Sumitomo Heavy Industries, ltd.
POWER TRANSMISSION & CONTROLS GROUP
5-9-11, KITA-SHINAGAWA SHINAGAWA-KU, TOKYO 141-8686, JAPAN
PHONE: (03)5488-8363 FAX: (03)5488-8365
TELEX: J24580 SUMIJUKA
Home page http://www.shi.co.jp/ptc/

DM2001E-1.0 2004.9

HF-320α Operating and Maintenance Manual Sumitomo Heavy Industries, ltd.

Sumitomo Drive Technologies
Always on the Move

HF-320α Series

Single phase input 200V class 0.2~2.2kW
Three phase input 200V class 0.2~7.5kW
Three phase input 400V class 0.4~7.5kW

NOTICE

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

Operating and Maintenance Manual | DM2001E-1.0

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I. Safety precautions

The items described in these instructions and on the inverter itself are very important so that you can use the inverter safely prevent injury to yourself and other people around you as well as prevent damage to property in the area. Thoroughly familiarize yourself with the symbols and indications shown below and then continue to read the manual. Make sure that you observe all warnings given.

Explanation of markings

Marking	Meaning of marking
Danger	Indicates that errors in operation may lead to death or serious injury.
Warning	Indicates that errors in operation may lead to injury (*1) to people or that these errors may cause damage to physical property. (*2)

(*1) Such things as injury, burns or shock that will not require hospitalization or long periods of outpatient treatment.

(*2) Physical property damage refers to wide-ranging damage to assets and materials.

Meanings of symbols

Marking	Meaning of marking
	Indicates prohibition (Don't do it). What is prohibited will be described in or near the symbol in either text or picture form.
	Indicates something mandatory (must be done). What is mandatory will be described in or near the symbol in either text or picture form.
	Indicates danger. What is dangerous will be described in or near the symbol in either text or picture form.
	Indicates warning. What the warning should be applied to will be described in or near the symbol in either text or picture form.

■ Limits in purpose

This inverter is used for controlling speeds of three-phase induction motors in general industrial use.

Safety precautions

- The inverter cannot be used in any device that would present danger to the human body or from which malfunction or error in operation would present a direct threat to human life (nuclear power control device, aviation and space flight control device, traffic device, life support or operation system, safety device, etc.). If the inverter is to be used for any special purpose, first get in touch with the people in charge of sales.
- This product was manufactured under the strictest quality controls but if it is to be used in critical equipment, for example, equipment in which errors in malfunctioning signal output system would cause a major accident, safety devices must be installed on the equipment.
- Do not use the inverter for loads other than those of properly applied three-phase induction motors in general industrial use. (Use in other than properly applied three-phase induction motors may cause an accident.)

■ General Operation

Danger		See item
 Disassembly prohibited	• Never disassemble, modify or repair. This can result in electric shock, fire and injury. For repairs, call your sales agency.	2.
 Prohibited	• Never remove the front cover when power is on or open door if enclosed in a cabinet. The unit contains many high voltage parts and contact with them will result in electric shock. • Don't stick your fingers into openings such as cable wiring hole and cooling fan covers. This can result in electric shock or other injury. • Don't place or insert any kind of object into the inverter (electrical wire cuttings, rods, wires). This can result in electric shock or fire. • Do not allow water or any other fluid to come in contact with the inverter. This can result in electric shock or fire.	2.1 2. 2. 2.
 Mandatory	• Turn power on only after attaching the front cover or closing door if enclosed in a cabinet. If power is turned on without the front cover attached or closing door if enclosed in a cabinet. This can result in electric shock or other injury. • If the inverter begins to emit smoke or an unusual odor, or unusual sounds, immediately turn power off. If the equipment is continued in operation in such a state, the result may be fire. Call your local sales agency for repairs. • Always turn power off if the inverter is not used for long periods of time since there is a possibility of malfunction caused by leaks, dust and other material. If power is left on with the inverter in that state, it may result in fire.	2.1 3. 3.

Warning		See item
 Prohibited contact	• Do not touch heat radiating fins or discharge resistors. These device are hot, and you'll get burned if you touch them.	3.
 Prohibited	• Avoid operation in any location where there is direct spraying of the following solvents or other chemicals. The plastic parts may be damaged to a certain degree depending on their shape, and there is a possibility of the plastic covers coming off and the plastic units being dropped. If the chemical or solvent is anything other than those shown below, please contact us in advance. (Table 1) Examples of applicable chemicals and solvents Acetic acid (density of 10% or less) Hydrochloric acid (density of 10% or less) Sulfuric acid (density of 10% or less) Sodium chloride Hexane Triethylene glycol (Table 2) Examples of unapplicable chemicals and solvents Acetone Benzene Chloroform Ethylene chloride Ethyl acetate Glycerin Tetrachloroethylene Trichloroethylene Xylene	1.4.4

■ Transportation & installation

Danger		See item
Prohibited	• Do not install or operate the inverter if it is damaged or any component is missing. This can result in electric shock or fire. Please consult your local sales agency for repairs. Call your local sales agency for repairs.	1.4.4
	• Do not place any inflammable objects nearby. If a flame is emitted due to malfunction, it may result in a fire.	1.4.4
	• Do not install in any location where the inverter could come into contact with water or other fluids. This can result in electric shock or fire.	2.
Mandatory	• Must be used in the environmental conditions prescribed in the instruction manual. Use under any other conditions may result in malfunction.	1.4.4
	• Mount the inverter on a metal plate. The rear panel gets very hot. If installation is in an inflammable object, this can result in fire.	1.4.4
	• Do not operate with the front panel cover removed. This can result in electric shock. Failure to do so can lead to risk of electric shock and can result in death or serious injury.	1.4.4
	• An emergency stop device must be installed that fits with system specifications (e.g. shut off input power then engage mechanical brake). Operation cannot be stopped immediately by the inverter alone, thus risking an accident or injury.	1.4.4
	• All options used must be those specified by Sumitomo. The use of any other option may result in an accident.	1.4.4

Warning		See item
Prohibited	• When transporting or carrying, do not hold by the front panel covers. The covers may come off and the unit will drop out resulting in injury.	2.
	• Do not install in any area where the unit would be subject to large amounts of vibration. That could result in the unit falling, resulting in injury.	1.4.4
Mandatory	• The main unit must be installed on a base that can bear the unit's weight. If the unit is installed on a base that cannot withstand that weight, the unit may fall resulting in injury.	1.4.4
	• If braking is necessary (to hold motor shaft), install a mechanical brake. The brake on the inverter will not function as a mechanical hold, and if used for that purpose, injury may result.	1.4.4

■ Wiring

Danger		See item
Prohibited	• Do not connect input power to the output (motor side) terminals (U/T1,V/T2,W/T3). That will destroy the inverter and may result in fire.	2.2
	• Do not connect resistors to the DC terminals (across P(+)-N(-) or P1-N(-)). That may cause a fire. Connect a resistor in accordance with 6.13.4.	2.2
	• Within ten minutes after turning off input power, do not touch wires of devices (MCCB) connected to the input side of the inverter. That could result in electric shock.	2.2

Danger		See item
Mandatory	• Electrical construction work must be done by a qualified expert. Connection of input power by someone who does not have that expert knowledge may result in fire or electric shock.	2.1
	• Connect output terminals (motor side) correctly. If the phase sequence is incorrect, the motor will operate in reverse and that may result in injury.	2.1
	• Wiring must be done after installation. If wiring is done prior to installation that may result in injury or electric shock	2.1
	• The following steps must be performed before wiring. (1) Turn off all input power. (2) Wait at least ten minutes and check to make sure that the charge lamp is no longer lit. (3) Use a tester that can measure DC voltage (800VDC or more), and check to make sure that the voltage to the DC main circuits (across P(+)-N(-)) is 45V or less. If these steps are not properly performed, the wiring will cause electric shock.	2.1
	• Tighten the screws on the terminal board to specified torque. If the screws are not tightened to the specified torque, it may lead to fire.	2.1
	• Check to make sure that the input power voltage is +10%, -15% of the rated power voltage written on the rating label (±10% when the load is 100% in continuous operation). If the input power voltage is not +10%, -15% of the rated power voltage (±10% when the load is 100% in continuous operation) this may result in fire.	1.4.4
Be Grounded	• Ground must be connected securely. If the ground is not securely connected, it could lead to electric shock or fire when a malfunction or current leak occurs.	2.1 2.2

Warning		See item
Prohibited	• Do not attach equipment (such as noise filters or surge absorbers) that have built-in capacitors to the output (motor side) terminals. That could result in a fire.	2.1

■ Operations

Danger		See item
Prohibited	• Do not touch inverter terminals when electrical power is going to the inverter even if the motor is stopped. Touching the inverter terminals while power is connected to it may result in electric shock.	3.
	• Do not touch switches when the hands are wet and do not try to clean the inverter with a damp cloth. Such practices may result in electric shock.	3.
	• Do not go near the motor in alarm-stop status when the retry function is selected. The motor may suddenly restart and that could result in injury. Take measures for safety, e.g. attaching a cover to the motor, against accidents when the motor unexpectedly restarts.	3.
Mandatory	• Turn input power on after attaching the front cover. When storing inside the cabinet and using with the front cover removed, always close the cabinet doors first and then turn power on. If the power is turned on with the front cover or the cabinet doors open, it may result in electric shock.	3.
	• Make sure that operation signals are off before resetting the inverter after malfunction. If the inverter is reset before turning off the operating signal, the motor may restart suddenly causing injury.	3.

⚠ Warning		See item
Prohibited	• Observe all permissible operating ranges of motors and mechanical equipment. (Refer to the motor's instruction manual.) Not observing these ranges may result in injury.	3.

When sequence for restart after a momentary failure is selected (inverter)

⚠ Warning		See item
Mandatory	• Stand clear of motors and mechanical equipment. If the motor stops due to a momentary power failure, the equipment will start suddenly after power recovers. This could result in unexpected injury. • Attach warnings about sudden restart after a momentary power failure on inverters, motors and equipment for prevention of accidents in advance.	6.12.1 6.12.1

When retry function is selected (inverter)

⚠ Warning		See item
Mandatory	• Stand clear of motors and equipment. If the motor and equipment stop when the alarm is given, selection of the retry function will restart them suddenly after the specified time has elapsed. This could result in unexpected injury. • Attach warnings about sudden restart in retry function on inverters, motors and equipment for prevention of accidents in advance.	6.12.3 6.12.3

Maintenance and inspection

⚠ Danger		See item
Prohibited	• Do not replace parts. This could be a cause of electric shock, fire and bodily injury. To replace parts, call the local sales agency.	14.2
Mandatory	• The equipment must be inspected every day. If the equipment is not inspected and maintained, errors and malfunctions may not be discovered and that could result in accidents. • Before inspection, perform the following steps. (1) Turn off all input power to the inverter. (2) Wait at least ten minutes and check to make sure that the charge lamp is no longer lit. (3) Use a tester that can measure DC voltages (800VDC or more), and check to make sure that the voltage to the DC main circuits (across P(+)-N(-)) is 45V or less. If inspection is performed without performing these steps first, it could lead to electric shock.	14. 14.

Disposal

⚠ Warning		See item
Mandatory	• If you throw away the inverter, have it done by a specialist in industry waste disposal(*). If you throw away the inverter by yourself, this can result in explosion of capacitor or produce noxious gases, resulting in injury. (*) Persons who specialize in the processing of waste and known as "industrial waste product collectors and transporters" or "industrial waste disposal persons. "If the collection, transport and disposal of industrial waste is done by someone who is not licensed for that job, it is a punishable violation of the law. (Laws in regard to cleaning and processing of waste materials)	16.

Attach warning labels

Shown here are examples of warning labels to prevent, in advance, accidents in relation to inverters, motors and other equipment.

Be sure to affix the caution label where it is easily visible when selecting the auto-restart function (6.13.1) or the retry function (6.13.3).

If the inverter has been programmed for restart sequence of momentary power failure, place warning labels in a place where they can be easily seen and read.

(Example of warning label)

⚠ Warning (Functions programmed for restart)

Do not go near motors and equipment.
Motors and equipment that have stopped temporarily after momentary power failure will restart suddenly after recovery.

If the retry function has been selected, place warning labels in a location where they can be easily seen and read.

(Example of warning label)

⚠ Warning (Functions programmed for retry)

Do not go near motors and equipment.
Motors and equipment that have stopped temporarily after an alarm will restart suddenly after the specified time has elapsed.

II. Introduction

Thank you for your purchase of the Sumitomo "HF-320 α" inverter.

Please be informed that CPU version will be frequently upgraded.

■ Features

1. Built-in noise filter

1) All models in both the 200V and 400V series have a noise filter inside.
2) Compliant with European CE marking standard
3) Reduces space requirements and cuts down on time and labor needed in wiring.

2. Simple operation

1) Automatic functions (torque boost acceleration/deceleration time, function programming)
   Just by wiring the motor to the power supply allows instant operation without the need to program parameters.
2) The potentiometer dial and the RUN/STOP button allow easy operation.

3. Superior basic performance

1) 200% or more starting torque
2) Smooth operation : Reduced rotation ripple through the use of Sumitomo's unique dead-band compensation.
3) Built-in current surge suppression circuit : Can be safely connected even if power load is low.
4) Maximum 500Hz high frequency output : Optimum for use with high speed motors such as those in lumber machinery and milling machines.
5) Maximum carrier frequency : 16kHz quiet operation
   Sumitomo's unique PWM control reduces noise at low carrier.

4. Globally compatible

1) Compatible with 240V and 500V power supplies
2) Conforms to CE marking and with UL and CSA.
3) Sink/source switching of control input/output.

5. Options allow use with a wide variety of applications

- Internal communications devices (RS485, Modbus RTU, DeviceNET, LonWorks)(Under preparation)
- Extension panel/Parameter writer
- Foot-mounted type noise reduction filter (EMC directive: For class A and class B) (Under preparation)
- Other options are common to all models

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1. Read first

1.1 Check product purchase

Before using the product you have purchased, check to make sure that it is exactly what you ordered.

⚠ Warning	
Mandatory	Use an inverter that conforms to the specifications of power supply and three-phase induction motor being used. If the inverter being used does not conform to those specifications, not only will the three-phase induction motor not rotate correctly, but it may cause serious accidents through overheating and fire.

Rating label

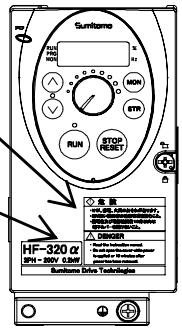
Pet name

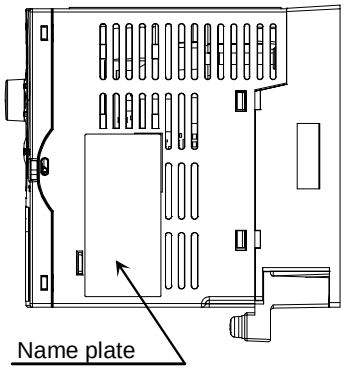
Power supply
Motor capacity

HF-320 α
1PH-200/240V-0.75kW/1HP

Inverter main unit

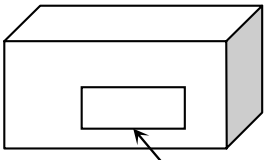
Warning label





Name plate

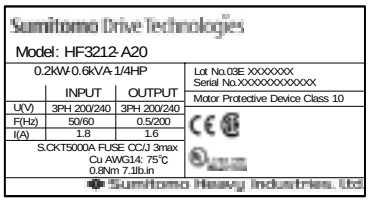
Carton box



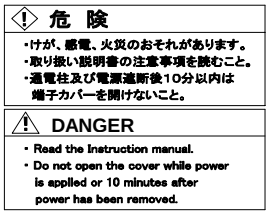
Type indication label

Name plate

Inverter Type
Inverter rated output capacity
Power supply
Related input current
Related output current

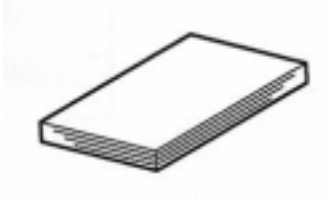


Warning label



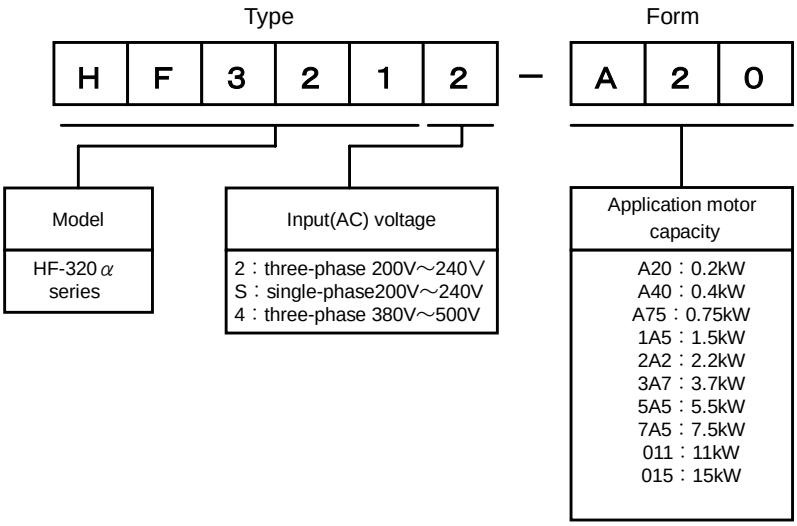
Instrucution manual

This manual



1.2 Contents of the product

Here is explained the type and form written on the label.

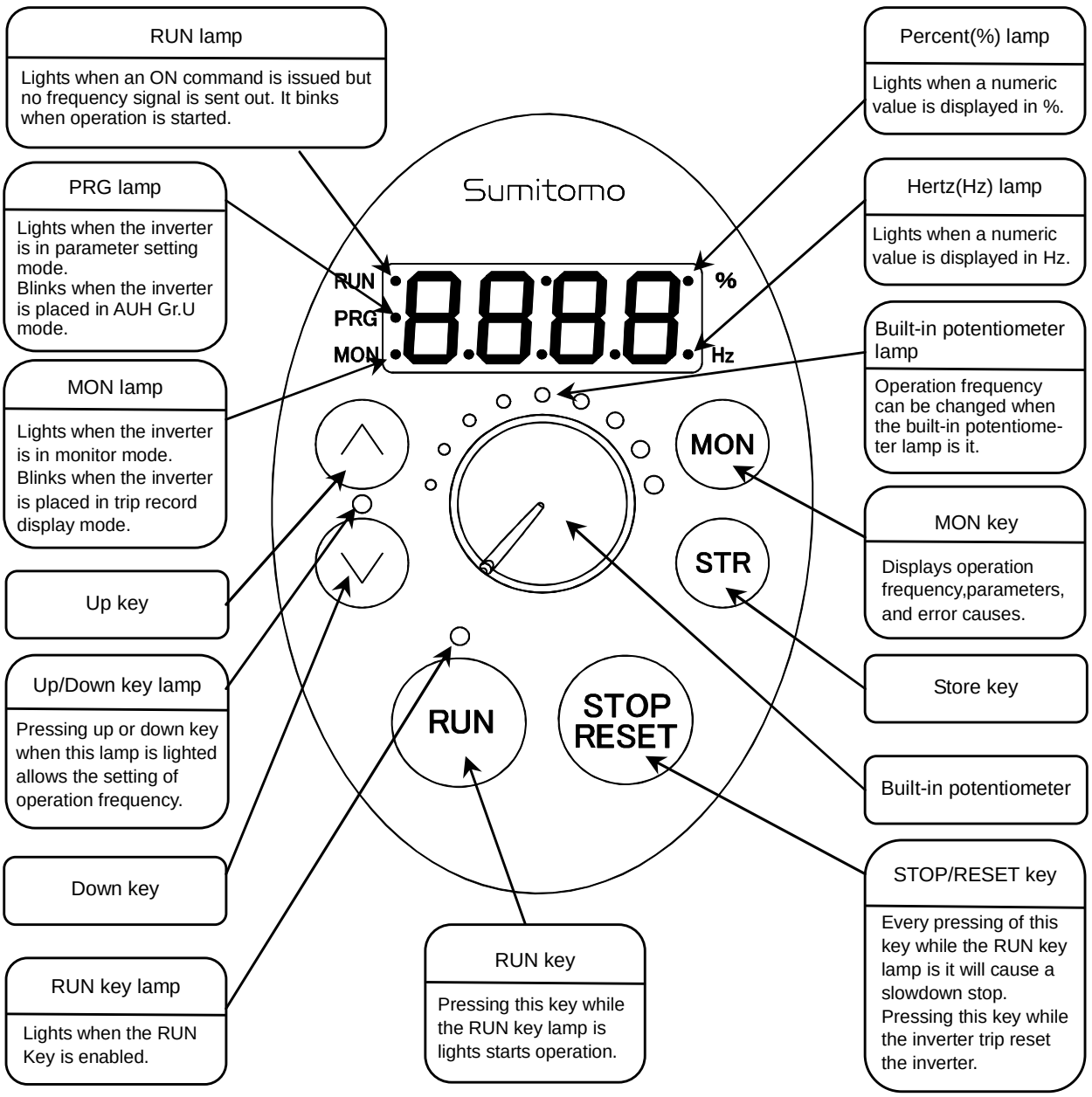


* You can switch from one input/output logic to the other using slide switch SW1. (See 2.3.2)

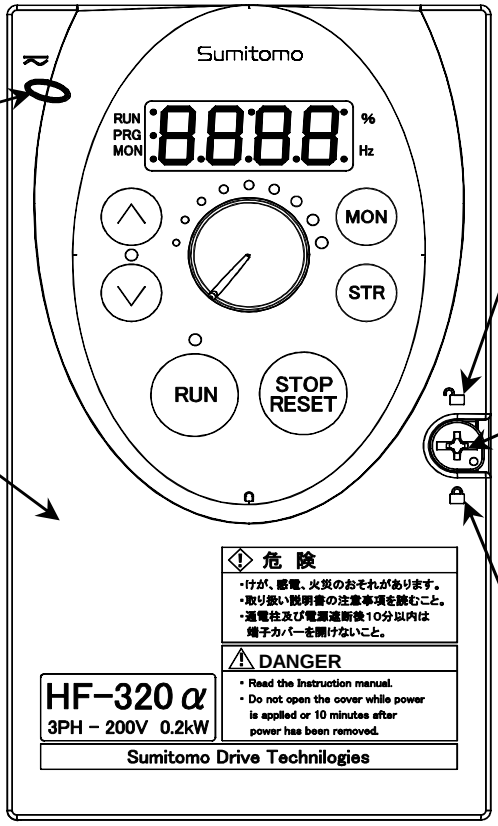
Warning: Always shut power off first then check the ratings label of inverter held in a cabinet.

1.3 Names and functions

1.3.1 Outside view



[Front panel 1]



Charge lamp

Indicates that high voltage is still present within the inverter. Do not open the terminal board cover while this is lit.

Front panel

The front panel of the inverter or terminal board
To avoid touching the terminal board by mistake, be sure to close the front panel before starting operation.

Unlock position mark

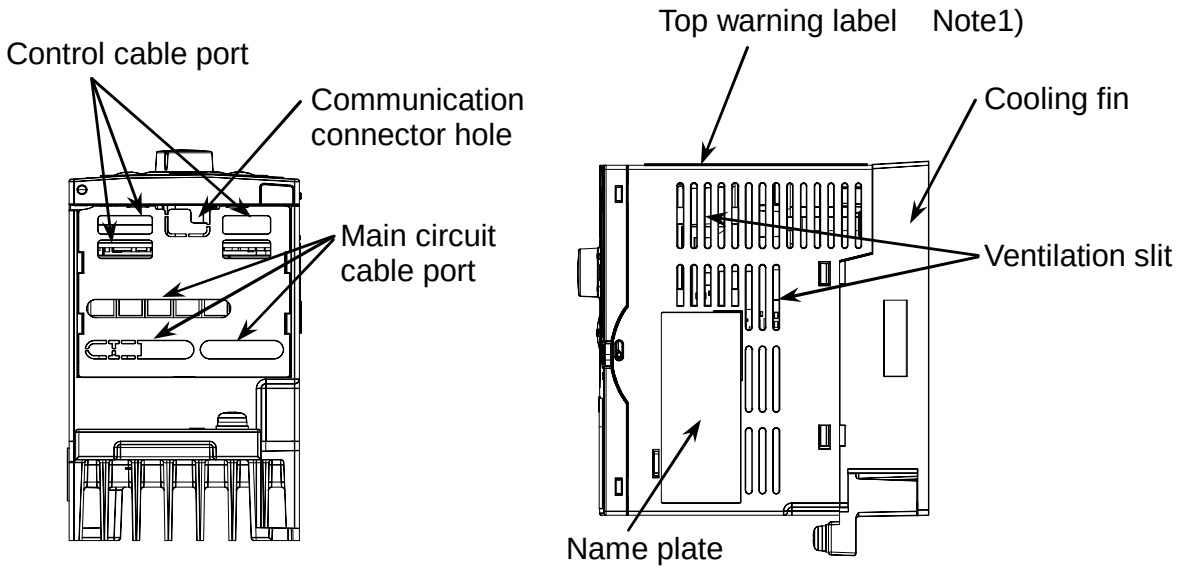
The front panel is unlocked when the dot on the locking screw is on this (upper) side.

Front panel locking screw

The inverter came with this screw in the locked position. So from this position, turn the screw 90° counterclockwise to unlock the front panel, or turn it 90° clockwise to lock the front panel.
The screw does not turn 360°. So avoid damage to the screw, do not use excessive force when turning it.

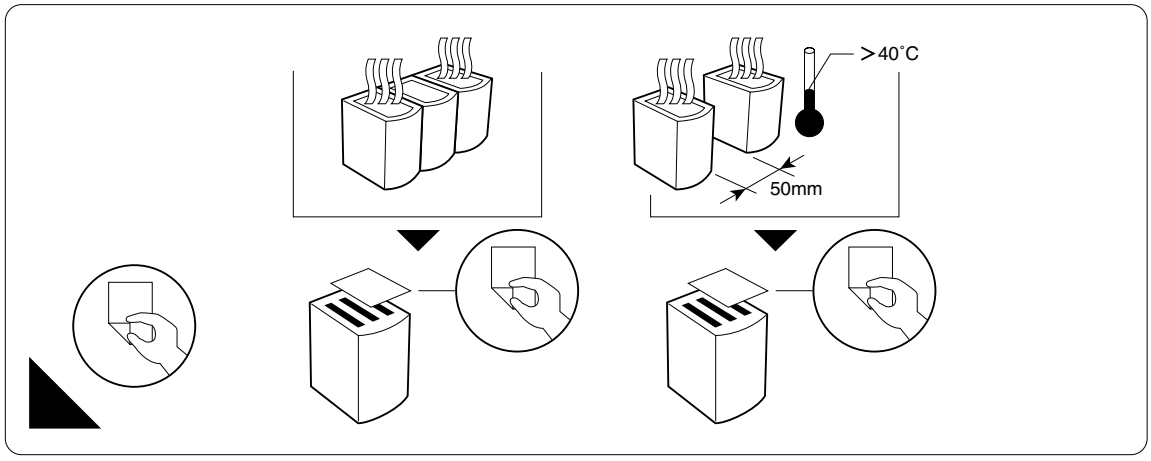
Lock position mark

The front panel is locked when the dot on the locking screw is on this (lower) side.



Note 1) Remove this seal when installed where the ambient temperature will rise above 40°C.

Example of the label



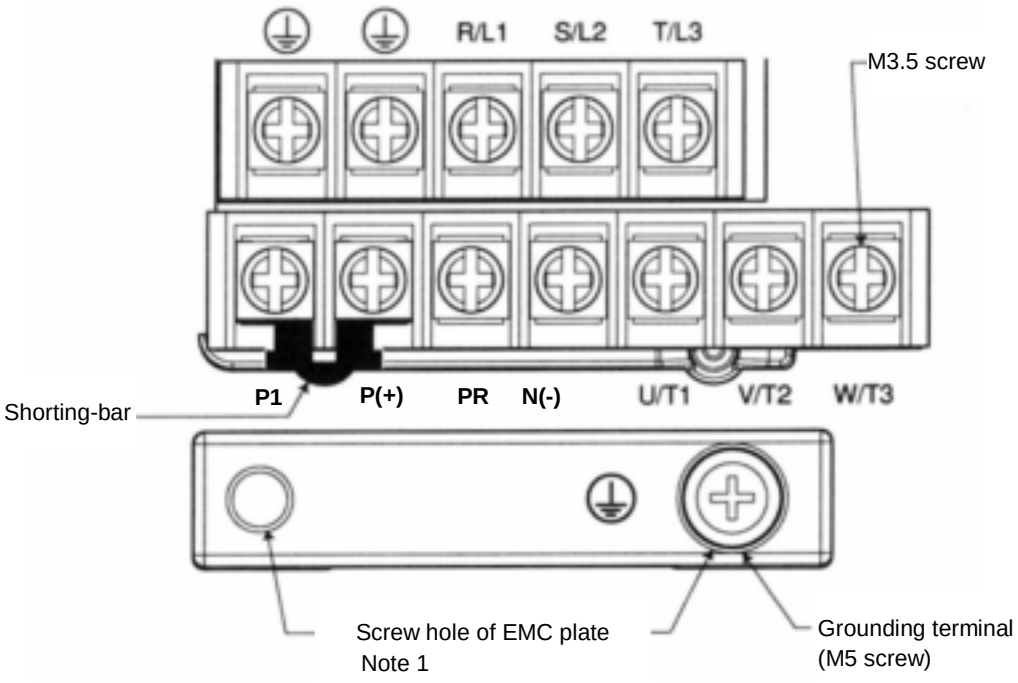
1.3.2 Main circuit and control circuit terminal boards

1) Main circuit terminal board

When using lug connector, cover the lug connector with insulated tube, or use the insulated lug connector.

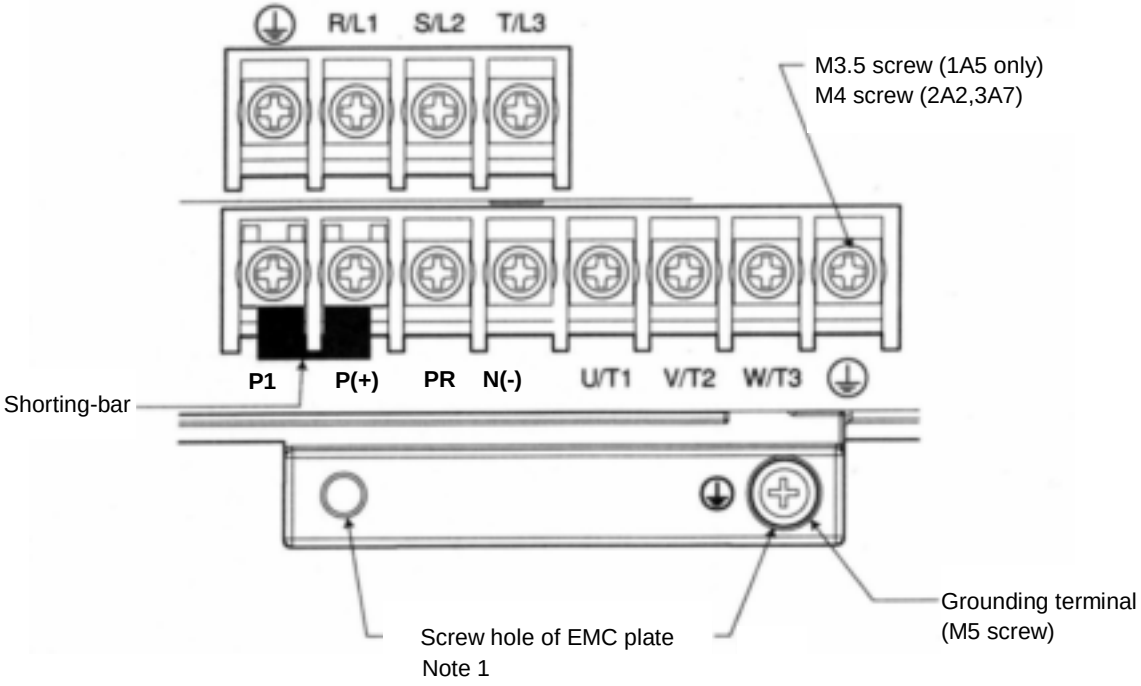
Screw size	tightening torque	
M3.5 screw	0.9N • m	7.1lb • in
M4 screw	1.3N • m	10.7lb • in
M5 screw	2.5N • m	22.3lb • in
M6 screw	4.5N • m	40.1lb • in

HF3212-A20 ~ A75

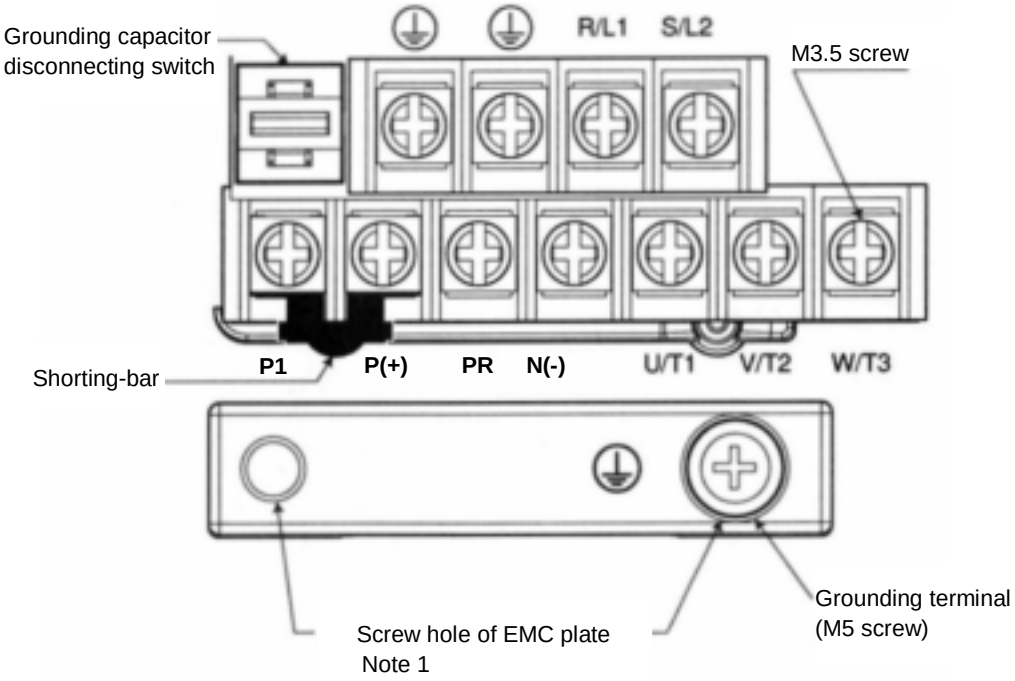


Note 1: EMC plate is optional.

HF3212-1A5 ~ 3A7

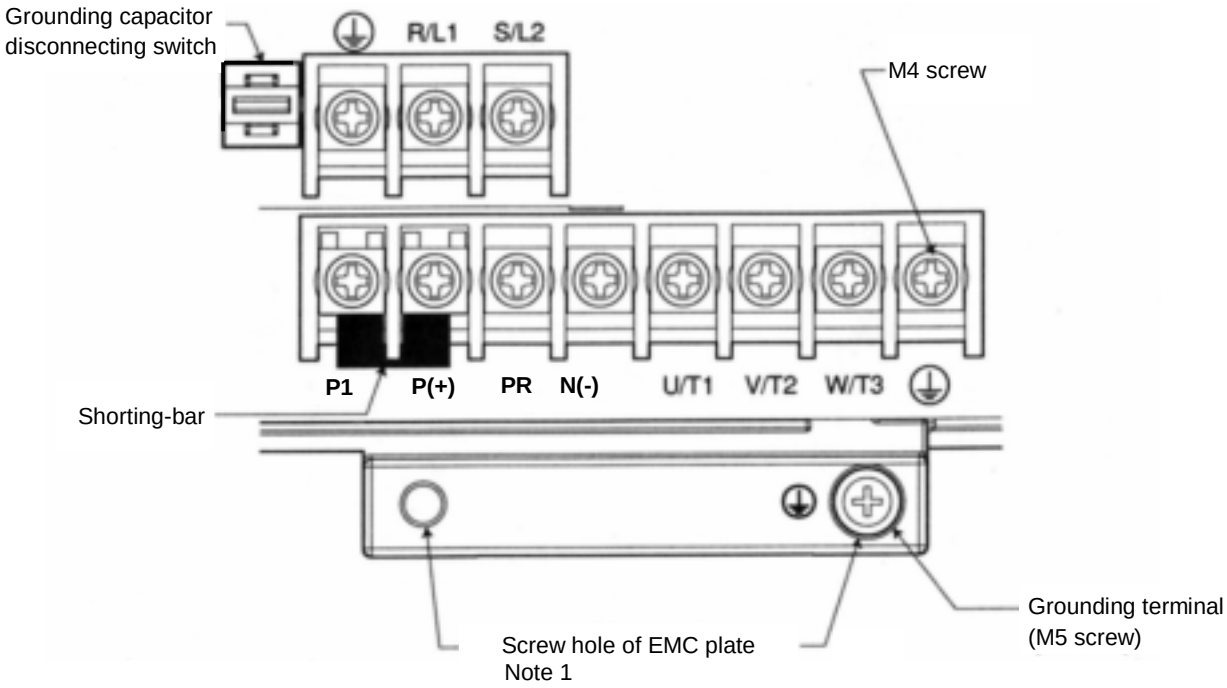


HF321S-A20 ~ A75

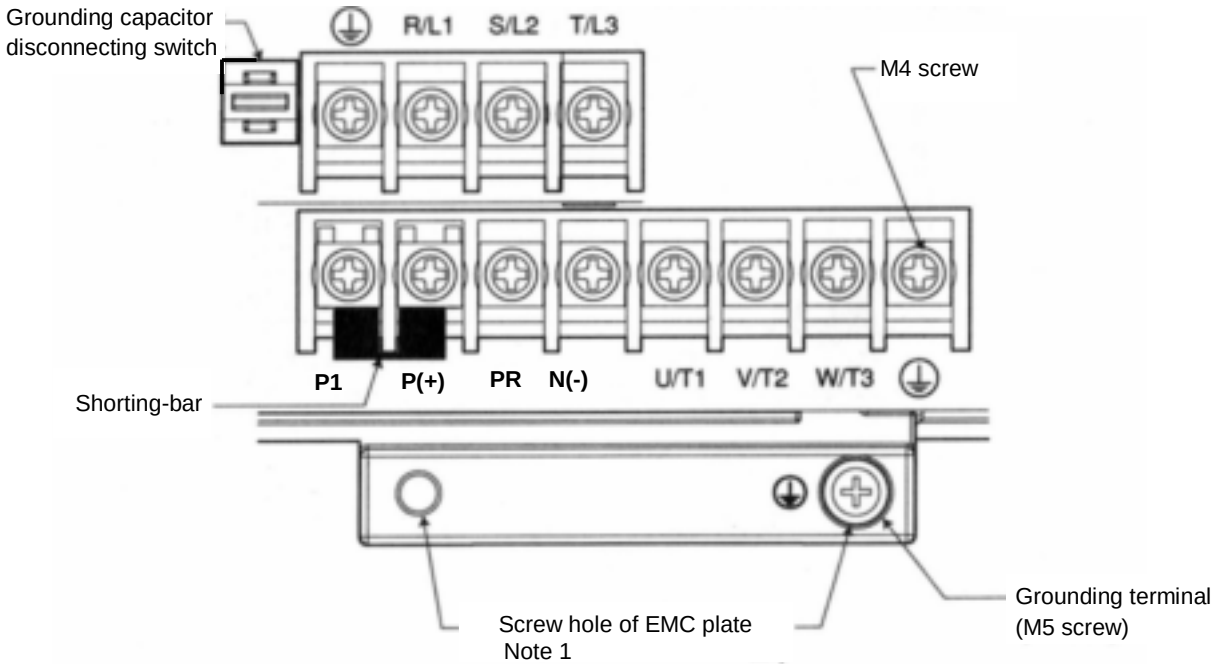


Note 1: EMC plate is optional.

