltage / Current			⎓
Name of meter	Ammeter AR, AS, AT	Voltmeter VR, VS, VT	Wattmeter WR, WT	Ammeter AU, AV, AW	Voltmeter VU, VV, VW	Wattmeter WU, WW	DC voltmeter V
Type of meter	Moving iron type	Rectifier or moving iron type	Digital AC power meter	Digital AC power meter	Digital AC power meter	Digital AC power meter	Moving coil type
Symbol of meter			—	—	—	—	

Note It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged.

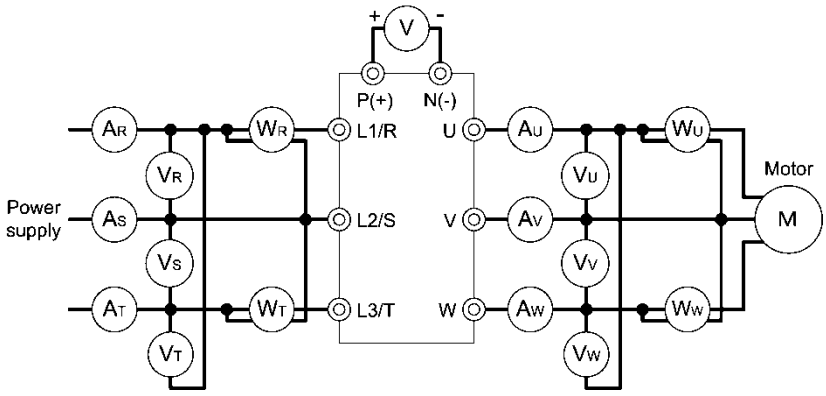


Figure 7.5-1 Connection of Meters

7.6 Insulation Test

Since the inverter has undergone an insulation test before shipment, avoid making a Megger test at the customer's site.

If a Megger test is unavoidable for the main circuit, observe the following instructions; otherwise, the inverter may be damaged.

A withstand voltage test may also damage the inverter if the test procedure is wrong. When the withstand voltage test is necessary, consult IMO.

(1) Megger test of main circuit

1) Use a 500 VDC Megger and ensure that the main power has been shut off before measurement.
2) If the test voltage leaks to the control circuit due to the wiring, disconnect all the wiring from the control circuit.
3) Connect the main circuit terminals with a common line as shown in Figure 7.6-1.
4) The Megger test must be limited to across the common line of the main circuit and the ground (⏚).
5) Value of 5 MΩ or more displayed on the Megger indicates a correct state. (The value is measured on the inverter alone.)

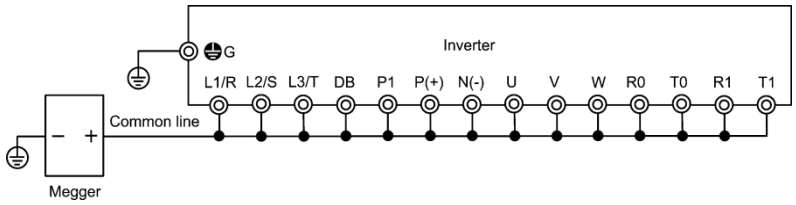


Figure 7.6-1 Main Circuit Terminal Connection for Megger Test

(2) Insulation test of control circuit

Do not make a Megger test or withstand voltage test for the control circuit. Use a high resistance range tester for the control circuit.

1) Disconnect all the external wiring from the control circuit terminals.
2) Perform a continuity test to the ground. One MΩ or a larger measurement indicates a correct state.

(3) Insulation test of external main circuit and sequence control circuit

Disconnect all the wiring connected to the inverter so that the test voltage is not applied to the inverter.

7.7 Inquiries about Product and Guarantee

7.7.1 When making an inquiry

Upon breakage of the product, uncertainties, failure or inquiries, contact IMO.

1) Inverter type. Refer to Chapter 1 "1.1 Acceptance Inspection (Nameplates and Inverter Type)".
2) SER No. (serial number of equipment). Refer to Chapter 1 "1.1 Acceptance Inspection (Nameplates and Inverter Type)".
3) Function codes and their data that you changed. Refer to the VXT User manual, checking changed function codes "Data Checking: *"rep"* "".
4) ROM version. Refer to the maintenance item *5_14* in the VXT User manual, reading maintenance information "Maintenance Information: *%che*"".
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)

7.7.2 Product warranty

To all our customers who purchase IMO Jaguar inverters included in this documentation:

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalogue, specifications or other materials will be as mentioned below.

In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this IMO.

Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

[1] Warranty period and warranty range

IMO Jaguar inverter 5 year warranty

. **Terms of IMO 5 year warranty.**

- IMO Jaguar Inverters are covered by a 5 year warranty from date of dispatch.
- In the event of failure due to faulty components or inferior workmanship, the Inverter will be replaced or repaired free Warranty replacements and repaired units will be dispatched free of charge, all costs related to faulty units being returned to IMO for inspection/repair are the responsibility of the sender.
- In circumstances where it is viable for the Inverter to be repaired in situ due to size (>30kw), an Engineer from IMO or contracted to represent IMO can be supplied. Site visits are chargeable at IMO's current service rate, any warranty parts will be replaced free of charge.
- All Inverters require a Returns Authorization reference to be supplied with the Inverter upon returning the drive to IMO, this reference can be obtained from our website www.imopconline.com by registering and following the returns instructions.

Warranty restrictions.

- Incorrect, or unsafe installation.
- Poor condition due to abuse, neglect or improper maintenance.
- Modifications, repairs performed by anyone other than IMO or without prior written agreement.
- Inverter used in incorrect application or used for function other than for which it is designed.
- Any alterations, which may invalidate the Inverters CE declaration.
- Non IMO options or ancillary devices used.

Liability.

- Regardless whether a breakdown occurs during or after the warranty period, IMO shall not be liable for any loss of opportunity, loss of profits, penalty clauses or damages arising from any special circumstances, secondary damages, accident compensation to another company, damages to any equipment, or personal injury.

(3) Fault diagnosis

As a rule, the customer is requested to carry out a preliminary fault diagnosis. However, at the customer's request, IMO can perform the fault diagnosis on a chargeable basis. In this case, the customer is asked to accept the charges levied in accordance with IMO'S fee schedule.

[2] Exclusion of liability for loss of opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, IMO shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than IMO'S products, whether foreseen or not by IMO, which IMO is not be responsible for causing.

[3] Repair period after production stop, spare parts supply period (holding period)

Concerning models (products) which have gone out of production, IMO can perform repairs for a period of 5 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 5 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 5-year period. For details, contact IMO.

[4] Transfer rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

[5] Service contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

[6] Applicable scope of service

Above contents shall be assumed to apply to transactions and use of the country where you purchased the products.

Consult IMO.

Chapter 8 SPECIFICATIONS

This chapter describes the output ratings, input power, basic functions and other specifications of the Jaguar VXT standard and EMC Filter Built-in model.

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8.1 Standard Model

8.1.1 ND-mode inverters for general load

Standard-model, Three-phase 400 V (460 V) class series (ND-mode: 0.75 kW to 5.5 kW)

Item			Specifications				
Type (VXT-***A-4)			2	4	6	7	12
Nominal applied motor (kW) (Output rating)		***1**	0.75	1.5	2.2	3.0	5.5
Output ratings	Rated capacity (kVA)	***2**	1.6 [1.7]	3.1 [3.3]	4.2 [4.4]	5.3 [5.5]	9.1 [9.6]
	Rated voltage (V)	***3**	Three-phase 380 to 480 V (with AVR function)				
	Rated current (A)	***4**	2.1	4.1	5.5	6.9	12
	Overload capability		120%-1 min				
Input power	Voltage, frequency		Three-phase 380 to 480 V, 50/60 Hz				
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A)	***7**	2.7	4.8	7.3	11.3	16.8
	(with DCR) (A)		1.5	2.9	4.2	5.8	10.1
	Required capacity (with DCR) (kVA)	***8**	1.1	2.1	3.0	4.1	7.0
Braking	Torque (%)	***9**	53%	50%	48%	29%	27%
	DC braking		Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 60%				
	Braking transistor		Built-in as standard				
	Minimum resistance value (Ω)		200		160		130
	Braking resistor		Separately mounted option				
DC reactor (DCR)			Separately mounted option				
Applicable safety standards			IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)			IP20, UL open type				
Cooling method			Natural cooling		Fan cooling		
Weight / Mass (kg)			1.2	1.5	1.5	1.6	1.9

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
ND spec. of all types : 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance (\%)} = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (ND-mode: 11 kW to 55 kW)

Item		Specifications							
Type (VXT-***A-4)		22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**		11	15	18.5	22	30	37	45	55
Output ratings	Rated capacity (kVA) ***2**	16 [17]	22 [23]	28 [29]	34 [35]	45 [47]	55 [57]	65 [68]	80 [84]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)							
	Rated current (A) ***4**	21.5	28.5	37.0	44.0	59.0	72.0	85.0	105
	Overload capability	120%-1 min							
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz							
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%							
	Rated input current (w/o DCR) (A) ***7**	33.0	43.8	52.3	60.6	77.9	94.3	114	140
	(with DCR) (A)	21.1	28.8	35.5	42.2	57.0	68.5	83.2	102
	Required capacity (with DCR) (kVA) ***8**	15	20	25	29	39	47	58	71
Braking	Torque (%) ***9**	12%						5% to 9%	
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 60%							
	Braking transistor	Built-in as standard						Separately mounted option	
	Minimum resistance value (Ω)	80	60	40	34.4	16		-	-
	Braking resistor	Separately mounted option							
DC reactor (DCR)		Separately mounted option							
Applicable safety standards		IEC/EN61800-5-1: 2007							
Enclosure (IEC60529)		IP20, UL open type						IP00, UL open type	
Cooling method		Fan cooling							
Weight / Mass (kg)		5.0	5.0	8.0	9.0	9.5	10	2	26

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
ND spec. of all types: 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $$\text{Voltage unbalance}\,(\%) = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (ND-mode: 75 kW to 315 kW)

Item		Specifications								
Type (VXT-***A-4)		139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**		75	90	110	132	160	200	220	280	315
Output ratings	Rated capacity (kVA) ***2**	106 [111]	128 [134]	155 [162]	183 [191]	221 [231]	275 [288]	316 [331]	396 [414]	450 [470]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)								
	Rated current (A) ***4**	139	168	203	240	290	361	415	520	590
	Overload capability	120%-1 min								
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz		Three-phase 380 to 440 V, 50 Hz Three-phase 380 to 480 V, 60 Hz ***5**						
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%								
	Rated input current (w/o DCR) (A) ***7**	–	–	–	–	–	–	–	–	–
	(with DCR) (A)	138	164	201	238	286	357	390	500	559
	Required capacity (with DCR) (kVA) ***8**	96	114	139	165	199	248	271	347	388
Braking	Torque (%) ***9**	5% to 9%								
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 60%								
	Braking transistor	Separately mounted option								
	Minimum resistance value (Ω)	–								
	Braking resistor	Separately mounted option								
DC reactor (DCR)		Must be used. Separately mounted component. ***11**								
Applicable safety standards		IEC/EN61800-5-1: 2007								
Enclosure (IEC60529)		IP00, UL open type								
Cooling method		Fan cooling								
Weight / Mass (kg)		30	33	40	62	63	95	96	130	140

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
ND spec. of all types : 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*5 Inverters of VXT-203-4 or above (400 V class series) are equipped with a power switching connector. Use the connector depending upon the applied voltage. For details, refer to Chapter 2 “2.2.7 Switching Connector.”

*6 $$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

*11 Please consult IMO for details.

8.1.2 HD-mode inverters for heavy duty load

Standard-model, Three-phase 400 V (460 V) class series (HD-mode: 0.75 kW to 5.5 kW)

Item			Specifications				
Type (VXT-***A-4)			2	4	6	7	12
Nominal applied motor (kW) (Output rating)		***1**	0.75	1.1	2.2	3.0	5.5
Output ratings	Rated capacity (kVA)	***2**	1.4 [1.4]	2.6 [2.7]	3.8 [4.0]	4.8 [5.0]	8.5 [8.8]
	Rated voltage (V)	***3**	Three-phase 380 to 480 V (with AVR function)				
	Rated current (A)	***4**	1.8	3.4	5.0	6.3	11.1
	Overload capability		150%-1 min				
Input power	Voltage, frequency		Three-phase 380 to 480 V, 50/60 Hz				
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A)	***7**	2.7	3.9	7.3	11.3	16.8
	(with DCR) (A)		1.5	2.1	4.2	5.8	10.1
	Required capacity (with DCR) (kVA)	***8**	1.1	1.5	3.0	4.1	7.0
Braking	Torque (%)	***9**	53%	68%	48%	29%	27%
	DC braking		Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%				
	Braking transistor		Built-in as standard				
	Minimum resistance value (Ω)		200		160		130
	Braking resistor		Separately mounted option				
DC reactor (DCR)			Separately mounted option				
Applicable safety standards			IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)			IP20, UL open type				
Cooling method			Natural cooling		Fan cooling		
Weight / Mass (kg)			1.2	1.5	1.5	1.6	1.9

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HD spec. of all types : 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage}\,(V) - \text{Min. voltage}\,(V)}{\text{Three - phase average voltage}\,(V)} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimate to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HD-mode: 7.5 kW to 45 kW)

Item		Specifications							
Type (VXT-***A-4)		22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**		7.5	11	15	18.5	22	30	37	45
Output ratings	Rated capacity (kVA) ***2**	13 [14]	18 [18]	24 [25]	29 [30]	34 [36]	46 [48]	57 [60]	69 [73]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)							
	Rated current (A) ***4**	17.5	23	31	38	45	60	75	91
	Overload capability	150%-1 min							
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz							
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%							
	Rated input current (w/o DCR) (A) ***7**	23.2	33.0	43.8	52.3	60.6	77.9	94.3	114
	(with DCR) (A)	14.4	21.1	28.8	35.5	42.2	57.0	68.5	83.2
	Required capacity (with DCR) (kVA) ***8**	10	15	20	25	29	39	47	58
Braking	Torque (%) ***9**	15%						7% to 12%	
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%							
	Braking transistor	Built-in as standard						Separately mounted option	
	Minimum resistance value (Ω)	80	60	40	34.4	16		-	-
	Braking resistor	Separately mounted option							
DC reactor (DCR)		Separately mounted option							
Applicable safety standards		IEC/EN61800-5-1: 2007							
Enclosure (IEC60529)		IP20, UL open type						IP00, UL open type	
Cooling method		Fan cooling							
Weight / Mass (kg)		5.0	5.0	8.0	9.0	9.5	10	25	26

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HD spec. of all types : 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HD-mode: 55 kW to 250 kW)

Item			Specifications								
Type (VXT-***A-4)			139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating)		***1**	55	75	90	110	132	160	200	220	250
Output ratings	Rated capacity (kVA)	***2**	85 [89]	114 [120]	134 [140]	160 [167]	193 [202]	232 [242]	287 [300]	316 [331]	364 [380]
	Rated voltage (V)	***3**	Three-phase 380 to 480 V (with AVR function)								
	Rated current (A)	***4**	112	150	176	210	253	304	377	415	477
	Overload capability		150%-1 min								
Input power	Voltage, frequency		Three-phase 380 to 480 V, 50/60 Hz		Three-phase 380 to 440 V, 50 Hz Three-phase 380 to 480 V, 60 Hz ***5**						
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%								
	Rated input current (w/o DCR) (A)	***7**	140	–	–	–	–	–	–	–	–
	(with DCR) (A)		102	138	164	201	238	286	357	390	443
	Required capacity (with DCR) (kVA)	***8**	71	96	114	140	165	199	248	271	307
Braking	Torque (%)	***9**	7% to 12%								
	DC braking		Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%								
	Braking transistor		Separately mounted option								
	Minimum resistance value (Ω)		–								
	Braking resistor		Separately mounted option								
DC reactor (DCR)			Separately mounted option	Must be used. Separately mounted component. ***11**							
Applicable safety standards			IEC/EN61800-5-1: 2007								
Enclosure (IEC60529)			IP00, UL open type								
Cooling method			Fan cooling								
Weight / Mass (kg)			30	33	40	62	63	95	96	130	140

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HD spec. of all types : 4 kHz
If the ambient temperature is 40°C (104°F) or above, derating of 2%/°C (2%/1.8°F) relative to the rated current given in this manual is required. For details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*5 Inverters of VXT-203-4 or above (400 V class series) are equipped with a power switching connector. Use the connector depending upon the applied voltage. For details, refer to Chapter 2 “2.2.7 Switching Connector.”

*6 $$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

*11 Please consult IMO for options.

8.1.3 HND-mode inverters for general load

Standard-model, Three-phase 200 V (230 V) class series (HND-mode: 0.75 kW to 5.5 kW)

Item			Specifications				
Type (VXT-***A-2)			4	6	10	12 ***10**	20 ***10**
Nominal applied motor (kW) (Output rating) ***1**			0.75	1.1	2.2	3.0	5.5
Output ratings	Rated capacity (kVA) ***2**		1.3 [1.4]	2.3 [2.4]	3.7 [3.8]	4.6 [4.8]	7.5 [7.8]
	Rated voltage (V) ***3**		Three-phase 200 to 240 V (with AVR function)				
	Rated current (A) ***4**		3.5	6.0	9.6	12	19.6
	Overload capability		120%-1 min				
Input power	Voltage, frequency		Three-phase 200 to 240 V, 50/60 Hz				
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A) ***7**		4.9	6.7	12.8	17.9	31.9
		(with DCR) (A)	3.0	4.3	8.3	11.7	19.9
	Required capacity (with DCR) (kVA) ***8**		1.1	1.5	2.9	4.1	6.9
Braking	Torque (%) ***9**		53%	68%	48%	29%	27%
	DC braking		Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80% (Type VXT12A-2 and VXT20A-2 : 0 to 60%)				
	Braking transistor		Built-in as standard				
	Minimum resistance value (Ω)		100		40		33
	Braking resistor		Separately mounted option				
DC reactor (DCR)			Separately mounted option				
Applicable safety standards			IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)			IP20, UL open type				
Cooling method			Natural cooling		Fan cooling		
Weight / Mass (kg)			0.6	0.8	1.5	1.5	1.8

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V (230 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HND/ND spec. of types VXT-4A-2 to VXT-20A-2 : 4 kHz,
If reduction is necessary, for details, refer to Chapter 10, Section 10.4.2 "Guideline for selecting inverter drive mode and capacity."

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

*10 Types VXT-12A-2 and VXT-20A-2 are ND spec; allowable ambient temperature 40°C (+104°F) or less. The rated output current is decreased 1% for every 1°C (1.8°F) when ambient temperature is +40°C (+104°F) or more.

Standard-model, Three-phase 200 V (230 V) class series (HND-mode: 7.5 kW to 30 kW)

Item		Specifications					
Type (VXT-***A-2)		30	40	56	69	88	115
Nominal applied motor (kW) (Output rating) ***1**		7.5	11	15	18.5	22	30
Output ratings	Rated capacity (kVA) ***2**	11 [12]	15 [16]	21 [22]	26 [27]	34 [35]	44 [46]
	Rated voltage (V) ***3**	Three-phase 200 to 240 V (with AVR function)					
	Rated current (A) ***4**	30	40	56	69	88	115
	Overload capability	120%-1 min					
Input power	Voltage, frequency	Three-phase 200 to 240 V, 50/60 Hz					
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%					
	Rated input current (w/o DCR) (A) ***7**	42.7	60.7	80.0	97.0	112	151
	(with DCR) (A)	28.8	42.2	57.6	71.0	84.4	114
	Required capacity (with DCR) (kVA) ***8**	10	15	20	25	30	40
Braking	Torque (%) ***9**	15%					
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%					
	Braking transistor	Built-in as standard					
	Minimum resistance value (Ω)	20	15	10	8.6	4	
	Braking resistor	Separately mounted option					
DC reactor (DCR)		Separately mounted option					
Applicable safety standards		IEC/EN61800-5-1: 2007					
Enclosure (IEC60529)		IP20, UL open type					
Cooling method		Fan cooling					
Weight / Mass (kg		5.0	5.0	8.0	9.0	9.5	10

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V (230 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HND spec of type VXT-30A-2 to VXT-115A-2: 10 kHz
HND spec of type VXT-88A-2, VXT-115A-2: 4 kHz
If reduction is necessary, for details, refer to Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage}\,(V) - \text{Min. voltage}\,(V)}{\text{Three - phase average voltage}\,(V)} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HND-mode: 0.75 kW to 5.5 kW)

Item		Specifications				
Type (VXT-***A-4)		2	4	6	7 *10	12 *10
Nominal applied motor (kW) (Output rating) ***1**		0.75	1.1	2.2	3.0	5.5
Output ratings	Rated capacity (kVA) ***2**	1.4 [1.4]	2.6 [2.7]	3.8 [4.0]	4.8 [5.0]	8.5 [8.8]
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)				
	Rated current (A) *4	1.8	3.4	5.0	6.3	11.1
	Overload capability	120%-1 min				
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz				
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A) ***7**	2.7	3.9	7.3	11.3	16.8
	(with DCR) (A)	1.5	2.1	4.2	5.8	10.1
	Required capacity (with DCR) (kVA) ***8**	1.1	1.5	3.0	4.1	7.0
Braking	Torque (%) ***9**	53%	68%	48%	29%	27%
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80% (Type VXT-7A-2 and VXT-12A-2 : 0 to 60%)				
	Braking transistor	Built-in as standard				
	Minimum resistance value (Ω)	200		160		130
	Braking resistor	Separately mounted option				
DC reactor (DCR)		Separately mounted option				
Applicable safety standards		IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)		IP20, UL open type				
Cooling method		Natural cooling		Fan cooling		
Weight / Mass (kg)		1.2	1.5	1.5	1.6	1.9

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HND spec of type VXT-2A-4 to VXT-6A-4: 8 kHz,
ND spec of type VXT-7A-4 to VXT-12A-4: 4 kHz,
HND spec of type VXT-22A-4 to VXT-59A-4: 10 kHz,
HND spec of type VXT-72A-4 to VXT-168A-4: 6 kHz,
HND spec of type VXT-203A-4 to VXT-590A-4: 4 kHz
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.)

*10 Types VXT-7A-4 and VXT-12A-4 are ND spec; allowable ambient temperature 40°C (+104°F) or less. The rated output current is decreased 1% for every 1°C (1.8°F) when ambient temperature is +40°C (+104°F) or more.

Standard-model, Three-phase 400 V (460 V) class series (HND-mode: 7.5 kW to 45 kW)

Item		Specifications							
Type (VXT-***A-4)		22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**		7.5	11	15	18.5	22	30	37	45
Output ratings	Rated capacity (kVA) ***2**	13 [14]	18 [18]	24 [25]	29 [30]	34 [36]	46 [48]	57 [60]	69 [73]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)							
	Rated current (A) ***4**	17.5	23	31	38	45	60	75	91
	Overload capability	120%-1 min							
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz							
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%							
	Rated input current (w/o DCR) (A) ***7**	23.2	33	43.8	52.3	60.6	77.9	94.3	114
	(with DCR) (A)	14.4	21.1	28.8	35.5	42.2	57.0	68.5	83.2
	Required capacity (with DCR) (kVA) ***8**	10	15	20	25	29	39	47	58
Braking	Torque (%) ***9**	15%						7% to 12%	
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%							
	Braking transistor	Built-in as standard						Separately mounted option	
	Minimum resistance value (Ω)	80	60	40	34.4	16		-	-
	Braking resistor	Separately mounted option							
DC reactor (DCR)		Separately mounted option							
Applicable safety standards		IEC/EN61800-5-1: 2007							
Enclosure (IEC60529)		IP20, UL open type						IP00, UL open type	
Cooling method		Fan cooling							
Weight / Mass (kg)		5.0	5.0	8.0	9.0	9.5	10	25	26

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HND spec of type VXT-22A-4 to VXT-59A-4: 10 kHz,
HND spec of type VXT-72A-4 to VXT-168A-4: 6 kHz,
HND spec of type VXT-203A-4 to VXT-590A-4: 4 kHz
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage}\,(V) - \text{Min. voltage}\,(V)}{\text{Three - phase average voltage}\,(V)} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HND-mode: 55 kW to 280 kW)

Item		Specifications								
Type (VXT-***A-4)		139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**		55	75	90	110	132	160	200	220	280
Output ratings	Rated capacity (kVA) *2	85 [89]	114 [120]	134 [140]	160 [167]	193 [202]	232 [242]	287 [300]	316 [331]	396 [380]
	Rated voltage (V) *3	Three-phase 380 to 480 V (with AVR function)								
	Rated current (A) *4	112	150	176	210	253	304	377	415	520
	Overload capability	120%-1 min								
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz		Three-phase 380 to 440 V, 50 Hz Three-phase 380 to 480 V, 60 Hz ***5**						
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%								
	Rated input current (w/o DCR) (A) ***7**	140	–	–	–	–	–	–	–	–
	(with DCR) (A)	102	138	164	201	238	286	357	390	500
	Required capacity (with DCR) (kVA) ***8**	71	96	114	140	165	199	248	271	347
Braking	Torque (%) ***9**	7% to 12%								
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 80%								
	Braking transistor	Separately mounted option								
	Minimum resistance value (Ω)									
	Braking resistor	Separately mounted option								
DC reactor (DCR)		Separately mounted option	Must be used. Separately mounted component. ***11**							
Applicable safety standards		IEC/EN61800-5-1: 2007								
Enclosure (IEC60529)		IP00, UL open type								
Cooling method		Fan cooling								
Weight / Mass (kg)		30	33	40	62	63	95	96	130	140

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HND spec of type VXT-22A-4 to VXT-59A-4: 10 kHz,
HND spec of type VXT-72A-4 to VXT-168A-4: 6 kHz,
HND spec of type VXT-203A-4 to VXT-590A-4: 4 kHz
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*5 Inverters of VXT-203A-4 or above (400 V class series) are equipped with a power switching connector. Use the connector depending upon the applied voltage. For details, refer to Chapter 2 “2.2.7 Switching Connector.”

*6 $$\text{Voltage unbalance}\,(\%) = \frac{\text{Max. voltage}\,(V) - \text{Min. voltage}\,(V)}{\text{Three - phase average voltage}\,(V)} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

*11 Please consult IMO for options.

8.1.4 HHD-mode inverters for heavy duty load

Standard-model, Three-phase 200 V (230 V) class series (HHD-mode: 0.4 kW to 4.0 kW)

Item			Specifications				
Type (VXT-***A-2)			4	6	10	12	20
Nominal applied motor (kW) (Output rating)		***1**	0.4	0.75	1.5	2.2	4.0
Output ratings	Rated capacity (kVA)	***2**	1.1 [1.2]	1.9 [2.0]	3.0 [3.2]	4.2 [4.4]	6.7 [7.0]
	Rated voltage (V)	***3**	Three-phase 200 to 240 V (with AVR function)				
	Rated current (A)	***4**	3.0	5.0	8.0	11	17.5
	Overload capability		150%-1 min, 200%-0.5 s				
Input power	Voltage, frequency		Three-phase 200 to 240 V, 50/60 Hz				
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A)	***7**	3.1	5.3	9.5	13.2	22.2
	(with DCR) (A)		1.6	3.0	5.7	8.3	14.0
	Required capacity (with DCR) (kVA)	***8**	0.6	1.1	2.0	2.9	4.9
Braking	Torque (%)	***9**	100%		70%	40%	
	DC braking		Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%				
	Braking transistor		Built-in as standard				
	Minimum resistance value(Ω)		100		40		33
	Braking resistor		Separately mounted option				
DC reactor (DCR)			Separately mounted option				
Applicable safety standards			IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)			IP20, UL open type				
Cooling method			Natural cooling		Fan cooling		
Weight / Mass (kg)			0.6	0.8	1.5	1.5	1.8

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V (230 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec. of types VXT-4A-2 to VXT-20A-2 : 8 kHz,
HHD spec. of types VXT-30A-2 to VXT-115A-2 : 10 kHz,
If reduction is necessary, for details, refer to Chapter 10, Section 10.4.2 "Guideline for selecting inverter drive mode and capacity."

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 200 V (230 V) class series (HHD-mode: 5.5 kW to 22 kW)

Item		Specifications					
Type (VXT-***A-2)		30	40	56	69	88	115
Nominal applied motor (kW) (Output rating) ***1**		5.5	7.5	11	15	18.5	22
Output ratings	Rated capacity (kVA) ***2**	9.5 [10]	13 [13]	18 [19]	23 [24]	29 [30]	34 [36]
	Rated voltage (V) ***3**	Three-phase 200 to 240 V (with AVR function)					
	Rated current (A) ***4**	25	33	47	60	76	90
	Overload capability	150%-1 min, 200%-0.5 s					
Input power	Voltage, frequency	Three-phase 200 to 240 V, 50/60 Hz					
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%					
	Rated input current (w/o DCR) (A) ***7**	31.5	42.7	60.7	80.0	97.0	112
	(with DCR) (A)	21.1	28.8	42.2	57.6	71.0	84.4
	Required capacity (with DCR) (kVA) ***8**	7.3	10	15	20	25	30
Braking	Torque (%) ***9**	20%					
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%					
	Braking transistor	Built-in as standard					
	Minimum resistance value (Ω)	20	15	10	8.6	4	
	Braking resistor	Separately mounted option					
DC reactor (DCR)		Separately mounted option					
Applicable safety standards		IEC/EN61800-5-1: 2007					
Enclosure (IEC60529)		IP20, UL open type					
Cooling method		Fan cooling					
Weight / Mass (kg)		5.0	5.0	8.0	9.0	9.5	10

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V (230 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec. of types VXT-30A-2 to VXT-115A-2: 10 kHz
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance (\%)} = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HHD-mode: 0.4 kW to 4.0 kW)

Item		Specifications				
Type (VXT-***A-4)		2	4	6	7	12
Nominal applied motor (kW) (Output rating) ***1**		0.4	0.75	1.5	2.2	4.0
Output ratings	Rated capacity (kVA) ***2**	1.1 [1.2]	1.9 [2.0]	3.2 [3.3]	4.2 [4.4]	6.9 [7.2]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)				
	Rated current (A) ***4**	1.5	2.5	4.2	5.5	9.0
	Overload capability	150%-1 min, 200%-0.5 s				
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz				
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%				
	Rated input current (w/o DCR) (A) ***7**	1.7	3.1	5.9	8.2	13.0
	(with DCR) (A)	0.85	1.6	3.0	4.4	7.3
	Required capacity (with DCR) (kVA) ***8**	0.6	1.2	2.1	3.1	5.1
Braking	Torque (%) ***9**	100%		70%	40%	
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%				
	Braking transistor	Built-in as standard				
	Minimum resistance value (Ω)	200		160		130
	Braking resistor	Separately mounted option				
DC reactor (DCR)		Separately mounted option				
Applicable safety standards		IEC/EN61800-5-1: 2007				
Enclosure (IEC60529)		IP20, UL open type				
Cooling method		Fan cooling				
Weight / Mass (kg)		1.2	1.5	1.5	1.6	1.9