HF321S-1A5,2A2

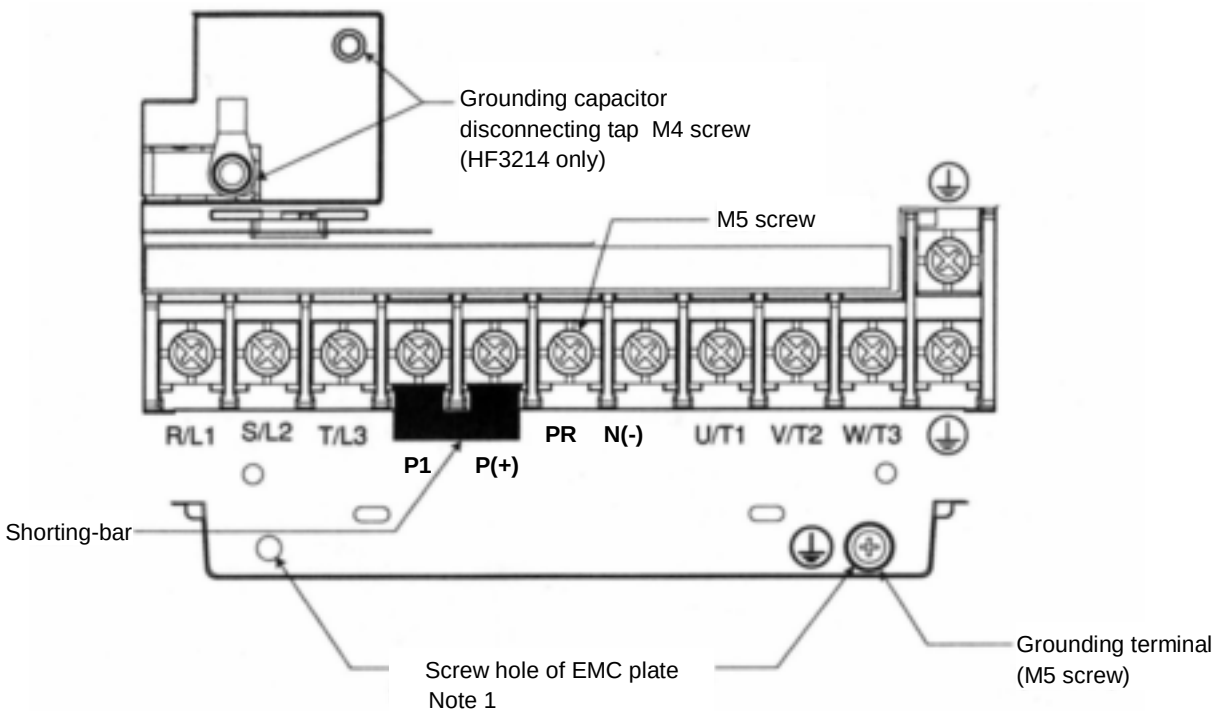


HF3214-A40 ~ 3A7



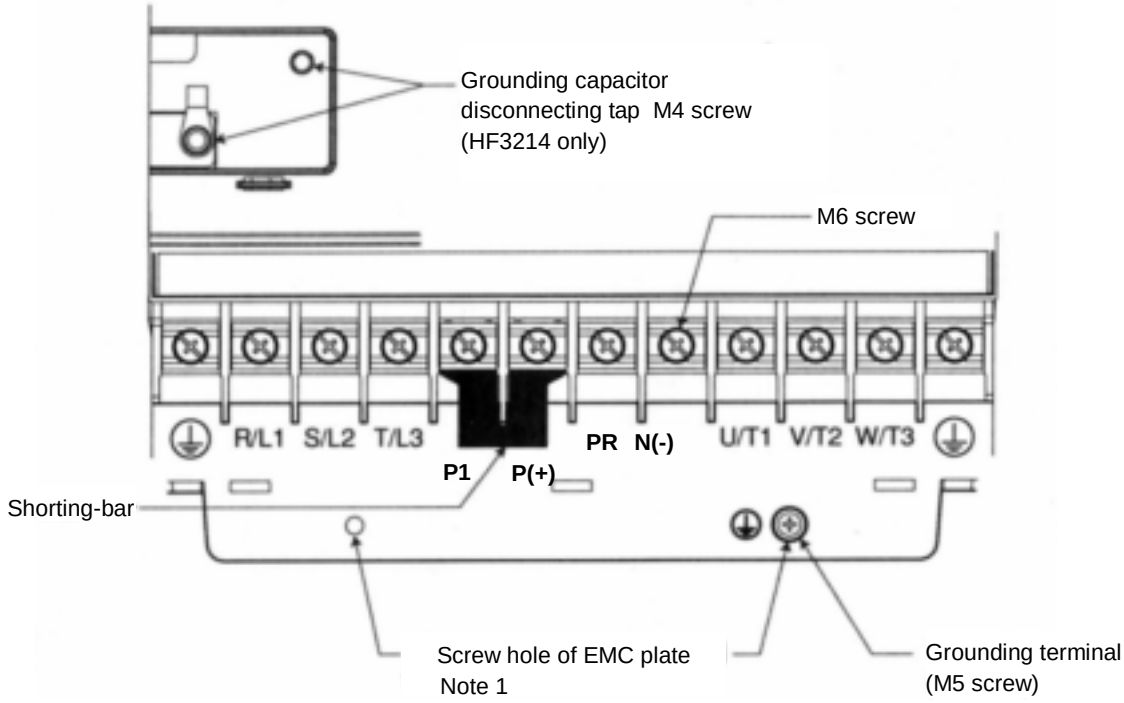
Note 1: EMC plate is optional.

HF3212-5A5, 7A5
HF3214-5A5, 7A5



Note 1: EMC plate is optional.

HF3212-011, 015
HF3214-011, 015



In case of the lug connector, cover the lug connector with insulated tube, or use the insulated lug connector.

Note 1: EMC plate is optional.

2) Grounding capacitor disconnecting switch and taps

⚠ Warning	
Mandatory	The grounding capacitor disconnecting tap is provided with a protection cover. To avoid shock hazards, always attach the cover after connecting or disconnecting the capacitor to or from the tap.

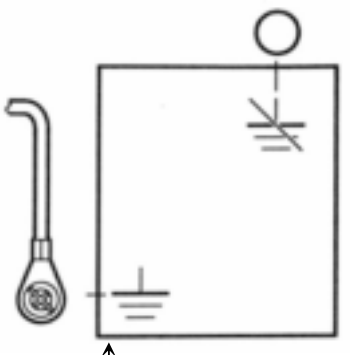
Every single-phase 200V/three-phase 400V model has a built-in high-attenuation noise filter, which is grounded through a capacitor.
If you want to disconnect the capacitor from the grounding line to reduce the amount of leakage current, you can do so easily using the switch or tap. Keep in mind, however, that disconnecting the capacitor from the grounding line causes the inverter to become incompliant with the EMC directive. Also note that the inverter must always be turned off before the capacitor is disconnected or reconnected.

3.7kW or less : Switch

← To connect the capacitor from the grounding, push this switch. (Factory default position)

← To disconnect the capacitor from the grounding, pull up this switch.

5.5kW or more : Tap

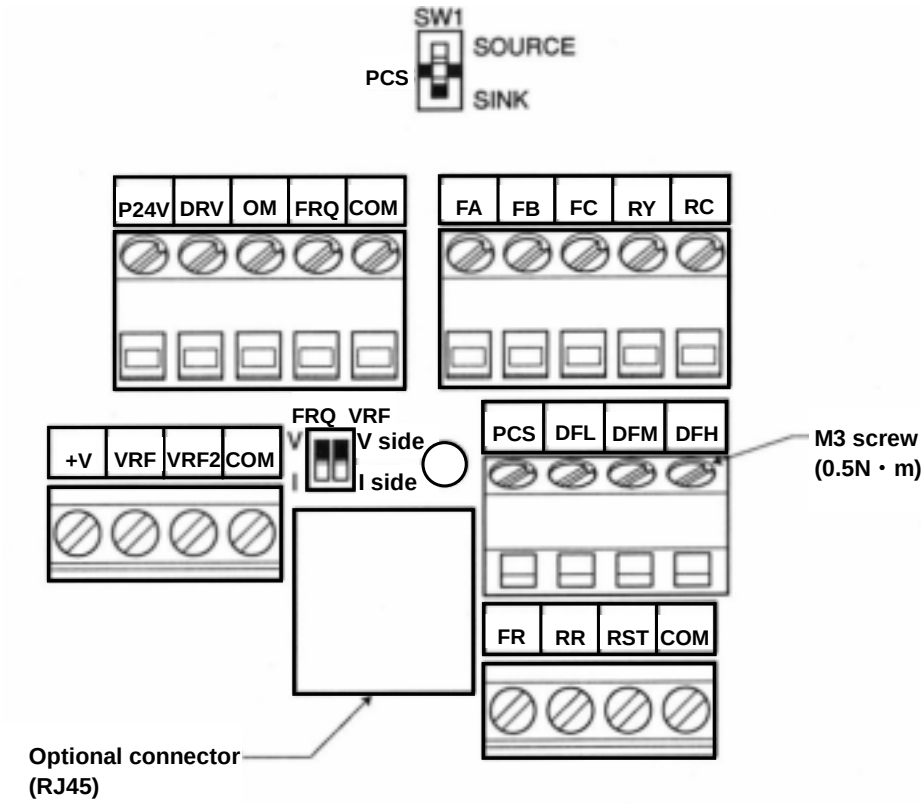


To disconnect the capacitor from the grounding, connect the lug terminal to this tap.

To connect the capacitor from the grounding, connect the lug terminal to this tap. (Factory default setting)

3) Control circuit terminal board

The control circuit terminal board is common to all equipment.



Wire size

Solid wire: 0.3 ~ 1.5 (mm^2)

Stranded wire: 0.3 ~ 1.5 (mm^2)
(AWG 22 ~ 16)

Sheath strip length: 6 (mm)

Factory default settings of slide switches

SW1: SINK side
SOURCE side

FRQ: V side

VRF: V side

Screwdriver: Small-sized flat-blade screwdriver
(Blade thickness: 0.4 mm or less, blade width: 2.2 mm or less)

See 2.3.2 for details on all terminal functions.

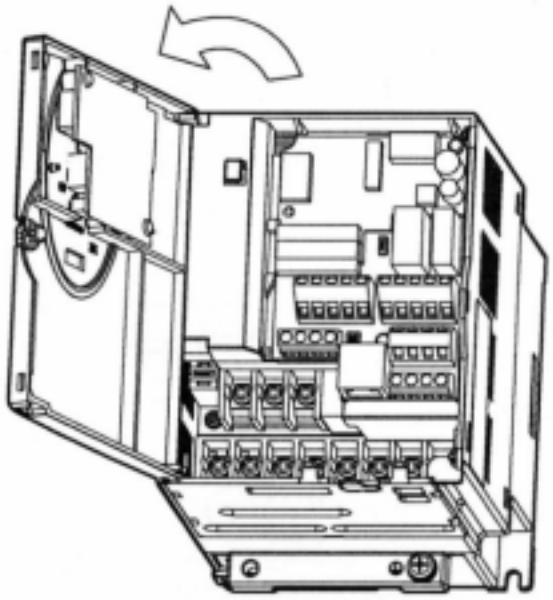
1.3.3 How to open the front (terminal board) cover

To wire the terminal board, remove the front lower cover in line with the steps given below.

(1)

Turn the locking screw on the right side of the front panel 90° counterclockwise to align the dot on the screw with the unlock position mark (upper side). To avoid damage to the screw, Do not apply excessive force to turn the screw more than 90° degrees.

(2)



Pull the front panel toward you and swing it open to the left.

1.4 Notes on the application

1.4.1 Motors

When the HF-320 α and the motor are used in conjunction, pay attention to the following items.

⚠ Warning	
Mandatory	Use an inverter that conforms to the specifications of power supply and three-phase induction motor being used. If the inverter being used does not conform to those specifications, not only will the three-phase induction motor not rotate correctly, but it may cause serious accidents through overheating and fire.

Comparisons with commercial power operation.

The HF-320 α Inverter employs the sinusoidal PWM system. However, the output voltage and output current do not assume a precise sine wave, they have a distorted wave that is close to sinusoidal waveform. This is why compared to operation with a commercial power there will be a slight increase in motor temperature, noise and vibration.

Operation in the low-speed area

When running continuously at low speed in conjunction with a general purpose motor, there may be a decline in that motor's cooling effect. If this happens, operate with the output decreased from rated load. To carry out low-speed operation continuously at the rated torque, we recommend to use a “AF motor” designed for use with an inverter. When operating in conjunction with a “AF motor”, you must change the inverter's motor overload protection level to AF motor use (OL A).

Adjusting the overload protection level

The HF-320 α Inverter protects against overloads with its overload detection circuits (electronic thermal). The electronic thermal's reference current is set to the inverter's rated current, so that it must be adjusted in line with the rated current of the general purpose motor being used in combination.

High speed operation at and above 60Hz

Operating at frequencies greater than 60Hz will increase noise and vibration. There is also a possibility that such operation will exceed the motor's mechanical strength limits and the bearing limits so that you should inquire to the motor's manufacturer about such operation.

Method of lubricating load mechanisms

Operating an oil-lubricated reduction gear and gear motor in the low-speed areas will worsen the lubricating effect. Check with the manufacturer of the reduction gear to find out about operable gearing area.

Low loads and low inertia loads

The motor may demonstrate instability such as abnormal vibrations or overcurrent trips at light loads of 50 % or under of the load percentage, or when the load's inertia moment is extremely small. If that happens reduce the carrier frequency.

Occurrence of instability

Unstable phenomena may occur under the load and motor combinations shown below.

- Combined with a motor that exceeds applicable motor ratings recommended for the inverter
- Combined with special motors

To deal with the above lower the settings of inverter carrier frequency.

- Combined with couplings between load devices and motors with high backlash

When using the inverter in the above combination, use the S-pattern acceleration/deceleration function, or when sensorless vector control is selected, adjust the speed control response/stability factor or switch to V/f control mode.

- Combined with loads that have sharp fluctuations in rotation such as piston movements

In this case, adjust the response time (inertial moment setting) during sensorless vector control or switch to V/f control.

Braking a motor when cutting off power supply

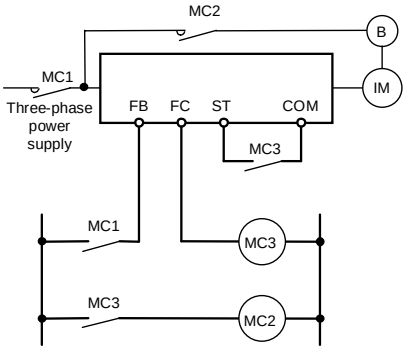
A motor with its power cut off goes into free-run, and does not stop immediately. To stop the motor quickly as soon as the power is cut off install an auxiliary brake. There are different kinds of brake devices, both electrical and mechanical. Select the brake that is best for the system.

Load that produces regenerative torque

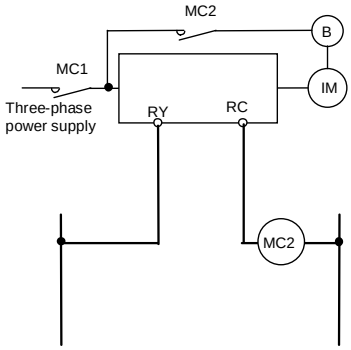
When combined with a load that produces regenerative torque, the overvoltage or overcurrent protection function may be activated to trip the inverter. For this kind of situation, you must install a dynamic braking resistor, etc. that complies with the load conditions.

Motor with brake

If a motor with brake is connected directly to the output side of the inverter, the brake will not release because voltage at startup is low. Wire the brake circuit separately from the motor's main circuits.



Circuit Configuration 1



Circuit Configuration 2

In circuit configuration 1, the brake is turned on and off through MC2 and MC3. If the circuit is configured in some other way, the overcurrent trip may be activated because of the locked rotor current when the brake goes into operation.
Circuit configuration 2 uses low-speed signal RY to turn on and off the brake.
Turning the brake on and off with a low-speed signal may be better in such applications as elevators. Please confer with us before designing the system.

Measures to protect motors against surge voltages

In a system in which a 400V-class inverter is used to control the operation of a motor, very high surge voltages may be produced, applied to the motor coils repeatedly for a long time and cause deterioration of their insulation, depending on the cable length, cable routing and types of cables used.
Here are some examples of measures against surge voltages.

(1) Lower the inverter's carrier frequency.
(2) Set the parameter F316 (Carrier frequency control mode selection) to 2 or 3.
(3) Use a motor with high insulation strength.
(4) Insert an AC reactor or a surge voltage suppression filter between the inverter and the motor.

1.4.2 Inverters

Protecting inverters from overcurrent

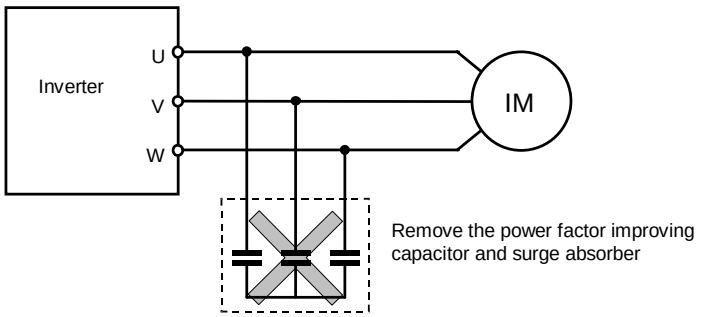
The inverter has an overcurrent protection function. However because the programmed current level is set to the inverter's maximum applicable motor, if the motor is one of small capacity and it is in operation, the overcurrent level and the electronic thermal protection must be readjusted. If adjustment is necessary, see 5-13, and make adjustments as directed.

Inverter capacity

Do not use small-capacity (kVA) inverter to control the operation of a large-capacity, motor no matter how light the load is. Current ripple will raise the output peak current making it easier to set off the overcurrent trip.

Power factor improving capacitor

Power factor improving capacitors cannot be installed on the output side of the inverter. When a motor is run that has a power factor improving capacitor attached to it, remove the capacitors. This can cause inverter malfunction trips and capacitor destruction.

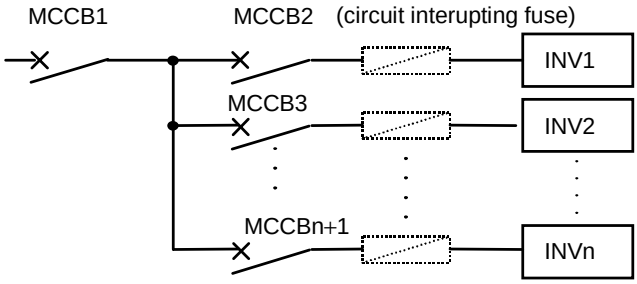


Power factor improving capacitor

Operating at other than rated voltage

Connections to voltages other than the rated voltage described in the rating label cannot be made. If a connection must be made to a power supply other than one with rated voltage, use a transformer to raise or lower the voltage to the rated voltage.

Circuit interrupting when two or more inverters are used on the same power line.



Breaking of selected inverter

There is no fuse in the inverter's main circuit. Thus, as the diagram above shows, when more than one inverter is used on the same power line, you must select interrupting characteristics so that only the MCCB2 will trip and the MCCB1 will not trip when a short occurs in the inverter (INV1). When you cannot select the proper characteristics install a circuit interrupting fuse between the MCCB2 and the INV1.

If power supply distortion is not negligible

If the power supply distortion is not negligible because the inverter shares a power distribution line with other systems causing distorted waves, such as systems with thyristors or large-capacity inverters, install an input reactor to improve the input power factor, to reduce higher harmonics, or to suppress external surges.

■ Disposal

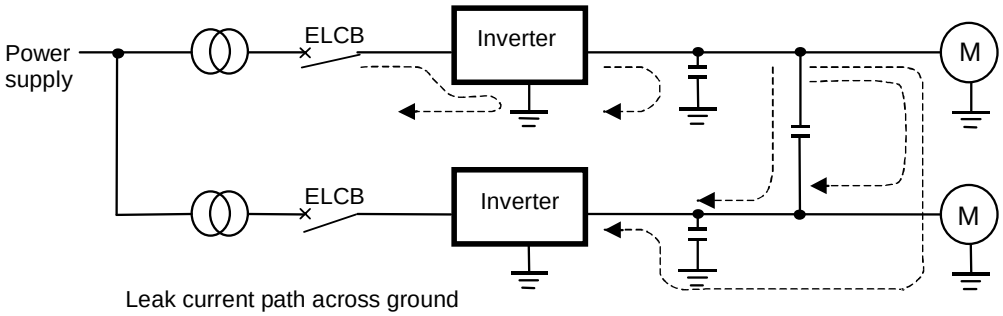
If an inverter is no longer usable, dispose of it as industrial waste.

1.4.3 What to do about the leak current

⚠ Warning
Current may leak through the inverter's input/output wires because of insufficient electrostatic capacity on the motor with bad effects on peripheral equipment. The leak current's value is affected by the carrier frequency and the length of the input/output wires. Test and adopt the following remedies against leak current.

(1) Effects of leak current across ground

Leak current may flow not just through the inverter system but also through ground wires to other systems. Leak current will cause earth leakage breakers, leak current relays, ground relays, fire alarms and sensors to operate improperly, and it will cause superimposed noise on the CRT screen or display of incorrect current amounts during current detection with the CT.

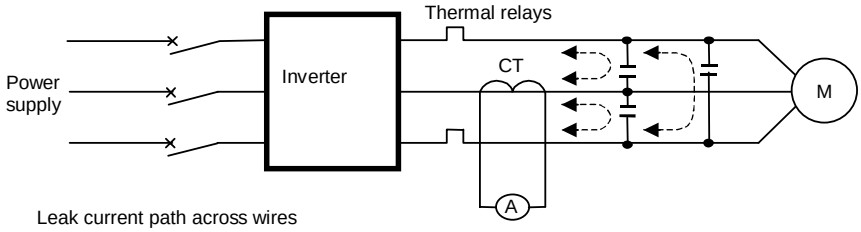


Leak current path across ground

Remedies:

1. If there is no radio-frequency interference or similar problem, detach the built-in noise filter capacitor, using the grounding capacitor disconnecting switch or tap. (See 1.3.2-2)
2. Reduce PWM carrier frequency.
   The setting of PWM carrier frequency is done with the parameter F300.
3. Use high frequency remedial products for earth leakage breakers. PWM carrier frequency.
4. If the sensors and CRT are affected, it can be remedied using the reduction of PWM carrier frequency described in 1 above, but if this cannot be remedied since there is an increase in the motor's magnetic noise, please consult with Toshiba.

(2) Affects of leak current across lines

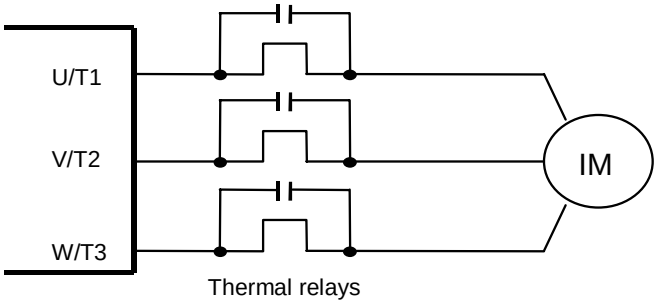


(1) Thermal relays

The high frequency component of current leaking into electrostatic capacity between inverter output wires will increase the effective current values and make externally connected thermal relays operate improperly. If the wires are more than 50 meters long, it will be easy for the external thermal relay to operate improperly with models having motors of low rated current (several A(ampere) or less), especially the 400V class low capacity (3.7kW or less) models, because the leak current will increase in proportion to the motor rating.

Remedies:

1. Use the electronic thermal built into the inverter. (See 5.13)
   The setting of the electronic thermal is done using parameter oLn, tHr.
2. Reduce the inverter's PWM carrier frequency. However, that will increase the motor's magnetic noise.
   The setting of PWM carrier frequency is done with the parameter $F300$. (See 6.12)
3. This can be improved by installing 0.1µ~0.5µF - 1000V film capacitor to the input/output terminals of each phase in the thermal relay.



(2) CT and ammeter

If a CT and ammeter are connected externally to detect inverter output current, the leak current's high frequency component may destroy the ammeter. If the wires are more than 50 meters long, it will be easy for the high frequency component to pass through the externally connected CT and be superimposed on and burn the ammeter with models having motors of low rated current (several A(ampere) or less), especially the 400V class low capacity (3.7kW or less) models, because the leak current will increase in proportion to the motor's rated current.

Remedies:

1.Use a meter output terminal in the inverter control circuit.
The output current can be output on the meter output terminal (FRQ). If the meter is connected, use an ammeter of 1mAdc full scale or a voltmeter of 7.5V-1mA full scale.

2.Use the monitor functions built into the inverter.
Use the monitor functions on the panel built into the inverter to check current values.

1.4.4 Installation

■ Installation environment

The HF-320 α Inverter is an electronic control instrument. Take full consideration to installing it in the proper operating environment.

Danger	
Prohibited	• Do not place any flammable substances near the HF-320 α Inverter. If an accident occurs in which flame is emitted, this could lead to fire.
Mandatory	• Operate under the environmental conditions prescribed in the instruction manual. Operations under any other conditions may result in malfunction.

Warning	
Prohibited	• Do not install the HF-320 α Inverter in any location subject to large amounts of vibration. This could cause the unit to fall, resulting in bodily injury.
Mandatory	• Check to make sure that the input power voltage is +10%, -15% of the rated power voltage written on the rating label (±10% when the load is 100% in continuous operation) If the input power voltage is not +10%, -15% of the rated power voltage (±10% when the load is 100% in continuous operation) this may result in fire.

⚠ Warning

Prohibited

- Avoid operation in any location where there is direct spraying of the following solvents or other chemicals. The plastic parts may be damaged to a certain degree depending on their shape, and there is a possibility of the plastic covers coming off and the plastic units being dropped. If the chemical or solvent is anything other than those shown below, please contact us in advance.

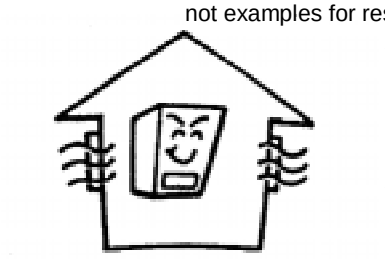
(Table 1) Examples of applicable chemicals and solvents

Chemical	Solvent
Hydrochloric acid (density of 10% or less)	Methanol
Sulfuric acid (density of 10% or less)	Ethanol
Nitric acid (density of 10% or less)	Triol
Caustic soda	Mesopropanol
Ammonia	Glycerin
Sodium chloride (salt)	

(Table 2) Examples of unapplicable chemicals and solvents

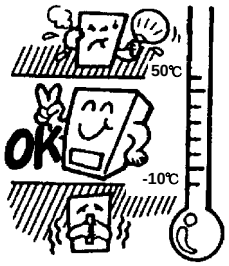
Chemical	Solvent
Phenol	Gasoline, kerosene, light oil
Benzenesulfonic acid	Turpentine oil
	Benzol
	Thinner

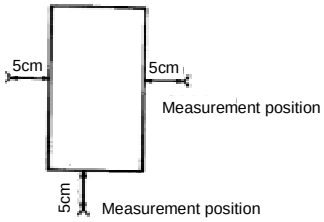
Note: The plastic cover has resistance to deformation by the above applicable solvents. They are not examples for resistance to fire or explosion.



- Do not install in any location of high temperature, high humidity, moisture condensation and freezing and avoid locations where there is exposure to water and/or where there may be large amounts of dust, metallic fragments and oil mist.
- Do not install in any location where corrosive gases or grinding fluids are present.

- Operate in areas where ambient temperature ranges from -10°C to 50°C. Operation over 40°C is allowed when peel off the top warning label.



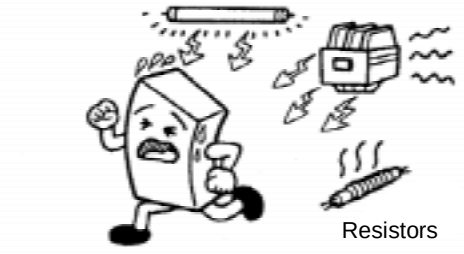


Note: The inverter is a heat-emitting body. Make sure to provide proper space and ventilation when installing in the cabinet. When installing inside a cabinet, we recommend peel of the top seal although 40°C or less.

- Do not install in any location that is subject to large amounts of vibration.

Note: If the HF-320 α Inverter is installed in a location that is subject to vibration, anti-vibration measures are required. Please consult with Sumitomo about these measures.

- If the HF-320 α Inverter is installed near any of the equipment listed below, provide measures to insure against errors in operation.



Solenoids:	Attach surge suppressor on coil.
Brakes:	Attach surge suppressor on coil.
Magnetic contactors:	Attach surge suppressor on coil.
Fluorescent lights:	Attach surge suppressor on coil.
Resistors:	Place far away from HF-320 α Inverter.

■ How to install

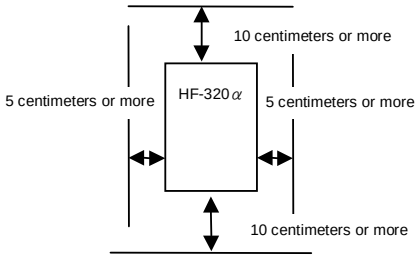
Danger	
Prohibited	• Do not install or operate the inverter if it is damaged or any component is missing. This can result in electric shock or fire. Please consult your local sales agency for repairs. Call your local sales agency for repairs.
Mandatory	• Mount the inverter on a metal plate. The rear panel gets very hot. If installation is in an inflammable object, this can result in fire. • Do not operate with the front panel cover removed. This can result in electric shock. • An emergency stop device must be installed that fits with system specifications (e.g. shut off input power then engage mechanical brake). Operation cannot be stopped immediately by the inverter alone, thus risking an accident or injury. • All options used must be those specified by Sumitomo. The use of any other option may result in an accident.

Warning	
Mandatory	• The main unit must be installed on a base that can bear the unit's weight. If the unit is installed on a base that cannot withstand that weight, the unit may fall resulting in injury. • If braking is necessary (to hold motor shaft), install a mechanical brake. The brake on the inverter will not function as a mechanical hold, and if used for that purpose, injury may result.

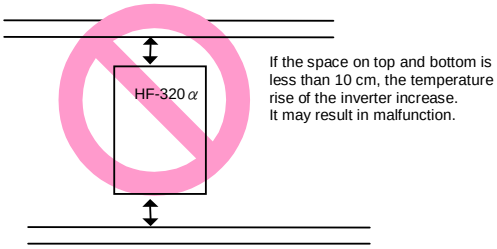
■ How to install

Install the inverter in a well-ventilated indoor place and mount it on a flat metal plate in portrait orientation. If you are installing more than one inverter, the separation between inverters should be at least 5 centimeters, and they should be arranged in horizontal rows. It is necessary to decrease the current if the inverter is operated at over 40°C. For more information, refer to “Load Reduction and Thermal Environment Instruction Manual.”

•Standard installation



•Bad installation



The space shown in the diagram is the minimum allowable space. Because air cooled equipment has cooling fans built in on the top or bottom surfaces, make the space on top and bottom as large as possible to allow for air passage.

Note: Do not install in any location where there is high humidity or high temperatures and where there are large amounts of dust, metallic fragments and oil mist. If you are going to install the equipment in any area that presents a potential problem, please consult with Sumitomo before doing so.

■ Watt loss values of the inverter and the required ventilation

About 5% of the rated power of the inverter will be lost as a result of conversion from AC to DC or from DC to AC. In order to suppress the rise in temperature inside the cabinet when this loss becomes heat loss, the interior of the cabinet must be ventilated and cooled.

The amount of forcible air-cooling ventilation required and the necessary heat discharge surface quantity when operating in a sealed cabinet according to motor capacity are as follows.

Voltage class	Operating motor capacity (kW)	Inverter type		Watt loss Values: Carrier frequency 4kHz	Watt loss Values: Carrier frequency 12kHz	Amount of forcible air cooling ventilation required (m^3/min)	Heat discharge surface area required for sealed storage cabinet(m^2)
Single-phase 200V class	0.2	HF321S-	A20	23	29	0.23	0.8
	0.4		A40	47	60	0.29	1.0
	0.75		A75	74	88	0.40	1.4
	1.5		1A5	142	169	0.60	2.1
	2.2		2A2	239	270	0.80	2.8
Three -Phase 200V class	0.2	HF3212-	A20	21	26	0.23	0.8
	0.4		A40	43	54	0.29	1.0
	0.75		A75	67	79	0.40	1.4
	1.5		1A5	131	150	0.60	2.1
	2.2		2A2	168	195	0.80	2.8
	3.7		3A7	330	374	1.2	4.3
	5.5		5A5	450	510	1.7	6.1
	7.5		7A5	576	635	2.3	8.1
	11		011	750	820	3.4	12.0
	15		015	942	1035	4.6	16.0
Three-Phase 400V class	0.4	HF3214-	A40	30	42	0.32	1.1
	0.75		A75	44	57	0.40	1.4
	1.5		1A5	77	99	0.60	2.1
	2.2		2A2	103	134	0.80	2.8
	3.7		3A7	189	240	1.2	4.3
	5.5		5A5	264	354	1.7	6.1
	7.5		7A5	358	477	2.3	8.1
	11		011	490	650	3.4	12.0
	15		015	602	808	4.6	16.0

Notes

1) The heat loss for the optional external devices (input reactor, DC reactor, radio noise reduction filters, etc.) is not included in the calorific values in the table
2) Case of 100% Load Continuation operation.

■ Panel designing taking into consideration the effects of noise

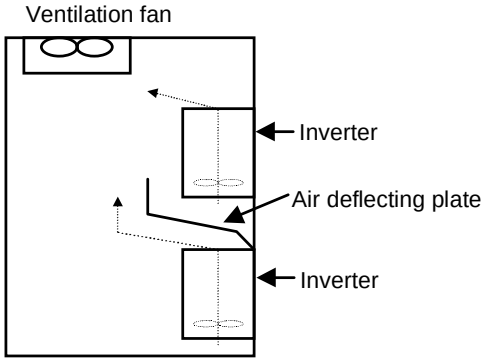
The inverter generates high frequency noise. When designing the control panel setup, consideration must be given to that noise. Examples of measures are given below.

- Wire so that the main circuit wires and the control circuit wires are separated. Do not place them in the same conduit, do not run them parallel, and do not bundle them.
- Provide shielding and twisted wire for control circuit wiring.
- Separate the input (power) and output (motor) wires of the main circuit. Do not place them in the same conduit, do not run them parallel, and do not bundle them.
- Ground the inverter ground terminals (⏚).
- Install surge suppressor on any magnetic contactor and relay coils used around the inverter.
- Install noise filters if necessary.

■ Installing more than one unit in a cabinet

If you are installing two or more inverters in one cabinet, pay attention to the following.

- When using inverters where the ambient temperature will rise above 40°C, leave a space of 5 cm or more between them and remove the caution label from the top of each inverter, or operate each inverter at a current lower than the rated one. For more information, refer to “Load Reduction and Thermal Environment Instruction Manual.”
- Ensure a space of at least 20 centimeters on the top and bottom of the inverters.
- Install an air deflecting plate so that the heat rising up from the inverter on the bottom does not affect the inverter on the top.



2. Connection equipment

Danger	
 Disassembly prohibited	• Never disassemble, modify or repair. This can result in electric shock, fire and injury. For repairs, call your sales agency.
 Prohibited	• Don't stick your fingers into openings such as cable wiring hole and cooling fan covers. This can result in electric shock or other injury. • Don't place or insert any kind of object into the inverter (electrical wire cuttings, rods, wires). This can result in electric shock or fire. • Do not allow water or any other fluid to come in contact with the inverter. That may result in electric shock or fire.

Warning	
 Prohibited	• When transporting or carrying, do not hold by the front panel covers. The covers may come off and the unit will drop out resulting in injury.

2.1 Cautions on wiring

Danger	
 Prohibited	• Never remove the front cover when power is on or open door if enclosed in a cabinet. The unit contains many high voltage parts and contact with them will result in electric shock.
 Mandatory	• Turn power on only after attaching the front cover or closing door if enclosed in a cabinet. If power is turned on without the front cover attached or closing door if enclosed in a cabinet. This can result in electric shock or other injury. • Electrical construction work must be done by a qualified expert. Connection of input power by someone who does not have that expert knowledge may result in fire or electric shock. • Connect output terminals (motor side) correctly. If the phase sequence is incorrect, the motor will operate in reverse and that may result in injury. • Wiring must be done after installation. If wiring is done prior to installation that may result in injury or electric shock. • The following steps must be performed before wiring. (1) Shut off all input power. (2) Wait at least ten minutes and check to make sure that the charge lamp is no longer lit. (3) Use a tester that can measure DC voltage (800VDC or more), and check to make sure that the voltage to the DC main circuits (across P(+)-N(-)) is 45V or less. If these steps are not properly performed, the wiring will cause electric shock. • Tighten the screws on the terminal board to specified torque. If the screws are not tightened to the specified torque, it may lead to fire.