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec of type VXT-2A-4 to VXT-12A-4: 8 kHz,
HHD spec of type VXT-22A-4 to VXT-168A-4: 10 kHz,
HHD spec of type VXT-203A-4 to VXT-590A-4: 6 kHz,
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $\text{Voltage unbalance}\,(\%) = \dfrac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HHD-mode: 5.5 kW to 37 kW)

Item		Specifications							
Type (VXT-***A-4)		22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**		5.5	7.5	11	15	18.5	22	30	37
Output ratings	Rated capacity (kVA) ***2**	9.9 [10]	14 [14]	18 [19]	23 [24]	30 [31]	34 [36]	46 [48]	57 [60]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)							
	Rated current (A) ***4**	13	18	24	30	39	45	60	75
	Overload capability	150%-1 min, 200%-0.5 s							
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz							
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%							
	Rated input current (w/o DCR) (A) ***7**	17.3	23.2	33	43.8	52.3	60.6	77.9	94.3
	(with DCR) (A)	10.6	14.4	21.1	28.8	35.5	42.2	57.0	68.5
	Required capacity (with DCR) (kVA) ***8**	7.3	10	15	20	25	29	39	47
Braking	Torque (%) ***9**	20%						10% to 15%	
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%							
	Braking transistor	Built-in as standard							
	Minimum resistance value (Ω)	80	60	40	34.4	16		—	
	Braking resistor	Separately mounted option							
DC reactor (DCR)		Separately mounted option							
Applicable safety standards		IEC/EN61800-5-1: 2007							
Enclosure (IEC60529)		IP20, UL open type							
Cooling method		Fan cooling							
Weight / Mass (kg)		5.0	5.0	8.0	9.0	9.5	10	25	26

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec of type VXT-2A-4 to VXT-12A-4: 8 kHz,
HHD spec of type VXT-22A-4 to VXT-168A-4: 10 kHz,
HHD spec of type VXT-203A-4 to VXT-590A-4: 6 kHz,
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*6 $$\text{Voltage unbalance}\,(\%) = \frac{\text{Max. voltage}\,(V) - \text{Min. voltage}\,(V)}{\text{Three - phase average voltage}\,(V)} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

Standard-model, Three-phase 400 V (460 V) class series (HHD-mode: 45 kW to 220 kW)

Item		Specifications								
Type (VXT-***A-4)		139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**		45	55	75	90	110]	132	160	200	220
Output ratings	Rated capacity (kVA) ***2**	69 [73]	85 [89]	114 [120]	134 [140]	160 [167]	193 [202]	232 [242]	287 [300]	316 [331]
	Rated voltage (V) ***3**	Three-phase 380 to 480 V (with AVR function)								
	Rated current (A) ***4**	91	112	150	176	210	253	304	377	415
	Overload capability	150%-1 min, 200%-0.5 s								
Input power	Voltage, frequency	Three-phase 380 to 480 V, 50/60 Hz		Three-phase 380 to 440 V, 50 Hz Three-phase 380 to 480 V, 60 Hz ***5**						
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) ***6**, Frequency: +5 to -5%								
	Rated input current (w/o DCR) (A) ***7**	114	140	–	–	–	–	–	–	–
	(with DCR) (A)	83.2	102	138	164	201	238	286	357	390
	Required capacity (with DCR) (kVA) ***8**	58	71	96	114	140	165	199	248	271
Braking	Torque (%) ***9**	10% to 15%								
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%								
	Braking transistor	Separately mounted option								
	Minimum resistance value (Ω)									
	Braking resistor	Separately mounted option								
DC reactor (DCR)		Separately mounted option		Must be used. Separately mounted component. ***11**						
Applicable safety standards		IEC/EN61800-5-1: 2007								
Enclosure (IEC60529)		IP00, UL open type								
Cooling method		Fan cooling								
Weight / Mass (kg)		30	33	40	62	63	95	96	130	140

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 440 V (460 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec of type VXT-22A-4 to VXT-168A-4: 10 kHz,
HHD spec of type VXT203A-4 to VXT590A-4: 6 kHz,
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 Guideline for selecting inverter drive mode and capacity.”

*5 Inverters of VXT-203A-4 or above (400 V class series) are equipped with a power switching connector. Use the connector depending upon the applied voltage. For details, refer to Chapter 2 “2.2.7 Switching Connector.”

*6 $$\text{Voltage unbalance}\,(\%) = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$$ (IEC 61800-3)

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

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected. When applying with motors of 75 kW or above, a DC reactor (DCR) should be used.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

*11 Please consult IMO for options.

Standard-model, Single-phase 200 V (230 V) class series (HHD-mode: 0.4 kW to 2.2 kW)

Item		Specifications			
Type (VXT-***A-1)		3	5	8	11
Nominal applied motor (kW) (Output rating) ***1**		0.4	0.75	1.5	2.2
Output ratings	Rated capacity (kVA) ***2**	1.1 [1.2]	1.9 [2.0]	3.0 [3.2]	4.2 [4.4]
	Rated voltage (V) ***3**	Three-phase 200 to 240 V (with AVR function)			
	Rated current (A) ***4**	3.0	5.0	8.0	11
	Overload capability	150%-1 min, 200%-0.5 s			
Input power	Voltage, frequency	Single-phase 200 to 240 V, 50/ 60 Hz			
	Allowable voltage/frequency	Voltage: +10 to -10%, Frequency: +5 to -5%			
	Rated input current (w/o DCR) (A) ***7**	5.4	9.7	16.4	24.8
	(with DCR) (A)	3.5	6.4	11.6	17.5
	Required capacity (with DCR) (kVA) ***8**	0.7	1.3	2.4	3.5
Braking	Torque (%) ***9**	100%		70%	40%
	DC braking	Braking starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100%			
	Braking transistor	Built-in as standard			
	Minimum resistance value (Ω)	100		40	
	Braking resistor	Separately mounted option			
DC reactor (DCR)		Separately mounted option			
Applicable safety standards		IEC/EN61800-5-1: 2007			
Enclosure (IEC60529)		IP00, UL open type			
Cooling method		Natural cooling		Fan cooling	
Weight / Mass (kg)		0.6	0.9	1.6	1.8

*1 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V (230 V).

*3 Output voltage cannot exceed the power supply voltage.

*4 Setting the carrier frequency (F26) to the following value or above requires current derating.
HHD spec of type VXT-3A-1 to VXT-11A-1: 8 kHz,
If reduction is necessary, for details, refer to Figure 10.4-1 in Chapter 10 “10.4.2 “Guideline for selecting inverter drive mode and capacity.”

*7 This specification is an estimated value to be applied when the power supply capacity is 500 kVA (Inverter capacity × 10 when the capacity exceeds 50 kVA) and the power supply with %X = 5% is connected.

*8 This specification applies when a DC reactor (DCR) is used.

*9 Average braking torque for the motor running alone. It depends on the efficiency of the motor.

8.2 EMC Filter Built-in Type

8.2.1 ND-mode inverters for general load

Three-phase 400 V (460 V) class series

Item	Specifications				
Type (VXT-***A-4E)	2	4	6	7	12
Nominal applied motor (kW) (Output rating) ***1**	0.75	1.5	2.2	3.0	5.5
EMC filter	Compliant with EMC Directives. Emission: Category C2. Immunity: 2nd Env. (EN61800-3:2004)				
Weight / Mass (kg)	1.5	1.8	2.3	2.3	2.4

Item	Specifications							
Type (VXT-***A-4E)	22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**	11	15	18.5	22	30	37	45	55
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)							
Weight / Mass (kg)	6.5	6.5	11.2	11.2	10.5	11.2	26	27

Item	Specifications								
Type (VXT-***A-4E)	139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**	75	90	110	132	160	200	220	280	315
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)								
Weight / Mass (kg)	31	33	40	62	63	95	96	130	140

*1 4-pole standard motor

The specification other than the above items is the same as “8.1.1 ND-mode inverters for general load”.

8.2.2 HD-mode inverters for heavy duty load

Three-phase 400 V (460 V) class series

Item	Specifications				
Type (VXT-***A-4E)	2	4	6	7	12
Nominal applied motor (kW) (Output rating) ***1**	0.75	1.1	2.2	3.0	5.5
EMC filter	Compliant with EMC Directives. Emission: Category C2. Immunity: 2nd Env. (EN61800-3:2004)				
Weight / Mass (kg)	1.5	1.8	2.3	2.3	2.4

Item	Specifications							
Type (VXT-***A-4E)	22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**	7.5	11	15	18.5	22	30	37	45
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)							
Weight / Mass (kg)	6.5	6.5	11.2	11.2	10.5	11.2	26	27

Item	Specifications								
Type (VXT-***A-4E)	139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**	55	75	90	110	132	160	200	220	250
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)								
Weight / Mass (kg)	31	33	40	62	63	95	96	130	140

*1 4-pole standard motor

The specification other than the above items is the same as “8.1.2 HD-mode inverters for heavy duty load”.

8.2.3 HND-mode inverters for general load

Three-phase 400 V (460 V) class series

Item	Specifications				
Type (VXT-***A-4E)	2	4	6	7 ***10**	12 ***10**
Nominal applied motor (kW) (Output rating) ***1**	0.75	1.1	2.2	3.0	5.5
EMC filter	Compliant with EMC Directives. Emission: Category C2. Immunity: 2nd Env. (EN61800-3:2004)				
Weight / Mass (kg)	1.5	1.8	2.3	2.3	2.4

Item	Specifications							
Type (VXT-***A-4E)	22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**	7.5	11	15	18.5	22	30	37	45
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)							
Weight / Mass (kg)	6.5	6.5	11.2	11.2	10.5	11.2	26	27

Item	Specifications								
Type (VXT-***A-4E)	139	168	203	240	290	361	415	520	590
Nominal applied motor (kW) (Output rating) ***1**	55	75	90	110	132	160	200	220	280
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)								
Weight / Mass (kg)	31	33	40	62	63	95	96	130	140

*1 4-pole standard motor

*10 Types VXT7A-4E and VXT-12A-4E are ND spec; allowable ambient temperature 40°C (+104°F) or less. The rated output current is decreased 1% for every 1°C (1.8°F) when ambient temperature is +40°C (+104°F) or more.

The specification other than the above items is the same as “8.1.3 HND-mode inverters for general load”.

8.2.4 HHD-mode inverters for heavy duty load

Three-phase 400 V (460 V) class series

Item	Specifications				
Type (VXT-***A-4E)	2	4	6	7	12
Nominal applied motor (kW) (Output rating) ***1**	0.4	0.75	1.5	2.2	4.0
EMC filter	Compliant with EMC Directives. Emission: Category C2. Immunity: 2nd Env. (EN61800-3:2004)				
Weight / Mass (kg)	1.5	1.8	2.3	2.3	2.4

Item	Specifications							
Type (VXT-***A-4E)	22	29	37	44	59	72	85	105
Nominal applied motor (kW) (Output rating) ***1**	5.5	7.5	11	15	18.5	22	30	37
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)							
Weight / Mass (kg)	6.5	6.5	11.2	11.2	10.5	11.2	26	27

Item	Specifications								
Type (VXT-***A-4E)	0139	0168	0203	0240	0290	0361	0415	0520	0590
Nominal applied motor (kW) (Output rating) ***1**	45	55	75	90	110	132	160	200	220
EMC filter	Compliant with EMC Directives. Emission: Category C3. Immunity: 2nd Env. (EN61800-3:2004)								
Weight / Mass (kg)	31	33	40	62	63	95	96	130	140

Single-phase 200 V (230 V) class series

Item	Specifications			
Type (VXT-***A-1E)	3	5	8	11
Nominal applied motor (kW) (Output rating) ***1**	0.4	0.75	1.5	2.2
EMC filter	Compliant with EMC Directives. Emission: Category C2. Immunity: 2nd Env. (EN61800-3:2004)			
Weight / Mass (kg)	0.7	1.1	2.3	2.3

*1 4-pole standard motor

The specification other than the above items is the same as “8.1.4 HHD-mode inverters for heavy duty load”.

8.3 Common Specifications

Item			Explanation	Remarks
Output	Setting range	Maximum frequency	HHD/HND/HD mode: 25 to 500 Hz variable (under V/f control, Magnetic pole position sensorless vector control) (Up to 200 Hz in case of under vector control with speed sensor) ND mode: 25 to 120 Hz (under any drive control)	IMPG-VC
		Base frequency	25 to 500 Hz variable (in conjunction with the maximum frequency)	
		Starting frequency	0.1 to 60.0 Hz variable (0.0 Hz under vector control with speed sensor)	IMPG-VC
		Carrier frequency	Three phase 200 V class series VXT-4A-2 to VXT-10A-2, VXT-30A-2 to VXT-88A-2: • 0.75 to 16 kHz variable (HHD/HND spec.) VXT-12A-2 to VXT-20A-2: • 0.75 to 16 kHz variable (HHD spec.) • 0.75 to 10 kHz variable (ND spec.) VXT-115A-2: • 0.75 to 16 kHz variable (HHD spec.) • 0.75 to 10 kHz variable (HND spec.) Three phase 400 V class series VXT-2A-4 to VXT-59A-4: • 0.75 to 16 kHz variable (HHD/HND/HD spec.) • 0.75 to 10 kHz variable (ND spec.) VXT-72A-4 to VXT-168A-4: • 0.75 to 16 kHz variable (HHD spec.) • 0.75 to 10 kHz variable (HND/HD spec.) • 0.75 to 6 kHz variable (ND spec.) VXT-203A-4 to VXT-590A-4: • 0.75 to 10 kHz variable (HHD spec.) • 0.75 to 6 kHz variable (HND/HD/ND spec.) Single phase 200 V class series VXT-3A-1 to VXT-11A-1: • 0.75 to 16 kHz variable (HHD spec.) **Note:** The carrier frequency may automatically lower depending upon the ambient temperature or the output current to protect the inverter. (The automatic lowering function can be disabled.)	
	Output frequency accuracy (Stability)		• Analog setting: ±0.2% of maximum frequency (at 25±10°C) (77±18°F) • Keypad setting: ±0.01% of maximum frequency (at -10 to +50°C) (14±22°F)	
	Frequency setting resolution		• Analog setting: 0.05% of maximum frequency • Keypad setting: 0.01 Hz (99.99 Hz or less), 0.1 Hz (100.0 to 500 Hz) • Link setting: 0.005% of maximum frequency or 0.01 Hz (fixed)	
	Speed control range		• 1: 1500 (Minimum speed : Nominal speed, 4P, 1 to 1500 r/min) • 1: 100 (Minimum speed : Nominal speed, 4P, 15 to 1500 r/min) • 1: 10 (Minimum speed : Nominal speed, 6P, 180 to 1800 r/min)	IMPG-VC IMPG-VF PM-SVC
	Speed control accuracy		• Analog setting: ±0.2% of maximum frequency or below (at 25 ±10°C) (77±18°F) • Digital setting: ±0.01% of maximum frequency or below (at -10 to +50°C) (14 to 122°F)	IMPG-VC
			• Analog setting: ±0.5% of base frequency or below (at 25 ±10°C) (77±18°F) • Digital setting: ±0.5% of base frequency or below (-10 to +50°C) (14 to 122°F)	PM-SVC
	Control method		• V/f control • Vector control without speed sensor (Dynamic torque vector) • V/f control, with slip compensation • V/f control, with slip sensor (PG option) • V/f Control with speed sensor (+Auto Torque Boost)(PG option) • Vector control with speed sensor (PG option) • Vector control without magnetic pole position sensor	VF IM-SVC VF with SC IMPG-VF IMPG-ATB IMPG-VC PM-SVC

	Item	Explanation	Remarks
Control	Control method	• V/f control • Vector control without speed sensor (Dynamic torque vector) • V/f control, with slip compensation • V/f control, with slip sensor (PG option) • V/f Control with speed sensor (+Auto Torque Boost)(PG option) • Vector control with speed sensor (PG option) • Vector control without magnetic pole position sensor	VF IM-SVC VF with SC IMPG-VF IMPG-ATB IMPG-VC PM-SVC
	Voltage/frequency characteristics	• Possible to set 80 to 240 V / 160 to 500 V at base frequency and at maximum output frequency.	
		• Non-linear V/f setting (3 points): Free voltage (0 to 240 V / 500 V) and frequency (0 to 500 Hz) can be set.	
	Torque boost	• Auto torque boost (For constant torque load) • Manual torque boost: Torque boost value can be set between 0.0 and 20.0% • Select application load with the function code. (Variable torque load or constant torque load)	
	Starting torque	Three phase 400 V class series • 200% or above, reference frequency 0.5 Hz (HHD-mode inverters of VXT-72A-4 or below) 150% or above, reference frequency 0.5 Hz (HHD-mode inverters of VXT-85A-4 or above) • 120% or above, reference frequency 0.5 Hz (HND/ND mode) • 150% or above, reference frequency 0.5 Hz (HD mode) Three phase 200 V class series • 200% or above, reference frequency 0.5 Hz (HHD-mode inverters of VXT-69A-2 or below) • 120% or above, reference frequency 0.5 Hz (HND-mode inverters of VXT-69A-2 or below) Single phase 200 V class series • 200% or above, reference frequency 0.5 Hz (HHD-mode inverters of VXT-11A-1 or below) Base frequency 50 Hz, with slip compensation and auto torque boost active	
	Start/stop operation	Keypad: Start and stop with RUN and STOP keys (Standard keypad) Start and stop with FWD / REV and STOP keys (Optional multi-function keypad)	
		External signals (digital inputs): Forward (Reverse) rotation, stop command (capable of 3-wire operation), coast-to-stop command, external alarm, alarm reset, etc.	
		Link operation: Operation through RS-485 (built-in as standard), CANopen (built-in as standard) or field bus (option) communications link	
		Switching run command: Remote/local switching, link switching	
	Frequency setting	Keypad: Using ∧ and ∨ keys	
		External potentiometer: Using external frequency command potentiometer. (External resistor of 1 to 5 kΩ 1/2 W)	
		Analog input: 0 to ±10 VDC (±5 VDC)/ 0 to ±100% (terminal [12]), 0 to +10 VDC (+5 VDC)/ 0 to +100% (terminal [12]) 4 to 20 mADC/ 0 to +100% (terminal [C1] (C1 function)) 4 to 20 mADC/ 0 to ±100% (terminal [C1] (C1 function)) 0 to 20 mADC/ 0 to +100% (terminal [C1] (C1 function)) 0 to 20 mADC/ 0 to ±100% (terminal [C1] (C1 function)) 0 to +10 VDC (+5 VDC)/ 0 to +100% (terminal [C1] (V2 function)), 0 to +10 VDC (+5 VDC)/ 0 to ±100% (terminal [C1] (V2 function))	
		UP/DOWN operation: Frequency can be increased or decreased while the digital input signal is ON.	
		Multistep frequency: Selectable from 16 different frequencies (step 0 to 15)	
		Pattern operation: The inverter runs automatically according to the previously specified run time, rotation direction, acceleration/deceleration time and reference frequency. Up to 7 stages can be specified.	

Item		Explanation	Remarks
		Link operation: Operation through RS-485 (built-in as standard), CANopen (built-in as standard) or field bus (option) communications link	
		Frequency setting: Two types of frequency settings can be switched with an external signal (digital input). Remote/local switching, link switching	
Control	Frequency setting	Auxiliary frequency setting: Inputs at terminal [12], [C1] (C1 function) or [C1] (V2 function) can be added to the main setting as auxiliary frequency settings.	
		Operation at a specified ratio: The ratio can be set by analog input signal. 0 to 10 VDC/0 (4) to 20 mA/0 to 200% (variable)	
		Inverse operation: Switchable from “0 to +10 VDC/0 to 100%” to “+10 to 0 VDC/0 to 100%” for the external command (terminals [12] and [C1] (V2 function) Switchable from “0 to -10 VDC/0 to -100%” to “-10 to 0 VDC/0 to -100%” for the external command (terminal [12]) Switchable from “4 to +20 mA DC/0 to 100%” to “20 to 4 mA DC/0 to 100%” for the external command (terminal [C1] (C1 function)) Switchable from “0 to +20 mA DC/0 to 100%” to “20 to 0 mA DC/0 to 100%” for the external command (terminal [C1] (C1 function))	
		Pulse train input (standard): Pulse input = Terminal [X5], Rotational direction = general terminal Complementary output: Max. 100 kHz, Open collector output: Max. 30 kHz	
		Pulse train input (option): A PG option card is required. CW/CCW pulse, pulse + rotational direction Complementary output: Max. 100 kHz, Open collector output: Max. 30 kHz	
	Acceleration/ deceleration time	Setting range: Between 0.00 and 6000 s	
		Switching: The four types of acceleration/deceleration time can be set or selected individually (switchable during operation).	
		Acceleration/deceleration pattern: Linear acceleration/deceleration, S-curve acceleration/deceleration (weak, arbitrary (with function code)), curvilinear acceleration/deceleration	
		Deceleration mode (coast-to-stop): Shutoff of the run command lets the motor coast to a stop.	
		Acceleration/deceleration time exclusive to jogging (0.00 to 6000 s)	
		Forcible stop deceleration time: Deceleration stop by the forcible stop ***STOP***. During forced stop operation, S-curve acceleration/deceleration is disabled.	
	Frequency limiter (Upper limit and lower limit frequencies)	• Specifies the upper and lower limits in Hz. • “Continue to run” or “Decelerate to a stop” selectable when the reference frequency drops below the lower limit.	
	Frequency/PID command bias	• Bias of reference frequency and PID command can be independently set (setting range: 0 to ±100%).	
	Analog input	• Gain: Setting range from 0 to 200% • Offset: Setting range from -5.0 to +5.0% • Filter: Setting range from 0.00 s to 5.00 s • Polarity selection (±/+)	
	Jump frequency	• Three operation points and their common jump width (0 to 30.0 Hz) can be set.	
	Timed operation	The inverter drives the motor for the run time specified from the keypad and stops its output. (Single-cycle operation)	
	Jogging operation	• Operation with (RUN) key (standard keypad), (FWD) or (REV) key (multi-function keypad), or digital input signal ***FWD*** or ***REV*** (Exclusive acceleration/deceleration time setting, exclusive frequency setting)	

	Item	Explanation	Remarks
	Auto-restart after momentary power failure	• Trip immediately: Trip immediately at the time of power failure. • Trip after a recovery from power failure: Coast to a stop at the time of power failure and trip when the power is recovered. • Trip after decelerate-to-stop: Deceleration stop at power failure, and trip after stoppage • Continue to run: Operation is continued using the load inertia energy. • Start at the frequency selected before momentary power failure: Coast-to-stop at power failure and start after power recovery at the frequency selected before momentary stop. • Start at starting frequency: Coast-to-stop at power failure and start at the starting frequency after power recovery. • Start at the frequency searched at the time of power recovery: Coast-to-stop at power failure, search for the idling motor speed, and restart the motor.	
Control	Hardware current limiter	Limits the current by hardware to prevent an overcurrent trip from being caused by fast load variation or momentary power failure, which cannot be covered by the software current limiter. This limiter can be canceled.	
	Operation by commercial power supply	With commercial power selection commands (***SW50***, ***SW60***), the inverter outputs 50/60 Hz.	
	Slip compensation	• Compensates for decrease in speed according to the load • Possible to set constants for the response of slip compensation.	
	Droop control	• Decreases the speed according to the load torque.	
	Torque limiter	Control output torque so that output torque is preset limiting value or less. • Switchable between 1st and 2nd torque limit values	
	Torque current limiter	• Torque limit and Torque current limit are selectable. • Torque limit by analog input.	IMPG-VC PM-SVC
	Software current limiter	Automatically reduces the frequency so that the output current becomes lower than the preset operation level. This limiter can be canceled.	
	Overload stop	If the detected torque or current exceeds the preset value, the inverter decelerates the motor to a stop or causes the motor to coast to a stop.	
	PID control	• PID processor for process control/dancer control • Normal operation/inverse operation • PID command: Keypad, analog input (from terminals [12], [C1] (C1 function) and [C1] (V2 function)), multistep frequency (3 steps), RS-485 communication • PID feedback value: Analog input (from terminals [12], [C1] (C1 function) and [C1] (V2 function)) • Alarm output (absolute value alarm, deviation alarm) • Low liquid level stop function (pressurized operation possible before low liquid level stop) • Anti-reset wind-up function • PID output limiter • Integration reset/hold	
	Auto search for idling motor speed	The inverter automatically searches for the idling motor speed and starts to drive it without stopping it. Motor parameters require tuning. (Offline tuning)	
	Automatic deceleration	• If the DC link bus voltage or calculated torque exceeds the automatic deceleration level during deceleration, the inverter automatically prolongs the deceleration time to avoid overvoltage trip. (It is possible to select forcible deceleration actuated when the deceleration time becomes three times longer.) • If the calculated torque exceeds automatic deceleration level during constant speed operation, the inverter avoids overvoltage trip by increasing the frequency.	
	Deceleration characteristic (improved braking capacity)	The motor loss is increased during deceleration to reduce the regenerative energy in the inverter to avoid overvoltage trip.	
	Auto energy saving operation	Controls the output voltage to minimize the total sum of the motor loss and inverter loss.	
	Overload prevention control	If the surrounding temperature or IGBT junction temperature increases due to overload, the inverter lowers the output frequency to avoid overload.	

Item		Explanation	Remarks
	Battery/UPS operation	Cancels the undervoltage protection so that the inverter under an undervoltage condition runs the motor with battery/UPS power.	
	Offline tuning	Tunes the motor while the motor is stopped or running, for setting up motor parameters.	
	Online tuning	Controls the motor speed variation caused by the motor temperature rise during running.	
	Cooling fan ON/OFF control	• Detects inverter internal temperature and stops cooling fan when the temperature is low. • Possible to output a fan control signal to an external device.	
	1st to 2nd motor settings	• Switchable between two motors It is possible to set the base frequency, rated current, torque boost, and electronic thermal slip compensation as the data for 1st and 2nd motors.	

	Item	Explanation	Remarks
Control	Universal DI	Transfers the status of an external digital signal connected with the general-purpose digital input terminal to the host controller.	
	Universal DO	Outputs a digital command signal sent from the host controller to the general-purpose digital output terminal.	
	Universal AO	Outputs an analog command signal sent from the host controller to the analog output terminal.	
	Speed control	• Notch filter for vibration control • Selectable among the four set of the auto speed regulator (ASR) parameters. (a PG option card is required.)	IMPG-VC PM-SVC
	Line speed control	In a machine such as winder/unwinder, regulates the motor speed to keep the peripheral speed of the spool constant. (a PG option card is required.)	IMPG-VF
	Positioning control with pulse counter	The positioning control starts from the preset start point and counts the feedback pulses by means of PG card installed in the inverter. The motor can be automatically started decelerating to the creep speed at which the target position can be detected, so that the motor can stop near the position (a PG option card is required).	Excluded IMPG-VC PM-SVC
	Master-follower operation	Enables synchronous operation of two motors equipped with a pulse generator (PG). (a PG option card is required.)	
	Pre-excitation	Excitation is carried out to create the motor flux before starting the motor. (a PG option card is required.)	IMPG-VC
	Zero speed control	The motor speed is held to zero by forcibly zeroing the speed command. (a PG option card is required.)	IMPG-VC
	Servo lock	Stops the motor and holds the motor in the stopped position.(a PG option card is required.)	IMPG-VC
	DC braking	Applies DC current to the motor at the operation start time or at the time of inverter stop to generate braking torque.	
	Mechanical brake control	• Possible to output mechanical brake control signals with the brake ON/OFF timing adjusted by the output current, torque command, output frequency and timer. • Mechanical brake application check input.	
	Torque control	• Analog torque/torque current command input • Speed limit function is provided to prevent the motor from becoming out of control. • Torque bias (analog setting, digital setting) (The PG option card is required.)	IMPG-VC
	Rotation direction control	Select either of reverse or forward rotation prevention.	
	Customizable logic interface	Possible to select or connect digital logic circuits or analog operation circuits with digital/analog I/O signals, configure a simple relay sequence, and operate it freely. • Logic circuits: (Digital) AND, OR, XOR, flip-flop, detection of rising and falling edges, various counters. (Analog) Addition, subtraction, multiplication, division, limiters, absolute values, sign inversion addition, comparison, maximum value selection, minimum value selection, average values, scale conversion. • Multifunction time: On-delay timer, off-delay timer, pulse train output, etc. Setting range: 0.0 to 9990 s • Input/output signals: Terminal input/output, inverter control functions • Others: Available in 200 steps configured with 2 inputs and 1 output per step.	
	Functions for wiredrawing machines, hoists, and spinning frames	Customizable logic function enables dedicated functions for each application.	

Item		Explanation	Remarks
Display	Indicators	Detachable, 7-segment, 4-digit LED, 7 push-buttons (PRG/RESET, FUNC/DATA, UP, DOWN, RUN, STOP, and SHIFT), and 6 LED indicators (KEYPAD CONTROL, Hz, A, kW, X10, and RUN)	
	Running/stopping	Speed monitor (reference frequency, output frequency, motor speed, load shaft speed, line speed, and speed indication with percent), output current (A), output voltage (V), calculated torque (%), input power (kW), PID command value, PID feedback amount, PID output, timer values for timed operation (s), load factor (%), and motor output (kW), Torque current [%] , Magnetic flux command [%], Analog input monitor, input watt-hour, constant feeding rate time (min.), and remaining time for timed operation (s) can be displayed.	
	Maintenance monitor	DC link bus voltage, maximum effective current, input watt-hour, input watt-hour data, temperature (inverter internal temperature, maximum inverter internal temperature, heat sink temperature, maximum heat sink temperature), capacitance of the DC link bus capacitor, service life of DC ink but capacitor (elapsed time/remaining time), cumulative run times (inverter power-ON time, electrolytic capacitors on printed circuit boards, cooling fans, individual motors), light-alarm contents (last four alarms), RS-485 error contents and number of error times, CANopen error contents, option error contents and number of error times, ROM version (inverter, keypad, and option)	
	I/O check	Displays the I/O signal states of control circuit terminals using the segment ON/OFF of the 7-segment LED monitor or hexadecimal format. (digital and analog signals)	
	Trip	Displays the cause of a trip by codes.	
	Light-alarm	Shows the light-alarm display *l-al*.	
	During running or at the time of a trip	• Trip history: Saves and displays the cause of the last four trips (with a code). • Saves and displays the detailed running status data of the last four trips.	

*Note: The meaning of the described abbreviations are shown as follows.
VF V/f Control
IM-SVC(DTV) Speed Sensorless Vector control (Dynamic Torque Vector Control)
VF with SC V/f Control with Slip Compensation
IMPG-VF V/f Control with Speed Sensor (a PG option card is required.)
IMPG-ATB V/f Control with speed sensor (＋Auto Torque Boost)(A PG option card is required.)
IMPG-VC Vector Control with Speed Sensor (a PG option card is required.)
PM-SVC Magnetic Pole Position Sensorless Vector Control

When the protective function is activated so that the LED monitor shows alarm codes, refer to Chapter 6 “TROUBLESHOOTING.”