Danger	
 Be Grounded	• Ground must be connected securely. If the ground is not securely connected, it could lead to electric shock or fire when a malfunction or current leak occurs.

Warning	
 Prohibited	• Do not attach devices with built-in capacitors (such as noise filters or surge absorber) to the output (motor side) terminal. This could cause a fire.

■ Preventing radio noise

To prevent electrical interference such as radio noise, separately bundle wires to the main circuit's power terminals (R/L1, S/L2, T/L3) and wires to the motor terminals (U/T1, V/T2, W/T3).

■ Control and main power supply

The control power supply and the main circuit power supply for the HF-320α are the same.

If a malfunction or trip causes the main circuit to be shut off, control power will also be shut off. When checking the cause of the malfunction or the trip, use the trip holding retention selection parameter. (See 6.19.3)

■ Wiring

- Because the space between the main circuit terminals is small use sleeved pressure terminals for the connections. Connect the terminals so that adjacent terminals do not touch each other.
- For ground terminal ⏚ use wires of the size that is equivalent to or larger than those given in table 10.1 and always ground the inverter (200V voltage class: D type ground [former type 3 ground]; 400V class: C type ground [former special type 3 ground]).
  Use as large and short a ground wire as possible and wire it as close as possible to the inverter.
- For the sizes of electric wires used in the main circuit, see the table in 10.1.
- The length of the main circuit wire in 10-1 should be no longer than 30 meters. If the wire is longer than 30 meters, the wire size (diameter) must be increased.

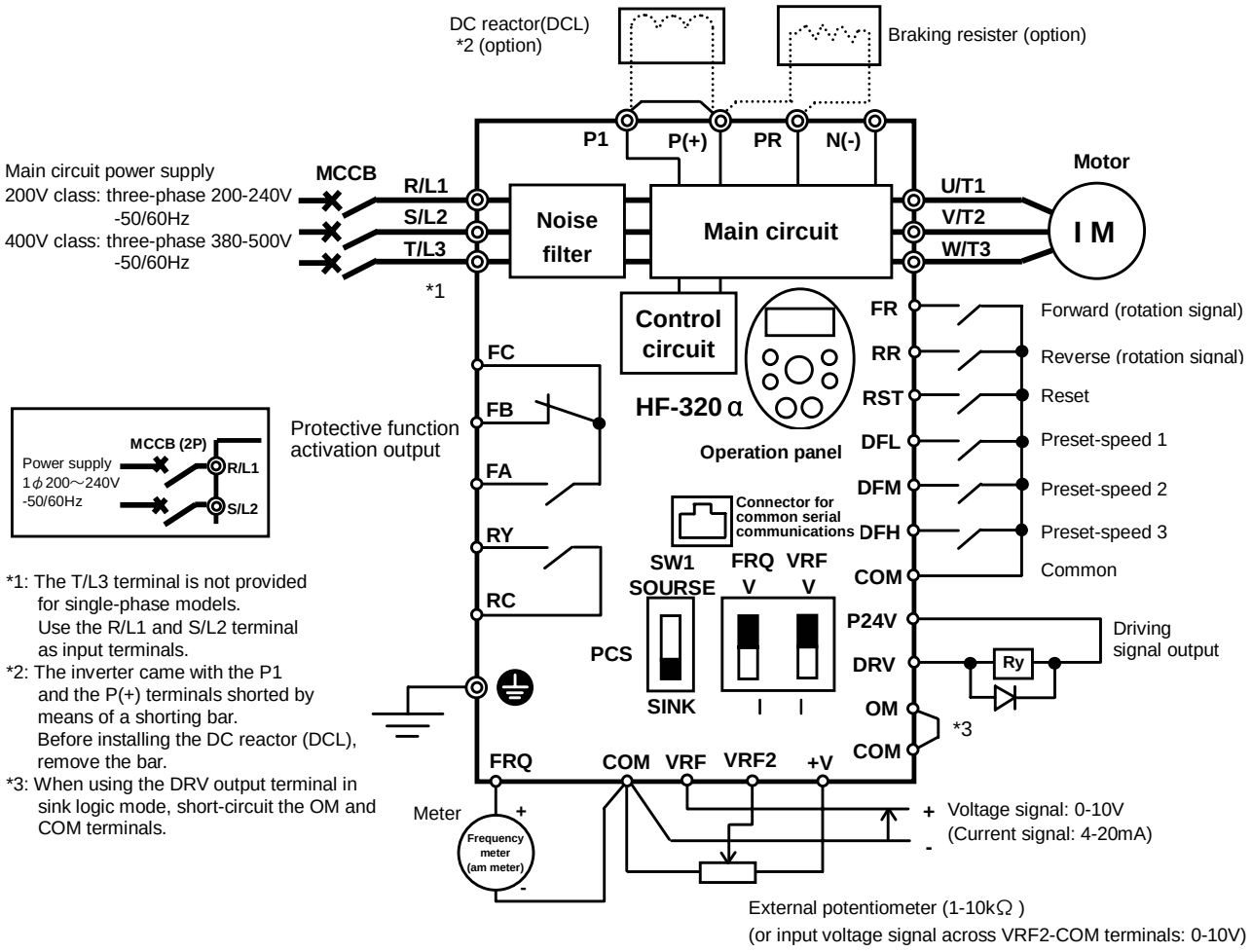
2.2 Standard connections

Danger	
 Prohibited	• Do not connect input power to the output (motor side) terminals (U/T1, V/T2, W/T3). Connecting input power to the output could destroy the inverter or cause a fire. • Do not insert a resistor between DC terminals (between P(+) and N(-), or between P1 and N(-)). It could cause a fire. See 6.13.4 for the connection of a resistor. • First shut off input power and wait at least 10 minutes before touching wires on equipment (MCCB) that is connected to inverter power side. Touching the wires before that time could result in electric shock.
 Be Grounded	• Securely connect to ground with a ground wire. It could lead to electric shock or fire when a malfunction or current leak occurs.

2.2.1 Standard connection diagram 1

This diagram shows a standard wiring of the main circuit.

Standard connection diagram-sink (common:COM)



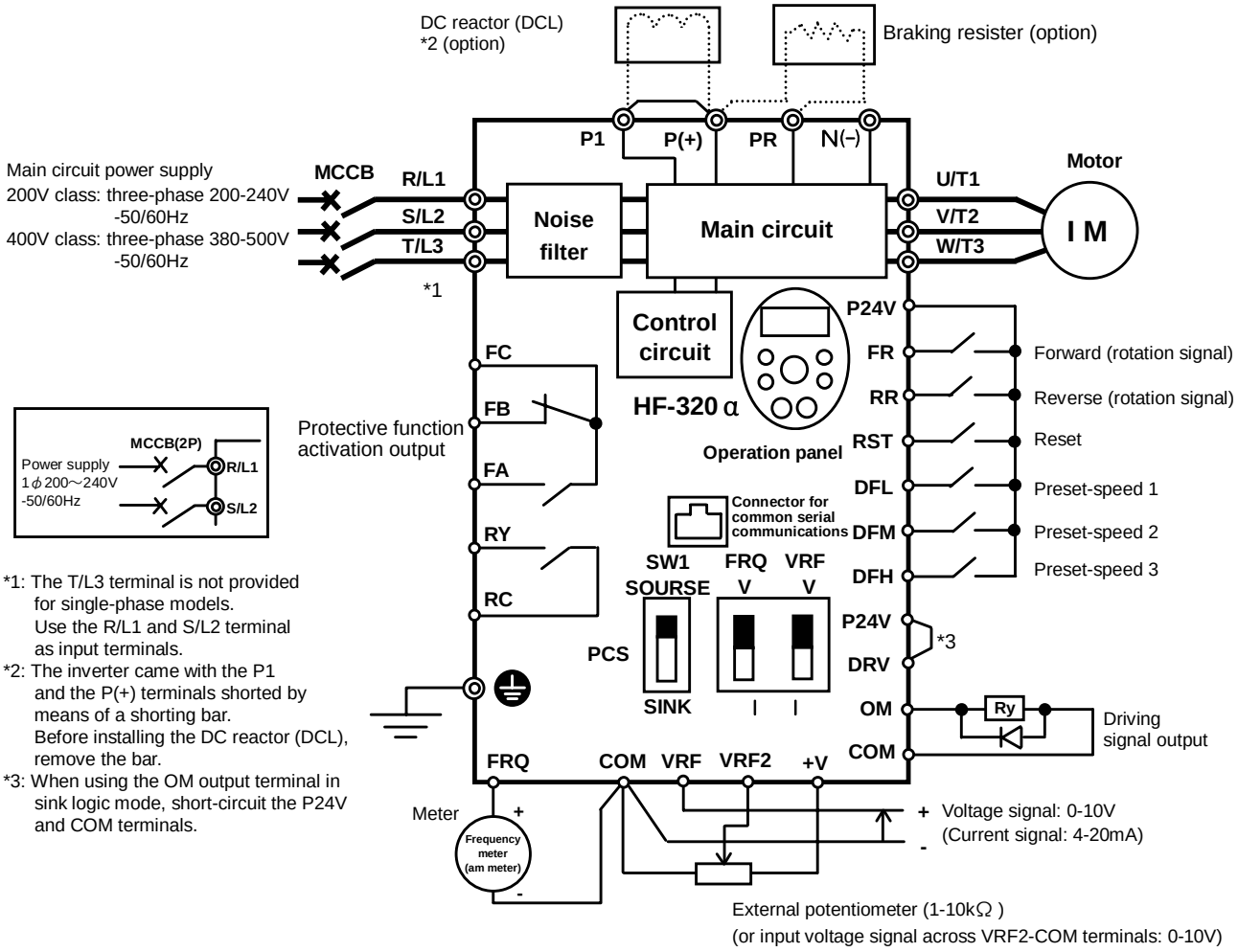
*1: The T/L3 terminal is not provided for single-phase models. Use the R/L1 and S/L2 terminal as input terminals.

*2: The inverter came with the P1 and the P(+) terminals shorted by means of a shorting bar. Before installing the DC reactor (DCL), remove the bar.

*3: When using the DRV output terminal in sink logic mode, short-circuit the OM and COM terminals.

2.2.2 Standard connection diagram 2

Standard connection diagram-source (common:P24V)



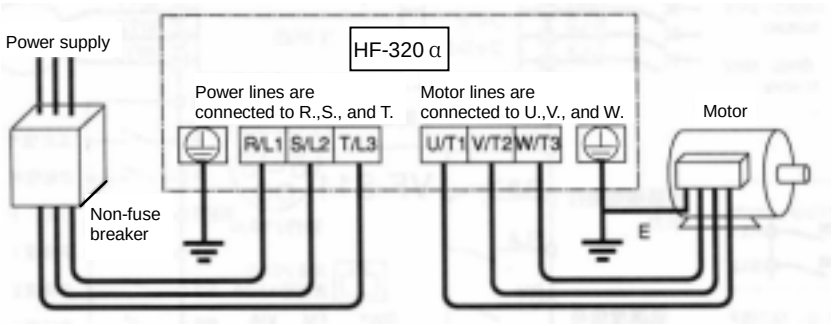
*1: The T/L3 terminal is not provided for single-phase models. Use the R/L1 and S/L2 terminal as input terminals.
*2: The inverter came with the P1 and the P(+) terminals shorted by means of a shorting bar. Before installing the DC reactor (DCL), remove the bar.
*3: When using the OM output terminal in sink logic mode, short-circuit the P24V and COM terminals.

2.3 Description of terminals

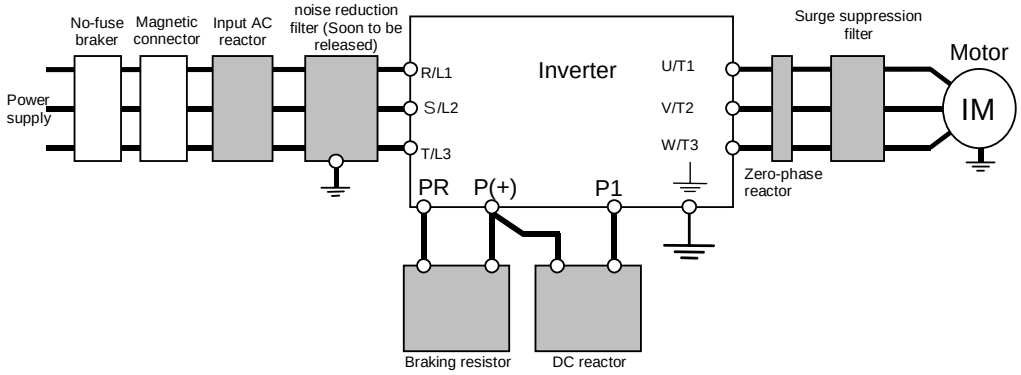
2.3.1 Main circuit terminals

This diagram shows an example of wiring of the main circuit. Use options if necessary.

■ Power supply and motor connections



■ Connections with peripheral equipment



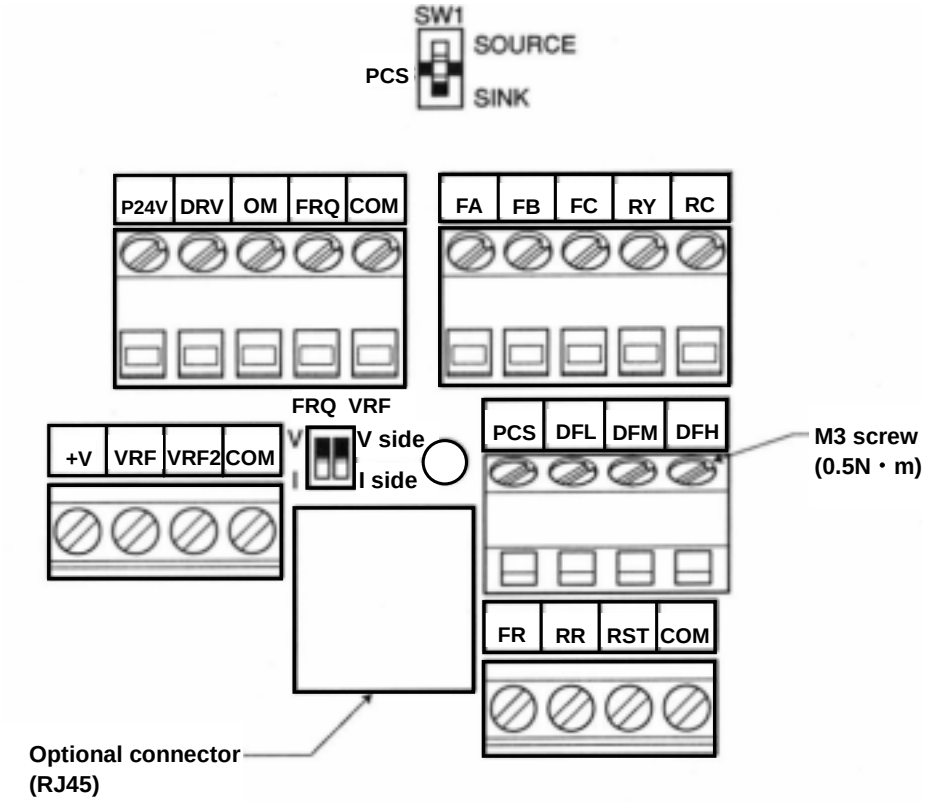
Note: The T/L3 terminal is not provided for any single-phase 200V model. So if you are using a single-phase 200V model, use the R/L1 and S/L2 terminals to connect power cables.

■ Main circuit

Terminal symbol	Terminal function
⏚	Grounding terminal for connecting inverter. There are 3 terminals in total. 2 terminals in the terminal board, 1 terminal in the cooling fin.
R/L1,S/L2,T/L3	200V class: single-phase 200~240V-50/60Hz three-phase 200~240V-50/60Hz 400V class: three-phase 380~500V-50/60Hz * Single-phase input: R/L1 and S/L2 terminals
U/T1,V/T2,W/T3	Connect to a (three-phase induction) motor.
P(+), PR	Connect to braking resistors. Change parameters F304, F305, F308, F309 if necessary.
N(-)	This is a negative potential terminal in the internal DC main circuit. DC common power can be input across the P(+) terminals (positive potential).
P1, P(+)	Terminals for connecting a DC reactor (DCL: optional external device). Shorted by a short bar when shipped from the factory. Before installing DCL, remove the short bar.

2.3.2 Control circuit terminals (sink logic)

The control circuit terminal board is common to all equipment.



Wire size

Solid wire: 0.3 ~ 1.5（mm^2）

Stranded wire: 0.3 ~ 1.5（mm^2）
（AWG 22 ~ 16）

Sheath strip length: 6（mm）

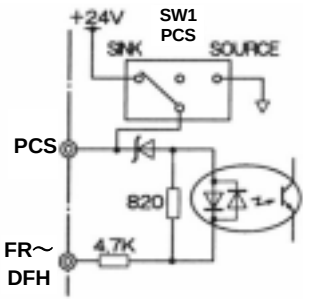
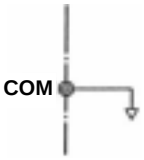
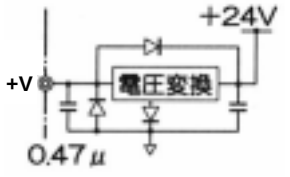
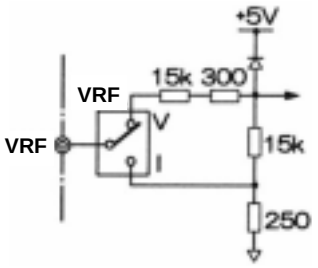
Screwdriver: Small-sized flat-blade screwdriver
(Blade thickness: 0.4 mm or less, blade width: 2.2 mm or less)

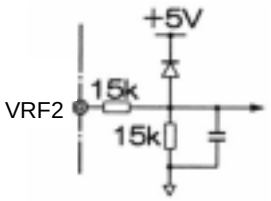
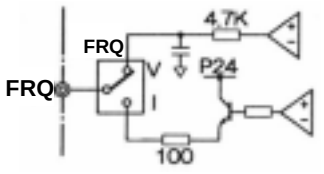
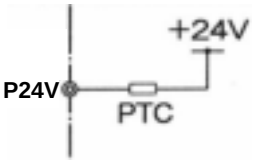
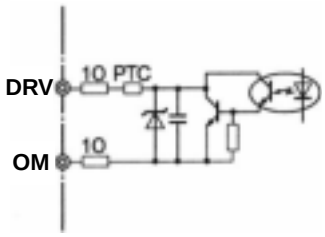
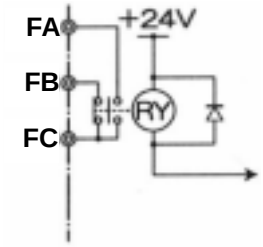
Factory default settings of slide switches

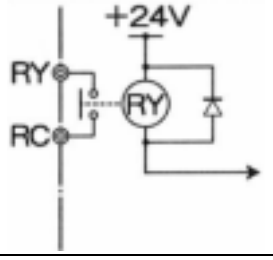
SW1: SINK side
SOURCE side

FRQ: V side

VRF: V side

Terminal symbol	Input/output	Function		Electrical specifications	Inverter internal circuits
FR	Input	Multifunction programmable contact input	Shorting across FR-COM causes forward rotation; open causes slow-down and stop. (When ST is always ON)	No voltage contact input 24Vdc-5mA or less *Sink/Source/PCS selectable using SW1	
RR	Input		Shorting across RR-COM causes reverse rotation; open causes slow-down and stop. (When ST is always ON)		
RST	Input		Shorting across RST-COM causes a held reset when the inverter protector function is operating. Note that when the inverter is operating normally, it will not operate even if there is a short across RST-COM		
DFL	Input		Shorting across DFL-COM causes preset speed operation.		
DFM	Input		Shorting across DFM-COM causes preset speed operation.		
DFH	Input		Shorting across DFH-COM causes preset speed operation.		
PCS	Input (common)	External 24Vdc power input When the source logic is used, a common terminal is connected.		24VDC (Insulation resistance: DC50V)	
COM	Common to Input/output	Control circuit's equipotential terminal (3 terminals)			
+V	Output	Analog input setting power output		10Vdc (permissible load current: 10mAdc)	
VRF	Input	Multifunction programmable analog input. Factory default setting: 0~10Vdc and 0~60Hz frequency input. The function can be changed to 4~20mAdc (0~20mA) current input by flipping the slide switch to the I position. By changing parameter setting, this terminal can also be used as a multifunction programmable contact input terminal. When using the sink logic, be sure to insert a resistor between P24V-VRF (4.7 kΩ—1/2 W). Also turn the VRF slide switch to the V position.		10Vdc (internal impedance: 30kΩ) 4-20mA (internal impedance: 250Ω)	

Terminal symbol	Input/output	Function	Electrical specifications	Inverter internal circuits
VRF2	Input	Multifunction programmable analog input. Standard default setting: 0~10Vdc input and 0~60Hz frequency By changing parameter setting, this terminal can also be used as a multifunction programmable contact input terminal. When using the sink logic, be sure to insert a resistor between P24V and VRF. (4.7 kΩ—1/2 W)	10Vdc (internal impedance: 30kΩ)	
FRQ	Output	Multifunction programmable analog output. Standard default setting: output frequency. Connect a 1mAdc full-scale ammeter or 7.5Vdc (10Vdc)-1mA full-scale voltmeter. The function can be changed to 0-20mAdc (4-20mA) current input by flipping the FRQ slide switch to the I position.	1mA full-scale DC ammeter or 7.5Vd (10Vdc)1mA full-scale DC voltmeter 0-20mA (4-20mA) full-scale DC ammeter	
P24V	Output	24Vdc power output	24Vdc-100mA	
DRV OM	Output	Multifunction programmable open collector output. Standard default settings detect and output driving signal output frequencies. Multifunction output terminals to which two different functions can be assigned. The OM terminal is an isoelectric output terminal. It is insulated from the COM terminal. By changing parameter settings, these terminals can also be used as multifunction programmable pulse train output terminals.	Open collector output 24Vdc-50mA To output pulse trains, a current of 10mA or more needs to be passed. Pulse frequency range: 38～1600Hz	
FA FB FC	Output	Multifunction programmable relay contact output. Contact ratings: 250 Vac-1A(cosϕ=1), 30Vdc-0.5A, 250Vac-0.5A(cosϕ=0.4). Detects the operation of the inverter's protection function. Contact across FA-FC is closed and FB-FC is opened during protection function operation.	250Vac-1A (cosϕ=1) : at resistance load 30Vdc-0.5A 250Vac-0.5A (cosϕ=0.4)	

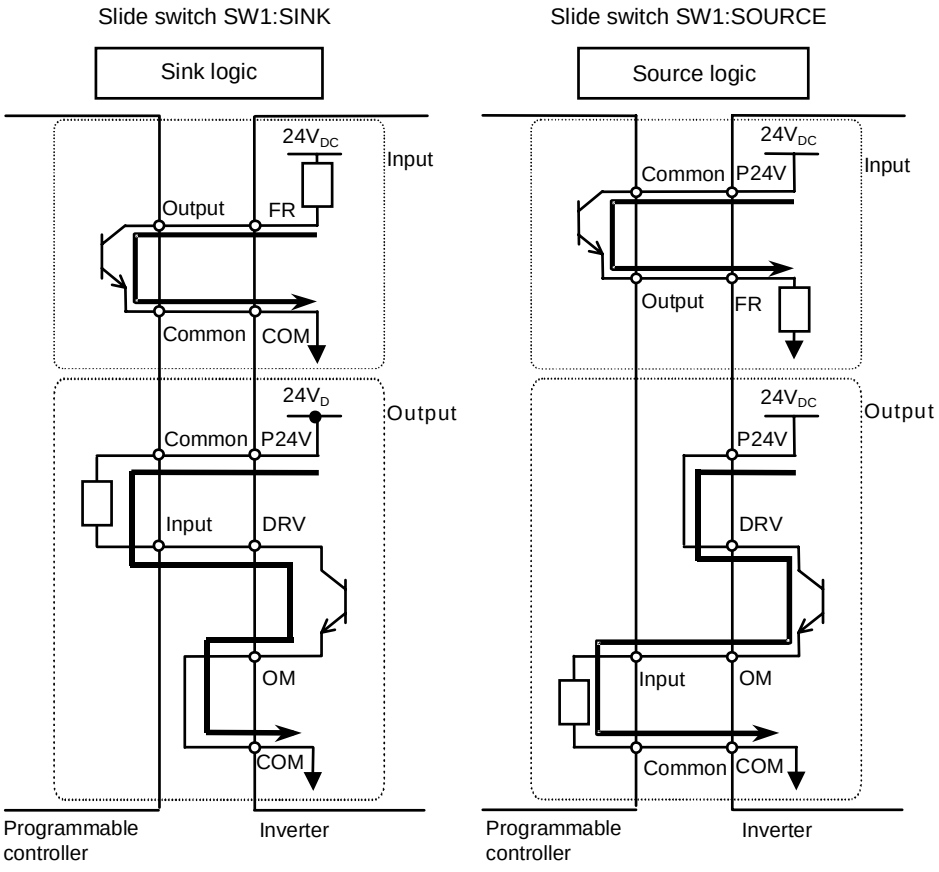
Terminal symbol	Input/output	Function	Electrical specifications	Inverter internal circuits
RY RC	Output	Multifunction programmable relay contact output. Contact ratings: 250 Vac-1A(cosϕ=1), 30Vdc-0.5A, 250Vac-0.5A(cosϕ=0.4). Multifunction output terminals to which two different functions can be assigned.	250Vac-1A (cosϕ=1) : at resistance load 30Vdc-0.5A 250Vac-0.5A (cosϕ=0.4)	

■ Sink logic/source logic (When the inverter's internal power supply is used)

Current flowing out turns control input terminals on. These are called sink logic terminals.
The general used method in Europe is source logic in which current flowing into the input terminal turns it on.
Sink logic terminals and source logic terminals are sometimes referred to as minus common terminals and positive common terminals, respectively.
Each logic is supplied with electricity from either the inverter's internal power supply or an external power supply, and its connections vary depending on the power supply used.

2

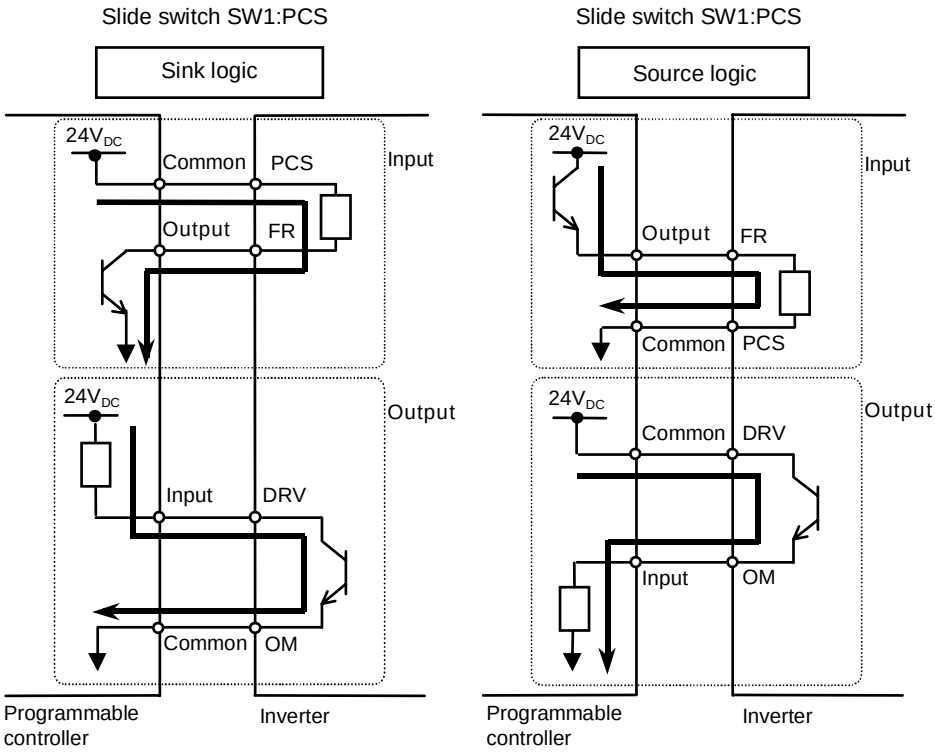
＜Examples of connections when the inverter's internal power supply is used＞



■ Sink logic/source logic (When an external power supply is used)

The PCS terminal is used to connect to an external power supply or to insulate a terminal from other input or output terminals. As for input terminals, turn the SW1 slide switch to the PCS position.

＜Examples of connections when an external power supply is used＞



■ Selecting the functions of the VRF and VRF2 terminals between analog input and contact input

The functions of the VRF and VRF2 terminals can be selected between analog input and contact input by changing parameter settings (F 109). (Factory default setting: Analog input)

When using these terminals as contact input terminals in a sink logic circuit, be sure to insert a resistor between the P24V and VRF terminals or between the P24V and VRF2 terminals. (Recommended resistance: 4.7KΩ-1/2W)

When using the VRF terminal as a contact input terminal, be sure to turn the VRF switch to the V position. If no resistor is inserted or the VRF slide switch is not turned to the V position, contact input will be left always ON, which is very dangerous.

Switch between analog input and contact input before connecting the terminals to the control circuit terminals. Otherwise the inverter or devices connected to it may be damaged.

■ Logic switching/Voltage-current output switching (slide switch)

(1) Logic switching

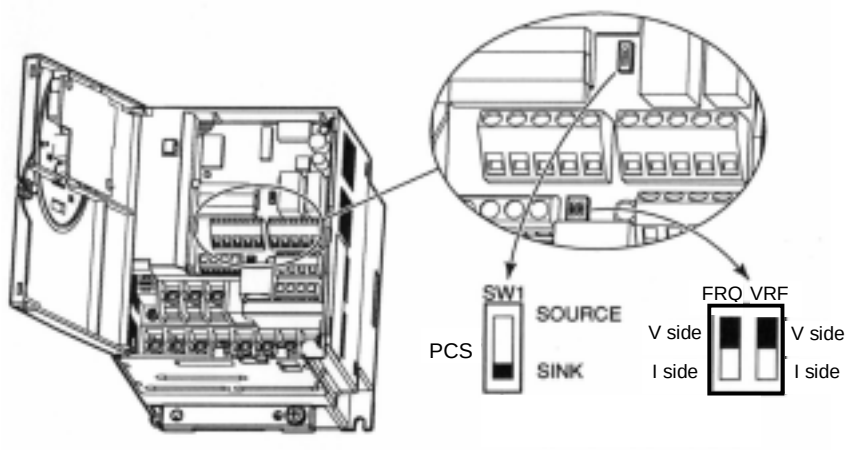
Use SW1 to switch between logics.

Switch between logics before wiring to the inverter and without supplying power. If switching between sink, source and PCS is done when power is turned on after switching or when the inverter is supplied with power, the inverter might become damaged. Confirm it before supplying power.

(2) Voltage-current output switching

Use the FRQ switch to switch between voltage output and current output.

Switch the FRQ terminal's voltage-current output before wiring to inverter or without supplying power.



Factory default settings of slide switches

SW1 : SINK side
SOURCE side

FRQ : V side

VRF : V side

* After you have selected a logic between sink and source, take measures to prevent the logic from being changed.

3. Operations

Danger	
 Prohibited	• Do not touch inverter terminals when electrical power is going to the inverter even if the motor is stopped. Touching the inverter terminals while power is connected to it may result in electric shock. • Do not touch switches when the hands are wet and do not try to clean the inverter with a damp cloth. Such practices may result in electric shock. • Do not go near the motor in alarm-stop status when the retry function is selected. The motor may suddenly restart and that could result in injury. Take measures for safety, e.g. attaching a cover to the motor, against accidents when the motor unexpectedly restarts.
 Mandatory	• Turn power on only after attaching the front cover or closing door if enclosed in a cabinet. If power is turned on without the front cover attached or closing door if enclosed in a cabinet, that may result in electric shock or other injury. • If the inverter begins to emit smoke or an unusual odor, or unusual sounds, immediately turn power off. If the equipment is continued in operation in such a state, the result may be fire. Call your local sales agency for repairs. • Always turn power off if the inverter is not used for long periods of time. • Turn input power on after attaching the front cover. When enclosed inside a cabinet and using with the front cover removed, always close the cabinet doors first and then turn power on. If the power is turned on with the front cover or the cabinet doors open, it may result in electric shock. • Make sure that operation signals are off before resetting the inverter after malfunction. If the inverter is reset before turning off the operating signal, the motor may restart suddenly causing injury.

Warning	
 Contact prohibited	• Do not touch heat radiating fins or discharge resistors. These device are hot, and you'll get burned if you touch them.
 Prohibited	• Observe all permissible operating ranges of motors and mechanical equipment. (Refer to the motor's instruction manual.) Not observing these ranges may result in injury.

3.1 Simplified Operation of the HF-320 α

The procedures for setting operation frequency and the methods of operation can be selected from the following.

Start / Stop : (1) Start and stop using the operation panel keys
(2) Run and stop from the operation panel

Setting the frequency : (1) Setting using the potentiometer on the inverter main unit
(2) Setting using the operation panel
(3) Setting using external signals to the terminal board (0-10Vdc, 4-20mAdc)

Use the basic parameters CMOd (Operation command mode selection), FMOd (Speed setting mode selection).

Title	Function	Adjustment range	Default setting
CMOd	Command mode selection	0: Terminal board 1: Panel	1
FMOd	Frequency setting mode	0: Internal potentiometer setting 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: External contact up/down 6: VRF+VRF2 (Override)	0

* See 5.4 for FMOd=4, 5 and 6.

3.1.1 How to start and stop

[Example of a Cmod setting procedure]

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F710=0 [Operation frequency])
MON	AUH	Displays the first basic parameter [History (AUH)].
▲ ▼	Cmod	Press either the △ or ▽ key to select "Cmod".
STR	1	Press STR key to display the parameter setting. (Default setting: 1).
▲ ▼	0	Change the parameter to 0 (terminal board) by pressing the △ key.
STR	0⇔Cmod	Press the STR key to save the changed parameter. Cmod and the parameter set value are displayed alternately.

(1) Start and stop using the operation panel keys (Cmod= 1)

Use the RUN and STOP RESET keys on the operation panel to start and stop the motor.

RUN : Motor starts.

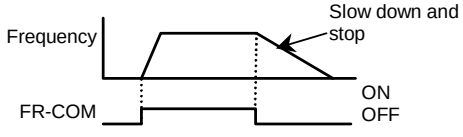
STOP RESET : Motor stops.

(2) RUN/STOP by means of an external signal to the terminal board (Cmod=0): Sink logic

Use external signals to the inverter terminal board to start and stop the motor.

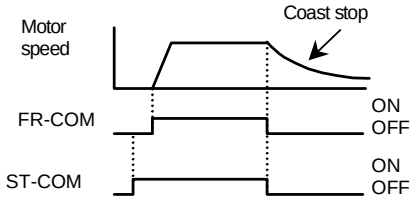
Short **FR** and **COM** terminals: run forward

Open **FR** and **COM** terminals: slow down and stop



* Coast stop

The standard default setting is for slowdown stop. To make a coast stop, assign a "1(ST)" terminal function to an idle terminal using the programmable terminal function.
Change to F110=0.
For coast stop, open the ST-COM when stopping the motor in the state described at left.The monitor on the inverter at this time will display OFF.



3.1.2 How to set the frequency

[Example of a F N O d setting procedure]

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F 7 10=0 [Operation frequency])
MON	A U H	Displays the first basic parameter [History (A U H)].
▲ ▼	F N O d	Press either the △ key or ▽ key to select "F N O d".
STR	0	Press STR key to display the parameter setting. (Default setting: 0).
▲ ▼	3	Change the parameter to 3 (Operation panel) by pressing the△key.
STR	3⇔F N O d	Press the STR key to save the changed parameter. F N O d and the parameter set value are displayed alternately.

* Pressing the MON key twice returns the display to standard monitor mode (displaying operation frequency).

(1) **Setting the frequency using the potentiometer on the inverter main unit** (F N O d=0)

Set the frequency with the notches on the potentiometer.

Move clockwise for the higher frequencies.

The potentiometer has hysteresis. So the set value may slightly change when the inverter is turned off, and then turned back on.

(2) **Setting the frequency using the operation panel** (F N O d=3)

Set the frequency with the operation panel..

▲ : Moves the frequency up

▼ : Moves the frequency down

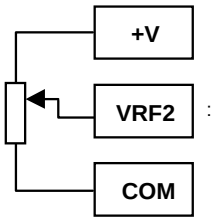
■ Example of operating a run from the panel

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (When standard monitor display selection F710=0 [Operation frequency])
▲ ▼	50.0	Set the operation frequency.
STR	50.0⇔FC	Press the STR key to save the operation frequency. FC and the frequency are displayed alternately.
▲ ▼	60.0	Pressing the △ key or the ▽ key will change the operation frequency even during operation.

(3) **Setting the frequency using the operation panel** (F 0 d = 1 or 2)

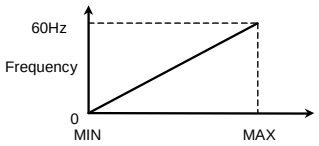
■ Frequency setting

1) Setting the frequency using external potentiometer



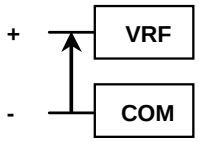
: Setting frequency using potentiometer

★Potentiometer
Setting frequency using the potentiometer (1-10kΩ, 1/4W)
For more detailed information on adjustments, see 6.5.



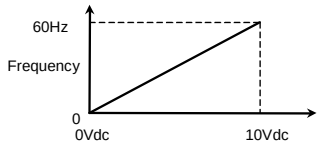
* The input terminal VRF can be used in the same way.
F 0 d = 1: VRF effective, F 0 d = 2: VRF2 effective
For more details, see 6.5.

2) Setting the frequency using input voltage (0~10V)



: Voltage signal 0-10mAdc

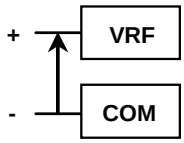
★Voltage signal
Setting frequency using voltage signals (0~10V).
For more detailed information on adjustments, see 6.5.



* The input terminal VRF2 can be used in the same way.
F 0 d = 1: VRF effective, F 0 d = 2: VRF2 effective
For more details, see 6.5.

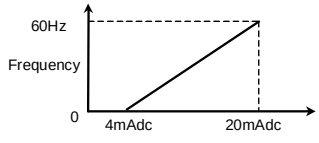
Note: Be sure to turn the VRF slide switch to the V (voltage) position.

3) Setting the frequency using current input (4~20mA)



: Current signal 4-20mAdc

★Current Signal
Current signal Setting frequency using current signals (4~20mA).For more detailed information on adjustments, see 6.5.



* Setting of parameters also allow 0-20mAdc.

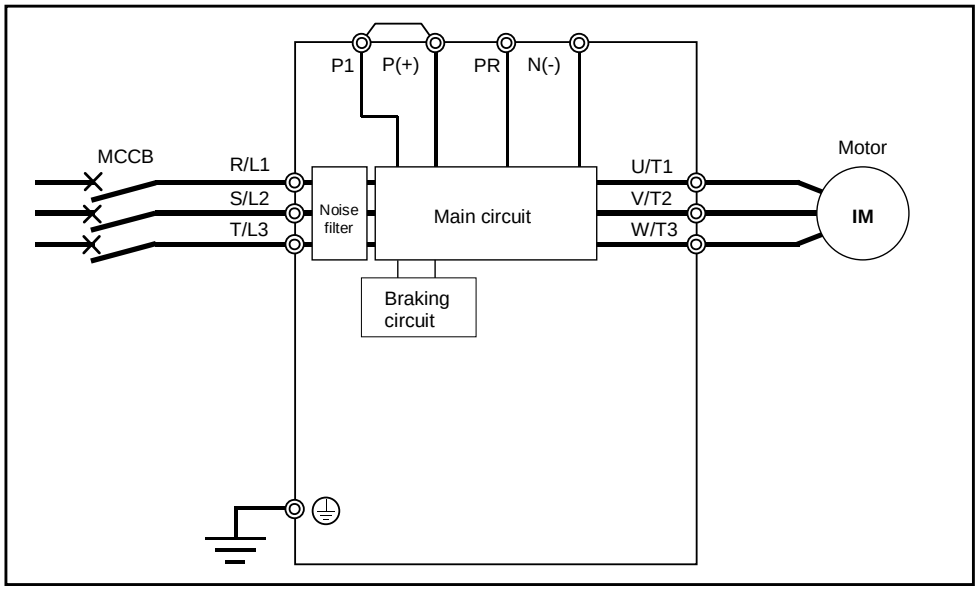
Note: Be sure to turn the VRF slide switch to the I (current) position.

3.2 How to operate the HF-320 α

Overview of how to operate the inverter with simple examples.

Ex.1 Setting the operation frequency using built-in potentiometer and running and stopping using the operation panel.

(1) Wiring



Parameter setting (default setting)

Title	Function	Programmed value
CMOd	Command mode selection	1
FMOd	Frequency setting mode selection 1	0

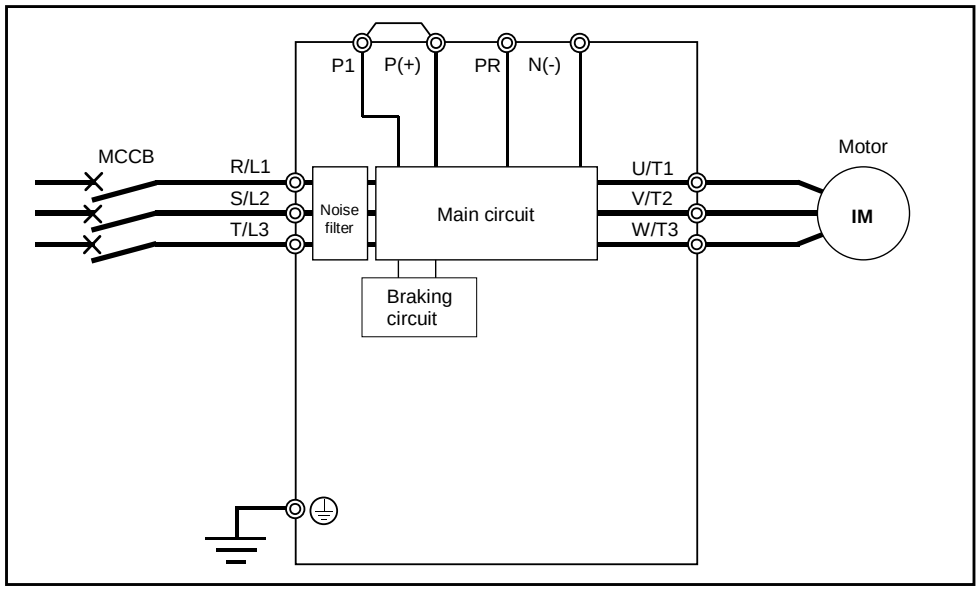
(3) Operation

Run/stop: Press the RUN and STOP RESET keys on the panel.

Frequency setting: Set adjusting position of notches on the potentiometer.

Ex.2 Setting the operation frequency using the operation panel and running and stopping using the operation panel.

(1) Wiring



(2) Parameter setting

Title	Function	Programmed value
CMOd	Command mode selection	1
FMOd	Frequency setting mode selection 1	3

(3) Operation

Run/stop: Press the RUN and STOP RESET keys on the panel.

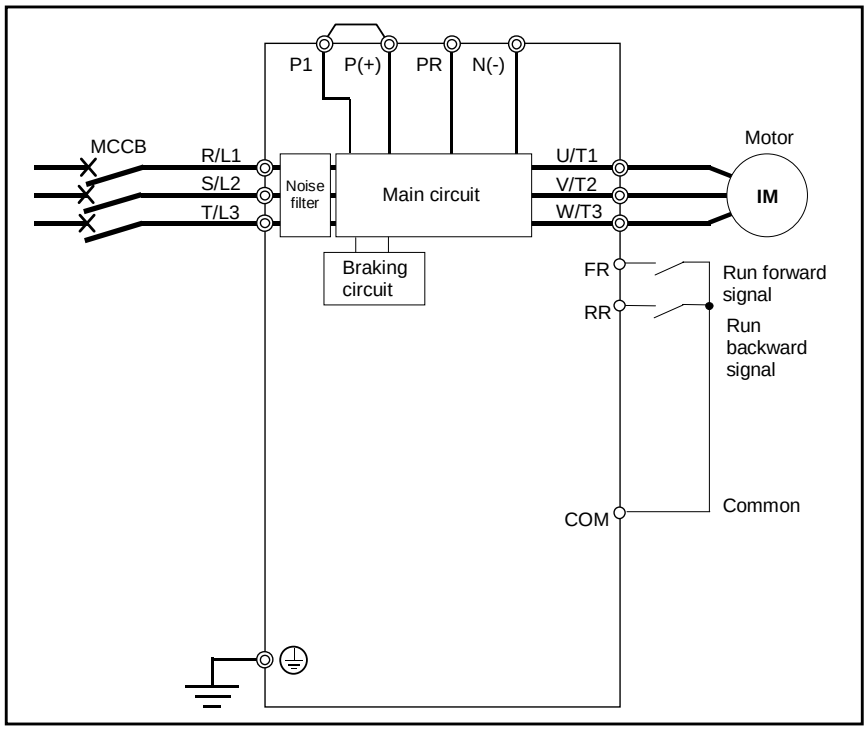
Frequency setting: Set with the ▲ ▼ keys on the operation panel.

To store the set frequencies in memory, press the STR key.

FC and the set frequency will flash on and off alternately.

Ex.3 Setting the operation frequency using built-in potentiometer and running and stopping using external signals.

(1) Wiring



(2) Parameter setting

Title	Function	Programmed value
CMOd	Command mode selection	0
FMOd	Frequency setting mode selection	0

(3) Operation

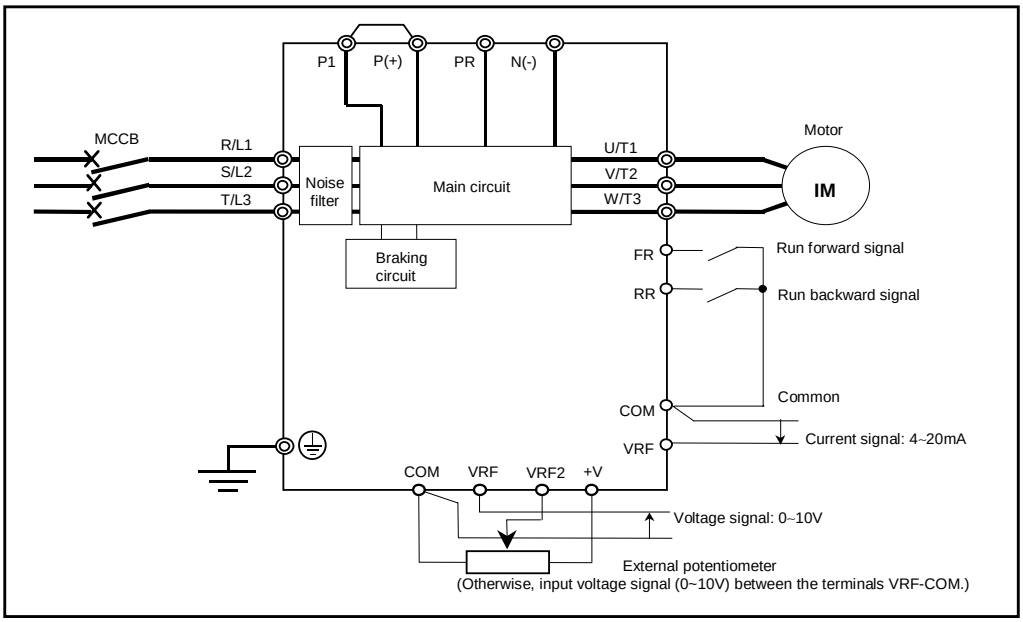
Run/stop: ON/OFF input to FR-COM, RR-COM. (Set SW1 to Sink logic)

Frequency setting: Set adjusting position of notches on the potentiometer.

Ex.4

Operation frequency setting, running and stopping using external signals.

(1) Wiring



(2) Parameter setting

Title	Function	Programmed value
CMOd	Command mode selection	0
FMOd	Frequency setting mode selection	1or2

(3) Operation

Run/stop: ON/OFF input to FR-COM, RR-COM. (Set SW1 to Sink logic)

Frequency setting: VRF and VRF2: 0-10Vdc (External potentiometer)

VRF: Input 4-20mAdc.

* Use the VIA slide switch to switch between voltage and current to the VRF terminal.

Voltage input: V side

Current input: I side

4. Basic HF-320α operations

The HF-320α has the following three monitor modes.

Standard monitor mode : The standard inverter mode. This mode is enabled when inverter power goes on.

This mode is for monitoring the output frequency and setting the frequency designated value. In it is also displayed information about status alarms during running and trips.

- Setting frequency designated values ⇒ see 3.2.2
- Status alarm
  If there is an error in the inverter, the alarm signal and the frequency will flash alternately in the LED display.
  - E: When a current flows at or higher than the overcurrent stall level.
  - P: When a voltage is generated at or higher than the over voltage stall level.
  - L: When a load reaches 50% or higher of the overload trip value.
  - H: When the temperature reaches the overheating protection alarm level.

Setting monitor mode : The mode for setting inverter parameters.

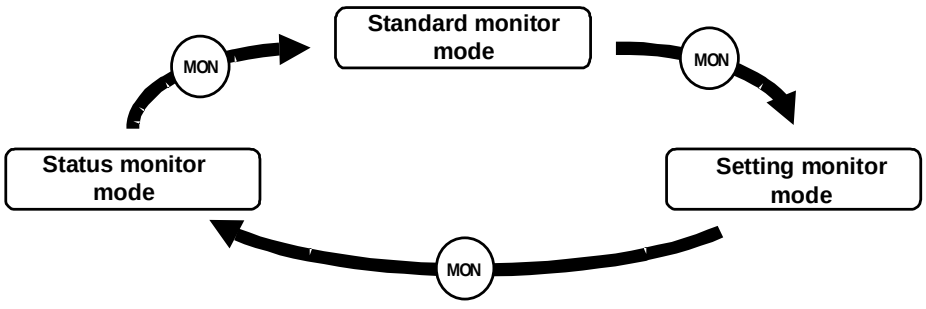
How to set parameters ⇒ see 4.1

Status monitor mode : The mode for monitoring all inverter status.

Allows monitoring of set frequencies, output current/voltage and terminal information.

For more on how to use the monitor ⇒ see 8.1.

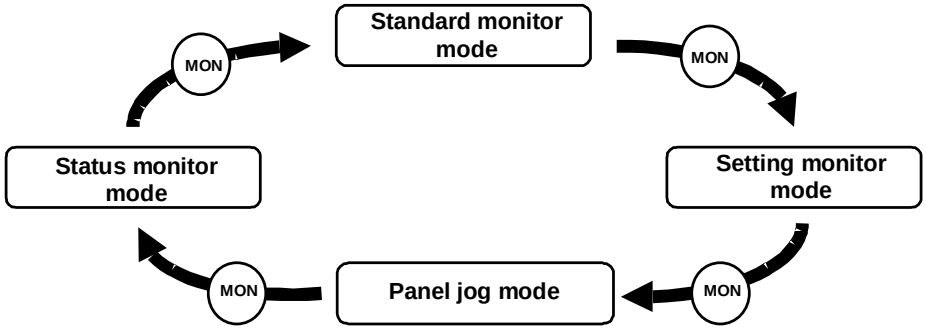
Pressing the key (MON) will move the inverter through each of the modes.



Panel jog mode : This mode allows you to jog the motor by controlling the operation from the operation panel.
This mode is hidden by default.

To use the panel jog mode, set the parameter F262 to 1.

Here is the sequence in which modes change each time you press the MON key.



Note: When the inverter is in operation (RUN lamp is blinking) or when an operation command is issued (RUN lamp is lit), the inverter cannot be switched to panel jog mode.

4.1 How to set parameters

Standard monitor mode

The standard default parameters are programmed before the unit is shipped from the factory. Parameters can be divided into 4 major categories. Select the parameter to be changed or to be searched and retrieved.

Basic parameters : The basic parameters that must be programmed before the first use. (See 4.1.1)

Extended parameters : The parameters for detailed and special setting. (See 4.1.2)

User parameters (automatic edit function) : Indicates parameters that are different from the standard default setting parameters. Use them to check after setting and to change setting. (Parameter title: Gr.U). (See 4.1.3)

History parameter : This parameter has the function of displaying, in reverse chronological order, the five parameters that were changed last. This function comes in very handy when you adjust the inverter repeatedly using the same parameter. (Parameter name: AUH). (See 4.1.4)

* Adjustment range of parameters

H 1: An attempt has been made to assign a value that is higher than the programmable range. Or, as a result of changing other parameters, the programmed value of the parameter that is now selected exceeds the upper limit.

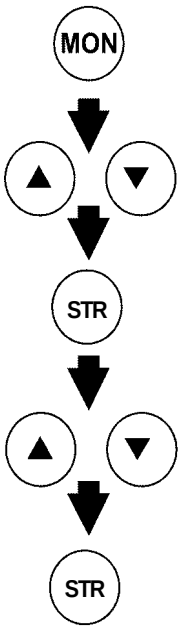
L 0: An attempt has been made to assign a value that is lower than the programmable range. Or, as a result of changing other parameters, the programmed value of the parameter that is now selected exceeds the lower limit.

If the above alarm is flashing on and off, no setting can be done of values that are equal to or greater than H 1 or equal to or lower than L 0.

4.1.1 How to set the basic parameters

All of the basic parameters can be set by the same step procedures.

[Steps in key entry for basic parameters]



Switches to the setting monitor mode.

Selects parameter to be changed.

Reads the programmed parameter setting.

Changes the parameter setting.

Saves the changed value of the parameter setting.

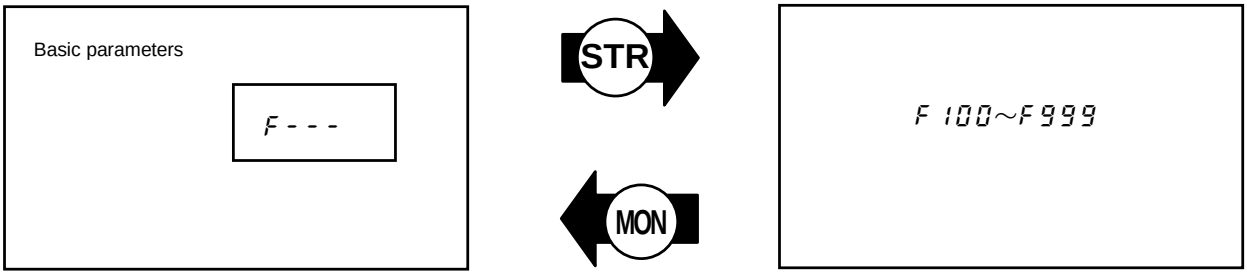
* Parameters were factory-set by default before shipment.
* Select the parameter to be changed from "Table of parameters".
* If there is something that you do not understand during the operation, press the MON key to return to the 0.0 indication.
* See 11.2 for basic parameters.

Steps in setting are as follows (the example shown is one of changing the maximum frequency from 80Hz to 60Hz).

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F710=0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	FH	Press either the △ or ▽ key to select "FH".
STR	80.0	Pressing the STR key reads the maximum frequency.
▲ ▼	60.0	Press the △ key to change the maximum frequency to 60Hz.
STR	60.0⇔FH	Press the STR key to save the maximum frequency. FH and the frequency are displayed alternately.
After this, STR →Displays the same programmed parameter.	MON →Switches to the display in the status monitor mode.	▲ ▼ →Displays names of other parameters.

4.1.2 How to set extended parameters

The HF-320 has extended parameters to allow you to make full use of its functions.
All extended parameters are expressed with F and three digits.

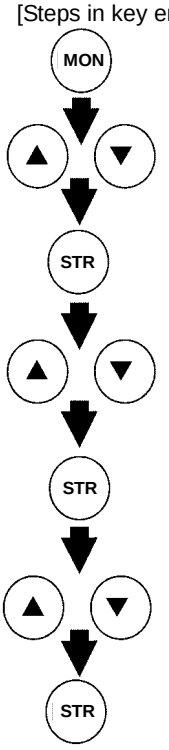


Press the MON key once and use the ▲▼ key to select F - - - from the basic parameters.

Press the ▲ key or the ▼ key to change the set value. Pressing the STR key allows the reading of parameter setting.

4

[Steps in key entry for extended parameters]



: switches to the setting monitor mode.(Displays AUX)

* See 11.3 for extended parameters.

: Selects "F - - -" from basic parameters.

: The first extended parameter "F 100" (Low-speed signal output frequency) is displayed.

: Selects the extended parameter whose setting needs to be changed.

: Reads the programmed parameter setting.

: Changes the parameter setting.

Saves the changed value of the extended parameter setting.

Pressing the MON key instead of the STR key moves back to the previous status.

■ Example of parameter setting

Steps in setting are as follows

(Example of changing the dynamic braking selection F304 from 0 to 1.)

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F710=0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	F---	Press either the △ or the ▽ to change to the parameter group F---.
STR	F100	Press the STR key to display the first extended parameter F100.
▲ ▼	F304	Press the △ key to change to the dynamic braking selection F304.
STR	0	Pressing the STR key allows the reading of parameter setting.
▲ ▼	1	Press the △ key to change the dynamic braking selection from 0 to 1.
STR	1⇔F304	Pressing the STR key alternately flashes on and off the parameter and changed value and allows the save of those values.

If there is anything you do not understand during this operation, press the MON key several times to start over from the step of AUH display.

4.1.3 Search and resetting of changed parameters (Gr.U)

Automatically searches for only those parameters that are programmed with values different from the standard default setting and displays them in the user parameter group Gr.U. Parameter setting can also be changed within this group.

Notes on operation

- If you reset a parameter to its factory default, the parameter will no longer appear in Gr.U.

■ How to search and reprogram parameters

The operations of search and resetting of parameters are as follows.

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F710=0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	Gr.U	Press △ or ▽ key to select Gr.U.

Key operated	LED display	Operation
STR	U - - -	Press the STR key to enable the user parameter automatic edit function.
STR or ▲ ▼	U - - F (U - - r) ↓ ACC	Searches for parameters that are different in value from the standard default setting and displays those parameters. Press the STR key or the △ key to change the parameter displayed. (Pressing the▽ key moves the search in the reverse direction).
STR	8.0	Press the STR key to display the set value.
▲ ▼	5.0	Press the△ key and▽ key to change set value.
STR	5.0⇔ACC	Press the STR key to save the changed value. The parameter name and the programmed value will flash on and off alternately. After the change has been saved, "U - - -" is displayed.
▲ (▼)	U - - F (U - - r)	Use the same steps as those given above to display parameters that you want to search for or change setting with the△ key and▽ key.
▲ (▼)	Gr.U	When Gr. U appears again, the search is ended.
MON MON	Gr.U ↓ Fr - F ↓ 0.0	A search can be canceled by pressing the MON key. Press the MON key once while the search is underway to return to the display of parameter setting mode. After that you can press the MON key to return to the status monitor mode or the standard monitor mode (display of operation frequency).

If there is anything you do not understand during this operation, press the (MON) key several times to start over from the step of auh display.

4.1.4 Searching for a history of changes, using the history function (AUH)

History function (AUH):
Automatically searches for 5 latest parameters that are programmed with values different from the standard default setting and displays them in the AUH. Parameter setting can also be changed within this group AUH.

Notes on operation
- If no history information is stored, this parameter is skipped and the next parameter "AU 1" is displayed.
- HEAd and End are added respectively to th efirst and last parameters in a history of changes.

■ How to use the history function

Key operated	LED display	Operation
	0.0	Displays the operation frequency (operation stopped). (When standard monitor display selection F710=0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
STR	ACC	The parameter that was set or changed last is displayed.
STR	8.0	Press the STR key to display the set value.
▲ ▼	5.0	Press the △ key and ▽ key to change set value.
STR	5.0⇔ACC	Press the STR key to save the changed value. The parameter name and the programmed value will flash on and off alternately.
▲ (▼)	****	Use the same steps as those given above to display parameters that you want to search for or change setting with the △ key and ▽ key.
▲ (▼)	HEAd (End)	HEAd: First historic record End: Last historic record
MON MON MON	Parameter display ↓ AUH ↓ Fr-F ↓ 0.0	Press the MON key to return to the parameter setting mode "AUH." After that you can press the MON key to return to the status monitor mode or the standard monitor mode (display of operation frequency).

4.1.5 Parameters that cannot be changed while running

For reasons of safety, the following parameters have been set up so that they cannot be reprogrammed while the inverter is running. Stop operation ("0.0" or "off" is displayed) before changing parameter settings.

[Basic parameters]

- AU1 (Automatic acceleration/deceleration)
- AU2 (Automatic torque boost)
- AU4 (Automatic function setting)
- CMOd (Command mode selection)
- FMOd (Frequency setting mode selection 1)

} Set F736, and they can be changed while the inverter is running.

- tYP (Default setting)
- FH (Maximum frequency)
- uL (Base frequency 1)
- uLu (Base frequency voltage1)
- Pt (V/F control mode selection 1)

[Extended parameters]

F105	: Priority selection
F109~F118	: Input terminal selection parameters
F130~F139	: Output terminal selection parameters
F170	: Base frequency 2
F171	: Base frequency voltage 2
F261	: Jog stopping pattern
F301~F311	: Protection parameters
F316	: Carrier frequency control mode selection
F342	: Braking mode selection
F343	: Release frequency
F345	: Creeping frequency
F400	: Auto-tuning
F415~F419	: Motor constant parameters
F480	: Exciting strengthening coefficient
F485	: Stall cooperation gain at field weakening zone 1
F492	: Stall cooperation gain at field weakening zone2
F494	: Motor adjustment factor
F603	: Emergency stop selection
F605	: Output phase failure detection mode selection
F608	: Input phase failure detection mode selection
F613	: Detection of output short-circuit during start-up selection
F626	: Over-voltage stall protection level
F627	: Under voltage trip/alarm selection
F669	: Logic output/pulse train output selection (OUT-NO)

The setting of any parameter other than the above can be changed even during operation.
Keep in mind, however, that when the parameter F700 (prohibition of change of parameter settings) is set to 1 (prohibited), no parameters can be set or changed.

4.1.6 Returning all parameters to standard default setting

Setting the standard default setting parameter tYP=8, all parameters can be returned to the those factory default settings.

Note: For more details on the standard default setting parameter tYP, see 5.6.

Notes on operation

- We recommend that before this operation you write down on paper the values of those parameters, because when setting tYP=8, all parameters with changed values will be returned to standard factory default setting.
- Note that FN, FNSL, F109, F669 and F880 will not be reset to their factory default settings.

■ Steps for returning all parameters to standard default setting

Key operated	LED display	Operation
	0.0	Displays the operation frequency (perform during operation stopped).
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	tYP	Press the △ key or the ▽ key to change to tYP.
STR	3 0	Pressing the STR key displays the programmed parameters. (tYP will always display "0 (zero)" on the right, the previous setting on the left.)
▲ ▼	3 8	Press the△ key or the▽ key to change the set value. To return to standard factory default setting, change to "8".
STR	In It	Pressing the STR key displays " In It " while returning all parameters to factory default setting.
	0.0	The monitor returns to the display of setup parameters.

If there is anything you do not understand during this operation, press the MON key several times to start over from the step of AUH display.

5. Basic parameters

Before you operate the inverter, the parameters that you must first program are the basic parameters.

5.1 Setting acceleration/deceleration time

AU 1 : Automatic acceleration/deceleration

ACC : Acceleration time 1

dEC : Deceleration time 1

- Function
  1) For acceleration time 1 ACC programs the time that it takes for the inverter output frequency to go from 0Hz to maximum frequency FH.
  2) For deceleration time 1 dEC programs the time that it takes for the inverter output frequency to got from maximum frequency FH to 0Hz.

5.1.1 Automatic acceleration/deceleration

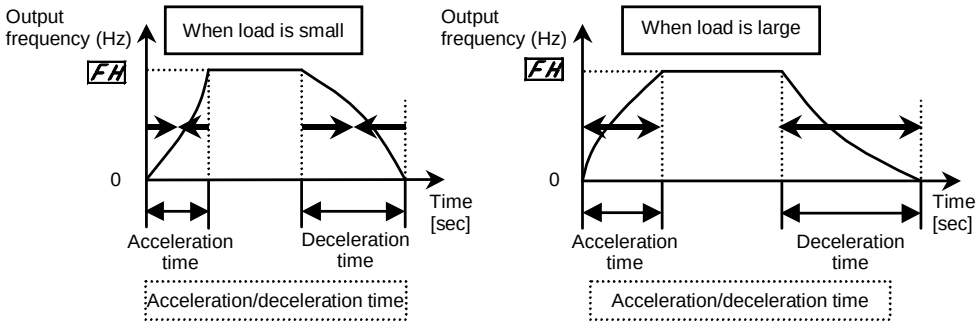
This automatically adjusts acceleration and deceleration time in line with load size.

AU 1 = 1

* Adjusts the acceleration/deceleration time automatically within the range of 1/8 to 8 times as long as the time set with the ACC or dEC, depending on the current rating of the inverter.

AU 1 =2

* Automatically adjusts speed during acceleration only. During deceleration, speed is not adjusted automatically but reduced at the rate set with dEC.



Set AU 1 (automatic acceleration/deceleration) to 1 or 2.

[Parameter setting]

Title	Function	Adjustment range	Default setting
AU1	Automatic acceleration/deceleration	0: Disabled (manual) 1: Automatic 2: Automatic (only at acceleration)	0

☆ When automatically setting acceleration/deceleration time, always change the acceleration/deceleration time so that it conforms with the load. The acceleration/deceleration time changes constantly with load fluctuations. For inverters that requires a fixed acceleration/deceleration time, use the manual settings (ACC, dEC).

☆ Setting acceleration/deceleration time (ACC,dEC) in conformance with mean load allows optimum setting that conforms to further changes in load.

☆ Use this parameter after actually connecting the motor.

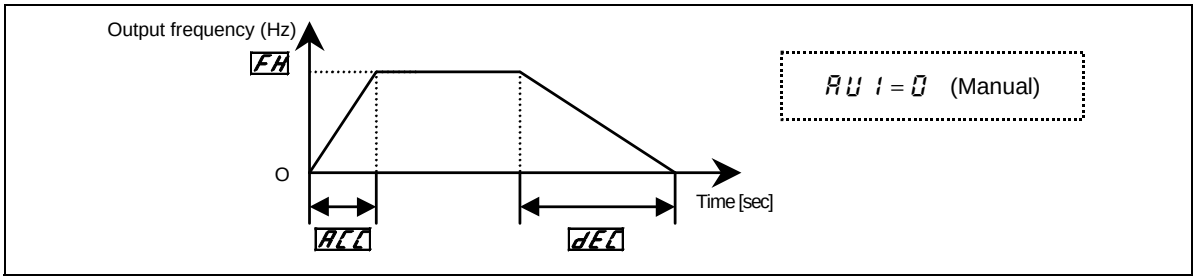
☆ When the inverter is used with a load that fluctuates considerably, it may fail to adjust the acceleration or deceleration time in time, and therefore may be tripped.

[Methods of setting automatic acceleration/deceleration]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲	AU1	Press the△ key to change the parameter to AU1.
STR	0	Pressing the STR key allows the reading of parameter setting.
▲	1	Press the △ key to change the parameter to 1 or 2.
STR	1⇔AU1	Press the STR key to save the changed parameter. AU1 and the parameter are displayed alternately.

5.1.2 Manually setting acceleration/deceleration time

Set acceleration time from 0 (Hz) operation frequency to maximum frequency FH and deceleration time as the time when operation frequency goes from maximum frequency FH to 0 (Hz).



[Parameter setting]

Title	Function	Adjustment range	Default setting
ACC	Acceleration time 1	0.0-3200 sec.	10.0
dEC	Deceleration time 1	0.0-3200 sec.	10.0

Note: When the acceleration/deceleration time is set at 0.0 seconds, the inverter speed increases or reduces speed within 0.05 seconds.

☆ If the programmed value is shorter than the optimum acceleration/deceleration time determined by load conditions, overcurrent stall or overvoltage stall function may make the acceleration/deceleration time longer than the programmed time. If an even shorter acceleration/deceleration time is programmed, there may be an overcurrent trip or overvoltage trip for inverter protection. (For further details, see 13.1)

5.2 Increasing starting torque

AU2: Automatic torque boost

- Function
  Simultaneously switches inverter output (V/F) control and programs motor constants automatically (On-line automatic-tuning function) to improve torque generated by the motor. This parameter integrates the setting of special V/F control selection such as vector control.

Title	Function	Adjustment range	Default setting
AU2	Automatic torque boost	0: Disabled 1: Automatic torque boost + auto-tuning 2: Sensorless vector control + auto-tuning 3: Energy saving + auto-tuning	0

Note: Parameter displays on the right always return to 0 after setting. The previous setting is displayed on the left.
Ex. 1 0

1) Increasing torque automatically according to the load

Set the automatic control AU2 is set to 1 (automatic torque boost + auto-tuning)

When the automatic control parameter AU2 is set to 1 (automatic torque boost + auto-tuning), the inverter keeps track of the load current in any speed range and automatically adjusts the output voltage to ensure enough torque and stable operation.

[Setting methods]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (Perform during operation stopped.) (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲	AU2	Press the△ key to change the parameter to AU2 (automatic torque boost)
STR	0 0	Pressing the STR key allows the reading of parameter setting.
▲	0 1	Press the△ key to change the parameter to 1 (sensorless vector control + auto-tuning). (Programmed value at the right and the history at the left)
STR	0 1⇔AU2	Press the STR key to save the changed parameter. AU2 and the parameter are displayed alternately.

Note 1: The same characteristic can be obtained by setting the V/F control mode selection parameter Pt to 2 (automatic torque boost control) and the auto-tuning parameter F400 to 2 (auto-tuning).
⇒ See 5.12

Note 2: Setting AU2 to 1 automatically programs Pt to 2.

Note 3: The accuracy of auto-tuning can be increased by specifying the rated current of the driven motor, using the motor rated current setting parameter F415.

2) When using sensorless vector control (increasing starting torque and high-precision operations)

Set the automatic control AU2 to 2 (sensorless vector control + auto-tuning)

Setting Automatic control AU2 to 2 (sensorless vector control + auto-tuning) provides high starting torque bringing out the maximum in motor characteristics from the low-speed range. This suppresses changes in motor speed caused by fluctuations in load to provide high precision operation. This is an optimum feature for elevators and other load transporting machinery.

[Setting methods]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (Perform during operation stopped.) (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲	AU2	Press the △ key to change the parameter to AU2 (automatic torque boost)
STR	0 0	Pressing the STR key allows the reading of parameter setting.
▲	0 2	Press the △ key to change the parameter to 2 (sensorless vector control + auto-tuning). (Programmed value at the right and the history at the left)
STR	0 2 ⇔ AU2	Press the STR key to save the changed parameter. AU2 and the parameter are displayed alternately.

Note 1: The same characteristic can be obtained by setting the V/F control mode selection parameter Pt to 3 (Sensorless vector control) and the auto-tuning parameter F400 to 2 (auto-tuning).⇒ See 5.12

Note 2: Setting AU2 to 2 automatically programs Pt to 3.

3) Energy-saving operation

Automatic torque boost parameter AU2 is set to 3 (automatic energy saving + auto-tuning)

When the automatic control parameter AU2 is set to 3 (automatic torque boost + auto-tuning), the inverter always passes a current appropriate to the load for energy saving.

[Setting methods]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (Perform during operation stopped.) (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲	AU2	Press the △ key to change the parameter to AU2 (automatic torque boost)
STR	0 0	Pressing the STR key allows the reading of parameter setting.
▲	0 3	Change the parameter setting to 3 (energy saving + auto-tuning), using the △ key.
STR	0 3⇔ AU2	Press the STR key to save the changed parameter. AU2 and the parameter are displayed alternately.

Note 1: The same characteristic can be obtained by setting the V/F control mode selection parameter Pt to 4 (automatic energy saving) and the auto-tuning parameter F400 to 2 (auto-tuning).

Note 2: When AU2 is set to 3, Pt is automatically set to 4.

If sensorless vector control cannot be programmed....
First read the precautions about vector control in 5.11, 8.
1) If the desired torque cannot be obtained ⇒ see 6.17,2
2) If auto-tuning error "Etn" appears ⇒ see 6.17,3

■ AU2 (automatic torque boost) and Pt (V/F control mode selection 1)

Automatic torque boost is the parameter for setting V/F control mode selection 1 (Pt:3) and auto-tuning (F400) together. That is why all parameters related to change automatically when AU2 is changed.

		Automatically programmed parameters		
AU2		Pt		F400
0	Displays 0 after resetting	-	Check the programmed value of Pt. (If AU2 is not changed, it becomes 0 (V/F constant)	-
1	Automatic torque boost + auto-tuning	2	Automatic torque boost	Executed (0 after execution)
2	Sensorless vector control + auto-tuning	3	Sensorless vector control	Executed (0 after execution)
3	Energy saving + auto-tuning	4	Automatic energy saving	Executed (0 after execution)

5

4) Increasing torque manually (V/F constant control)

This is the setting of constant torque characteristics that are suited for such things as conveyors. It can also be used to manually increase starting torque.

If V/F constant control is programmed after changing AU2,

Set V/F control mode selection 1 Pt = 0 (V/F constant).

⇒ see 5.11

Note 1: To further increase torque, increase the torque boost amount 1ub.
How to set the torque boost amount 1ub ⇒ see 5.12

Note 2: V/F control selection 1 Pt = 1 (variable torque) is an effective setting for the load on such equipment as fans and pumps. ⇒ see 5.11

5.3 Specifying an operation mode, using parameters

AU4: Automatic function setting

- Function
  Automatically programs all parameters (parameters described below) related to the functions by selecting the inverter's operating method.
  The major functions can be programmed simply.

[Parameter setting]

Title	Function	Adjustment range	Default setting
AU4	Automatic function setting	0: Disabled 1: Coast stop 2: 3-wire operation 3: External input UP/DOWN setting 4: 4-20mA current input operation	0:

Automatically programmed functions and parameter set values

	Default setting	1: Coast stop	2: 3-wire operation	3: External input UP/DOWN setting	4: 4-20mA current input operation
CMOd	1: Operation panel	0: Terminal board	0: Terminal board	0: Terminal board	0: Terminal board
FMOd	0: Potentiometer	0: Potentiometer	0: Potentiometer	5: UP/DOWN from external contact	1: VRF
F110 (Always)	1: ST	0: Disabled	1: ST	1: ST	1: ST
F111 (FR)	2: FR	2: FR	2: FR	2: FR	2: FR
F112 (RR)	3: RR	3: RR	3: RR	3: RR	3: RR
F113 (RST)	10: RST	10: RST	10: RST	10: RST	10: RST
F114 (DFL)	6: DFL	6: DFL	6: DFL	41:UP	6: DFL
F115 (DFM)	7: DFM	7: DFM	7: DFM	42: DOWN	7: DFM
F116 (DFH)	8: DFH	1: ST	49: HD	43: CLR	38: FCHG
F201	0 (%)	-	-	-	20 (%)

Note) See K-15 for input terminal functions.

Disabled (AU4=0)

Input terminals and parameters are standards programmed at the factory.

Coast stop (AU4= 1)

Setting for coast stopping. In sink logic mode, closing the circuit between the DFH and COM terminals places the inverter in standby mode and opening the circuit places it in coast stop mode, because ST (standby signal) is assigned to the DFH terminal.

3-wire operation (AU4=2)

Can be operated by a momentary push-button. HD (operation holding) is assigned to the terminal DFH. A self-holding of operations is made in the inverter by connecting the stop switch (b-contact) to the DFH terminal and connecting the running switch (a-contact) to the FR terminal or the RR terminal.
Refer to 7.2(3) for details.

External input UP/DOWN setting (AU4=3)

Allows setting of frequency with the input from an external contact. Can be applied to changes of frequencies from several locations.
UP (frequency up signal input from external contact) is assigned to the DFL terminal, and DOWN (frequency down signal input from external contact) are assigned to the DFM and CLR (frequency up/down clear signal input from external contact) are assigned to the DFH terminals respectively. Frequencies can be changed by input to the DFL and DFM terminals.
Refer to 6.5.2(3) for details.