For the usage environment and storage environment, refer to Chapter 1 “1.3 Precautions for Using Inverters.”

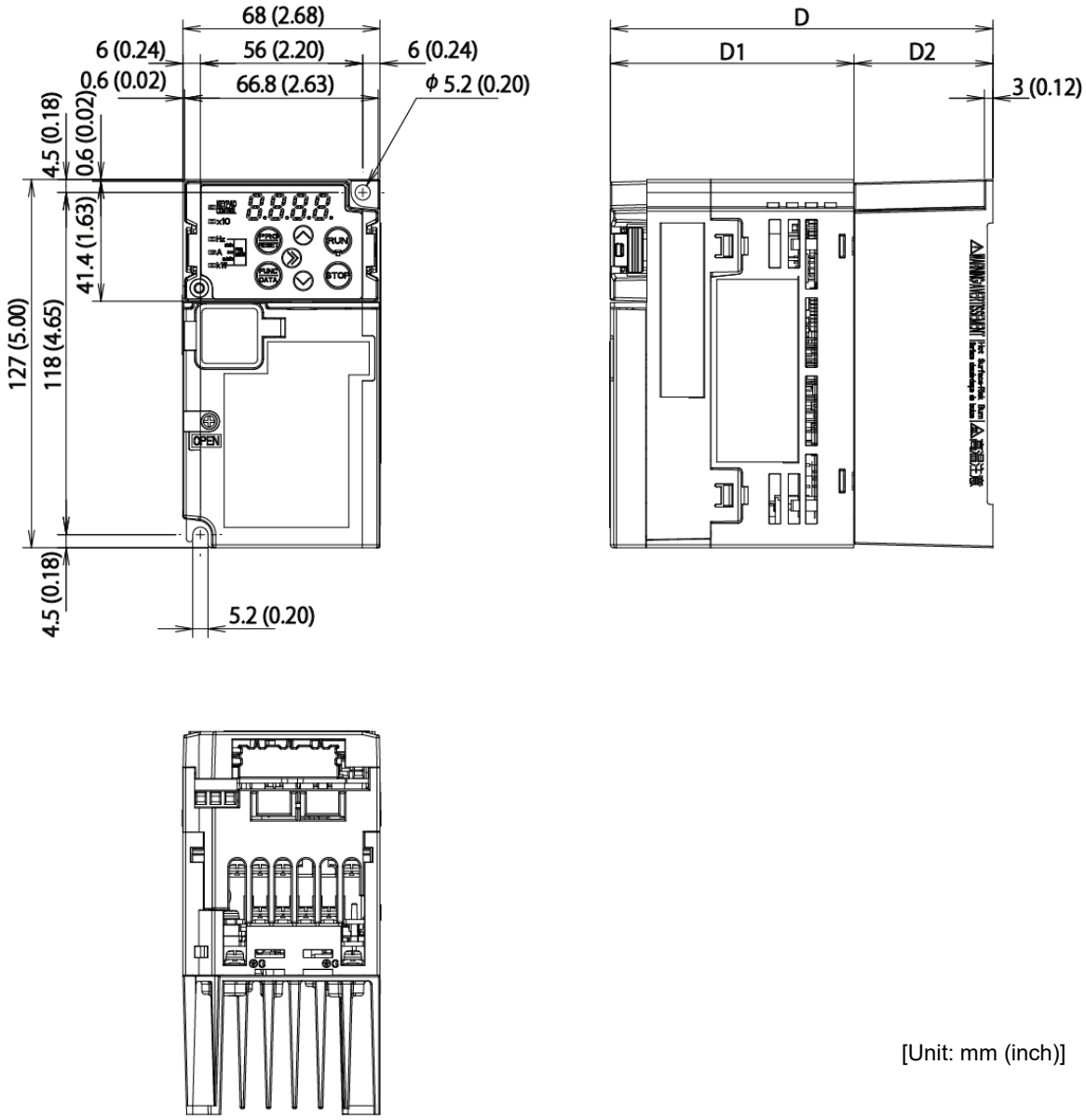
Chapter 9 EXTERNAL DIMENSIONS

This chapter describes the external dimensions of the inverter.

Contents

9.1 Standard Model (VXT-69A-2, VXT-44A-4, VXT-11A-1 or below) ····· 9-1
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9.3 Keypad ····· 9-16

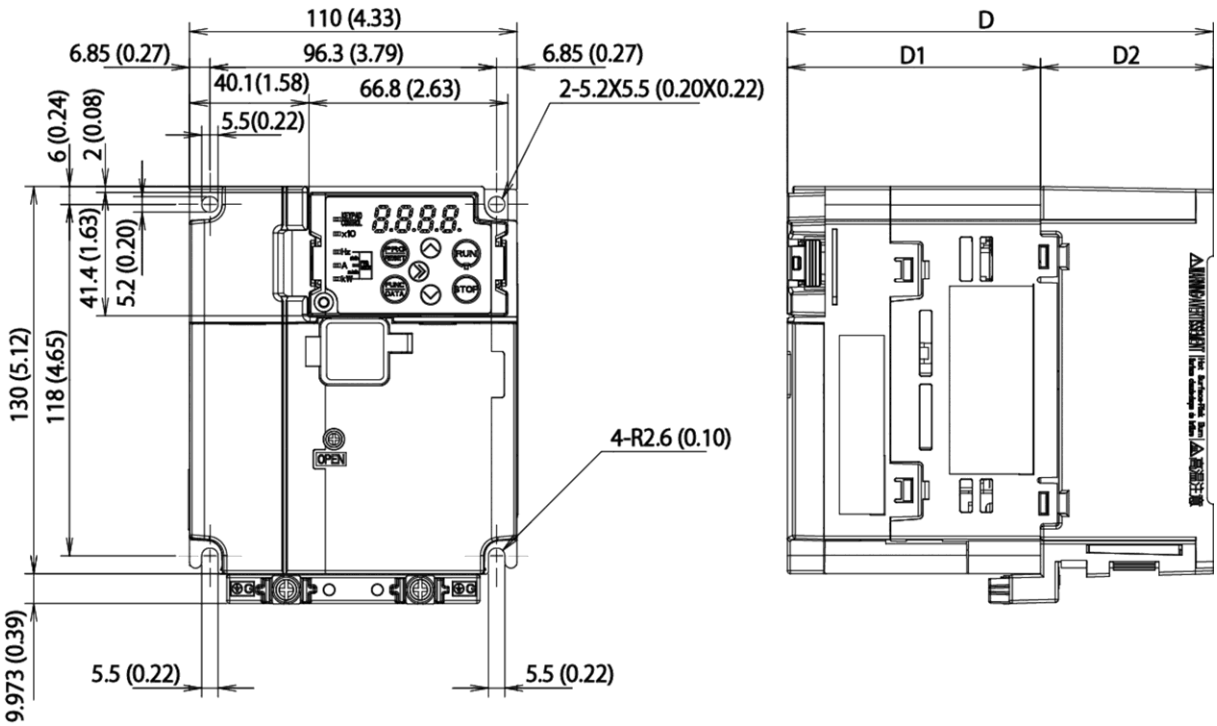
9.1 Standard Model



[Unit: mm (inch)]

Figure 9.1-1

Power supply voltage	Inverter type	Dimension [mm (inch)]		
		D	D1	D2
Three-phase 200V	VXT-4A-2	100 (3.94)	77 (3.03)	23 (0.91)
	VXT-6A-2	132 (5.20)	84 (3.31)	48 (1.89)
Single-phase 200V	VXT-3A-1	107 (4.21)	84 (3.31)	23 (0.91)
	VXT-5A-1	152 (5.98)	104 (4.09)	48 (1.89)



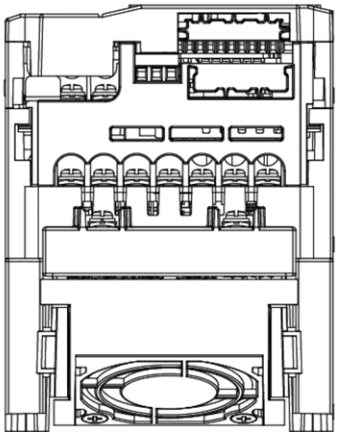
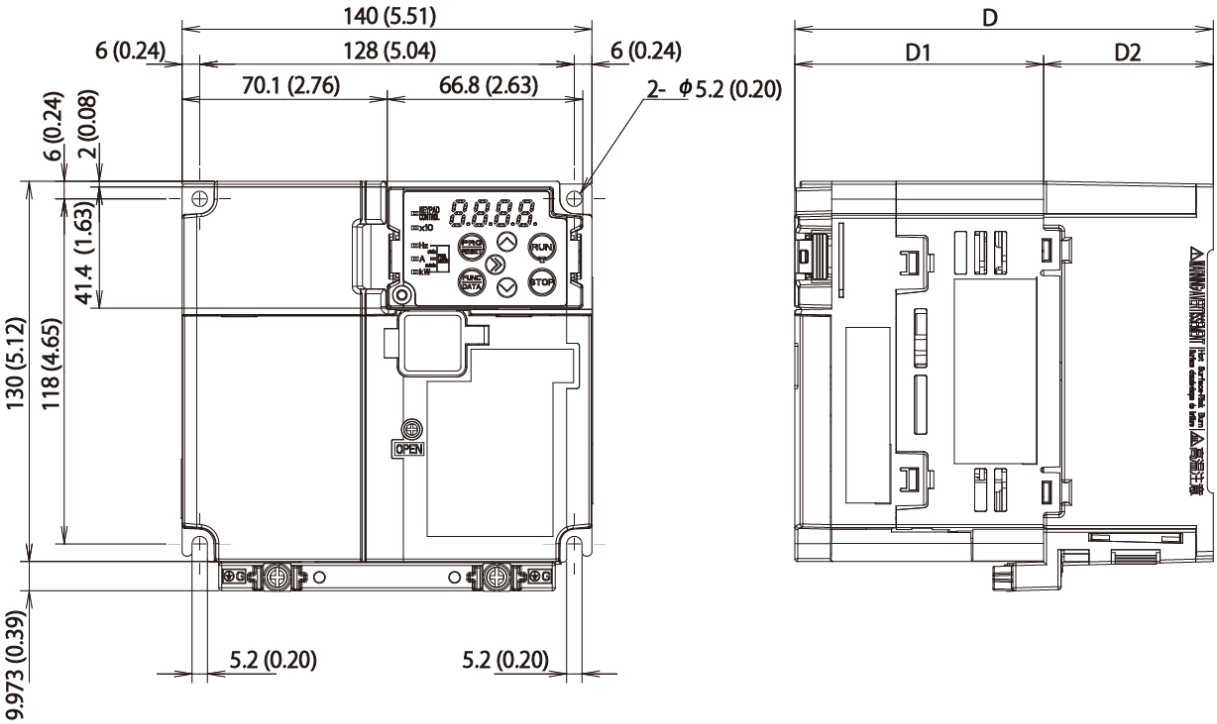


Figure 9.1-2

Power supply voltage	Inverter type	Dimension [mm (inch)]		
		D	D1	D2
Three-phase 200V	VXT-10A-2	143 (5.63)	85 (3.35)	58 (2.28)
	VXT-12A-2	143 (5.63)	85 (3.35)	58 (2.28)
Three-phase 400V	VXT-2A-4	119 (4.69)	85 (3.35)	34 (1.34)
	VXT-4A-4	143 (5.63)	85 (3.35)	58 (2.28)
	VXT-6A-4	143 (5.63)	85 (3.35)	58 (2.28)
	VXT-7A-4	143 (5.63)	85 (3.35)	58 (2.28)
Single-phase 200V	VXT-8A-1	153 (6.02)	95 (3.74)	58 (2.28)



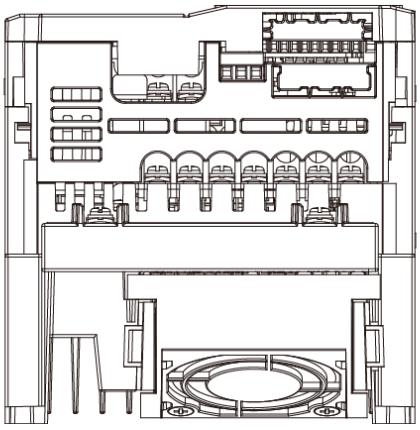


Figure 9.1-3

Power supply voltage	Inverter type	Dimension [mm (inch)]		
		D	D1	D2
Three-phase 200V	VXT-20A-2	143 (5.63)	85 (3.35)	58 (2.28)
Three-phase 400V	VXT-12A-4	143 (5.63)	85 (3.35)	58 (2.28)
Single-phase 200V	VXT-11A-1	143 (5.63)	85 (3.35)	58 (2.28)

* The figure given in the lower right-hand corner of each set of drawings shows the dimension of panel cutting required for external cooling. To employ external cooling for inverters VXT-30A-2 to VXT-115A-2/2E and VXT-22A-4 to VXT-72A-4/4E, the optional mounting adapter for external cooling is required.