4-20 mA current input(AU4=4)

Used for setting frequencies with 4-20mA current input. Switching between remote control and manual control (different frequency commands) can be made by turning on or off the DFH terminal, because FCHG (forced change of frequency commands) is assigned to the DFH terminal with priority to current input.

5.4 Selection of operation mode

CMOd: Command mode selection

FMOd: Frequency setting mode selection 1

- Function
  These parameters are used to specify which input device (operation panel or terminal board) takes priority in entering an operation stop command or a frequency setting command (internal potentiometer, VRF, VRF2, operation panel, serial communication device, external contact up/down, VRF+VRF2).

<Command mode selection>

Title	Function	Adjustment range	Default setting
CMOd	Command mode selection	0: Terminal board 1: Operation panel	1

Programmed value

0: Terminal board operation — ON and OFF of an external signal Runs and stops operation.

1: Operation panel operation — Press the RUN and STOP RESET keys on the operation panel to Run and stop a run. (Performs the Run and stop of a run when the optional expansion panel is used.)

* There are two types of function: the function that conforms to commands selected by CMOd, and the function that conforms only to commands from the terminal board. See the table of input terminal function selection in Chapter 11.
* When priority is given to commands from a linked computer or terminal board, they have priority over the setting of CMOd.

<Frequency setting mode selection>

Title	Function	Adjustment range	Default setting
FMOd	Frequency setting mode selection 1	0: Built-in potentiometer 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact 6: VRF+VRF2 (Override)	0

[Programmed value]

0: Potentiometer — The internal potentiometer to the inverter is used for setting frequencies. Turning the notches clockwise raises the frequency.

1: VRF input — A frequency command is set by means of a signal from an external input device (VRF terminal: 0-10Vdc or 4-20mAdc).

2: VRF2 input — An external signal (VRF2 terminal: 0-10Vdc) is used to specify a frequency command.

3: Operation panel — Press the ▲ key or the ▼ key on either the operation panel or the expansion panel (optional) to set frequency.

4: Communication — Frequencies are set by commands from an external control unit.

5: UP/DOWN frequency — Terminals are used to specify an up/down frequency command.

6: VRF+VRF2 (Override) — The sum of the values entered through the VRF and VRF2 terminals is used as a frequency command value.

☆ No matter what value the command mode selection CMOd and the frequency setting mode selection FMOd are set to the control input terminal functions described below are always in operative state.

- Reset terminal (default setting: RST, valid only for tripping)
- Standby terminal (when programmed by programmable input terminal functions).
- External input tripping stop terminal command (when so set using the programmable input terminal function)

☆ To make changes in the command mode selection CMOd and the frequency setting mode selection 1 FMOd, first stop the inverter temporarily.
(Can be changed while in operation when F736 is set to 0.)

■ Preset-speed operation
CMOd: Set to 0 (Terminal board).
FMOd: Valid in all setting values.

5.5 Meter setting and adjustment

FMSL: Meter selection

FM: Meter adjustment

- Function
  The signal output from the FRQ terminal is an analog voltage signal.
  For the meter, use either a full-scale 0-1mAdc ammeter or full-scale 0-7.5Vdc (or 10Vdc-1mA) voltmeter.
  Switching to 0-20mAdc (4-20mAdc) current input can be made by turning the FRQ slide switch to the I position. When switching to 4-20mAdc current input, make adjustments using F691 (analog output gradient) and F692 (analog output bias).

[Connected meter selection parameters]

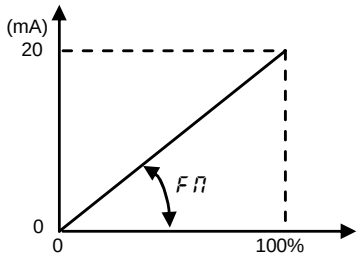
Title	Function	Adjustment range	Default setting
FMSL	Meter selection	0: Output frequency 1: Output current 2: Set frequency 3: DC voltage 4: Output voltage command value 5: Input power 6: Output power 7: Torque 8: Torque current 9: Motor cumulative load factor 10: Inverter cumulative load factor 11: DBR (braking resistor) cumulative load factor 12: Frequency setting value (after PID) 13: VRF Input value 14: VRF2 Input value 15: Fixed output 1 (Output current: 100%) 16: Fixed output 2 (Output current: 50%) 17: Fixed output 3 (Other than the output current: 100%) 18: Serial communication data 19: For adjustments (fm set value is displayed.)	0
FM	Meter adjustment	-	-

■ Resolution

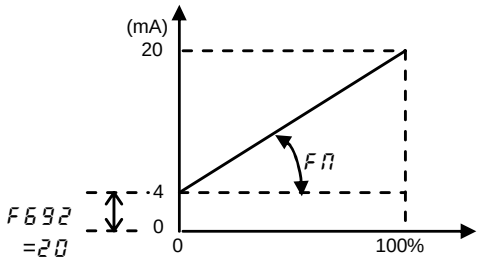
All FRQ terminals have a maximum of 1/256.

■ Example of 4-20mA programmed output (for details, see 6.20.2)

F691=1, F692=0



F691=1, F692=20



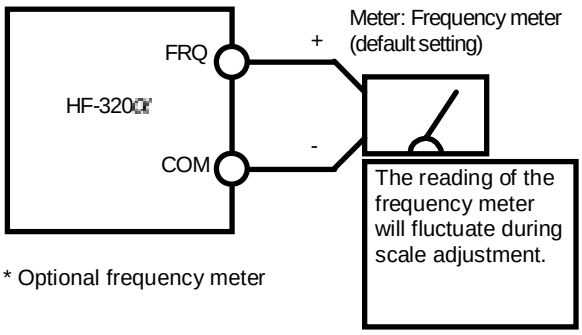
Note) Note that, if fmsl is set to 7 (torque), data will be updated at intervals of more than 40 ms.

5

■ Adjustment scale with meter adjustment FM parameter

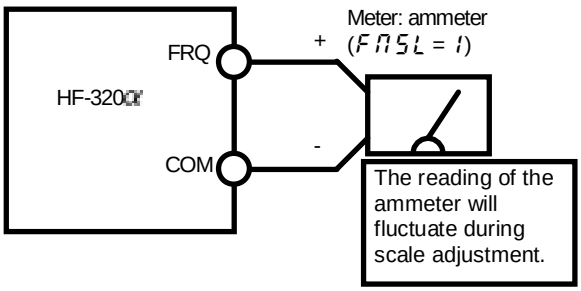
Connect meters as shown below.

<Frequency meter>



* Optional frequency meter

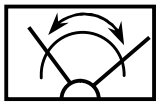
<Ammeter>



* Make the maximum ammeter scale at least 150 percent of the inverter's rated output current.

[Example of how to adjustment the FRQ terminal frequency meter]

* Use the meter's adjustment screw to pre-adjust zero-point.

Key operated	LED display	Operation
-	60.0	Displays the operation frequency. (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	FM	Press either the △ or the ▽ key to select "FM".
STR	60.0	Press the STR key to display the operation frequency
▲ ▼	60.0	Press either the △ key or the ▽ key to adjust the meter. The meter reading will change at this time but be careful because there will be no change in the inverter's digital LED (monitor) indication.  [Hint] It's easier to make the adjustment if you push and hold for several seconds.
STR	60.0 ⇔ FM	The adjustment is complete. FM and the frequency are displayed alternately.
MON + MON	60.0	The display returns to its original indications. (When standard monitor display selection F710 is set to 0 [Operation frequency])

■ Adjusting the meter in inverter stop state

If, when adjusting the meter for output current, there are large fluctuations in data during adjustment, making adjustment difficult, the meter can be adjusted in inverter stop state.

When setting FM5L to 15 for fixed output 1 (100% output current), a signal of absolute values will be output (inverter's rated current = 100%). In this state, adjust the meter with the FM (Meter adjustment) parameter.

Similarly, if you set FM5L to 16 for fixed output 2 (output current at 50%), a signal that is sent out when half the inverter's rated current is flowing will be output through the FRQ terminal.

After meter adjustment is ended, set FM5L to 1 (output current).

5.6 Standard default setting

tYP: Default setting

- Function,
  Allows setting of all parameters to the standard default setting, etc. at one time.
  Note that FN, FNSL, F 109, F669 and F880 will not be reset to their factory default settings.

Title	Function	Adjustment range	Default setting
tYP	Default setting	0: - 1: 50Hz default setting 2: 60Hz default setting 3: Don't choose 4: Trip record clear 5: Cumulative operation time clear 6: Initialization of type information 7: Don't choose 8: Standard default setting (Initialization) 9: Cumulative fan operation time record clear	0

★ This function will be displayed as 0 during reading on the right. This previous setting is displayed.
Example: 3 0

★ tYP cannot be set during the inverter operating. Always stop the inverter first and then program.

Programmed value

Trip clear (tYP = 4)

Setting tYP to 4 initializes the past four sets of recorded error history data.

☆ The parameter does not change.

Cumulative operation time clear (tYP = 5)

Setting tYP to 5 resets the cumulative operation time to the initial value (zero).

Cumulative operation time clear (tYP = 6)

Setting typ to 6 clears the trips when an EtYP format error occurs. But if the EtYP displayed, call us.

Default setting (tYP = 8)

Setting tYP to 8 will return all parameters to the standard values that were programmed at the factory.

☆ When 8 is programmed, <In·t will be displayed for a short time after setting and will then be erased and displayed the original indication 0.0. Trip history data will be cleared at this time.

Cumulative fan operation time record clear (tYP = 9)

Setting tYP to 9 resets the cumulative operation time to the initial value (zero).
Set this parameter when replacing the cooling fan, and so on.

5.7 Forward/reverse run selection (Operation panel operation)

Fr: Forward/reverse run selection (Operation panel operation)

- Function
  Program the direction of rotation of the motor when the running and stopping are made using the RUN key and STOP/RESET key on the operation panel.
  Valid when CMOd (command mode) is set to 1 (operation panel).

■ Parameter setting

Title	Function	Adjustment range	Default setting
Fr	Forward/reverse run selection (Operation panel operation)	0: Forward run 1: Reverse run 2: Forward run (F/R switching possible) 3: Reverse run (F/R switching possible)	0

★ When Fr is set to 2 or 3 and an operating status is displayed, pressing the ▲ key with the STRT key held down changes the direction of rotation from reverse to forward after displaying the message "Fr - F." Pressing the ▲ key again with the STRT key held down changes the direction of rotation from forward to reverse after displaying the message "Fr - r."

★ Check the direction of rotation on the status monitor. For monitoring, see8.1
Fr - F: Forward run
Fr - r: Reverse run

★ When the FR and RR terminals are used for switching between forward and reverse rotation from the terminal board, the Fr forward/reverse run selection parameter is rendered invalid.
Short across the FR-COM terminals: forward rotation
Short across the RR-COM terminals: reverse rotation.

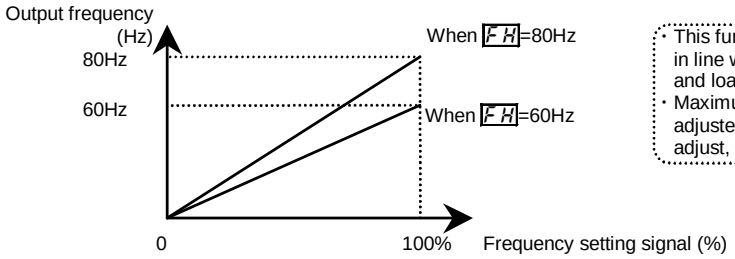
★ The inverter was factory-configured by default so that shorting terminals FR-COM and terminals RR-COM simultaneously would cause the motor to slow down to a stop. Using parameter F105, however, you can choose between stop and reverse run.
Using the parameter F105, however, you can select between forward run and reverse run.

★ This function is valid only when CMOd is set to 1 (operation panel).

5.8 Maximum frequency

FH : Maximum frequency

- Function
  1) Programs the range of frequencies output by the inverter (maximum output values).
  2) This frequency is used as the reference for acceleration/deceleration time.



- This function determines the value in line with the ratings of the motor and load.
- Maximum frequency cannot be adjusted during operation.To adjust, first stop the inverter.

★ If FH is increased, adjust the upper limit frequency UL as necessary.

■ Parameter setting

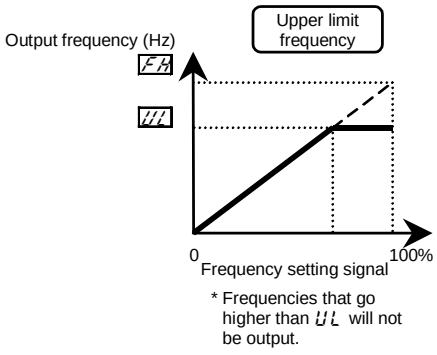
Title	Function	Adjustment range	Default setting
FH	Maximum frequency	30.0-500.0 (Hz)	60.0

5.9 Upper limit and lower limit frequencies

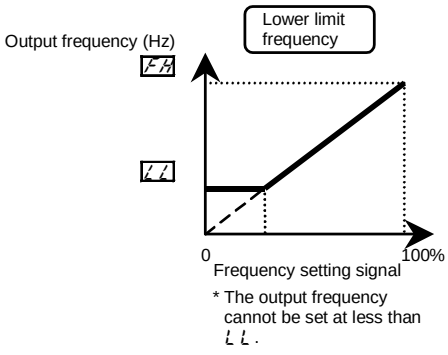
UL : Upper limit frequency

LL : Lower limit frequency

- Function
  Programs the lower limit frequency that determines the lower limit of the output frequency and the upper limit frequency that determines the upper limit of that frequency.



* Frequencies that go higher than UL will not be output.



* The output frequency cannot be set at less than LL.

■ Parameter setting

Title	Function	Adjustment range	Factory default setting
UL	Upper limit frequency	0.5 - FH (Hz)	60.0
LL	Lower limit frequency	0.0 - UL (Hz)	0.0

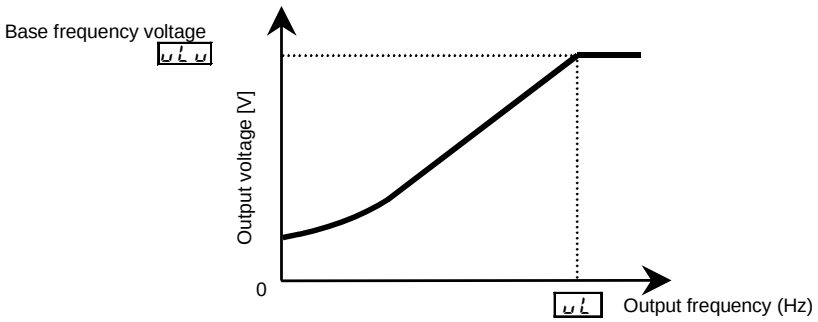
5.10 Base frequency

UL: Base frequency 1

ULU: Base frequency voltage 1

- Function
  Sets the base frequency and the base frequency voltage in conformance with load specifications or the Base frequency.

Note: This is an important parameter that determines the constant torque control area.



Title	Function	Adjustment range	Factory default setting
UL	Base frequency 1	25.0-500.0 (Hz)	60.0
ULU	Base frequency voltage1	50-330 (V) : 200V class 50-660 (V) : 400/600V class	200 (200V class) 400 (400V class)

5.11 Selecting control mode

Pt: V/F control mode selection

- Function
  With HF-320□, the V/F controls shown below can be selected.

○V/F constant
○Variable torque
○Automatic torque boost control *1
○Sensorless vector control *1
○Automatic energy saving *1
○Dynamic automatic energy-saving (for fans and pumps)
(*1) "Automatic torque boost": AU2 parameter can automatically set this parameter and auto-tuning at a time.

■ Parameter setting

Title	Function	Adjustment range	Default setting
Pt	V/F control mode selection 1	0: V/F constant 1: Variable torque 2: Automatic torque boost control 3: Sensorless Vector control 4: Automatic energy-saving 5: Dynamic automatic energy-saving (for fans and pumps) 6: Don't choose	0

Steps in setting are as follows
(In this example, the V/F control mode selection parameter Pt is set to 3 (sensorless vector control).

[Setting V/F control mode selection to 3 (sensorless vector control)]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (Perform during operation stopped.) (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲	Pt	Press the △key to change the parameter to Pt (V/F control mode selection).
STR	2	Press the STR key to display the parameter setting. (Standard default setting: 2 (automatic torque boost control)).
▲	3	Press the△ key to change the parameter to 3 (vector control).
STR	3 ⇔ Pt	Press the STR key to save the changed parameter. Pt and parameter set value "3" are displayed alternately.

Warning:

When setting the V/F control mode selection 1 parameter (Pt) to any number between 2 and 5, be sure to set at least the following parameters.

F415 (Motor rated current): See the motor's nameplate.

F416 (No-load current of motor): Refer to the motor test report.

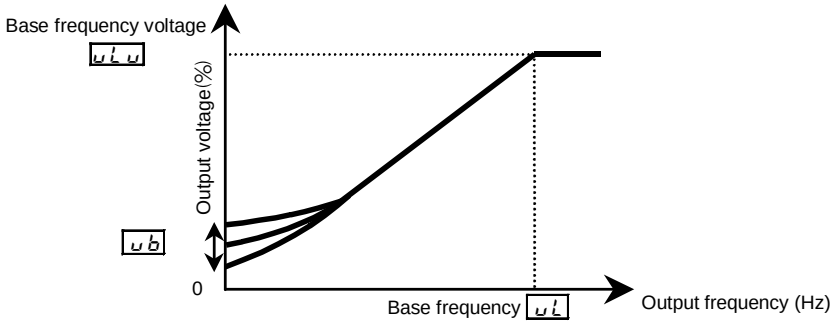
F417 (Rated rotational speed of motor): See the motor's nameplate.

Set also other torque boost parameters (F401 to F494), as required.

1) Constant torque characteristics

Setting of V/F control mode selection Pt to 0 (V/F constant)

This is applied to loads with equipment like conveyors and cranes that require the same torque at low speeds as at rated speeds.



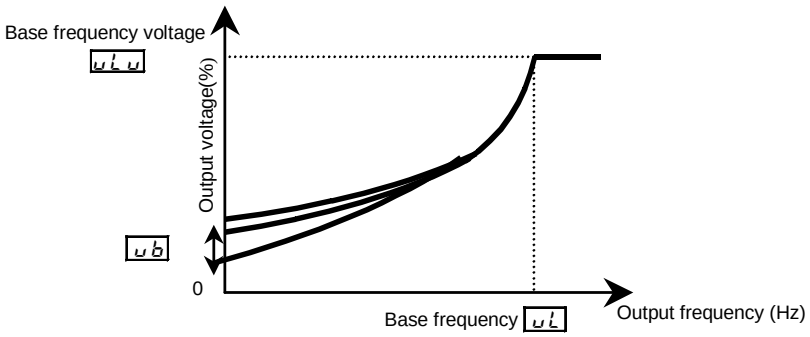
* To increase the torque further, increase the setting value of the manual torque boost ub.

⇒ For more details, see 5.12.

2) Setting for fans and pumps

Setting of V/F control mode selection Pt to 1 (variable torque)

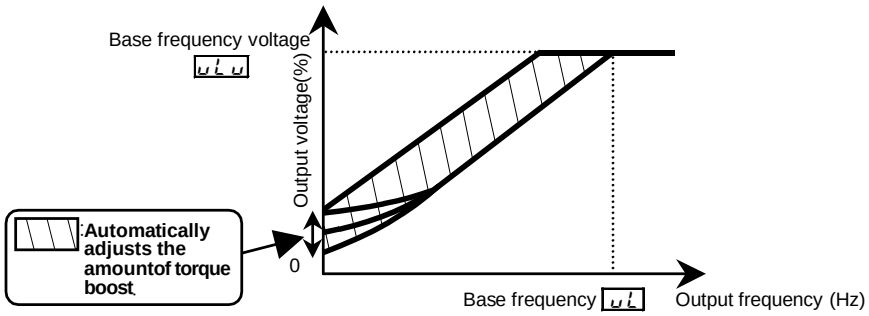
This is appropriate for load characteristics of such things as fans, pumps and blowers in which the torque in relation to load rotation speed is proportional to its square.



3) Increasing starting torque

Setting of V/F control mode selection Pt to 2 (automatic torque boost control)

Detects load current in all speed ranges and automatically adjusts voltage output (torque boost) from inverter. This gives steady torque for stable runs.



Note: This control system can oscillate and destabilize runs depending on the load. If that should happen, set V/F control mode selection Pt to 0 (V/F constant) and increase torque manually.

5

★ Motor constant must be set

If the motor you are using is a 4P Sumitomo AF motor and if it has the same capacity as the inverter, there is basically no need to set the motor constant. In any other case, be sure to set the parameters F415 to F417 properly.

Be sure to set F415 (rated current of motor) and F417 (rated speed of motor) correctly, as specified on the motor's nameplate. For the setting of F416 (no-load current of motor), refer to the motor test report. There are three procedures for setting the other motor constants.

1) Auto torque boost and a motor constant (auto-tuning) can be set at once.
   To do so, set the basic parameter AU2 to 1. ⇒For details, see 1 in 5.2.
2) The motor constant can be automatically set (auto-tuning). Set the extended parameter F400 to 2.
   ⇒ For details, see selection 2 in 6.17.
3) Each motor constant can be set individually. ⇒ For details, see selection 3 in 6.17.

4) Sensorless vector control - increasing starting torque and achieving high-precision operation.

Setting of V/F control Pt to 3 (Sensorless vector control)

Using sensor-less vector control with a Sumitomo AF motor will provide the highest torque at the low speed ranges.

(1) Provides large starting torque.
(2) Effective when stable operation is required to move smoothly up from the low speeds.
(3) Effective in elimination of load fluctuations caused by motor slippage.

★ Motor constant must be set

If the motor you are using is a 4P Sumitomo AF motor and if it has the same capacity as the inverter, there is basically no need to set the motor constant. In any other case, be sure to set the parameters F415 to F417 properly.

Be sure to set F415 (rated current of motor) and F417 (rated speed of motor) correctly, as specified on the motor's nameplate. For the setting of F416 (no-load current of motor), refer to the motor test report. There are three procedures for setting the other motor constants.

1) The sensorless vector control and motor constants (auto-tuning) can be set at a time.
   Set the basic parameter AU2 to 2. ⇒ For details, see 1 in 5.2.
2) The motor constant can be automatically set (auto-tuning).
   Set the extended parameter F400 to 2. ⇒ For details, see selection 2 in 6.17.
3) Each motor constant can be set individually. ⇒ For details, see selection 3 in 6.17.

5) Energy-saving

Setting of V/F control mode selection Pt to 4 (automatic energy-saving)

Energy can be saved in all speed areas by detecting load current and flowing the optimum current that fits the load.

★ Motor constant must be set

If the motor you are using is a 4P Sumitomo AF motor and if it has the same capacity as the inverter, there is no need to set the motor constant. In any other case, be sure to set the parameters F415 to F417 properly.

Be sure to set F415 (rated current of motor) and F417 (rated speed of motor) correctly, as specified on the motor's nameplate. For the setting of F416 (no-load current of motor), refer to the motor test report. There are three procedures for setting the other motor constants.

1) Automatic energy-saving operation and a motor constant can be set at once. Set the basic parameter AU2 to 3.
   ⇒ For details, see 1 in 5.2.
2) The motor constant can be automatically set (auto-tuning). Set the extended parameter F400 to 2.
   ⇒ For details, see selection 2 in 6.17.
3) Each motor constant can be set individually. ⇒ For details, see selection 3 in 6.17.

6) Achieving further energy savings

Setting of V/F control mode selection Pt to 5 (dynamic automatic energy-saving)

More substantial energy savings than those provided by setting Pt to 4 can be achieved in any speed range by keeping track of the load current and passing a current appropriate to the load. The inverter cannot respond to rapid load fluctuations, so that this feature should be used only for loads, such as fans and pumps, that are free of violent load fluctuations.

★ Motor constant must be set

If the motor you are using is a 4P Sumitomo AF motor and if it has the same capacity as the inverter, there is no need to set the motor constant. In any other case, be sure to set the parameters F415 to F417 properly.

Be sure to set F415 (rated current of motor) and F417 (rated speed of motor) correctly, as specified on the motor's nameplate. For the setting of F416 (no-load current of motor), refer to the motor test report.

For other types of motors, there are two ways to set a motor constant.

1) The motor constant can be set automatically (auto-tuning). Set the extended parameter F400 to 2.
   ⇒ For details, see selection 2 in 6.17.
2) Each motor constant can be set individually ⇒ For details, see selection 3 in 6.17.

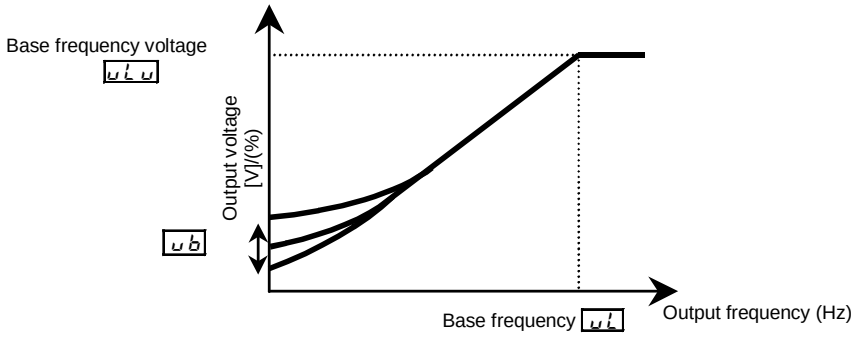
7) Precautions on sensorless vector control

1) When exercising sensorless vector control, be sure to set the extended parameters F415 to F417 properly. Be sure to set F415 (rated current of motor) and F417 (rated speed of motor) correctly, as specified on the motor's nameplate. For the setting of F416 (no-load current of motor), refer to the motor test report.
2) The sensorless vector control exerts its characteristics effectively in frequency areas below the base frequency (uL). The same characteristics will not be obtained in areas above the base frequency.
3) Set the base frequency to anywhere from 40 to 120Hz during sensorless vector control (Pt=3).
4) Use a general purpose squirrel-cage motor with a capacity that is the same as the inverter's rated capacity or one rank below.
   The minimum applicable motor capacity is 0.1kW.
5) Use a motor that has 2-8 P.
6) Always operate the motor in single operation (one inverter to one motor). Sensorless vector control cannot be used when one inverter is operated with more than one motor.
7) The maximum length of wires between the inverter and motor is 30 meters. If the wires are longer than 30 meters, set standard auto-tuning with the wires connected to improve low-speed torque during sensorless vector control.
   However the effects of voltage drop cause motor-generated torque in the vicinity of rated frequency to be somewhat lower.
8) Connecting a reactor or surge voltage suppression filter between the inverter and the motor may reduce motor-generated torque. Setting auto-tuning may also cause a trip (Etn1) rendering sensorless vector control unusable.

5.12 Manual torque boost - increasing torque boost at low speeds

ub: Torque boost 1

- Function
  If torque is inadequate at low speeds, increase torque by raising the torque boost rate with this parameter.



[Parameters]

Title	Function	Adjustment range	Default setting
ub	Torque boost 1	0.0 - 30.0 (%)	According to model (See Chapter 11, K-14)

★ Valid when Pt is set to 0 (V/F constant) or 1 (square reduction)

Note 1: The optimum value is programmed for each inverter capacity. Be careful not to increase the torque boost rate too much because it could cause an overcurrent trip at startup.

5.13 Setting the electronic thermal

tHr: Motor electronic-thermal protection level 1

OLn: Electronic thermal protection characteristic selection

- Function
  This parameter allows selection of the appropriate electronic thermal protection characteristics according to the particular rating and characteristics of the motor.

■ Parameter setting

Title	Function	Adjustment range				Default setting
tHr	Motor electronic thermal protection level 1	10 - 100 (%)				100
OLn	Electronic-thermal protection characteristic selection	Setting value		Overload protection	Overload stall	○
		0	Standard motor	○	×	
		1		○	○	
		2		×	×	
		3		×	○	
		4	AF motor (inverter motor)	○	×	
		5		○	○	
		6		×	×	
		7		×	○	

* ○ : valid, × : invalid

1) Setting the electronic thermal protection characteristics selection OLn and motor electronic thermal protection level 1 tHr

The electronic thermal protection characteristics selection OLn is used to enable or disable the motor overload trip function (OL2) and the overload stall function.

While the inverter overload trip (OL1) will be in constant detect operation, the motor overload trip (OL2) can be selected using the parameter OLn.

Explanation of terms

Overload stall: This is an optimum function for equipment such as fans, pumps and blowers with variable torque characteristics that the load current decreases as the operating speed decreases.

When the inverter detects an overload, this function automatically lowers the output frequency before the motor overload trip OL2 is activated. This function operates a motor at frequencies that allow the load current to keep its balance so that the inverter can continue operation without being tripped.

Note: Do not use the overload stall function with loads having constant torque characteristics (such as conveyor belts in which load current is fixed with no relation to speed).

[Using standard motors (other than motors intended for use with inverters)]

When a motor is used in the lower frequency range than the rated frequency, that will decrease the cooling effects for the motor. This speeds up the start of overload detection operations when a standard motor is used in order to prevent overheating.

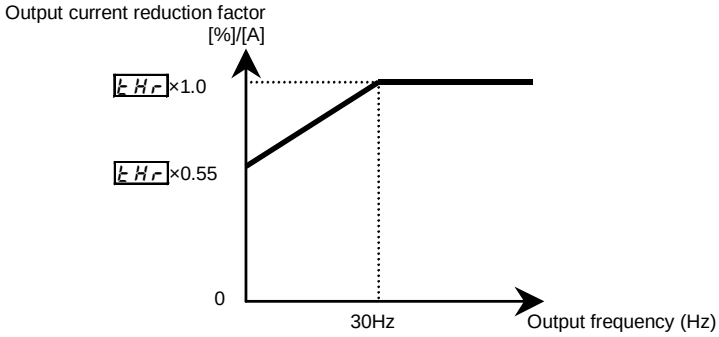
■ Setting of electronic thermal protection characteristics selection OLn

Setting value	Overload protection	Overload stall
0	○	×
1	○	○
2	×	×
3	×	○

○ : valid, × : invalid

■ Setting of motor electronic thermal protection level 1 [tHr]

If the capacity of the motor is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust the electronic thermal protection level 1 tHr so that it fits the motor's rated current.



Note: The motor overload protection start level is fixed at 30Hz.

[Example of setting: When the HF3212-A75 is running with a 0.4kW motor having 2A rated current]

Key operated	LED display	Operation
	0.0	Displays the operation frequency. (Perform during operation stopped.) (When standard monitor display selection F710 is set to 0 [Operation frequency])
MON	AUH	The first basic parameter "AUH" (history function) is displayed.
▲ ▼	tHr	Press either the△ key or the▽ key to change the parameter to tHr.
STR	100	Press the STR key to display the parameter setting. (Standard default setting: 100%)
▲ ▼	42	Press the△ key to change the parameter to 42 % (=motor rated current/inverter output rated current x 100=2.0//4.8×100).
STR	42 ⇔ tHr	Press the STR key to save the changed parameter. tHr and the parameter are displayed alternately.

Note: The rated output current of the inverter should be calculated from the rated current for frequencies below 4kHz, regardless of the setting of the PWM carrier frequency parameter (F300).

[Using a AF motor (motor for use with inverter)]

■ Setting of electronic thermal protection characteristics selection OLM

Setting value	Overload protection	Overload stall
4	○	×
5	○	○
6	×	×
7	×	○

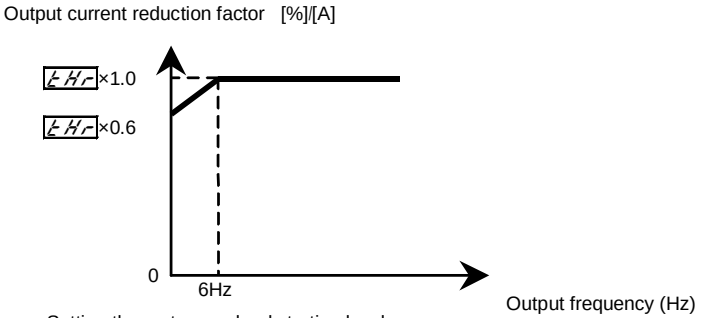
○ : valid, × : invalid

AF motors (motors designed for use with inverters) can be used in frequency ranges lower than those for standard motors, but their cooling efficiency decreases at frequencies below 6Hz.

■ Setting of motor electronic thermal protection level 1 ETHR

If the capacity of the motor is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust the electronic thermal protection level 1 ETHR so that it fits the motor's rated current.

* If the indications are in percentages (%), then 100% equals the inverter's rated output current (A).

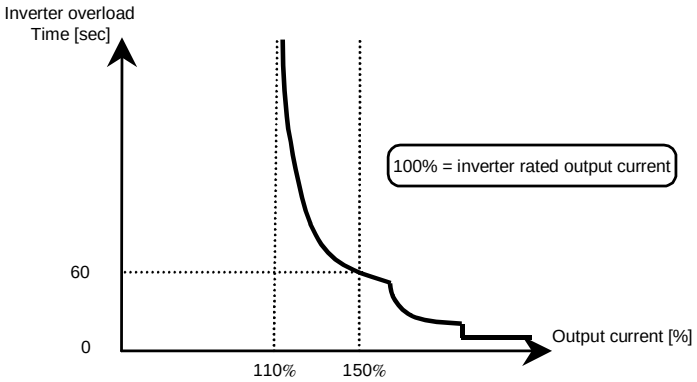


Setting the motor overload starting level

2) Inverter over load characteristics

Set to protect the inverter unit. Cannot be changed or turned off by parameter setting.

To prevent the inverter overload trip function (OL 1) from being activated too easily, lower the stall prevention level (F601) or increase the acceleration time (ACC) or deceleration time (dEC).



Inverter overload protection characteristics

* To protect the inverter, overload trip activates in a short period of time when output current reaches 150% or higher.

5.14 Preset-speed operation (speeds in 15 steps)

Sr1 - Sr7: Preset-speed operation frequencies 1-7

F287 - F294: Preset-speed operation frequencies 8-15

- Function
  A maximum of 15 speed steps can be selected just by switching an external contact signal. Multi-speed frequencies can be programmed anywhere from the lower limit frequency LL to the upper limit frequency UL.

When fire-speed control is assigned to the terminal board, the function of setting fire-speed operation frequencies is assigned to F294.

See 6.11.2, "Fire-speed control.

[Setting method]

1) Run/stop

The starting and stopping control is done from the terminal board.

Title	Function	Adjustment range	Setting value
CMOd	Command mode selection	0: Terminal board 1: Operation panel	1

Note: If speed commands (analog signal or digital input) are switched in line with preset-speed operations, select the terminal board using the frequency setting mode selection FMOd. ⇒ See 3) or 5.4

2) Preset-speed frequency setting

Set the speed (frequency) of the number of steps necessary.

Setting from speed 1 to speed 7

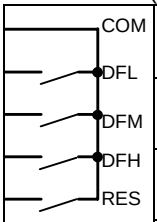
Title	Funtion	Adjustment range	Setting value
Sr 1- Sr 7	Preset-speed operation frequencies 1-7	LL - UL (Hz)	See Chapter 11, K-3

Setting from speed 8 to speed 15

Title	Function	Adjustment range	Setting value
f287- f294	Preset-speed operation frequencies 8-15	LL - UL (Hz)	See Chapter 11, K-7

Examples of preset-speed contact input signals: Slide switch SW1 set to sink logic

O: ON -: OFF (Speed commands other than preset-speed commands are valid when all are OFF)



Terminal	Preset-speed														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DFL-COM	O	-	O	-	O	-	O	-	O	-	O	-	O	-	O
DFM-COM	-	O	O	-	-	O	O	-	-	O	O	-	-	O	O
DFH-COM	-	-	-	O	O	O	O	-	-	-	-	O	O	O	O
RST-COM	-	-	-	-	-	-	-	O	O	O	O	O	O	O	O

☆ Terminal functions are as follows.

Terminal DFL ..... Input terminal function selection 4 (DFL)

F 114=6 (Preset-speed command 1: DFL)

Terminal DFM ..... Input terminal function selection 5 (DFM)

F 115=7 (Preset-speed command 2: DFM)

Terminal DFH..... Input terminal function selection 6 (DFH)

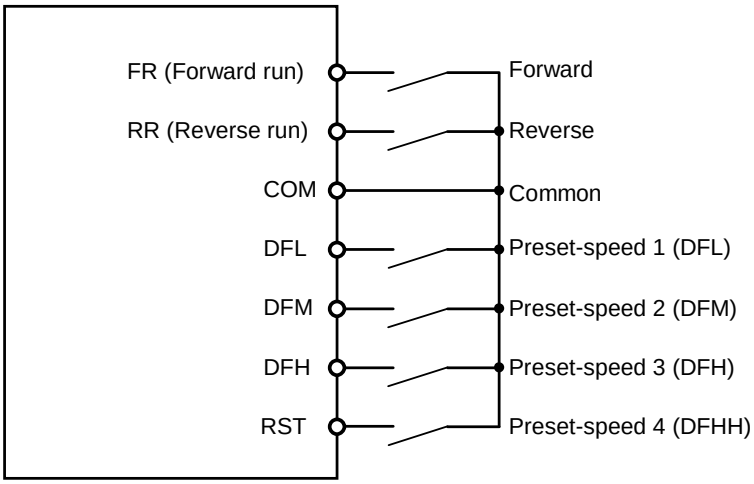
F 116=8 (Preset-speed command 3: DFH)

Terminal RST ..... Input terminal function selection 3 (RST)

F 113=9 (Preset-speed command 4: DFHH)

☆ DFHH is not allocated to standard default setting. Use the input terminal function selection to allocate DFHH an idle terminal. In the above example the RST terminal is used for DFHH.

[Example of a connection diagram] (SW1 set to sink logic)



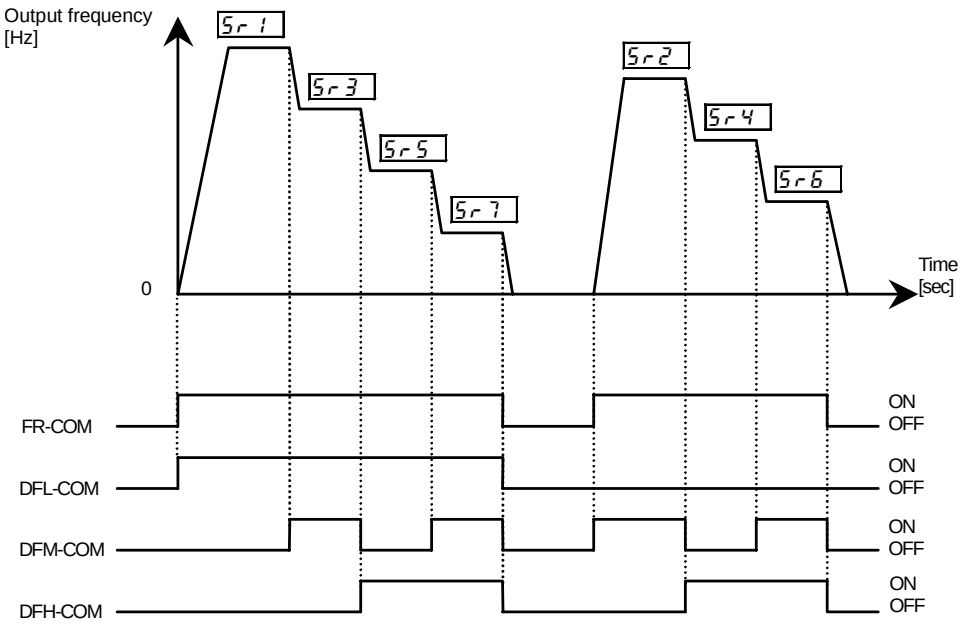
5

3) Using other speed commands with preset-speed command

Command mode selection CMOd		0: Terminal board				1: Operation panel			
Frequency setting mode selection FMOd		0: Built-in potentiometer	1: VRF 2: VRF2 5: UP/DOWN or 6: VRF + VRF2	3: Operation panel	4:Communication	0: Built-in potentiometer	1: VRF 2: VRF2 5: UP/DOWN or 6: VRF + VRF2	3: Operation panel	4:Communication
Preset-speed command	Entered	Preset-speed command valid Note)				Potentiometer command valid	Terminal command valid	Operation panel command valid	Communication command valid
	Not entered	Potentiometer command valid	Terminal command valid	Operation panel command valid	Communication command valid	(The inverter doesn't accept Preset-speed command.)			

Note) The preset-speed command is always given priority when other speed commands are input at the same time.

Below is an example of 7-step speed operation with standard default setting.



Example of 7-step speed operation

6. Extended parameters

Extended parameters are provided for sophisticated operation, fine adjustment and other special purposes. Modify parameter settings as required. See Section 11, Table of extended parameters.

6.1 Input/output parameters

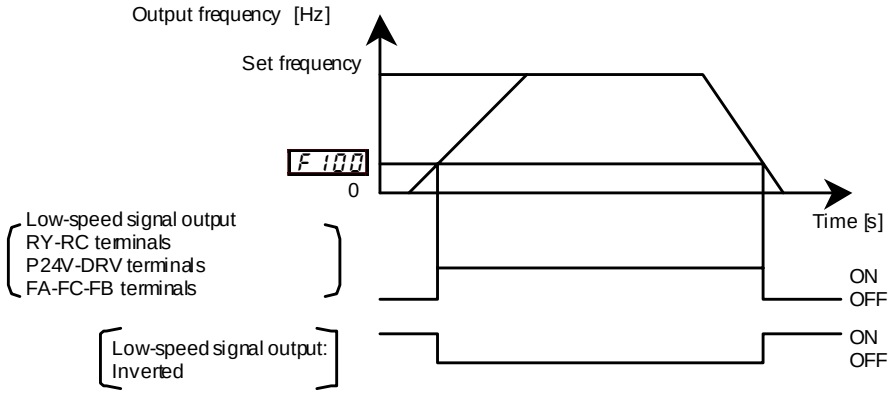
6.1.1 Low-speed signal

F 100: Low-speed signal output frequency

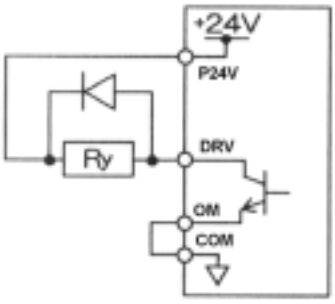
- Function
  When the output frequency exceeds the setting of F 100 an ON signal will be generated. This signal can be used as an electromagnetic brake excitation/release signal.
  This signal can also be used as an operation signal when F 100 is set to 0.01, because an ON signal is put out if the output frequency exceeds 0.0Hz.
  ★ Relay output (250Vac-1A (cosϕ=1), 30Vdc-0.5A, 250Vac-0.5A (cosϕ=0.4) at RY-RC, FA-FC-FB terminals.
  ★ If the inverter is so set, the signal will be put out through the open collector DRV and OM output terminals (24 Vdc-Max. 50 mA).

[Parameter setting]

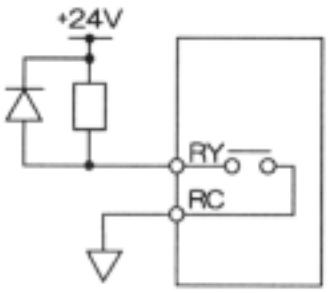
Title	Function	Adjustment range	Default setting
F 100	Low-speed signal output frequency	0.0 ~ F H (Hz)	0.0



An example of the connection of the open collector DRV terminal



An example of the connection of the relay output terminals



6

6.1.2 Output of designated frequency reach signal

F102: Speed reach detection band

- Function
  When the output frequency becomes equal to the setting by designated frequency ±F102, an ON or OFF signal is generated.

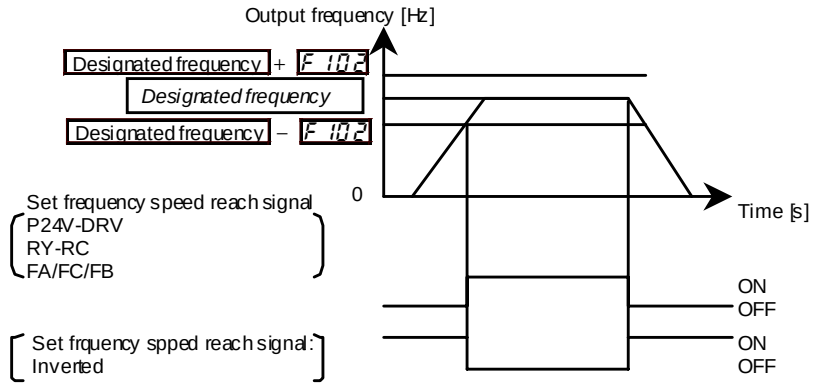
■ Parameter setting of designated frequency and detection band

Title	Function	Adjustment range	Default setting
F102	Speed reach detection band	0.0 ~ FH (Hz)	2.5

■ Parameter setting of output terminal selection

Title	Function	Adjustment range	Default setting
F131	Output terminal selection 2A (DRV-OM)	0-255 (See Section 11, K-18)	6: RCH (designated frequency - ON signal), or 7: RCHN (designated frequency - OFF signal)

Note: Select the F130 parameter to specify RY-RC terminal output, or the F132 parameter to specify FA-FC-FB terminal output.



6.1.3 Output of set frequency speed reach signal

F101: Speed reach setting frequency

F102: Speed reach detection band

- Function
  When the output frequency becomes equal to the frequency set by F101±F102, an ON or OFF signal is generated.

■ Parameter setting of frequency and detection band

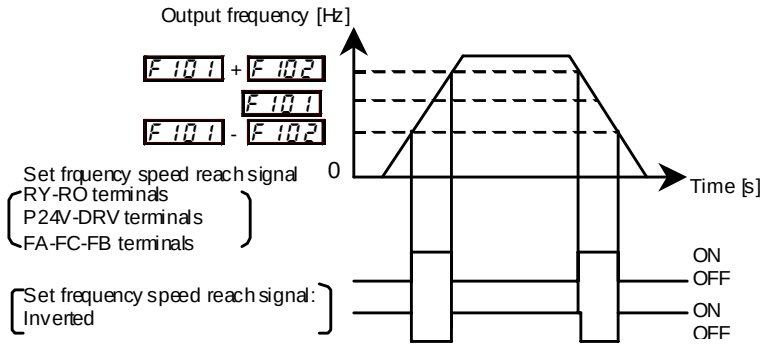
Title	Function	Adjustment range	Default setting
F101	Speed reach setting frequency	0.0 ~ FH (Hz)	0.0
F102	Speed reach detection band	0.0 ~ FH (Hz)	2.5

■ Parameter setting of output terminal selection

Title	Function	Adjustment range	Default setting
F131	Output terminal selection 2A (DRV-OM)	0-255 (See Section 11, K-18)	8: RCHF (designated frequency - ON signal), or 9: RCHFN (designated frequency - OFF signal)

Note: Select the F130 parameter to specify RY-RC terminal output, or set the F132 parameter function No. to 8 or 9 to specify FA-FC-FB terminal output.

If the detection band value + the set frequency is less than the designated frequency



6.2 Input signal selection

6.2.1 Priority selection (both FR-COM, RR-COM are ON)

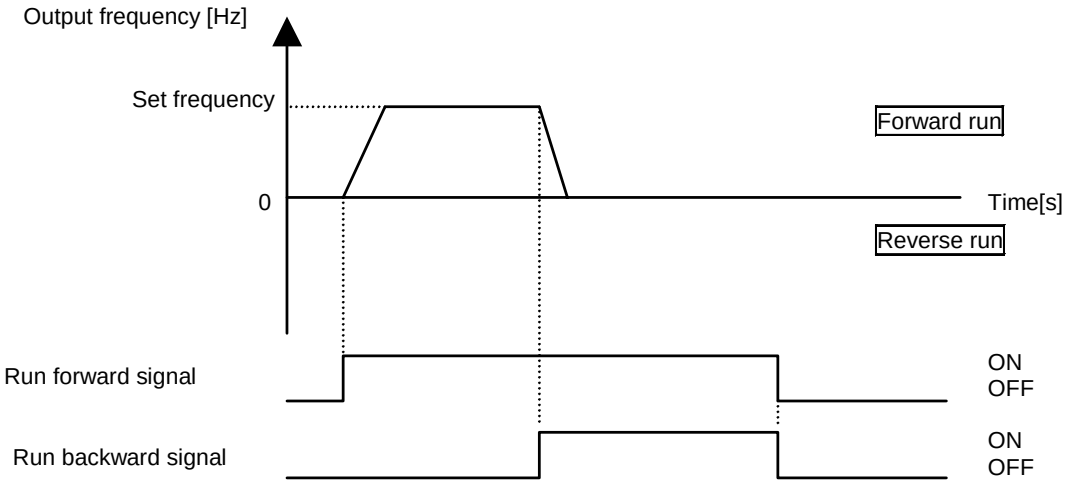
F105: Priority selection (both FR-COM, RR-COM are ON)

- Function
  This parameter allows you to select the direction in which the motor runs when a forward run (FR) command and a reverse run (RR) command are entered simultaneously.
  1) Reverse
  2) Slowdown stop

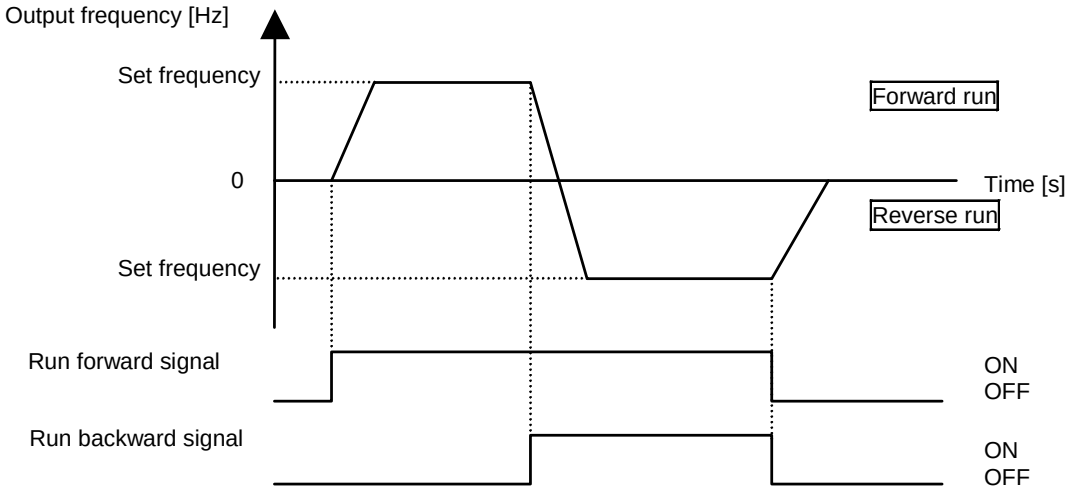
■ Parameter setting

Title	Function	Adjustment range	Default setting
F105	Priority selection (both FR-COM, RR-COM are ON)	0: Reverse 1: Slowdown stop	1

[F105 = 1 (Stop)]: If an FR command and an RR command are entered simultaneously, **the motor will slow down to a stop.**



[F 105 = 0 (Reverse)]: If an FR command and an RR command are entered simultaneously, **the motor will run in the reverse direction.**



6.2.2 Changing the functions of VRF and VRF2 terminals

F 109: VRF/VRF2 terminal function selection

- Function
  This parameter allows you to choose between signal input and contact signal input for the VRF and VRF2 terminals.

■ Parameter setting

Title	Function	Adjustment range	Default setting
F 109	Analog/contact input function selection (VRF/VRF2 terminal)	0: VRF - analog input VRF2 - anolog input 1: VRF - anolog input VRF2 - contact input (Sink) 2: VRF - analog input VRF2 - contact input (Source) 3: VRF - contact input (Sink) VRF2 - contact input (Sink) 4: VRF - contact input (Source) VRF2 - contact input (Source)	0

* When using the VRF and VRF2 terminals as contact input terminals in sink logic connection, be sure to insert a resistor between the P24V terminal and the VRF/VRF2 terminals. (Recommended resistance: 4.7kΩ-1/2W)

Note: When using the VRF terminal as a contact input terminal, be sure to turn the VRF slide switch to the V position.

6.3 Terminal function selection

6.3.1 Keeping an input terminal function always active (ON)

F110: Always-active function selection

- Function
  This parameter specifies an input terminal function that is always to be kept active (ON). (Only one function selectable)

■ Parameter setting

Title	Function	Adjustment range	Default setting
F110	Always-active function selection	0-64 (See section 11, K-15)	1 (Standby)

6.3.2 Modifying input terminal functions

F111: Input terminal selection 1 (FR)

F112: Input terminal selection 2 (RR)

F113: Input terminal selection 3 (RST)

F114: Input terminal selection 4 (DFL)

F115: Input terminal selection 5 (DFM)

F116: Input terminal selection 6 (DFH)

F117: Input terminal selection 7 (VRF2)

F118: Input terminal selection 8 (VRF)

- Function

  Use the above parameters to send signals from an external programmable controller to various control input terminals to operate and/or set the inverter.

  The desired contact input terminal functions can be selected from 65 types (0-64). This gives system design flexibility. (Note, however, for F117 and F118, a function can be selected from among 13 functions (5 - 17).)

  Note that the setting 52 (forced operation) can be enabled only when the inverter is so configured at the factory. For more information, contact your local Sumitomo dealer.

  The functions of the VRF2 and VRF terminals can be selected between analog input and contact input by changing parameter settings F109.

  To use the VRF and VRF2 terminals as contact input terminals, you need to set F109 to the number (1 to 4) that suits your needs, since analog input (voltage signal input) is assigned to the terminals by default.

■ Setting of contact input terminal function

Terminal symbol	Title	Function	Adjustment range	Default setting
-	F110	Always-active function selection	0-64 (See section 11, K-15-17)	1 (ST)
FR	F111	Input terminal selection 1 (FR)		2 (FR)
RR	F112	Input terminal selection 2 (RR)		3 (RR)
RST	F113	Input terminal selection 3 (RST)		10 (RST)
DFL	F114	Input terminal selection 4 (DFL)		6 (DFL)
DFM	F115	Input terminal selection 5 (DFM)		7 (DFM)
DFH	F116	Input terminal selection 6 (DFH)		8 (DFH)
Only when F109 is set to 1-4, the following terminals are valid.			-	-
VRF2	F117	Input terminal selection 7 (VRF2)	5-17 (Note 2)	9 (DFHH)
VRF	F118	Input terminal selection 8 (VRF)		5 (AD2)

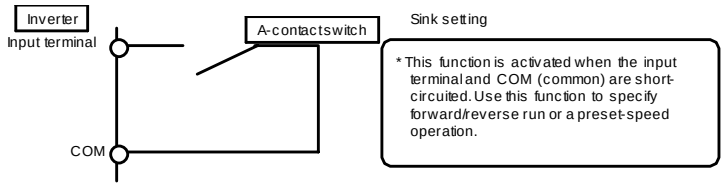
Note 1: The function that has been selected using F110 (always-active function selection parameter) is always activated.

Note 2: When using the VRF and VRF2 terminals as contact input terminals in sink logic connection, be sure to insert a resistor between the P24V terminal and the VRF/VRF2 terminals. (Recommended resistance: 4.7kΩ-1/2W)

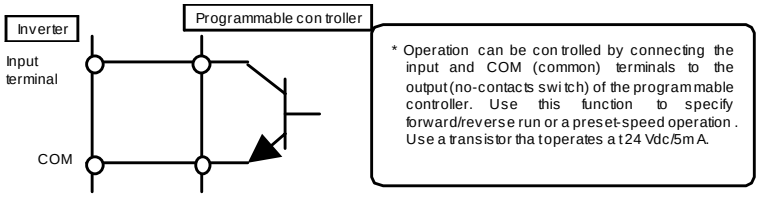
Be sure to turn the VRF slide switch to the V position.

■ Connection method

1) A-contact input



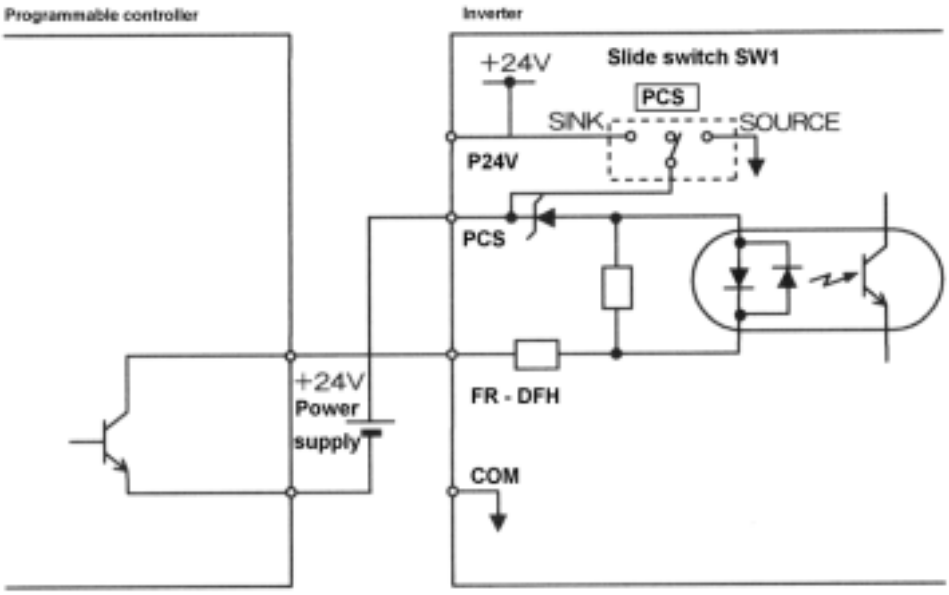
2) Connection with transistor output



* Interface between programmable controller and inverter

Note 1: When using a programmable controller with open collector outputs for control, connect it to the PCS terminal, as shown in the figure below, to prevent the inverter from malfunctioning because of a current that flows in.

Also, be sure to turn the SW1 slide switch to the PCS position.



3) Sink logic/source logic input

Sink logic/source logic (input/output terminal logic) switching is possible.
For more details, see 2.3.2.

6.3.3 Modifying output terminal functions

F130: Output terminal selection 1A (RY-RC)

F131: Output terminal selection 2A (DRV-OM)

F132: Output terminal selection 3 (FA, FB, FC)

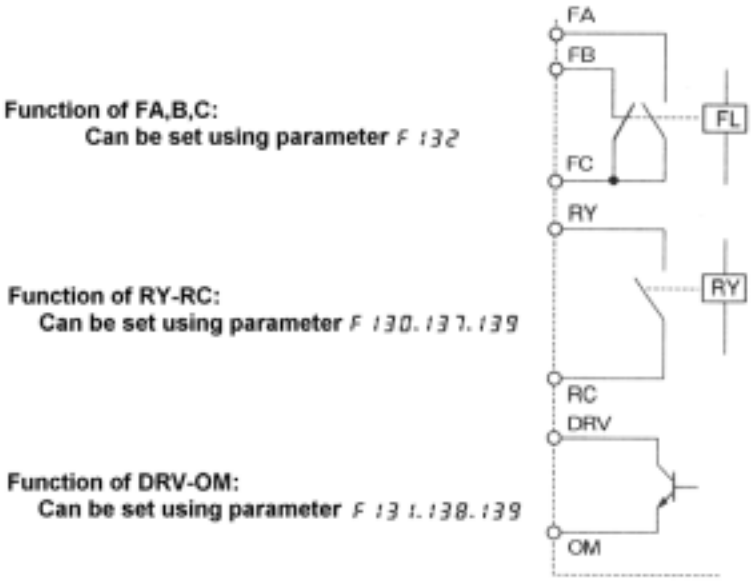
F137: Output terminal selection 1B (RY-RC)

F138: Output terminal selection 2B (DRV-OM)

F139: Output terminal logic selection (RY-RC, DRV-OM)

- Function
  Use the above parameters to send various signals from the inverter to external equipment.
  By setting parameters for the RY-RC, DRV-OM and FL (FA, FB and FC) terminals on the terminal board, you can use 58 functions and functions obtained by combining them.
  To assign only one function to output terminals, assign the function to F130 and F131 while leaving F137 to F139 as they are set by default.

■ Examples of application



(1) Assigning one function to an output terminal

Terminal symbol	Title	Function	Adjustment range	Default setting
RY - RC	F130	Output terminal selection 1A	0-255 (See section 11.)	254 (Always OFF)
DRV - OM	F131	Output terminal selection 2A		14 (Run)
FL (A, B, C)	F132	Output terminal selection 3		10(Failure FL)

☆ When assigning one function to each output terminal, set parameters F130 to F132 only
Do not change but leave parameters F137 to F139 as they were set by default.
(Standard default setting: F137=255, F138=255, F139=0)

(2) Assigning two functions to a group of terminals

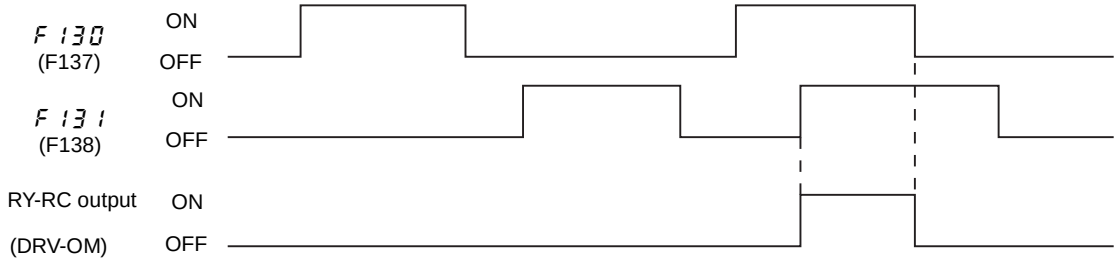
A signal is sent out when the two functions assigned are activated simultaneously.

Terminal symbol	Title	Function	Adjustment range	Default setting
RY-RC	F130	Output terminal selection 1A	0-255 (See section 11.)	254 (Always OFF)
DRV-OM	F131	Output terminal selection 2A		14 (Run)
RY-RC	F137	Output terminal selection 1B		255 (Always ON)
DRV-OM	F138	Output terminal selection 2B		

☆ Two different functions can be assigned to terminals RY-RC and terminals DRV-OM.

☆ If parameter F139 is set to 0 (default), a signal will be sent out when the two functions assigned are activated simultaneously.
Terminals RY-RC: Send out a signal when the functions assigned with F130 and F137 are activated simultaneously.
Terminals DRV-OM: Send out a signal when the functions assigned with F131 and F138 are activated simultaneously.

☆ Timing chart



☆ Only one function can be assigned to terminals FA-FB-FC at a time.

(3) Assigning two functions to a group of terminals

A signal is sent out when either of the two functions assigned is activated.

Terminal symbol	Title	Function	Adjustment range	Default setting
RY - RC	F130	Output terminal selection 1A	0～255 (See section 11.)	254 (Always OFF)
DRV - OM	F131	Output terminal selection 2A		14 (Run)
RY - RC	F137	Output terminal selection 1B		255 (Always ON)
DRV - OM	F138	Output terminal selection 2B		255 (Always ON)
RY - RC/ DRV - OM	F139	Output terminal logic selection	0 : F130 and F137 F131 and F138 1 : F130 or F137 F131 and F138 2 : F130 and F137 F131 or F138 3 : F130 or F137 F131 or F138	0

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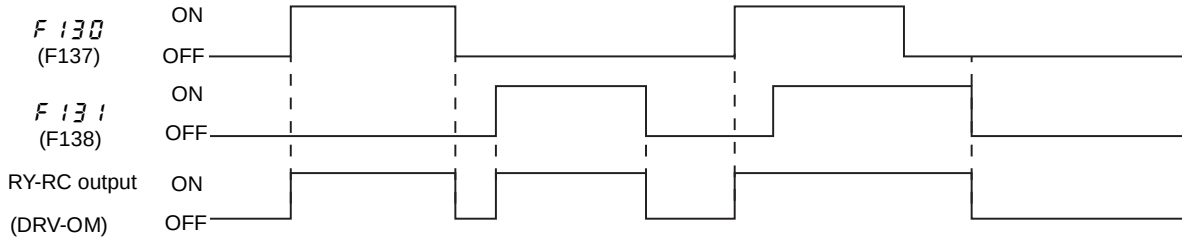
☆ Two different functions can be assigned to terminals RY-RC and terminals DRV-OM.

☆ If parameter F139 is set to 3, a signal will be sent out when either of the two functions assigned is activated.
Terminals RY-RC: Send out a signal when either of the functions set with F130 and F137 is activated.
Terminals DRV-OM: Send out a signal when either of the functions set with F131 and F138 is activated.

☆ Timing chart



☆ Only one function can be assigned to terminals FA-FB-FC at a time.

(4) Assigning two functions to a group of terminals

The logical product (AND) or logical sum (OR) of the two functions assigned is put out as a signal.

■ Setting of output terminal function

Terminal symbol	Title	Function	Adjustment range	Default setting
RY-RC	F130	Output terminal selection 1A	0-255 (See Section 11)	254 (Always OFF)
DRV-OM	F131	Output terminal selection 2A		14 (Run)
FL (A,B,C)	F132	Output terminal selection 3		10 (Failure FL)
RY-RC	F137	Output terminal selection 1B		255 (Always active)
DRV-OM	F138	Output terminal selection 2B		255 (Always active)
RY-RC/ DRV-OM	F139	Output terminal logic selection	0 : F130 and F137 F131 and F138 1 : F130 or F137 F131 and F138 2 : F130 and F137 F131 or F138 3 : F130 or F137 F131 or F138	0

Two different functions can be assigned to the output terminals (RY-RC and DRV-OM), and two logics with different functions can be selected using F139.

The logical product (AND) or logical sum (OR) of the two functions assigned is put out as a signal, depending on the setting of parameter F139.

If F139 = 0, the logical sum (AND) of F130 and F137 will be output to RY-RC.
The logical product (AND) of F131 and F138 will be output to DRV-OM.

If F139 = 1, the logical product (OR) of F130 and F137 will be output to RY-RC.
The logical sum (AND) of F131 and F138 will be output to DRV-OM.

If F139 = 2, the logical sum (AND) of F130 and F137 will be output to RY-RC.
The logical product (OR) of F131 and F138 will be output to DRV-OM.

If F139 = 3, the logical product (OR) of F130 and F137 will be output to RY-RC.
The logical product (OR) of F131 and F138 will be output to DRV-OM.

☆ To assign only one function to output terminals, assign the function to F130 and F131 while leaving f137 to f139 as they are set by default.

6.3.4 Comparing the frequency command values

F167: Frequency command agreement detection range

FN0d: Frequency setting mode selection 1

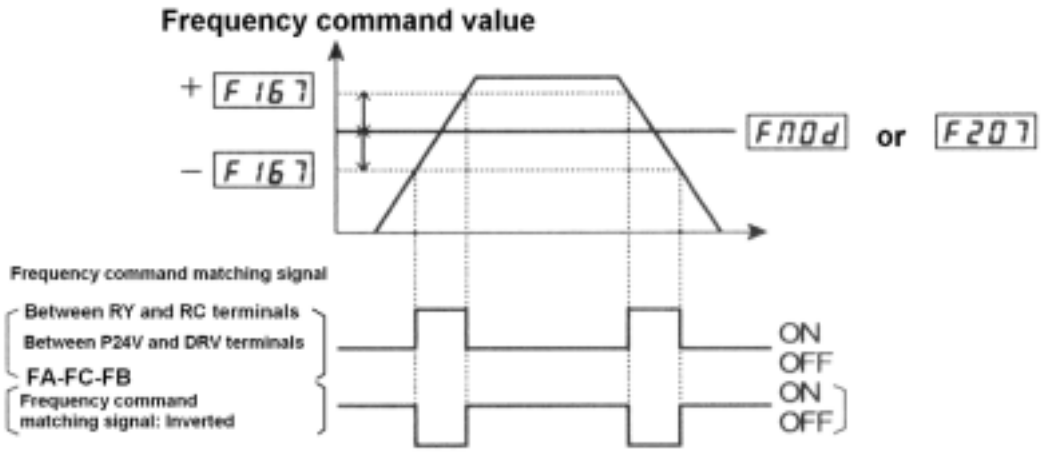
F207: Frequency setting mode selection 2

- Function
  If the frequency command value specified using FN0d (or F207) almost agrees with the frequency command value from the VRF terminal with an accuracy of ± the setting of F167, an ON or OFF signal will be sent out.

■ Frequency command value and agreement detection range parameter setting

Title	Function	Adjustment range	Default setting
F167	Frequency command agreement detection range	0.0 ~ FH (Hz)	2.5
FN0d	Frequency setting mode selection 1	0-6 (See Section 11, K-1, 5)	0
F207	Frequency setting mode selection 2		1

Note: To put out signals to RY-RC, DRV or FA-FB-FC, set F130, F131, or F132 respectively to 52 or 53.



Note: This function can be used, for example, to send out a signal indicating whether the amount of processing and the amount of feedback agree with each other when the PID function is in use.
For an explanation of the PID function, see 6.16.

6.4 Basic parameters 2

6.4.1 Switching motor characteristics via terminal input

F170: Base frequency 2

F171: Base frequency voltage 2

F172: Torque boost 2

F173: Motor electronic-thermal protection level 2

F185: Stall prevention level 2

- Function
  Use the above parameters to switch the operation of two motors with a single inverter and to select motor V/F characteristics (two types) according to the particular needs or operation mode.

  Note: The Pt (V/F control mode selection) parameter is enabled only for motor1.
  If motor 2 is selected, V/F control will be given constant torque characteristics.

■ Parameter setting

Title	Function	Adjustment range	Default setting
F170	Base frequency 2	25.0-500.0 (Hz)	60.0
F171	Base frequency voltage 2	50-660 (V)	200 (200V class) / 400 (400V class)
F172	Torque boost 2	0.0-30.0 (%)	According to model (See Section 11, K-14)
F173	Motor electronic-thermal protection level 2	10-100 (%)	100
F185	Stall prevention level 2	10-199 (%) 200 : Disabled	150

■ Setting of switching terminals

The terminal for switching to motor 2 needs to be set, since this function is not assigned under the default setting. Assign this function to an idle terminal.

The parameters to be switched depend on the particular identification number of the input terminal selection function. (Refer to K-15.)

Input terminal function number					Parameters used and applicable parameters
5 AD2	39 VF2	40 MOT2	58 AD3	61 OCS2	
OFF	OFF	OFF	OFF	OFF	Default setting: Pt, uL, uLu, ub, tHr, ACC, dEC, F502, F601
ON	OFF	OFF	OFF	OFF	ACC → F500, dEC → F501 . F502 → F503
-	OFF	OFF	ON	OFF	ACC → F510 . dEC → F511 . F502 → F512
OFF	OFF	OFF	OFF	ON	F601 → F185
OFF	ON	OFF	OFF	OFF	Pt → 0 . uL → F170 . uLu → F171 . ub → F172, tHr → F173
-	-	ON	OFF	-	Pt → 0 . uL → F170 . uLu → F171 . ub → F172, tHr → F173 . F601 → F185, ACC → F500 . dEC → F501 . F502 → F503

6.5 Frequency priority selection

6.5.1 Using a frequency command according to the particular situation

F1Od: Frequency setting mode selection 1

F200: Frequency priority selection

F207: Speed setting mode selection 2

- Function

  These parameters are used to switch between two types of frequency command signals.
  - Setting by parameters
  - Switching by frequency
  - Switching via terminal board input

■ Parameter setting

Title	Function	Adjustment range	Default setting
F M0d	Frequency setting mode selection 1	0: Built-in potentiometer 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact 6: VRF + VRF2 (Override)	0
F200	Frequency priority selection	0: F M0d (Switchable to F207 by the input terminal) 1: F M0d (F207 for output frequencies equal to or lower than 1.0 Hz)	0
F207	Speed setting mode selection 2	0: Built-in potentiometer 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact 6: VRF + VRF2 (Override)	1

1) External switching (Input terminal function 38 : FCHG enabled)

Frequency priority selection parameter F200 = 0

Switching between the command specified with F M0d and F207 can be made by entering a command from a terminal board.

To do so, however, the frequency command forced switching function (input terminal function selection: 38) needs to be set beforehand to an input terminal board.

If an OFF command is entered to the input terminal board: The command specified with F M0d will be selected.

If an ON command is entered to the input terminal board: The command specified with F207 will be selected.

2) Automatic switching by frequency command

Frequency priority selection parameter F200 = 1

The switching between the command specified with F M0d and F207 is done automatically according to the frequency command entered.

If the frequency set with F M0d is above 1Hz: The command specified with F M0d will be selected.

If the frequency set with F M0d is 1Hz or less: The command specified with F207 will be selected.

6.5.2 Setting frequency command characteristics

F201: VRF input point 1 setting
F202: VRF input point 1 frequency
F203: VRF input point 2 setting
F204: VRF input point 2 frequency
F210: VRF2 input point 1 setting
F211: VRF2 input point 1 frequency
F212: VRF2 input point 2 setting
F213: VRF2 input point 2 frequency
F811: Point 1 setting
F812: Point 1 frequency
F813: Point 2 setting
F814: Point 2 frequency

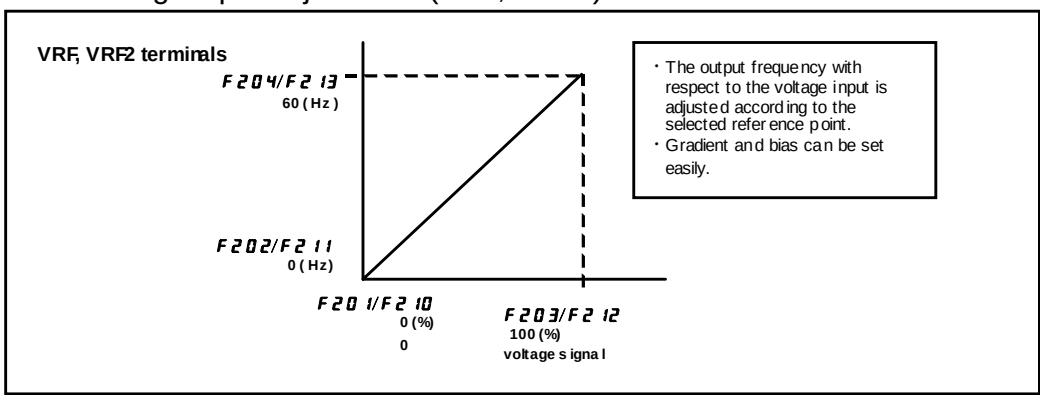
- Function
  These parameters adjust the output frequency according to the externally applied analog signal (0-10Vdc voltage, 4-20mAdc current) and the entered command for setting an external contact frequency.

■ Parameter setting

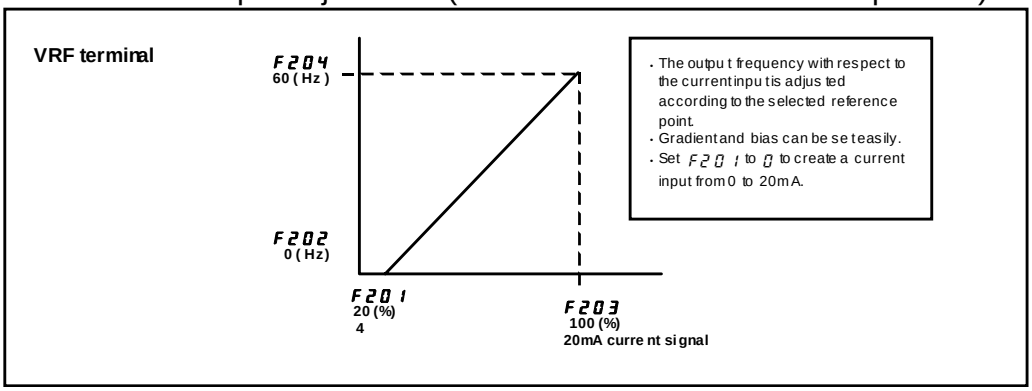
Title	Function	Adjustment range	Default setting
F201	VRF input point 1 setting	0-100 (%)	0
F202	VRF input point 1 frequency	0.0-500.0 (Hz)	0.0
F203	VRF input point 2 setting	0-100 (%)	100
F204	VRF input point 2 frequency	0.0-500.0 (Hz)	60.0
F210	VRF2 input point 1 setting	0-100 (%)	0
F211	VRF2 input point 1 frequency	0.0-500.0 (Hz)	0.0
F212	VRF2 input point 2 setting	0-100 (%)	100
F213	VRF2 input point 2 frequency	0.0-500.0 (Hz)	60.0
F811	Point 1 setting	0-100 (%)	0
F812	Point 1 frequency	0.0-500.0 (Hz)	0.0
F813	Point 2 setting	0-100 (%)	100
F814	Point 2 frequency	0.0-500.0 (Hz)	60.0

Note 1: Don't set the same value between point 1 and point 2. If set the same value, the Err 1 is displayed.