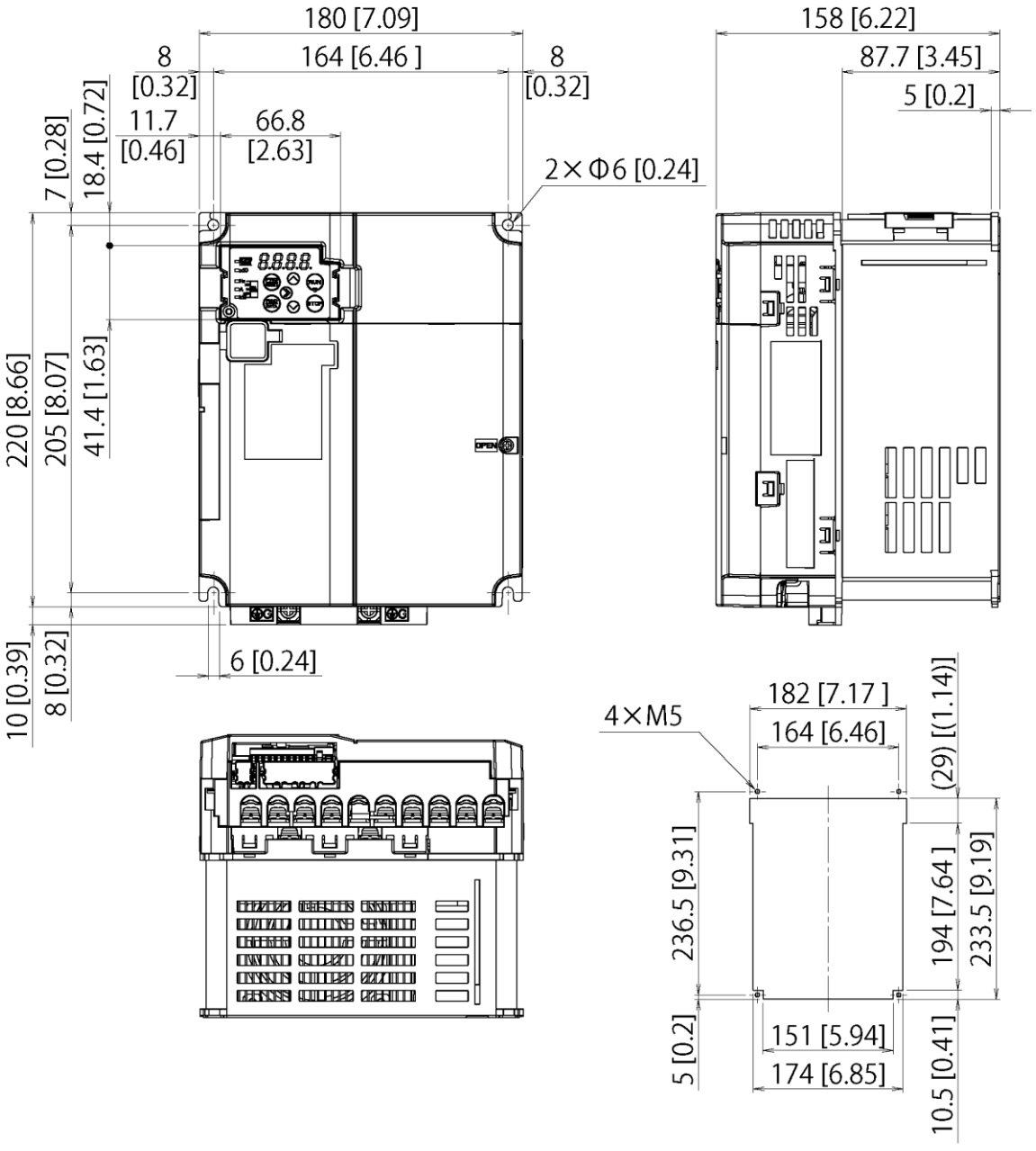
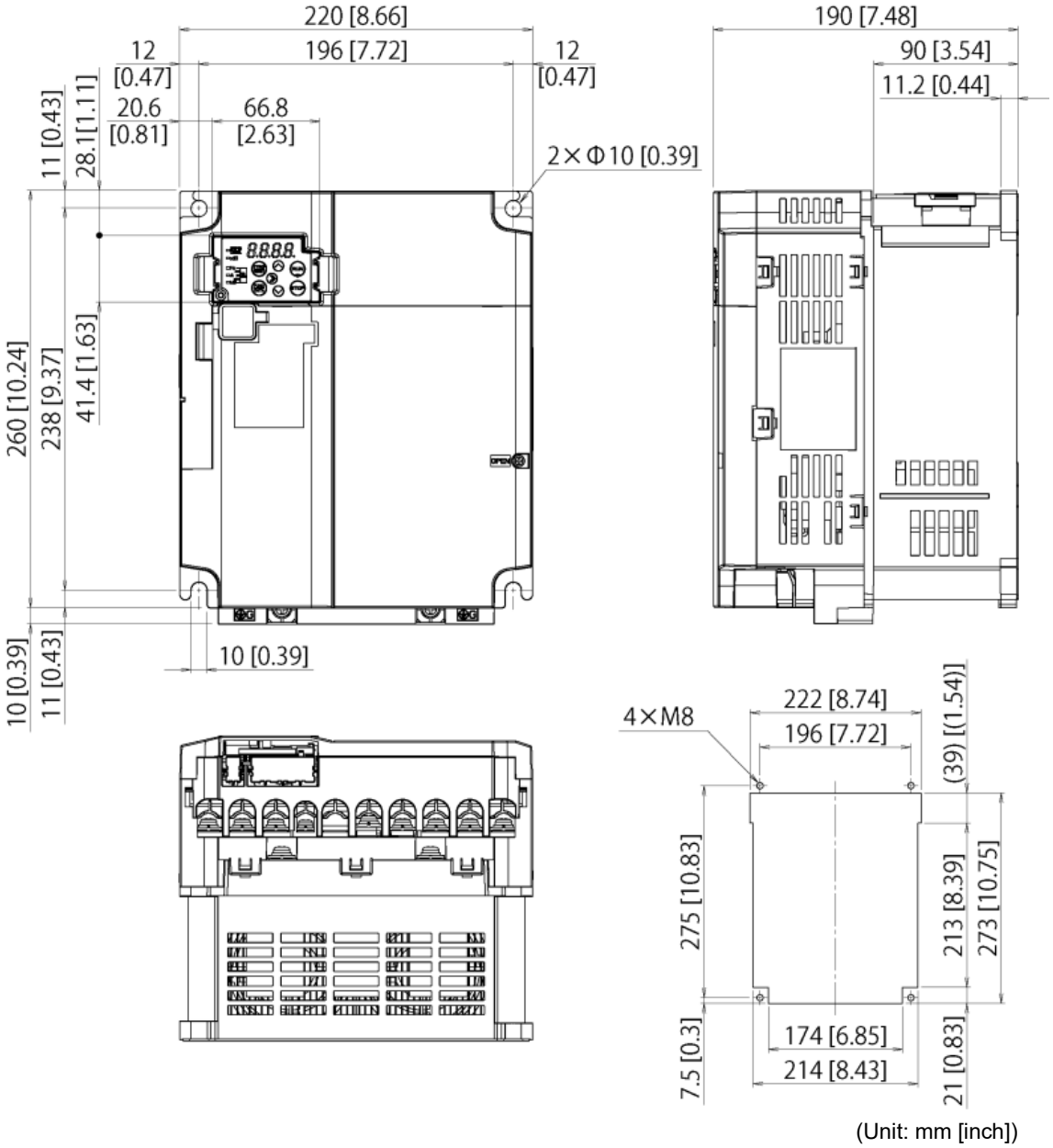


Figure 9.1-4

(Unit: mm [inch])

Power supply voltage	Inverter type
Three-phase 200V	VXT-30A-2
	VXT-40A-2
Three-phase 400V	VXT-22A-4
	VXT-29A-4

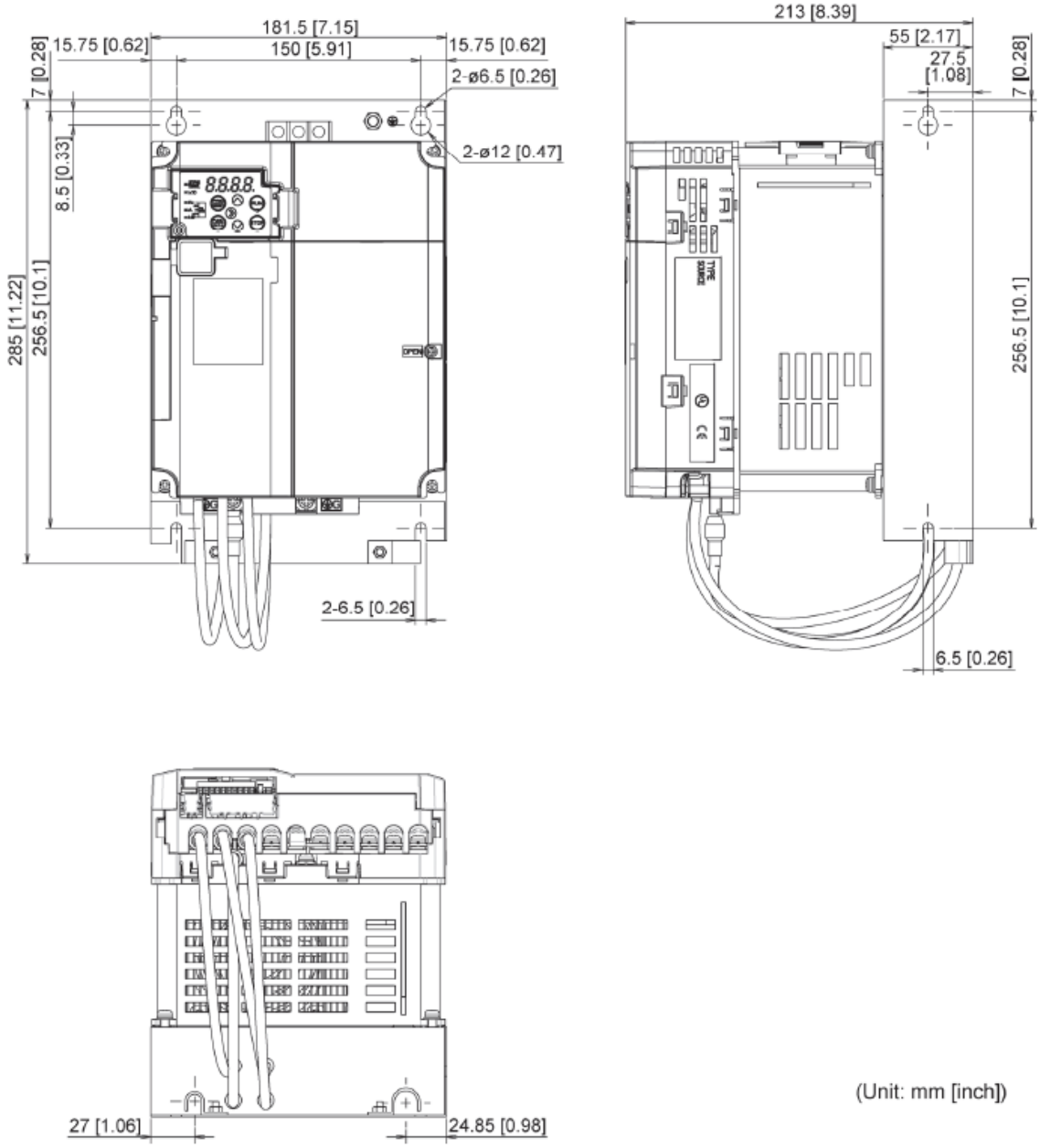


(Unit: mm [inch])

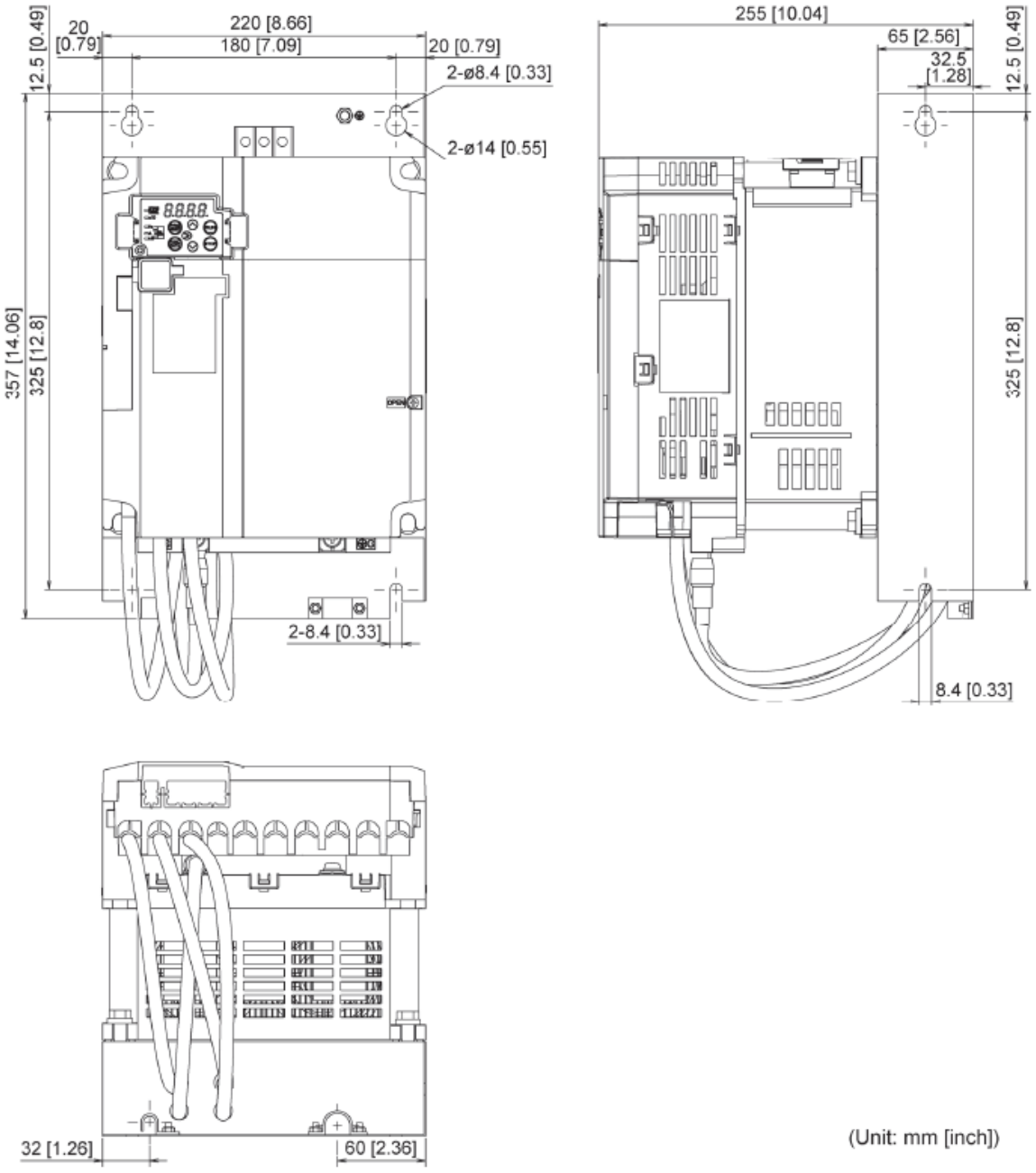
Figure 9.1-5

Power supply voltage	Inverter type
Three-phase 200V	VXT-56A-2
	VXT-69A-2
Three-phase 400V	VXT-37A-4
	VXT-44A-4

9.2 Standard / EMC Filter Built-in Type

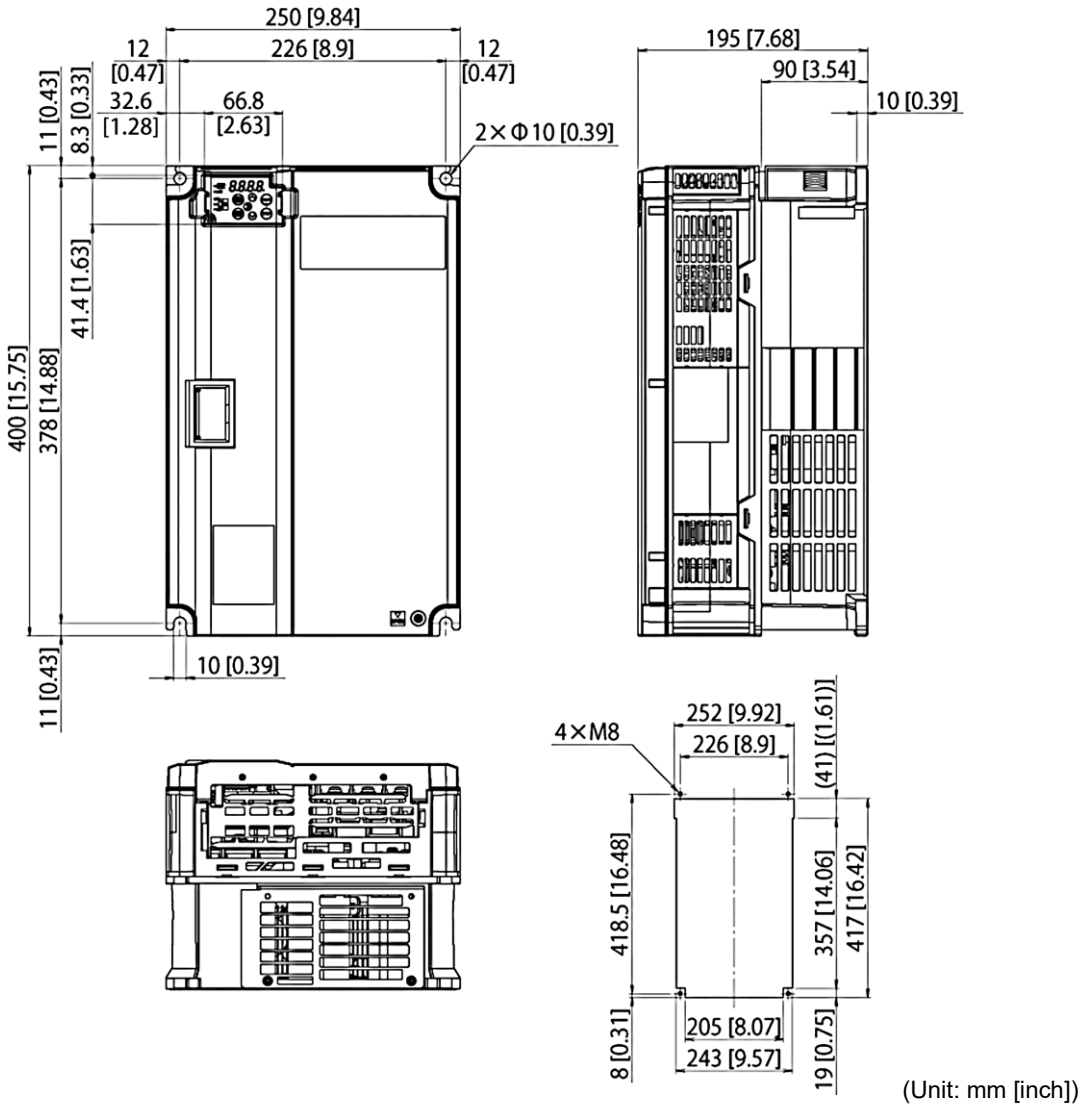


Power supply voltage	Model	Inverter type
Three-phase 400V	EMC-filter built in type	VXT-22A-4E
		VXT-29A-4E