1) 0-10Vdc voltage input adjustment (VRF, VRF2)



2) 4-20mAdc current input adjustment (VRF: VRF slide switch in the I position)



6.5.3 Setting of frequency with the input from an external contact

F264: External contact input - UP response time

F265: External contact input - Up frequency steps

F266: External contact input - DOWN response time

F267: External contact input - DOWN frequency steps

F268: Initial up/down frequency

F269: Change of the initial up/down frequency

- Function
  These parameters are used to set an output frequency by means of a signal from an external device.

Title	Function	Adjustment range	Default setting
F264	External contact input - UP response time	0.0 - 10.0 (S)	0.1
F265	External contact input - Up frequency steps	0.0 - FH (Hz)	0.1
F266	External contact input - DOWN response time	0.0 - 10.0 (S)	0.1
F267	External contact input - DOWN frequency steps	0.0 - FH (Hz)	0.1
F268	Initial up/down frequency	LL - UL (Hz)	0.0
F269	Change of the initial up/down frequency	0: Not changed 1: Setting of F268 changed when power is turned off	1

* These functions take effect when parameter FMOd (frequency setting mode selection 1) is set to 5 or parameter F207 (frequency setting mode selection 2) is set to 5 is enabled.

■ Adjustment with continuous signals (Parameter-setting example 1)

Set parameters as follows to adjust the output frequency up or down in proportion to the frequency adjustment signal input time:

Panel frequency incremental gradient = F265/F264 setting time

Panel frequency decremental gradient = F267/F266 setting time

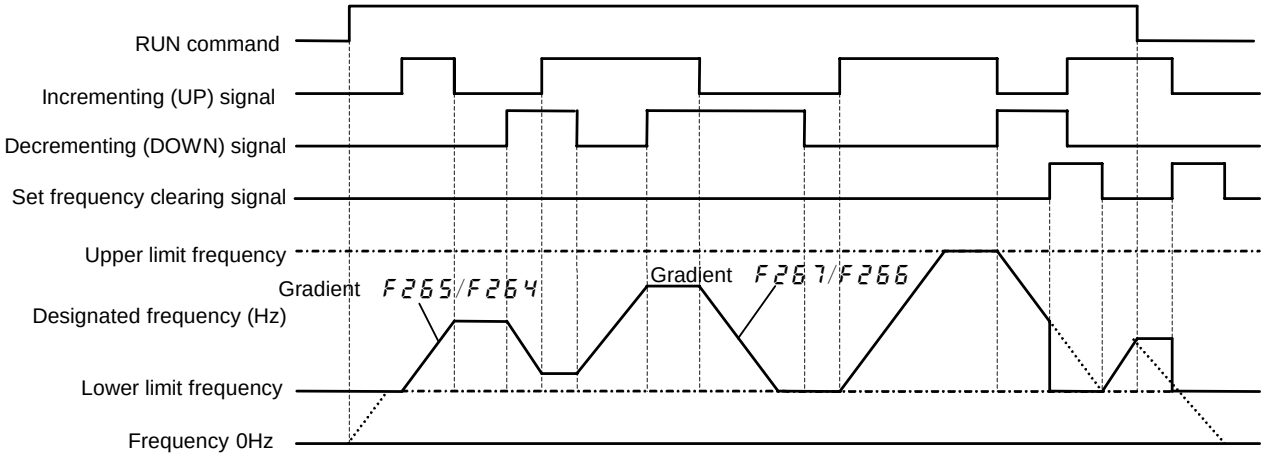
Set parameters as follows to adjust the output frequency up or down almost in synchronization with the adjustment by the panel frequency command:

F264 = F266 = 1

(ACC (or F500)/FH) ≤ (F265/F264 setting time)

(dEC (or F501)/FH) ≤ (F267/F266 setting time)

<<Sample sequence diagram 1: Adjustment with continuous signals>>



The dotted lines represent effective output frequencies.

■ Adjustment with pulse signals (Parameter-setting example 2)

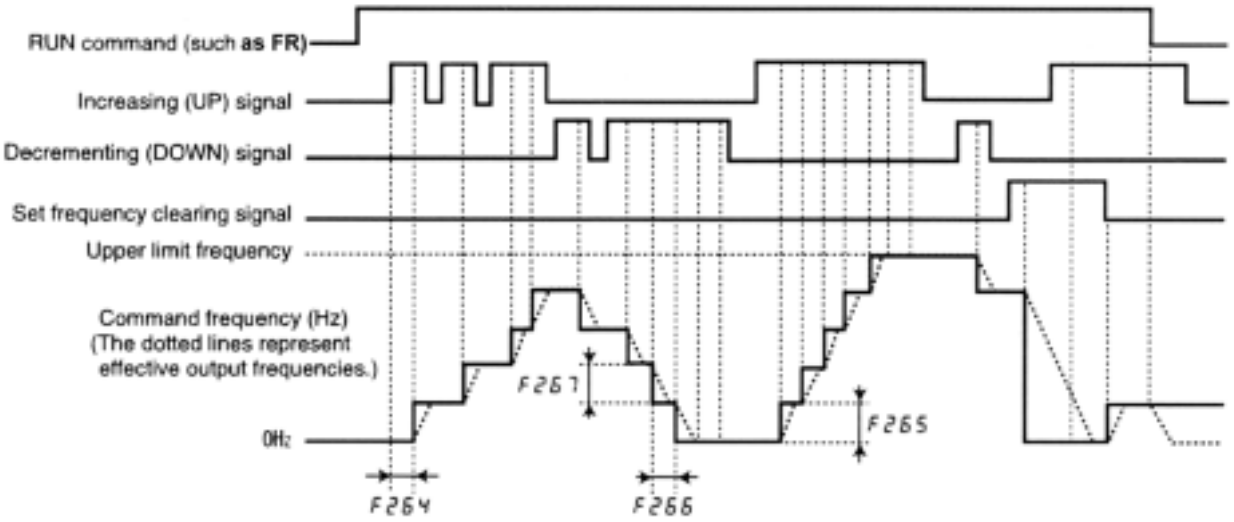
Set parameters as follows to adjust the frequency in steps of one pulse:

F264, F266 Pulse On time

F265, F267 = Frequency obtained with each pulse

* The inverter does not respond to any pulses with an ON time shorter than that set with F264 or F266. 12ms or more of clearing signal is allowed.

<<Sample sequence diagram 2: Adjustment with pulse signals>>



■ If two signals are impressed simultaneously

- If a clear single and an up or down signal are impressed simultaneously, priority will be given to the clear signal.
- If up and down signals are impressed simultaneously, The frequency will change at the specified up or down rate.

■ About the setting of the initial up/down frequency

To adjust the frequency starting at a specified frequency other than 0.0 Hz (default initial frequency) after turning on the inverter, specify the desired frequency using F268 (initial up/down frequency).

■ About the change of the initial up/down frequency

To make the inverter automatically save the frequency immediately before it is turned off and start operation at that frequency next time power is turned on, set F269 (change of initial up/down frequency) to 1 (which changes the setting of F268 when power is turned off).
Keep in mind that the setting of F268 is changed each time power is turned off.

■ Frequency adjustment range

The frequency can be set from 0.0Hz to FH (Maximum frequency). The lower-limit frequency will be set as soon as the set frequency clearing function (function number 43, 44) is entered from the input terminal.

■ Minimum unit of frequency adjustment

If F702 (Frequency free unit magnification) is set to 1.00, the output frequency can be adjusted in steps of 0.11Hz.

6.6 Operation frequency

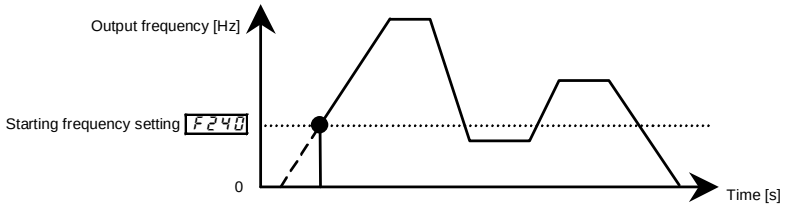
6.6.1 Starting frequency

F240: Starting frequency setting

- Function
  The frequency set with F240 is put out as soon as operation is started.
  Use the F240 parameter when a delay in response of starting torque according to the acceleration/deceleration time is probably affecting operation. Setting the starting frequency to a value from 0.5 to 3Hz is recommended. The occurrence of an overcurrent can be suppressed by setting this frequency below the rated slippage of the motor.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F240	Starting frequency setting	0.5-10.0 (Hz)	0.5



6.6.2 Run/stop control with frequency setting signals

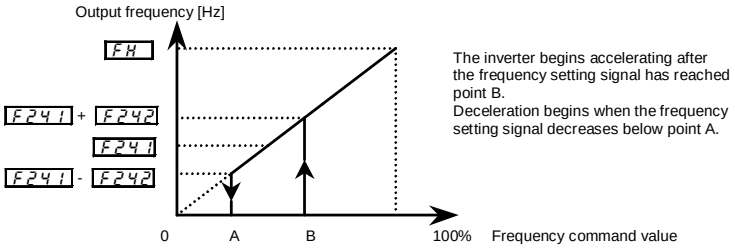
F241: Operation starting frequency

F242: Operation starting frequency hysteresis

- Function
  The Run/stop of operation can be controlled simply with frequency setting signals.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F241	Operation starting frequency	0.0-FH (Hz)	0.0
F242	Operation starting frequency hysteresis	0.0-FH (Hz)	0.0



6.7 DC braking

6.7.1 DC braking

F250: DC braking starting frequency

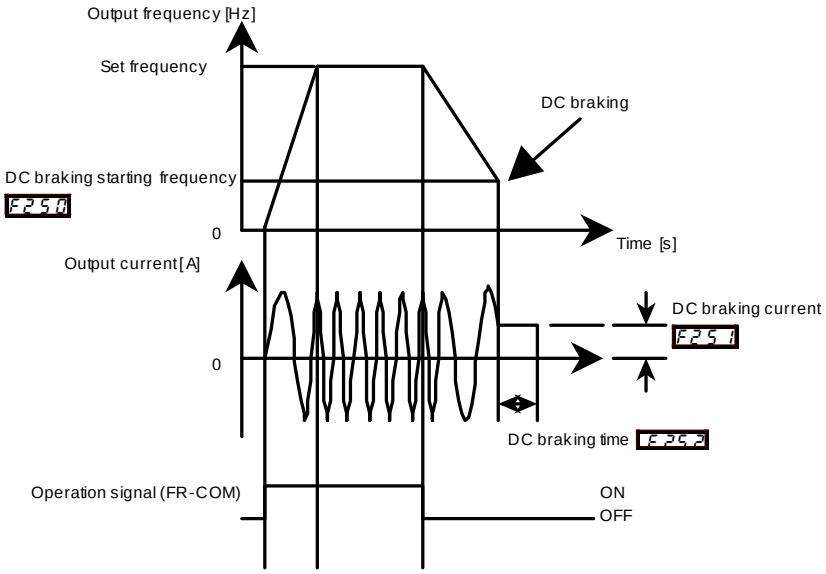
F251: DC braking current

F252: DC braking time

- Function
  A large braking torque can be obtained by applying a direct current to the motor. These parameters set the direct current to be applied to the motor, the application time and the starting frequency.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F250	DC braking starting frequency	0.0-FH (Hz)	0.0
F251	DC braking current	0.0-100 (%)	50
F252	DC braking time	0.0- 20.0 (sec)	1.0



Note: During DC braking, the overload protection sensitivity of the inverter increases. The DC braking current may be adjusted automatically to prevent tripping.

6.7.2 Motor shaft fixing control

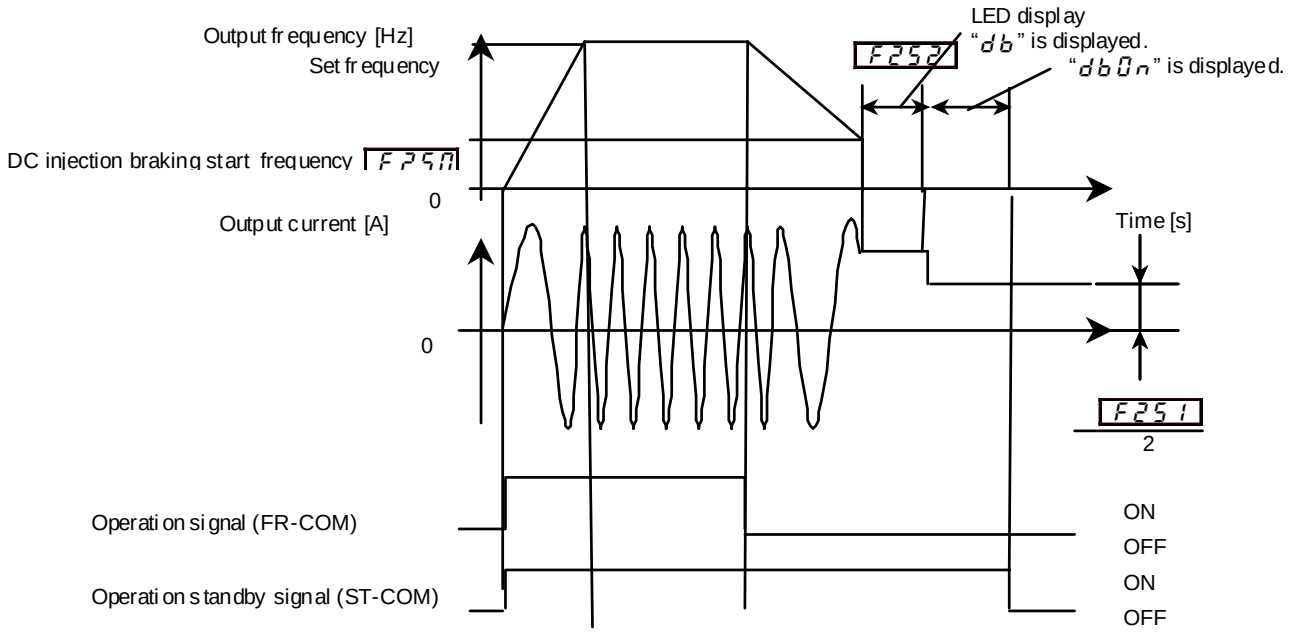
F254: Motor shaft fixing control

- Function
  This function is used to prevent the motor from running unexpectedly because its shaft is not restrained or to preheat the motor.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F254	Motor shaft fixing control	0: Disabled, 1: Enabled	0

If the motor shaft fixing control F254 is set to 1, half the braking force set with F251 (DC braking rate) will be applied to the motor to continue DC braking even after the completion of ordinary DC braking. To stop motor shaft fixing control, turn off the standby command (ST signal).



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Note1: About the same motor shaft fixing control can be exercised by entering a DC braking command from external contacts.

Note2: If a power failure occurs during motor shaft fixing control and the motor starts to coast, motor shaft fixing control will be canceled.
Also, if the inverter trips during motor shaft fixing control and is restored to working order by the retry function, motor shaft fixing control will be canceled.

6.8 Auto-stop in case of lower-limit frequency continuous operation

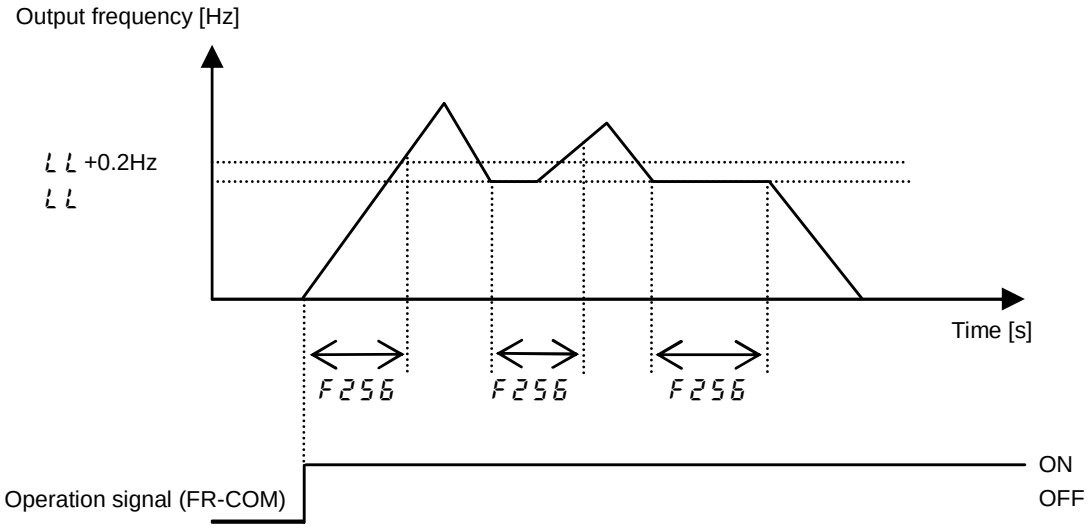
6.8.1 Auto-stop in case of lower-limit frequency continuous operation

F256: Auto-stop in case of lower-limit frequency continuous operation

- Function
  If operation is carried out continuously at a frequency below the lower-limit frequency (LL) for the period of time set with F256, the inverter will automatically slow down the motor to a stop. At that time, "LSTP" is displayed (alternately) on the operation panel.
  This function will be canceled if a frequency command above the lower-limit frequency (LL).

[Parameter setting]

Title	Function	Adjustment range	Default setting
F256	Auto-stop in case of lower-limit frequency continuous operation time	0.0: None 0.1-600.0 (sec.)	0.0



Note: This function is enabled even at the start of operation and during switching between forward and reverse run.

6.9 Jog run mode

F260: Jog run frequency

F261: Jog run stopping pattern

F262: Panel jog run mode

- Function
  Use the jog run parameters to operate the motor in jog mode. Input of a jog run signal generates a jog run frequency output at once, irrespective of the designated acceleration time.
  Also, you can choose an operation panel start/stop mode between the ordinary start/stop mode and the jog run start/stop mode.

The jog run function needs to be assigned to an input terminal. When assigning it to the RST terminal, set F113 to 4.
The motor can be operated in jog mode while the jog run setting terminals are connected (RST-COM ON). (Setting F113 to 4.)

[Parameter setting]

Title	Function	Adjustment range	Default setting
F260	Jog run frequency	F240-20.0 (Hz)	5.0
F261	Jog run stopping pattern	0: Slowdown stop 1: Coast stop 2: DC braking	0
F262	Panel jug run mode	0: Disabled 1: Panel jog run mode enabled	0

[Setting of jog run setting terminal (RST-COM)]

Assign control terminal RST ([10: reset signal] in default setting) as the jog run setting terminal.

Title	Function	Adjustment range	Default setting
F113	Input terminal selection (RST)	0-64	4 (jog run setting terminal)

Note 1: During the jog run mode, there is LOW (low speed detection signal) output but no RCH (designated frequency reach signal) output, and PID control does not work.

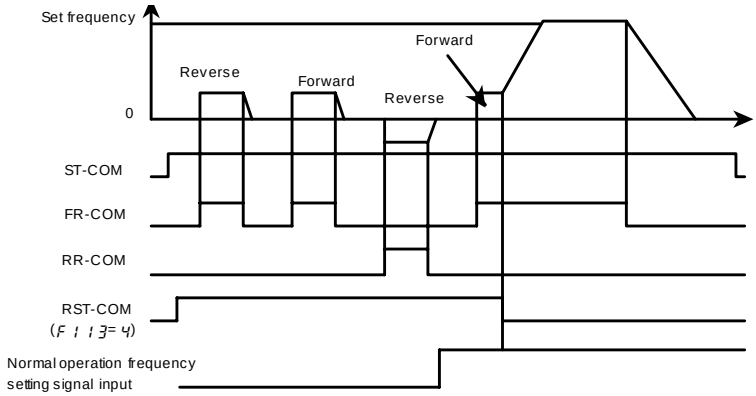
Note 2: When the operation panel only is used for operation in jog run mode, the jog run function does not need to be assigned to any input terminal.

<Examples of jog run>

RST-COM (JOG) ON + FR-COM ON: Forward jog run

RST-COM (JOG) ON + RR-COM ON: Reverse jog run

(Normal operation frequency signal input + FR-COM ON: Forward run, Normal operation frequency signal input + RR-COM ON: Reverse run)



- The jog run setting terminal (RST-COM) is enabled when the operation frequency is below the jog run frequency.
  This connection does not function at an operation frequency exceeding the jog run frequency.
- The motor can be operated in jog mode while the jog run setting terminals are connected (RST-COM).
- Jog run has priority, even when a new operation command is given during operation.
- Even for F261 = 0 or 1, an emergency DC braking becomes enabled when setting F603 = 2.
- No limits are imposed to the jog run frequency by the upper-limit frequency (parameter ul).

■ Panel jog mode (if f262 is set to 1)

- When the inverter is in panel jog mode, pressing the (▲) key displays fjog, while pressing the (▼) key displays rjog.
- When fjog is displayed, the inverter will be placed in forward jog run mode as long as the (RUN) key is held down.
- When rjog is displayed, the inverter will be placed in reverse jog run mode as long as the (RUN) key is held down.
- During jog run, the direction of rotation can be changed using the (▲) and (▼) keys. Press the (▲) key to run the motor in the forward direction, or press the (▼) key to run it in the reverse direction.
- If you press and hold down the (RUN) key for 20 seconds or more, the key failure alarm "E-17" will be displayed.

6.10 Jump frequency - jumping resonant frequencies

F270: Jump frequency 1

F271: Jumping width 1

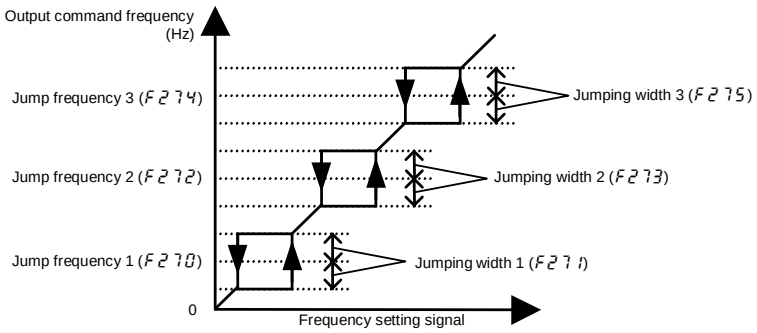
F272: Jump frequency 2

F273: Jumping width 2

F274: Jump frequency 3

F275: Jumping width 3

- Function
  Resonance due to the natural frequency of the mechanical system can be avoided by jumping the resonant frequency during operation. During jumping, hysteresis characteristics with respect to the jump frequency are given to the motor.



[Parameter setting]

Title	Function	Adjustment range	Default setting
F270	Jump frequency 1	0.0-FH (Hz)	0.0
F271	Jumping width 1	0.0-30.0 (Hz)	0.0
F272	Jump frequency 2	0.0-FH (Hz)	0.0
F273	Jumping width 2	0.0-30.0 (Hz)	0.0
F274	Jump frequency 3	0.0-FH (Hz)	0.0
F275	Jumping width 3	0.0-30.0 (Hz)	0.0

☆ Do not set the jump parameters, if multiple jump frequency setting width overlap.

☆ During acceleration or deceleration, the jumping function is disabled for the operation frequency.

6.11 Preset-speed operation frequencies

6.11.1 Preset-speed operation frequency 8 to 15

F287 - F294: Preset-speed operation frequency 8 to 15

See Section 5.14 for details.

6.11.2 Fire-speed control

F294: Preset-speed operation frequency 15 (fire-speed)

- Function
  Fire-speed control is used when operating the motor at the specified frequency in case of an emergency. If fire-speed control is assigned to the terminal board selection parameter and a fire-speed control signal is given, the motor will be operated at the frequency specified with F294 (preset-speed operation frequency 15). (When the terminal board selection parameter is set to 52 or 53).

6.12 PWM carrier frequency

F300: PWM carrier frequency

F312: Random mode

F316: Carrier frequency control mode selection

- Function
  1) The F300 parameter allows the tone of the magnetic noise from the motor to be changed by switching the PWM carrier frequency. This parameter is also effective in preventing the motor from resonating with its load machine or its fan cover.
  2) In addition, the F300 parameter reduces the electromagnetic noise generated by the inverter. Reduce the carrier frequency to reduce electromagnetic noise. Note: Although the electromagnetic noise level is reduced, the magnetic noise of the motor is increased.
  3) The random mode reduces motor electromagnetic noise by changing the pattern of the reduced carrier frequency.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F300	PWM carrier frequency	2.0-16.0 (kHz) (*)	4.0
F312	Random mode	0: Disabled, 1: Enabled	1
F316	Carrier frequency control mode selection	0: Carrier frequency not reduced automatically 1: Carrier frequency reduced automatically 2: Carrier frequency not reduced automatically Support for 400V models 3: Carrier frequency reduced automatically Support for 400V models.	1

* Load reduction will be required if the PWM carrier frequency is modified for each applicable motor model. Refer to the following table.

Load reduction ratios required.

[200V Class]

HF321S- HF3212-	Carrier frequency		
	4kHz or less	12kHz or less	16kHz or less
A20	1.6A	1.5A	1.5A
A40	3.3A	3.3A	3.3A
A75	5.0A	4.4A	4.2A
1A5	8.0A	7.9A	7.1A
2A2	11.0A	10.0A	9.1A
3A7	17.5A	16.4A	14.6A
5A5	27.5A	25.0A	25.0A
7A5	33.0A	33.0A	29.8A
011	54.0A	49.0A	49.0A
015	66.0A	60.0A	54.0A

[400V Class]

Input voltage	480V or less			more than 480V		
HF3214-	Carrier frequency			Carrier frequency		
	4kHz or less	12 kHz or less	16kHz or less	4kHz or less	12kHz or less	16kHz or less
A40	1.5A	1.5A	1.5A	1.5A	1.5A	1.2A
A75	2.5A	2.1A	2.1A	2.1A	1.9A	1.9A
1A5	4.1A	3.7A	3.3A	3.8A	3.4A	3.1A
2A2	5.5A	5.0A	4.5A	5.1A	4.6A	4.2A
3A7	9.5A	8.6A	7.5A	8.7A	7.9A	6.9A
5A5	14.3A	13.0A	13.0A	13.2A	12.0A	12.0A
7A5	17.0A	17.0A	14.8A	15.6A	14.2A	12.4A
011	27.7A	25.0A	25.0A	25.5A	23.0A	23.0A
015	33.0A	30.0A	26.0A	30.4A	27.6A	24.0A

* Default setting of PWM carrier frequency is 4kHz. Rated output current of rating label display at 4kHz.
  If F316 is set to 1 or 3, however, the carrier frequency will decrease automatically with increase in current in order to secure the rated current at frequencies of 4 kHz or less.
  If F316 is set to 0 or 2, OCP trip will occur when the current increases and reaches the level above which the carrier frequency is decreased automatically.
* Random control is exercised when the motor is operated in a low-frequency range where it produces annoying magnetic noise.
  If the carrier frequency (F300) is set above 7.1 kHz, the random control function will not be performed, because the level of motor magnetic noise is low at high frequencies.
* When the carrier frequency control mode selection (F316) is set to 2 or 3, the carrier frequency (F300) should be set preferably below 4 kHz. Otherwise the output voltage may drop.

6.13 Trip-less intensification

6.13.1 Auto-restart (Restart of coasting motor)

F301: Auto-restart control selection

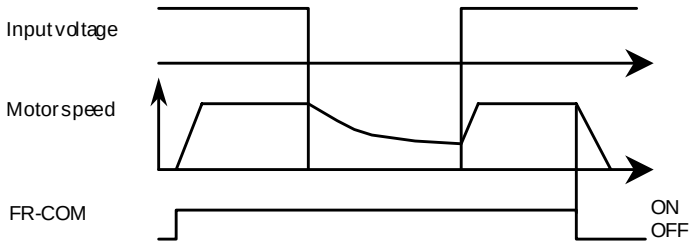
Caution	
Mandatory	• Stand clear of motors and mechanical equipment If the motor stops due to a momentary power failure, the equipment will start suddenly when power is restored. This could result in unexpected injury. • Attach warnings about sudden restart after a momentary power failure on inverters, motors and equipment for prevention of accidents in advance.

- Function
  The F301 parameter detects the rotating speed and rotational direction of the motor during coasting the event of momentary power failure, and then after power has been restored, restarts the motor smoothly (motor speed search function). This parameter also allows commercial power operation to be switched to inverter operation without stopping the motor.
  During operation, "rtry" is displayed.

Title	Function	Adjustment range	Default setting
F301	Auto-restart control selection	0: Disabled 1: At auto-restart after momentary stop 2: When turning ST-COM on or off 3: At auto-restart or when turning ST-COM on or off 4: At start-up	0

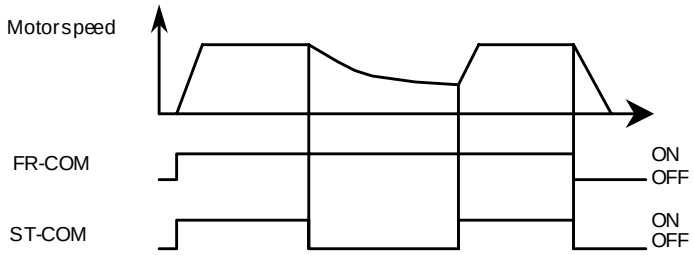
* If the motor is restarted in retry mode, this function will operate, regardless of the setting of this parameter.

1) Auto-restart after momentary power failure (Auto-restart function)



★ Setting F301 to 1, (3): This function operates after power has been restored following detection of an undervoltage by the main circuits and control power.

2) Restarting motor during coasting (Motor speed search function)



★ Setting F301 to 2 or 3: This function operates after the ST-COM terminal connection has been opened first and then connected again.

Note: The terminal function ST needs to be assigned to an input terminal, using the parameters F111 to F118.

3) DC braking during restart

When F301 is set to 4, a motor speed search is performed each time operation is started.
This function is useful especially when the motor is not operated by the inverter but it is running because of external force.

Warning!!

- At restart, it takes about 300 ms for the inverter to check to see the number of revolutions of the motor.
  For this reason, the start-up takes more time than usual.
- Use this function when operating a system with one motor connected to one inverter.
  This function may not operate properly in a system configuration with multiple motors connected to one inverter.

Application to a crane or hoist

The crane or hoist may have its load moved downward during the above waiting time from input of the operation starting command to the restart of the motor. To apply the inverter to such machines, therefore, set the auto-restart control mode selection parameter to "F301=0" (Disabled), Do not use the retry function, either.

6.13.2 Regenerative power ride-through control/Deceleration stop

F302: Regenerative power ride-through control/Deceleration stop

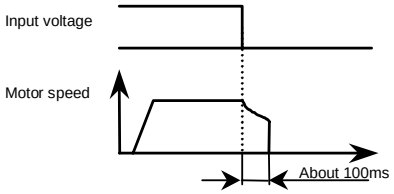
- Function
  1) Regenerative power ride-through control continues the operation of the motor by utilizing motor regenerative energy in the event of momentary power failure.
  2) Slowdown stop in the event of momentary power failure: If a momentary power failure occurs during operation, the inverter stops forcibly. (Deceleration time varies with control.) When operation is stopped, the message "StOP" is displayed (alternately) on the operation panel.
     After the forced stop, the inverter remains static until you put off the operation command momentarily.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F302	Regenerative power ride-through control / Deceleration stop	0: Disabled 1: Enabled 2: Slowdown stop	0

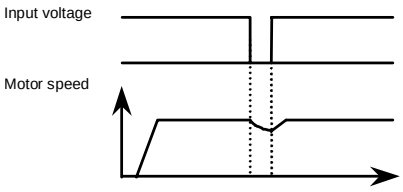
Note: Even when this parameter is set, the particular load conditions may cause the motor to coast. In this case, use the auto-restart function F301 along with this parameter function.

[When power is interrupted]



* The time for which the operation of the motor can be continued depends on the machine inertia and load conditions. Before using this function, therefore, perform verification tests.

[If momentary power failure occurs]



6.13.3 Retry function

F303: Retry selection (Selecting the number of times)

Caution	
Mandatory	• Do not go near the motor in alarm-stop status when the retry function is selected. The motor may suddenly restart, which could result in injury. • Take measures for safety, e.g. attach a cover to the motor, to prevent accidents if the motor suddenly restarts.

- Function
  This parameter resets the inverter automatically when the inverter gives an alarm. During the retry mode, the motor speed search function operated automatically as required and thus allows smooth motor restarting.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F303	Retry selection (number of times)	0: None, 1-10 times	0

The likely causes of tripping and the corresponding retry processes are listed below.

Cause of tripping	Retry process	Canceling conditions
Momentary power failure Overcurrent Overvoltage Overload Overheating	Up to 10 times in succession 1st retry: About 1 sec after tripping 2nd retry: About 2 sec after tripping 3rd retry: About 3 sec after tripping … 10th retry: About 10 sec after tripping	The retry function will be canceled at once if tripping is caused by an unusual event other than: momentary power failure, overcurrent, overvoltage or overload. This function will also be canceled if retrying is not successful within the specified number of times.

★ The retry function is disabled in the following unusual events:

- OCA : Arm overcurrent at start-up
- OCL : Overcurrent on the load side at start-up
- EPHO : Output phase failure
- OH2 : External thermal trip
- Ot : Overtorque trip
- E : External trip stop
- UC : Small-current operation trip
- UP1 : Undervoltage trip (main circuit)
- EF2 : Ground fault trip
- EPH1 : Input phase failure
- EtyP : Inverter type error
- Err2 : Main unit RAM fault
- Err3 : Main unit ROM fault
- Err4 : CPU fault trip
- Err5 : Remote control error
- Err7 : Current detector fault
- Err8 : Control circuit board format error
- EEP1 : EEPROM fault 1
- EEP2 : EEPROM fault 2
- EEP3 : EEPROM fault 3
- Etn1 : Auto-tuning error
- E-18 : VRF input detection error
- E-19 : Main unit CPU communication error
- E-20 : Excessive torque boost
- E-21 : CPU fault 2

★ Protective operation detection relay signals (FA, FB, FC terminal signals) are not sent during use of the retry function. (Default setting)
★ To allow a signal to be sent to the protective action detection relay (FA, B and C terminals) even during the retry process, assign the function 36 or 37 to F132.
★ A virtual cooling time is provided for overload tripping (OL1, OL2, OLr).
In this case, the retry function operates after the virtual cooling time and retry time.
★ In the event of tripping caused by an overvoltage (OP1 - OP3), the retry function will not be activated until the voltage in the DC section comes down to a normal level.
★ In the event of tripping caused by overheating (OH), the retry function will not be activated until the temperature in the inverter comes down low enough for it to restart operation.
★ Keep in mind that when F602 is set to 1 (trip retained), the retry function will not be performed, regardless of the setting of F303.
★ During retrying, the blinking display will alternate between rtry and the monitor display specified by status monitor display mode selection parameter F710.
★ The number of retries will be cleared if the inverter is not tripped for the specified period of time after a successful retry.
"A successful retry" means that the inverter output frequency reaches the command frequency without causing the inverter to re-trip.

6.13.4 Dynamic (regenerative) braking - For abrupt motor stop

F304: Dynamic braking selection

F308: Dynamic braking resistance

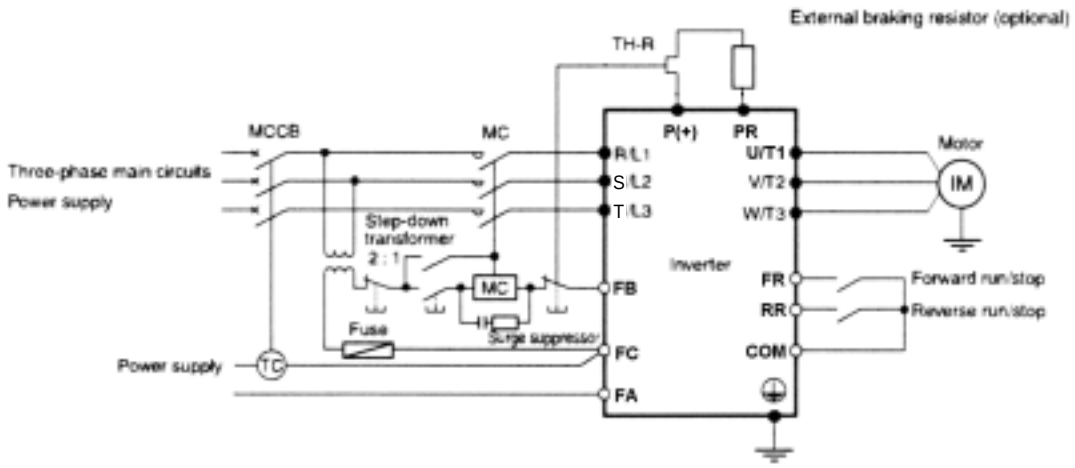
F309: Dynamic braking resistor capacity

- Function
The HF-320α does not contain a braking resistor. Connect an external braking resistor in the following cases to enable dynamic braking function:
  1) when decelerating the motor abruptly or if overvoltage tripping (OP) occurs during deceleration stop
  2) when a continuous regenerative status occurs during downward movement of a lift or the winding-out operation of a tension control machine
  3) when the load fluctuates and a continuous regenerative status results even during constant speed operation of a machine such as a press

[Parameter setting]

Title	Function	Adjustment range	Default setting
F304	Dynamic braking selection	0: Dynamic braking disabled 1: Dynamic braking enabled, over-load protection enabled	0
F308	Dynamic braking resistance	1-1000 (Ω)	According to model (See Section 11, K-14)
F309	Dynamic braking resistor capacity	0.01-30.00 (kW)	

1) Connecting an external braking resistor (optional)



Note 1: A TC is connected, as shown in this figure, when an MCCB with a trip coil is used instead of an MC. A step-down transformer is needed for every 400V-class inverter, but not for any 200V-class inverter.

Note 2: As a last resort to prevent fire, be sure to connect a thermal relay (THR). Although the inverter has a means of preventing overload and overcurrent to protect the braking resistor, the thermal relay is activated in case the protection function fails to work. Select and connect a thermal relay (THR) appropriate to the capacity (wattage) of the braking resistor.