(Unit: mm [inch])

Power supply voltage	Model	Inverter type
Three-phase 400V	EMC-filter built in type	VXT-37A-4E
		VXT-44A-4E



(Unit: mm [inch])

Figure 9.2-1

Power supply voltage	Model	Inverter type
Three-phase 200V	Standard model	VXT-88A-2
		VXT-115A-2
	EMC-filter built in type	VXT-88A-2E
		VXT-115A-2E
Three-phase 400V	Standard model	VXT-59A-4
		VXT-72A-4
	EMC-filter built in type	VXT-59A-4E
		VXT-72A-4E

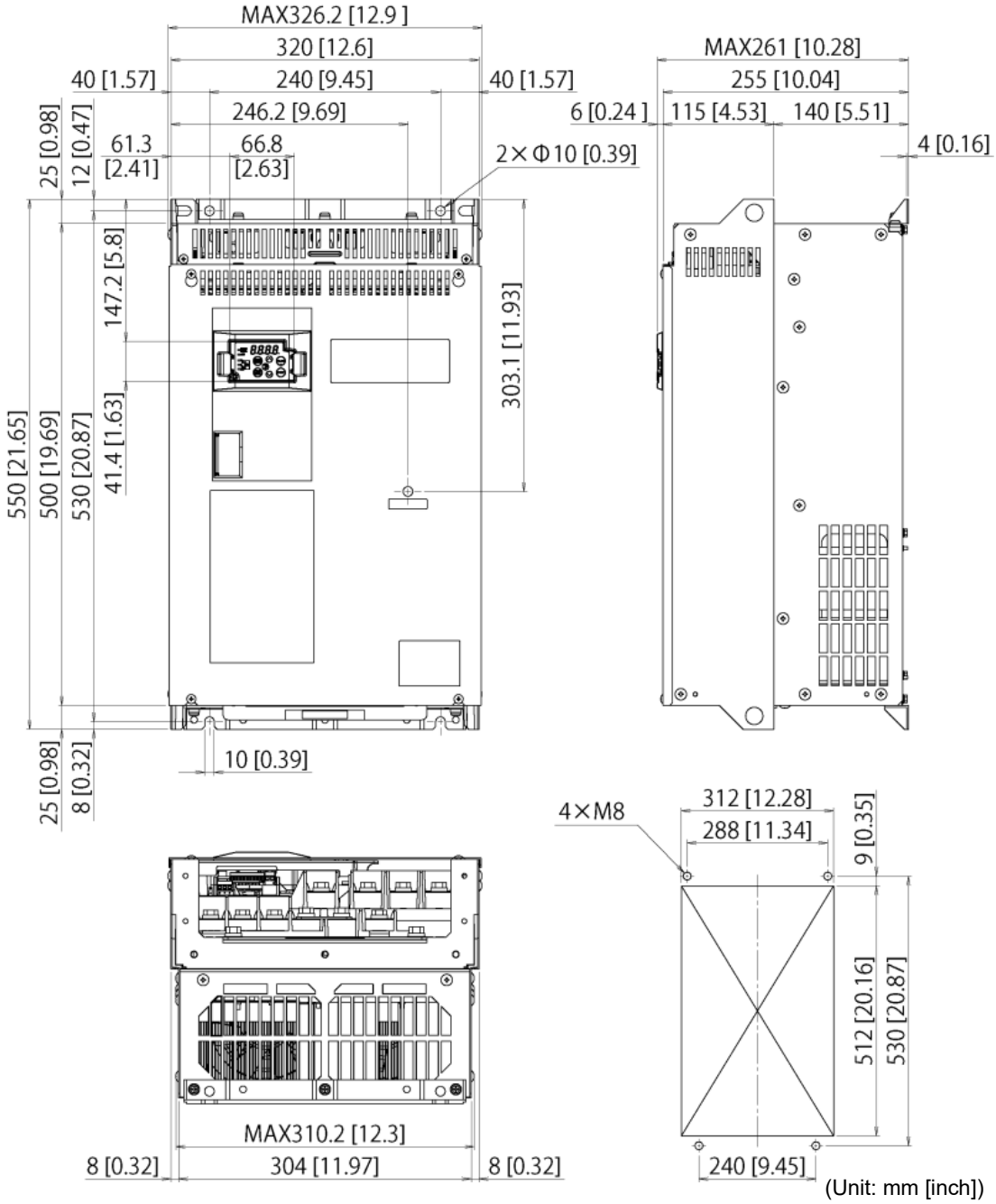
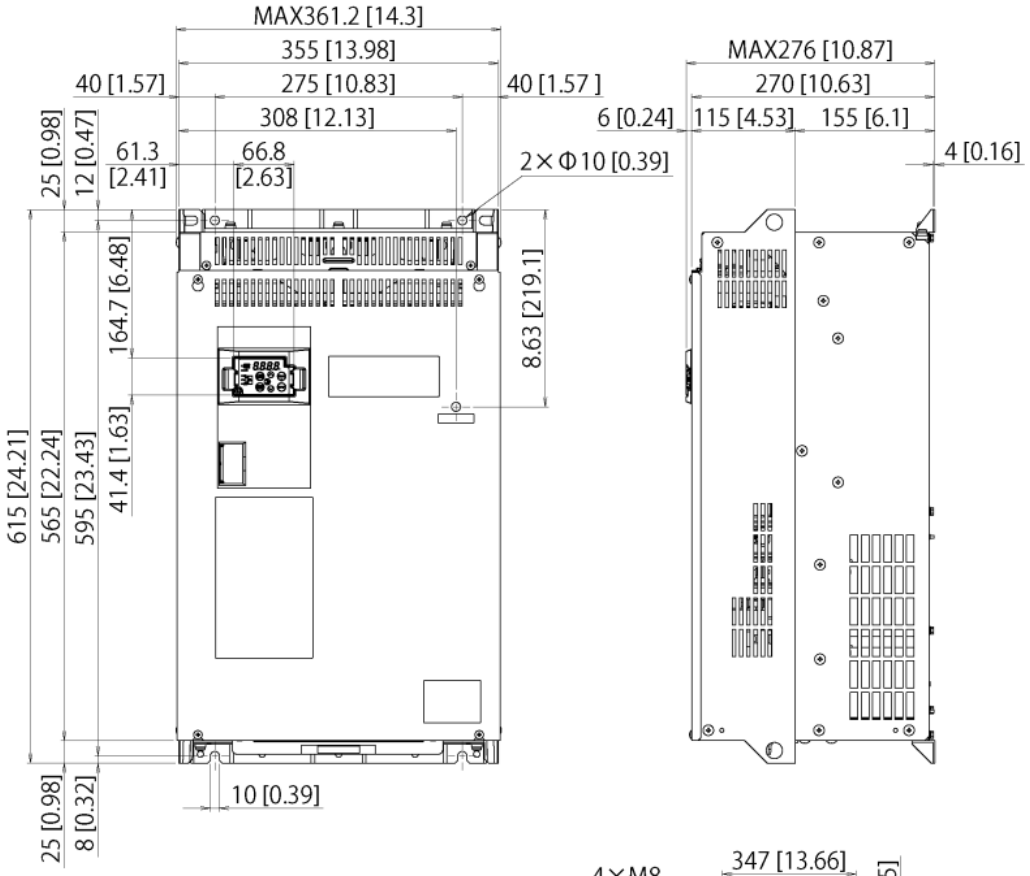


Figure 9.2-2

Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-85A-4
		VXT-105A-4
	EMC-filter built in type	VXT-85A-4E
		VXT-105A-4E



(Unit: mm [inch])

Figure 9.2-3

Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-139A-4
	EMC-filter built in type	VXT-139A-4E

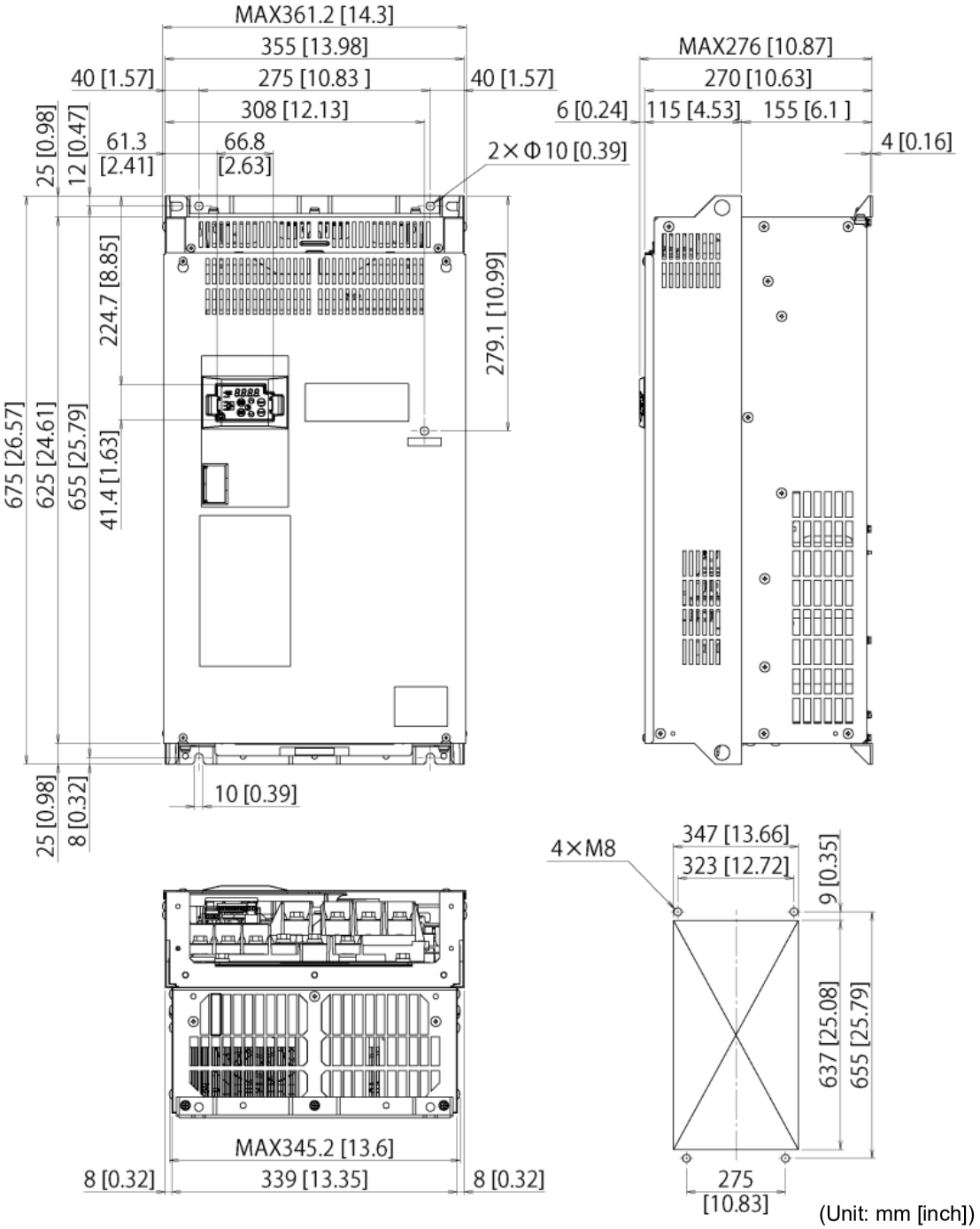
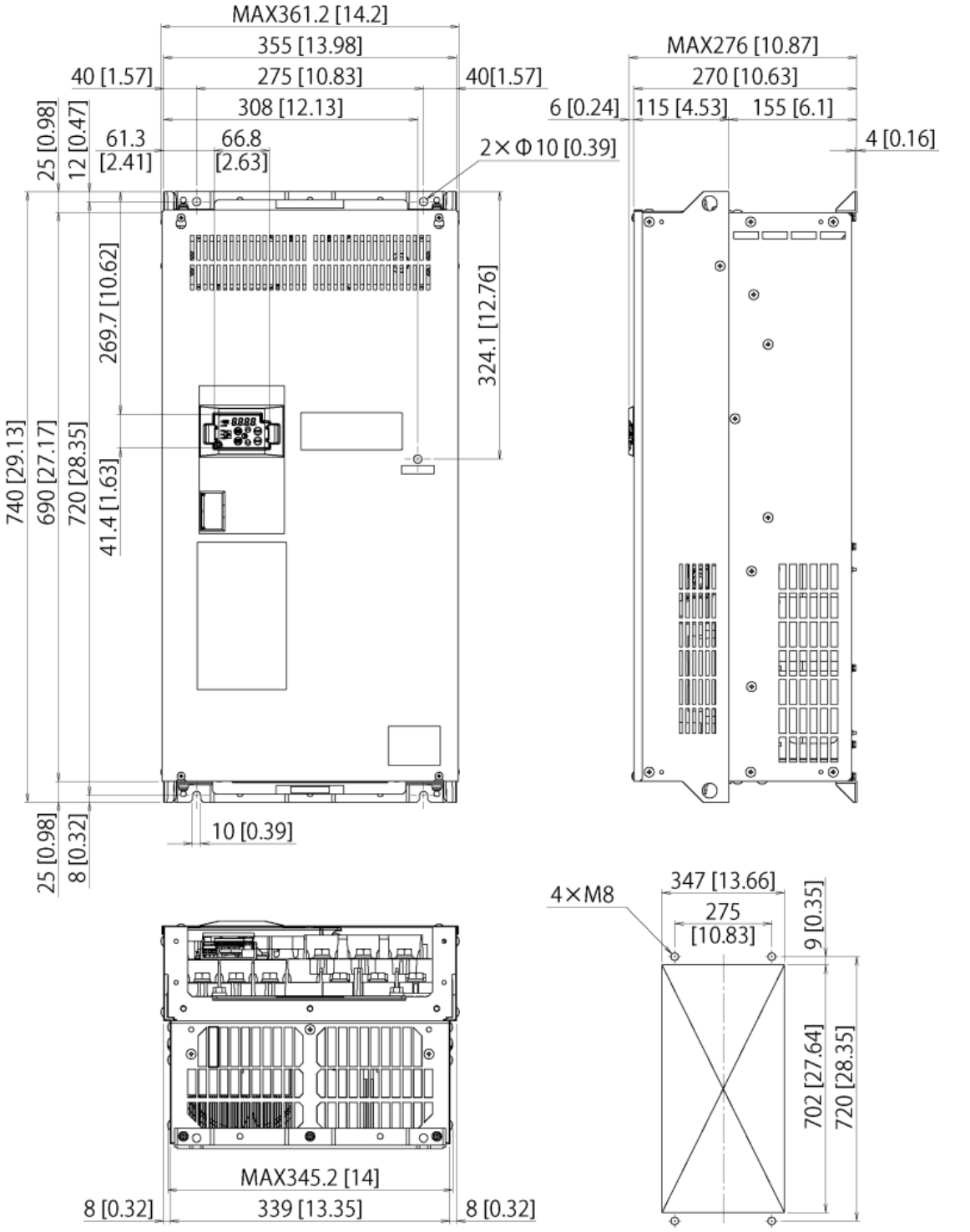


Figure 9.2-4

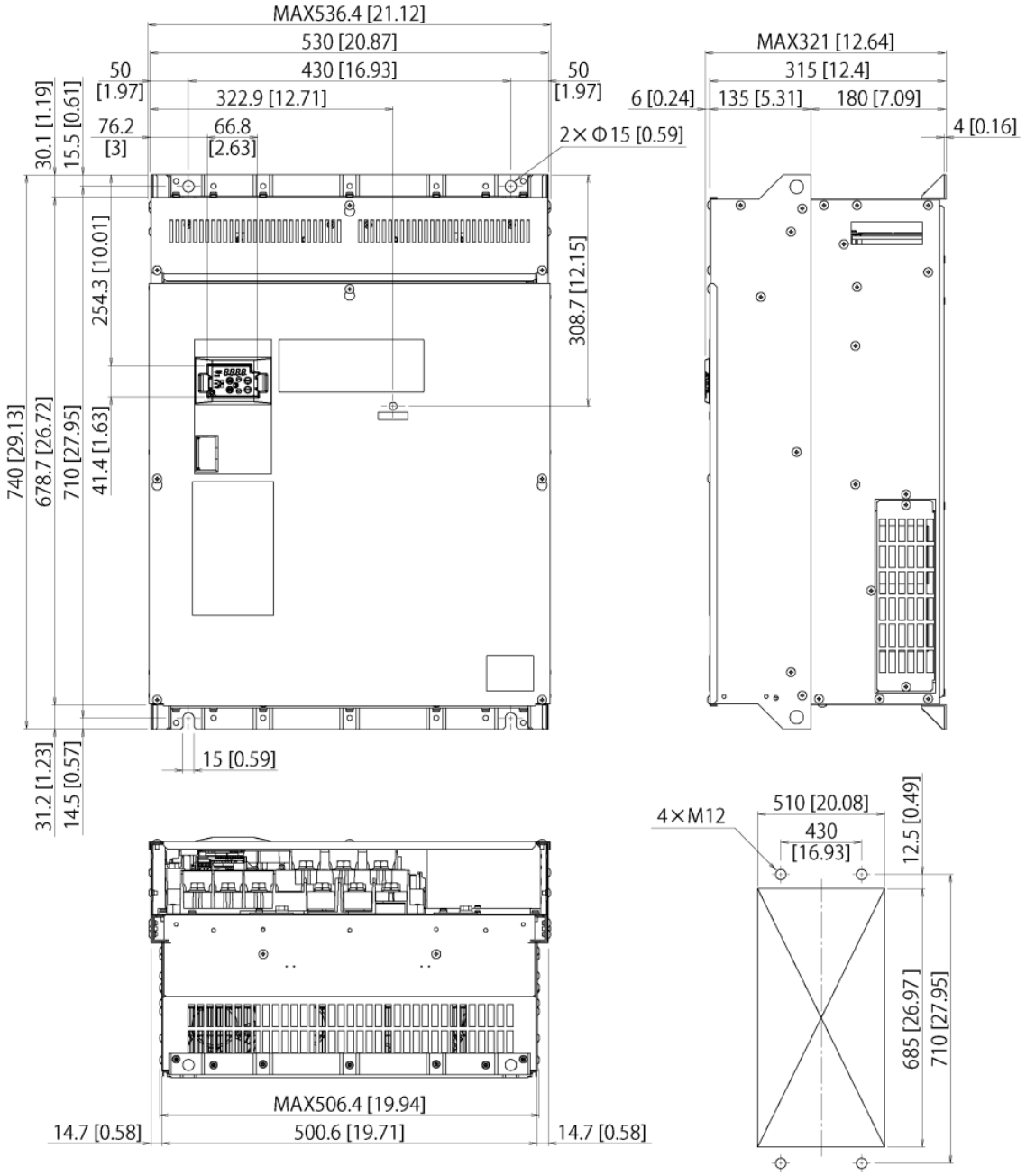
Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-168A-4
	EMC-filter built in type	VXT-168-4E



(Unit: mm [inch])

Figure 9.2-5

Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-203A-4
	EMC-filter built in type	VXT-203A-4E



(Unit: mm [inch])

Figure 9.2-6

Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-290A-4
		VXT-290A-4
	EMC-filter built in type	VXT-240A-4E
		VXT-290A-4E

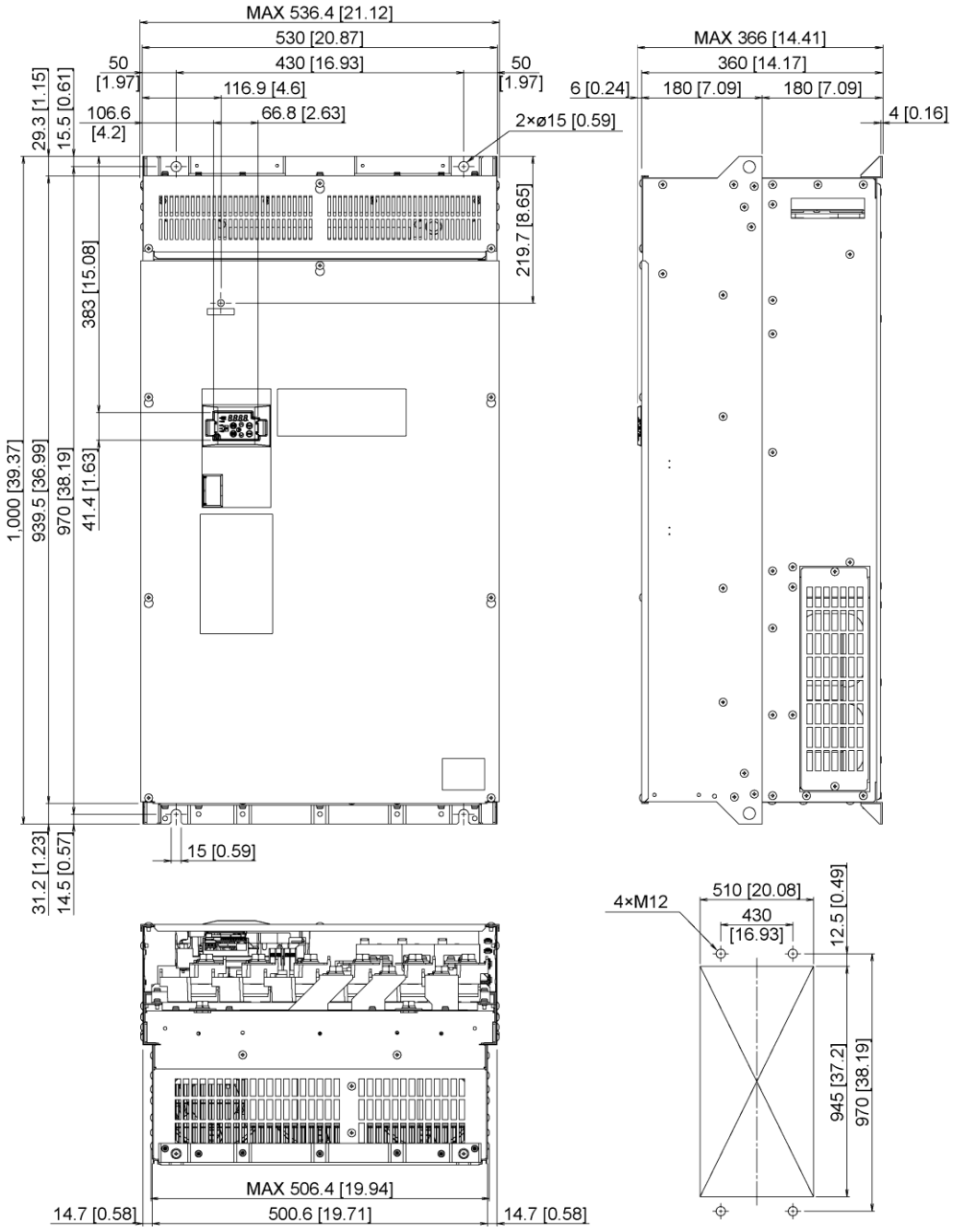
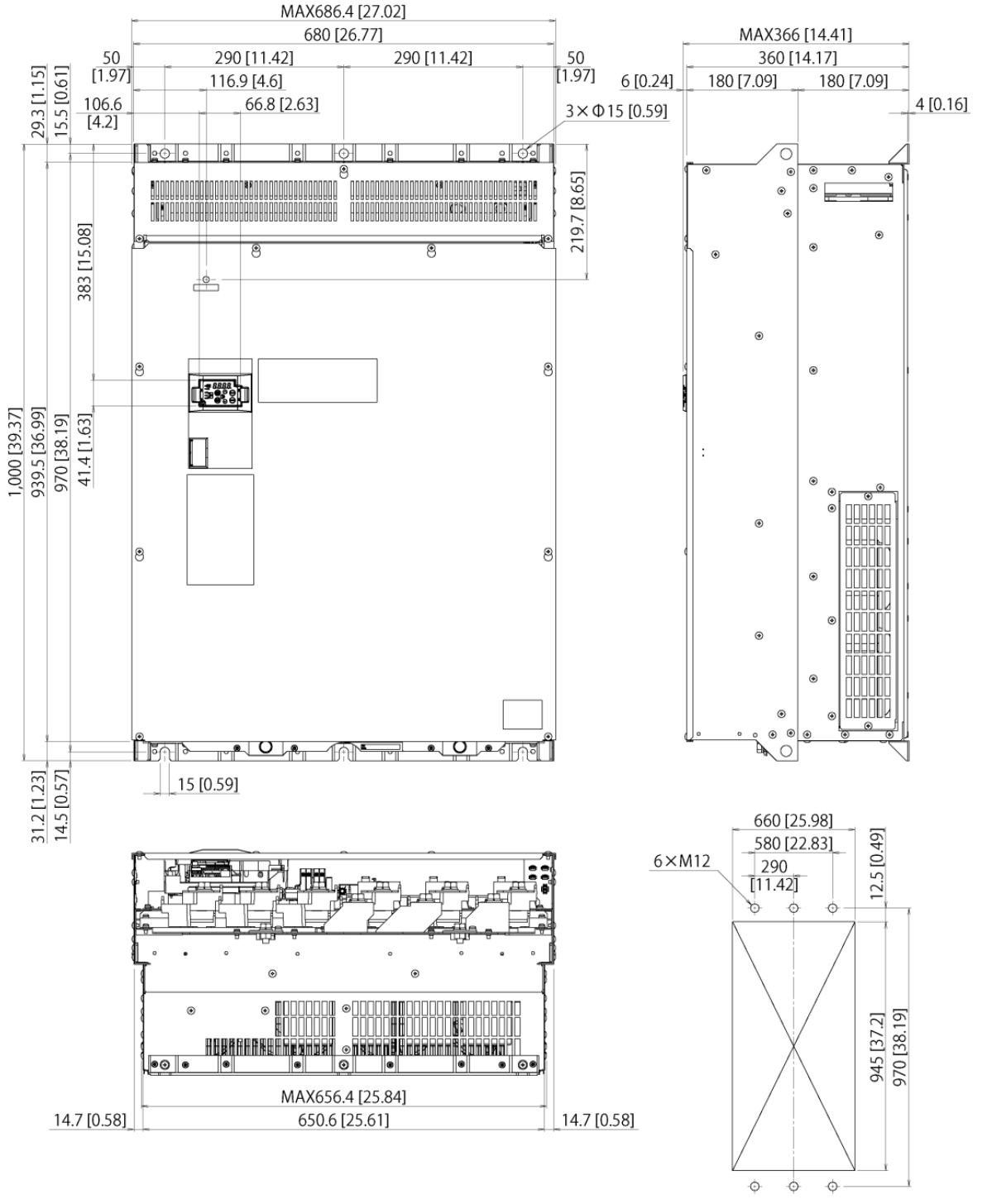


Figure 9.2-7

(Unit: mm [inch])

Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-361A-4
		VXT-415A-4
	EMC-filter built in type	VXT-361A-4E
		VXT-415A-4E



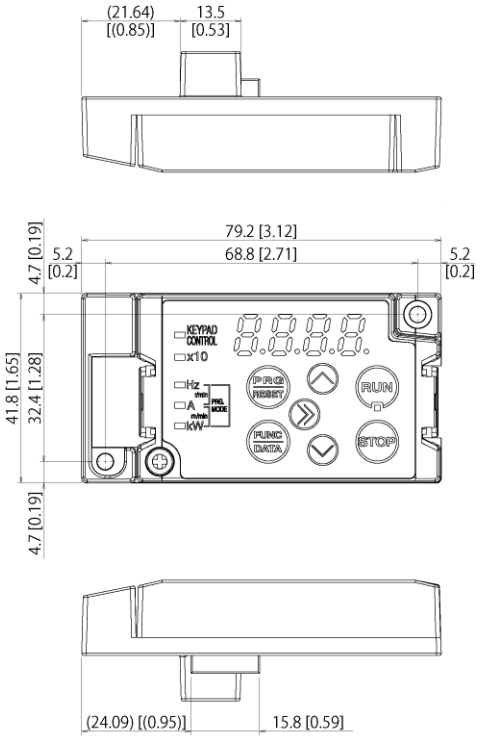
(Unit: mm [inch])

Figure 9.2-8

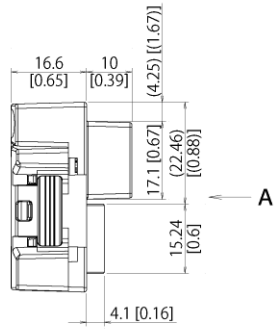
Power supply voltage	Model	Inverter type
Three-phase 400V	Standard model	VXT-520A-4
		VXT-590A-4
	EMC-filter built in type	VXT-520A-4E
		VXT-590A-4E

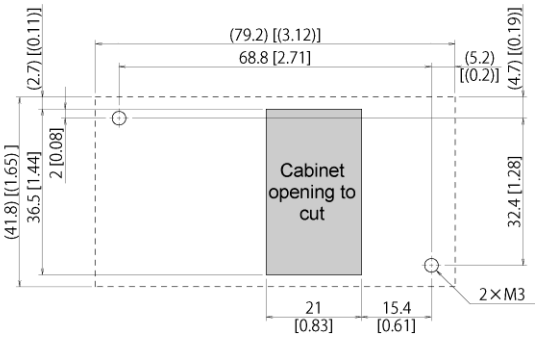
9.3 Keypad

(Unit: mm [inch])



When operating the keypad at remote location or mounting it in a panel (Keypad rear cover attached)





Cabinet cut dimensions (arrow A)

Dimensions of panel cutting (viewed from arrow “A”)

High Performance Inverter.

Jaguar VXT

Instruction Manual

1st Edition, Jan 2016

IMO Precision Controls Ltd

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the JAGUAR VXT series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event, will IMO Precision Controls Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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2017-02 S.Mc (Issue 2)