[Parameter setting]

Title	Function	Default setting
F304	Dynamic braking selection	1
F305	Overvoltage limit operation	1
F308	Braking resistor operation rate	Any value
F309	Dynamic braking resistor capacity	Any value

☆ To connect a dynamic braking resistor, set the overvoltage limit operation parameter F305 to "1" (Disabled).

☆ To use this inverter in applications that create a continuously regenerative status (such as downward movement of a lift, a press or a tension control machine), or in applications that require slowdown stopping of a machine with a significant load inertial moment, increase the dynamic braking resistor capacity according to the operation rate required.

☆ To connect an external dynamic braking resistor, select one with a resultant resistance value greater than the minimum allowable resistance value. Be sure to set the appropriate operation rate in F308 and F309 to ensure overload protection.

☆ When using a braking resistor with no thermal fuse, connect and use a thermal relay as a control circuit for cutting power off.

2) Optional dynamic braking resistors

Optional dynamic braking resistors are listed below. All these resistors are 10%ED in operation rate

Inverter type	Braking resistor/Braking unit	
	Model number	Rating
HF321S-A20/HF3212-A20	Y135AA201 x1	200W-400Ω
HF321S-A40/HF3212-A40	Y135AA200 x1	200W-200Ω
HF321S-A75/HF3212-A75	Y135AA205 x1	300W-200Ω
HF321S-1A5/HF3212-1A5	Y135AA204 x1	300W-80Ω
HF321S-2A2/HF3212-2A2	Y135AA208 x1	400W-70Ω
HF3212-3A7	Y135AA203 x2	600W-40Ω(300W-20Ωx2S)
HF3212-5A5	X435AC069 x2	1500W-20Ω(750W-10Ωx2S)
HF3212-7A5		
HF3212-011	X480AC063 x3	2250W-13.5Ω (750W-4.5Ωx3S)
HF3212-015	X480AC064 x4	3000W-10Ω (750W-2.5Ωx4S)
HF3214-A40	Y135AA202 x1	200W-750Ω
HF3214-A75	Y135AA207 x1	300W-750Ω
HF3214-1A5	Y135AA206 x1	300W-400Ω
HF3214-2A2	Y135AA209 x1	400W-250Ω
HF3214-3A7	Y135AA204 x2	600W-160Ω(300W-80Ωx2S)
HF3214-5A5	Y135AA209 x3	1200W-83Ω(400W-250Ωx3P)
HF3214-7A5		
HF3214-011	X480AC068 x3	2250W-54Ω (750W-18Ωx3S)
HF3214-015	X480AC069 x4	3000W-40Ω (750W-10Ωx4S)

Note 1: The data in Rating above refer to the resultant resistance capacities (watts) and resultant resistance values (Ω).
The numeric values inside parentheses refer to the internal compositions of resistors.

Note 2: Braking resistors for frequent regenerative braking are optionally available. For more information, contact your Sumitomo dealer.

3) Minimum resistances of connectable braking resistors

The minimum allowable resistance values of the externally connectable braking resistors are listed in the table below.

Do not connect braking resistors with smaller resultant resistances than the listed minimum allowable resistance values.

Inverter rated output capacity (kW)	[200V Class]		[400V Class]	
	Resistance of standard option	Minimum allowable resistance	Resistance of standard option	Minimum allowable resistance
0.2	400Ω	55Ω	-	-
0.4	200Ω	55Ω	750Ω	114Ω
0.75	200Ω	55Ω	750Ω	114Ω
1.5	80Ω	44Ω	400Ω	67Ω
2.2	70Ω	33Ω	250Ω	67Ω
3.7	40Ω	16Ω	160Ω	54Ω
5.5	20Ω	12Ω	83Ω	43Ω
7.5	20Ω	12Ω	63Ω	28Ω
11	13.5Ω	5Ω	54Ω	16Ω
15	10Ω	5Ω	40Ω	16Ω

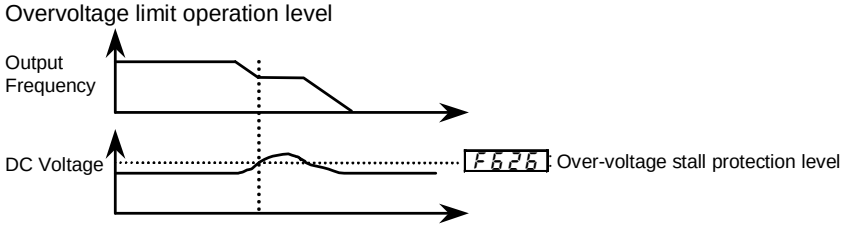
6.13.5 Avoiding overvoltage tripping

F305: Overvoltage limit operation

F626: Overvoltage stall protection level

- Function
  These parameters are used to keep the output frequency constant or increase it to prevent overvoltage tripping in case the voltage in the DC section rises during deceleration or varying speed operation. The deceleration time during overvoltage limit operation may increase above the designated time.

Overvoltage limit operation level



[Parameter setting]

Title	Function	Adjustment range	Default setting
F305	Overvoltage limit operation (Slowdown stop mode selection)	0: Enabled 1: Prohibited 2: Enabled (forced quick deceleration) 3: Enabled (dynamic quick deceleration)	1
F626	Overvoltage limit operation level	100-150%	200V models: 134% 400V models: 140%

☆ If F305 is set to 2 (quick deceleration), the inverter will increase the voltage to the motor (over-excitation control) to increase the amount of energy consumed by the motor when the voltage reaches the overvoltage protection level, and therefore the motor can be decelerated more quickly than normal deceleration.

☆ If F305 is set to 3 (dynamic quick deceleration), the inverter will increase the voltage to the motor (over-excitation control) to increase the amount of energy consumed by the motor as soon as the motor begins to slow down, and therefore the motor can be decelerated still more quickly than quick deceleration.

6.13.6 Output voltage adjustment/Supply voltage correction

uLu: Base frequency voltage 1

F307: Supply voltage correction (output voltage adjustment)

- Function

  Base frequency voltage1

  The F307 parameter adjusts the voltage corresponding to the base frequency 1 uL so that no voltage exceeding the uLu set value is put out. (This function is enabled only when F307 is set to either "0" or "1".)

  Supply voltage correction

  The F307 parameter maintains a constant V/F ratio, even when the input voltage decreases. The torque during low-speed operation is prevented from decreasing.

Maintains a constant V/F ratio, even when the input voltage fluctuates.
Output voltage adjustment ..... Limits the voltage at frequencies exceeding the base frequency. Applied when operating a special motor with low induced voltage.

[Parameter setting]

Title	Function	Adjustment range	Default setting
uLu	Base frequency voltage1	200V models: 50 - 330 (V) 400V models: 50 - 660 (V)	200V models: 200V 400V models: 400V
F307	Supply voltage correction (output voltage limited)	0: Supply voltage uncorrected, output voltage limited 1: Supply voltage corrected, output voltage limited 2: Supply voltage uncorrected, output voltage unlimited 3: Supply voltage corrected, output voltage unlimited	3

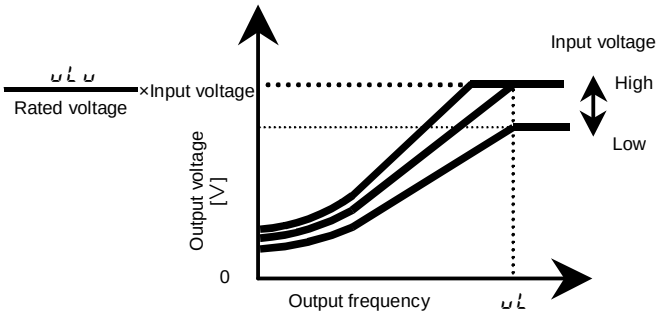
☆ If F307 is set to "0" or "2", the output voltage will change in proportion to the input voltage.

☆ Even if the base frequency voltage (ul u parameter) is set above the input voltage, the output voltage will not exceed the input voltage.

☆ The rate of voltage to frequency can be adjusted according to the rated motor capacity. For example, setting F307 to "0" or " 1" prevents the output voltage from increasing, even if the input voltage changes when operation frequency exceeds the base frequency.

☆ When the V/F control mode selection parameter (Pt) is set to any number between 2 and 6, the supply voltage is corrected regardless of the setting of F307.

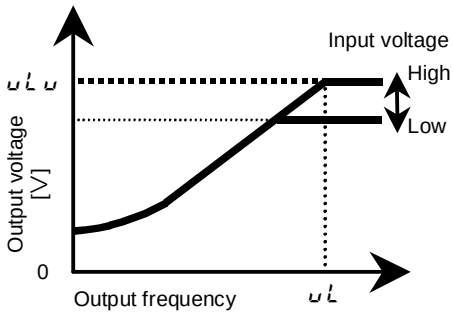
[0: Supply voltage uncorrected, output voltage limited]



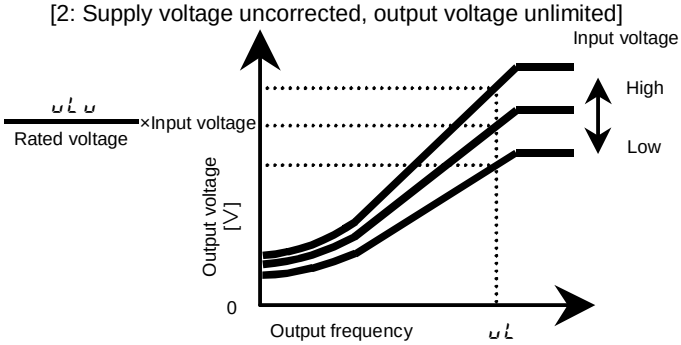
* The above applies when V/F control mode selection parameter Pt is set to "0" or "1".

ul u / Rated voltage > 1 the output voltage can be prevented from exceeding the input voltage.

[1: Supply voltage corrected, output voltage limited]



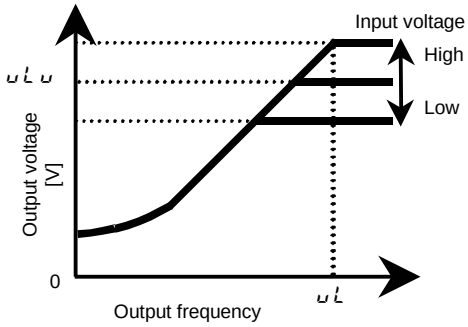
[2: Supply voltage uncorrected, output voltage unlimited]



* The above applies when V/F control mode selection parameter Pt is set to "0" or "1".

ul u / Rated voltage > 1 the output voltage can be prevented from exceeding the input voltage.

[3: Supply voltage corrected, output voltage unlimited]



* Even if ul u is set for an output voltage lower than the input voltage, the output voltage will exceed the voltage adjusted by ul u when the output frequency is higher than the base frequency 1 ul .

6.13.7 Canceling the operation command

F311: Reverse-run prohibition

- Function
  This function prevents the motor from running in the forward or reverse direction when it receives the wrong operation signal.

[Parameter setting]

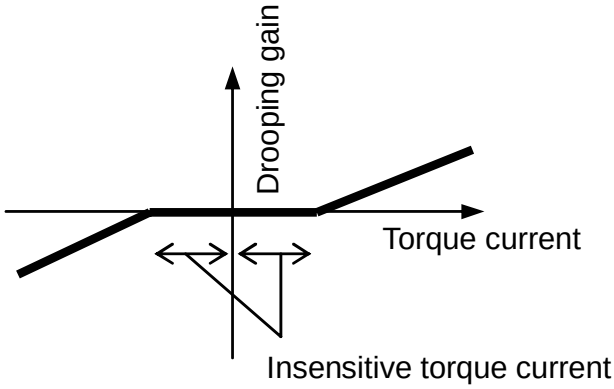
Title	Function	Adjustment range	Default setting
F311	Reverse-run prohibition	0: Forward/reverse run permitted 1: Reverse run prohibited 2: Forward run prohibited	0

6.14 Drooping control

F320: Drooping gain

F323: Drooping insensitive torque band

- Function
  These parameters are used to allow the motor to “slip” according to the load torque current. Using these parameters, the dead zone torque and the gain can be adjusted.



[Parameter setting]

Title	Function	Adjustment range	Default setting
F320	Drooping gain	0-100%	0%
F323	Drooping insensitive torque band	0-100%	10%

- When the torque current is above the specified dead zone torque current, the frequency is reduced (during operation) or increased (during DC braking).
- The drooping function is activated above the torque current set with F323.
- The amount of drooping varies depending on the amount of torque current.

The difference of the frequency after drooping can be calculated as follows.

Drooping speed
Drooping speed = Base frequency [UL] Note x F320 x (Torque current-F323)
Note: If the base frequency exceeds 100Hz, count it as 100Hz.
Control is exercised between the starting frequency (F240) and the maximum frequency (FH).

6.15 Braking setting functions

[F342]: Braking mode selection

[F343]: Release frequency

[F344]: Release time

[F345]: Creeping frequency

[F346]: Creeping time

6.16 Conducting PID control

[F359]: PID control wait time

[F360]: PID control

[F362]: Proportional gain

[F363]: Integral gain

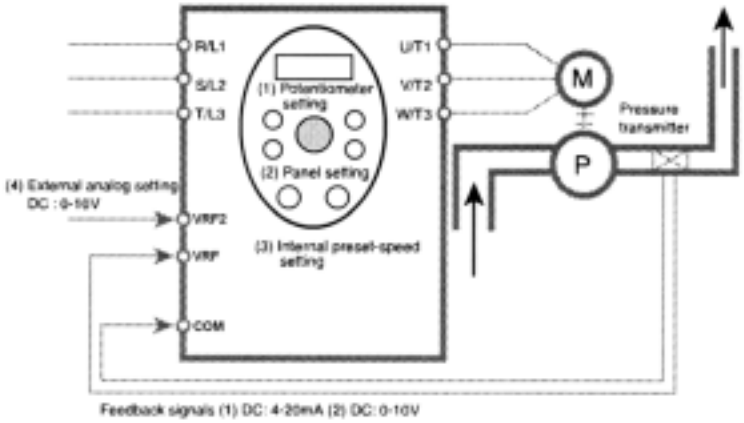
[F366]: Differential (D) gain

- Function
  Using feedback signals (4 to 20mA, 0 to 10V) from a detector, process control can be exercised, for example, to keep the airflow, amount of flow or pressure constant.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F359	PID control wait time	0-2400 [sec]	0
F360	PID control	0: Disabled, 1: Enabled	0
F362	Proportional gain	0.01-100.0	0.30
F363	Integral gain	0.01-100.0	0.20
F366	Differential (D) gain	0.00-2.55	0.00

1) External connection



2) Types of PID control interfaces

Process quantity input data (frequency) and feedback input data can be combined as follows for the PID control of the HF-320 α :

Process quantity input data (frequency setting)		Feedback input data
Setting method	Frequency setting mode selection 1 FMOd / F207 / F200	
(1) Internal potentiometer setting	0	External analog input VRF (DC:4-20V / DC:0-10V)
(2) Panel input setting	3	
(3) Internal preset-speed setting	-(CMOd=0)	
(4) External analog setting VRF2 (DC: 0-10V)	2	

Note 1: About the setting of FMOd, F207 and F200: Do not enable VRF using these parameters, because the VRF terminal is used for feedback signals.

Note 2: To make the inverter send out a signal that indicates whether the amount of feedback agree with (or reaches) the amount of processing, assign the function 52 or 53 to an unassigned output terminal. You can also specify a frequency agreement detection range (F167). For more information, see 6.3.4.

3) Setting PID control

Set "1" in the extended parameter F360 (PID control).

(1) Set parameters ACC (acceleration time), and dEC (deceleration time) to their minimum values (0.1 sec.).

(2) To limit the output frequency, set parameters UL (upper limit frequency) and LL (lower limit frequency). If process quantities are set from the operation panel, however, the process quantity setting range will be limited by the settings of UL and LL.

4) Adjusting the PID control gain level

Adjust the PID control gain level according to the process quantities, the feedback signals and the object to be controlled.

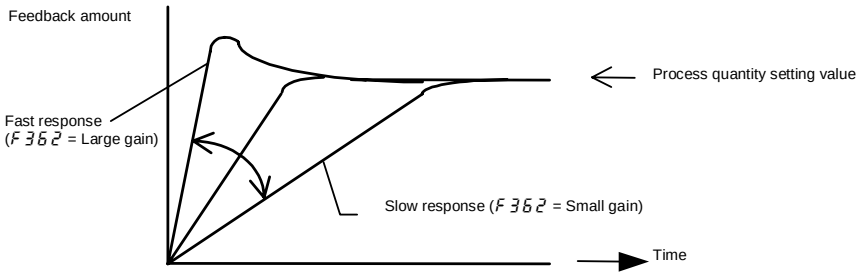
The following parameters are provided for gain adjustment:

Parameter	Setting range	Default setting
F362 (P-gain)	0.01-100.0	0.30
F363 (I-gain)	0.01-100.0	0.20
F366 (D-gain)	0.00-2.55	0.00

F362 (P-gain adjustment parameter)

This parameter adjusts the proportional gain level during PID control. A correction value proportional to the particular deviation (the difference between the set frequency and the feedback value) is obtained by multiplying this deviation by the parameter setting.

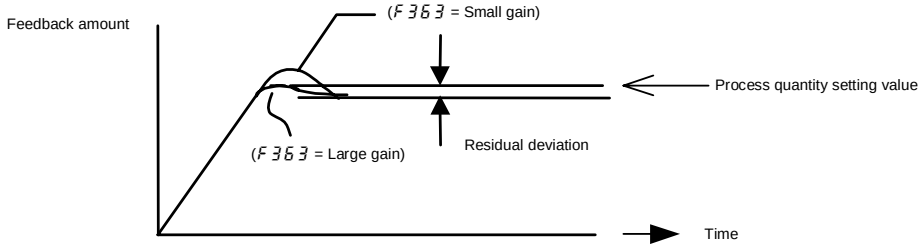
A larger P-gain adjustment value gives faster response. Too large an adjustment value, however, results in an unstable event such as hunting.



F363 (I-gain adjustment parameter)

This parameter adjusts the integral gain level during PID control. Any deviations remaining unremoved during proportional action are cleared to zero (residual deviation offset function).

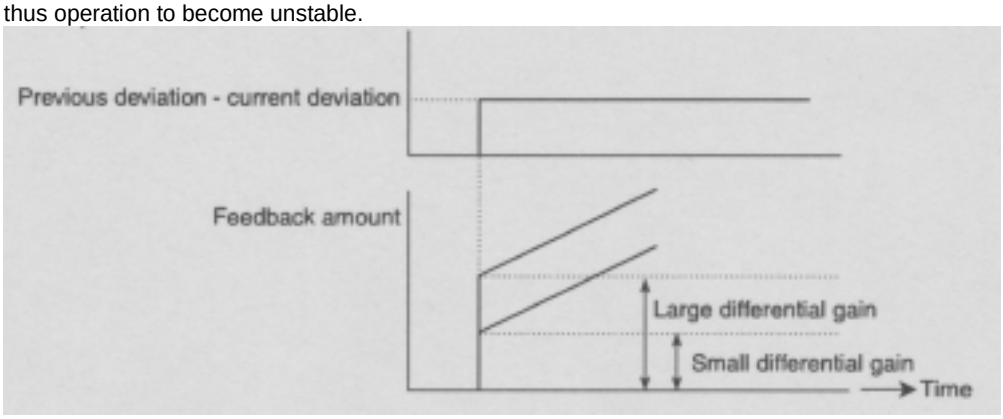
A larger I-gain adjustment value reduces residual deviations. Too large an adjustment value, however, results in an unstable event such as hunting.



F366 (D-gain adjustment parameter)

This parameter adjusts the differential gain level during PID control. This gain increases the speed of response to a rapid change in deviation (difference between the frequency setting and the amount of feedback).

Note that setting the gain more than necessary may cause great fluctuations in output frequency, and thus operation to become unstable.

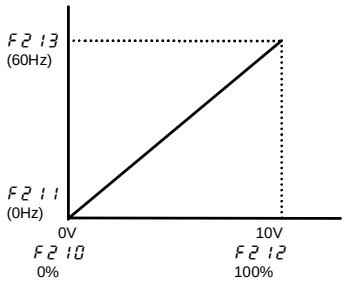


5) Adjusting analog command voltages

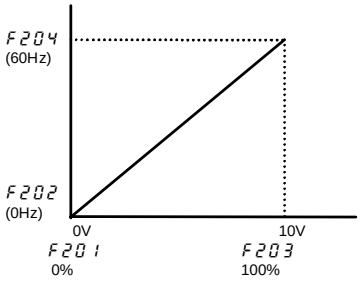
To use external analog setting (VRF2) or feedback input (VRF), perform voltage-scaling adjustments as required. See Section 6.5.2 for further details.

If the feedback input data is too small, voltage-scaling adjustment data can also be used for gain adjustment.

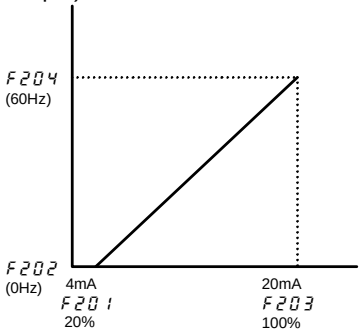
Example of VRF2 terminal setting



Example of VRF terminal setting (voltage input)



Example of VRF terminal setting (current input)



6) Setting the time elapsed before PID control starts

You can specify a waiting time for PID control to prevent the inverter from starting PID control before the control system becomes stable, for example, after start-up.

The inverter ignores feedback input signals, carries out operation at the frequency determined by the amount of processing for the period of time specified with F359 and enters the PID control mode after a lapse of the specified time.

6.17 Setting motor constants

F400: Auto-tuning

F401: Slip frequency gain

F402: Motor constant #1 (primary resistance)

F415: Motor rated current

F416: Motor no-load current

F417: Motor rated speed

F418: Speed control response coefficient

F419: Speed control stable coefficient

F480: Exciting strengthening coefficient

F485: Stall cooperation gain at field weakening zone 1

F492: Stall cooperation gain at field weakening zone 2

F494: Motor adjustment factor

To use vector control, automatic torque boost and automatic energy saving, motor constant setting (motor tuning) is required. The following three methods are available to set motor constants (for automatic torque boosting, however, two methods are available):
In case you use the Sumitomo 4-terminal AF motor in the same capacity as the inverter, auto-tuning is not necessary.

1) Using the automatic torque boost (AU2) for setting the V/F control mode selection (PT) and auto-tuning (F400) at the same time
2) Setting V/F control mode selection (PT) and auto-tuning (F400) independently
3) Combining the V/F control mode selection (PT) and manual tuning

☆ Check to be sure that the setting of the parameter vl and that of the parameter vlv agree with the base frequency (rated rotational speed) and base frequency voltage (rated voltage) of the motor to be operated, respectively. If not, set the parameters correctly.

☆ When using the inverter to control the operation of a motor smaller in capacity by one grade or more, be sure to set the motor rated current setting parameter (F415) properly.

☆ Vector control may not operate properly if the motor capacity differs from the applicable rated capacity of the inverter by more than two grades.
If current waveforms oscillate during operation, increase the speed control stability factor (F419). This is effective in suppressing oscillation.

[Selection 1: Setting by automatic torque boost]

This is the easiest of the available methods. It conducts vector control and auto-tuning at the same time.

Set the automatic torque boost AU2 to 1 (Automatic torque boost + auto-tuning)

Set the automatic torque boost AU2 to 2 (Sensorless vector control + auto-tuning).

Set the automatic torque boost AU2 to 3 (Energy-saving + auto-tuning)

See Section 5.2 for details of the setting method.

[Selection 2: Setting sensorless vector control and auto-tuning independently]

This method sets sensorless vector control or automatic torque boost, and auto-tuning independently.

Specify the control mode selection parameter (Pt) and then set auto-tuning.

Set the auto-tuning parameter F400 to 2 (Auto-tuning enabled)

[Parameter setting]

Title	Function	Adjustment range	Default setting
F400	Auto-tuning	0: Auto-tuning disabled (use of internal parameters) 1: Application of individual settings of F402 (after execution: 0) 2: Auto-tuning enabled (after execution: 0)	0

Set F400 to 2.

☆ Precautions on auto-tuning

(1) Conduct auto-tuning only after the motor has been connected and operation completely stopped. If auto-tuning is conducted immediately after operation stops, the presence of a residual voltage may result in abnormal tuning.

(2) Voltage is applied to the motor during tuning even though it barely rotates. During tuning, "AEn 1" is displayed on the operation panel.

(3) Tuning is usually completed within three seconds. If it is aborted, the motor will trip with the display of Etn 1 and no constants will be set for that motor.

(4) High-speed motors, high-slip motors or other special motors cannot be auto-tuned. For these motors, perform manual tuning using Selection 3 described below.

(5) Provide cranes and hoists with sufficient circuit protection such as mechanical braking. Without sufficient circuit protection, the resulting insufficient motor torque during tuning could create a risk of machine stalling/falling.

(6) If auto-tuning is impossible or an "Etn 1" auto-tuning error is displayed, perform manual tuning with Selection 3.

(7) If the inverter is tripped during auto-tuning because of an output phase failure (epho), check if the inverter is connected correctly. A check for output phase failures is made during auto-tuning, regardless of the setting of the output phase failure detection mode selection parameter (F605).

[Selection 3: Setting vector control and manual tuning independently]

If an "Etn" tuning error is displayed during auto-tuning or when vector control characteristics are to be improved, independent motor constants can be set.

Title	Function	Adjustment range	Default setting
F400	Auto-tuning	0: Auto-tuning disabled (use of internal parameters) 1: Application of individual settings of F402 (after execution: 0) 2: Auto-tuning enabled (after execution: 0)	0
F401	Slip frequency gain	0-150 (%)	Depends on the capacity (See Section 11, K-14)
F402	Motor constant #1 (primary resistance)	0.0-30.0 (%)	
F415	Motor rated current	0.1-100.0 (A)	
F416	Motor no-load current	10-90 (%)	
E417	Motor rated rotational speed	100-32000 (min^{-1})	
F418	Speed control response coefficient	1-150	40
F419	Speed control stability coefficient	1-100	20
F480	Exciting strengthening coefficient	100-130	100
F485	Stall cooperation gain at field weakening zone 1	10-250	100
F492	Stall cooperation gain at field weakening zone 2	50-150	100

Title	Function	Adjustment range	Default setting
F494	Motor adjustment factor	0-200	Depends on the capacity
tHr	Motor electronic thermal protection level 1	10-100 (%)	100

Setting procedure Adjust the following parameters:

F400: Select "1" to set the motor constant independently using the F401-F405 parameters.

F401: Set the compensation gain for the slipping of the motor. A higher slip frequency reduces motor slipping correspondingly. After setting F417, set F401 to adjust in detail.

F402: Adjust the primary resistive component of the motor. Decreases in torque due to a possible voltage drop during low-speed operation can be suppressed by setting a large value in this parameter. (Perform adjustments according to the actual operation.)

F415: Set the rated current of the motor. For the rated current, see the motor's nameplate or test report.

F416: Set the ratio of the no-load current of the motor to the rated current. Enter the value in % that is obtained by dividing the no-load current specified in the motor's test report by the rated current.

F417: Set the rated rotational speed of the motor. For the rated current, see the motor's nameplate or test report.

F418: Using this parameter along with F419, adjust the speed of response to the frequency command.

F419: Using this parameter along with F418, adjust the speed of response to the frequency command.

* How to make adjustments according to the moment of inertia of the load

The moment of inertia of the load (including that of the motor shaft) was set at the factory on the assumption that it would be three times as large as that of the motor shaft.

If this assumption does not hold, calculate the values to be entered in F418 and F419, using the following equations.

$F418 = \sqrt{(a/3)} \times 40$

$F419 = \sqrt{(a/3)} \times 20$

Where a is the times by which the moment of inertia of the load is larger than that of the motor.

After the above adjustments, if necessary, make fine adjustments as described below.

- To increase the response speed: Increase the setting of F418.
- To reduce the response speed: Decrease the setting of F418.
- If overshooting or hunting occurs: Increase the setting of F419.
- If reduction gears or the like squeak: Increase the setting of F419.
- If an over-voltage trip occurs on completion of acceleration: Increase the setting of F419.

When making the above adjustments, increase or decrease settings in steps of 10% or so while checking how things change.

Note also that, depending on the settings of f418 and f419, the frequency may exceed the upper-limit frequency if the inverter is set so as to accelerate the load in the shortest possible time.

F485: Using this parameter along with F492 adjust characteristics in areas in which the frequency is above the base frequency (areas where the field is weak).

F492: Using this parameter along with F485 adjust characteristics in areas in which the frequency is above the base frequency (areas where the field is weak).

* How to make adjustments where the frequency is above the base frequency (where the field is weak).
  If a heavy load is applied instantaneously (or transiently), the motor may stall before the load current reaches the current set with the stall prevention level 1 parameter F601. In many cases, this kind of stall can be avoided by gradually reducing the setting of F485.
  A drop in supply voltage may cause fluctuations of the load current or vibration of the motor. In some cases, such phenomena can be eliminated by changing the setting of F492 to between 80 and 90. However, this may cause an increase in load current, so that it is also necessary to adjust the setting of the electronic thermal protective level 1 parameter (tHr) properly according to the motor capacity.

F494: No need to adjust (Do not change the setting, unless otherwise instructed by Sumitomo technical staff)

tHr : If the rated capacity of the motor is one size smaller than that of the inverter, lower the thermal protective level according to the rated current of the motor.

* Sensorless vector control may not operate properly if the motor capacity differs from the applicable rated capacity of the inverter by more than two grades.

6.18 Acceleration/deceleration patterns 2 and 3

6.18.1 Selecting an acceleration/deceleration pattern

F502: Acceleration/deceleration 1 pattern

F506: S-pattern lower-limit adjustment amount

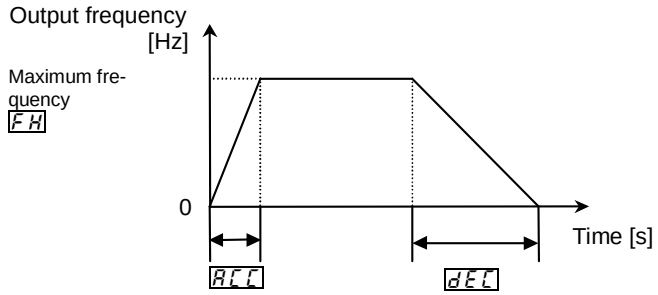
F507: S-pattern upper-limit adjustment amount

- Function
  These parameters allow you to select an acceleration/deceleration pattern that suits the intended use.

Title	Function	Adjustment range	Default setting
F502	Acceleration/ deceleration 1 pattern	0: Linear, 1: S-pattern 1, 2: S-pattern 2	0
F506	S-pattern lower-limit adjustment amount	0-50%	10%
F507	S-pattern upper-limit adjustment amount	0-50%	10%

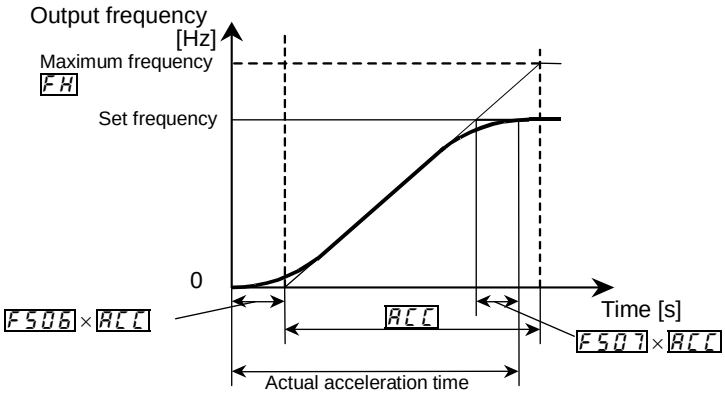
1) Linear acceleration/deceleration

A general acceleration/ deceleration pattern. This pattern can usually be used.



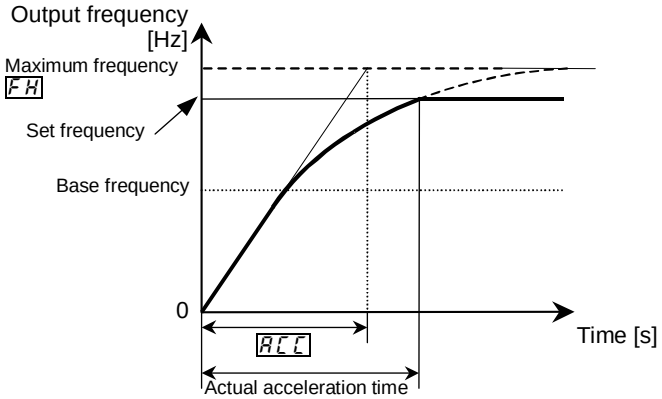
2) S-pattern acceleration/deceleration 1

Select this pattern to accelerate/decelerate the motor rapidly to a high-speed region with an output frequency of 60Hz or more or to minimize the shocks applied during acceleration/deceleration. This pattern is suitable for pneumatic transport machines.



3) S-pattern acceleration/deceleration

Select this pattern to obtain slow acceleration in a demagnetizing region with a small motor acceleration torque. This pattern is suitable for high-speed spindle operation.



6.18.2 Selecting an acceleration/deceleration pattern

F500: Acceleration time 2

F501: Deceleration time 2

F503: Acceleration/deceleration 2 pattern

F504: Selecting an acceleration/deceleration pattern

F505: Acceleration/deceleration 1 and 2 switching frequency

F510: Acceleration time 3

F511: Deceleration time 3

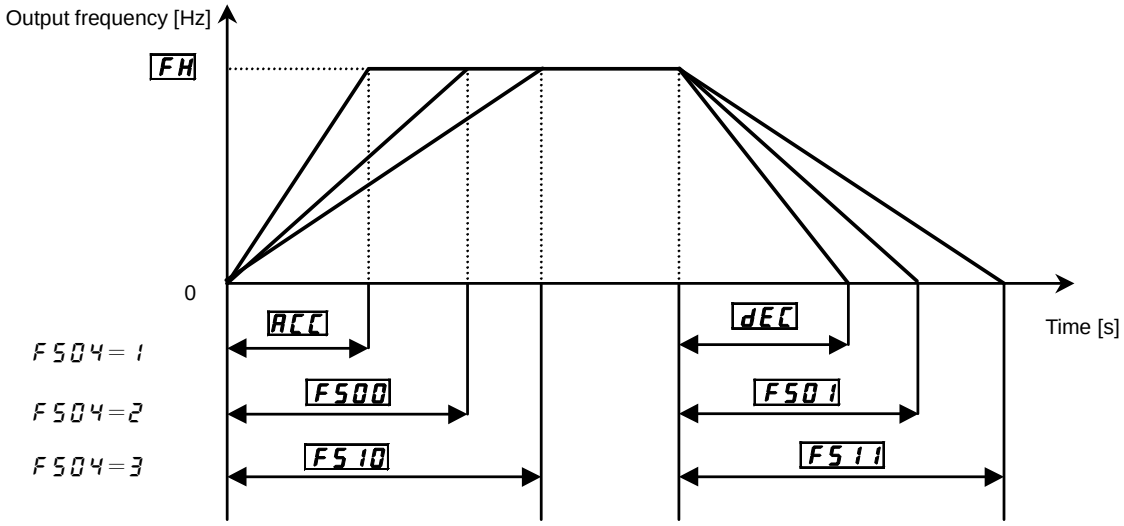
F512: Acceleration/deceleration 3 pattern

F513: Acceleration/deceleration 2 and 3 switching frequency

- Function
  Three acceleration times and three deceleration times can be specified individually. A method of selection or switching can be selected from among the following:
  1) Selection by means of parameters
  2) Switching by changing frequencies
  3) Switching by means of terminals

Title	Function	Adjustment range	Default setting
F500	Acceleration time 2	0.0-3200 [sec]	10.0
F501	Deceleration time 2	0.0-3200 [sec]	10.0
F504	Selecting an acceleration/deceleration pattern	1: Acceleration/deceleration 1 pattern, 2: Acceleration/deceleration 2 pattern, 3: Acceleration/deceleration 3 pattern	1
F510	Acceleration time 3	0.0-3200 [sec]	10.0
F511	Deceleration time 3	0.0-3200 [sec]	10.0

1) Selection using parameters

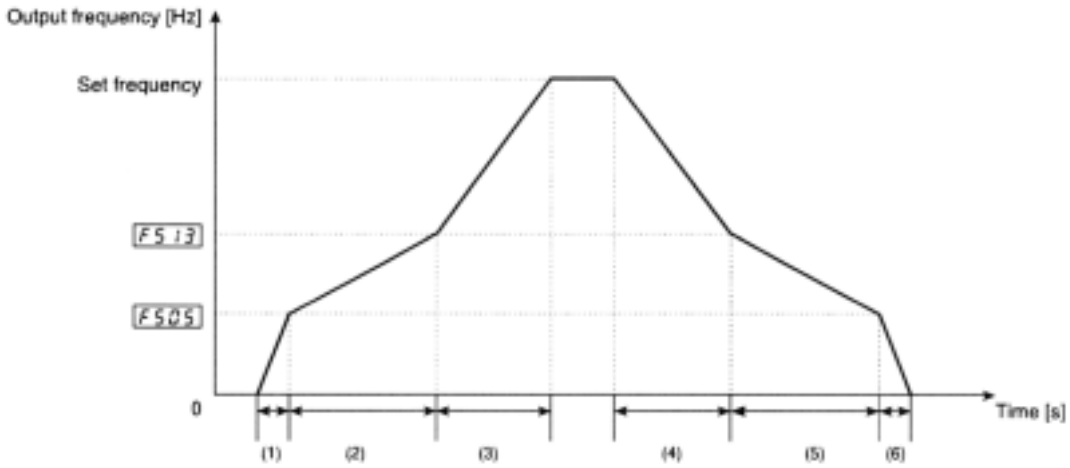


Acceleration/deceleration time 1 is initially set as the default. Acceleration/deceleration time 2 and 3 can be selected by changing the setting of the F504.
Enabled if CMOd=1 (panel input enabled)

2) Switching by frequencies - Switching the acceleration/deceleration time automatically at the frequency setting of F505.

Title	Function	Adjustment range	Default setting
F505	Acceleration/deceleration 1 and 2 switching frequency	0.0-UL	0.0
F513	Acceleration/deceleration 2 and 3 switching frequency	0.0-UL	0.0

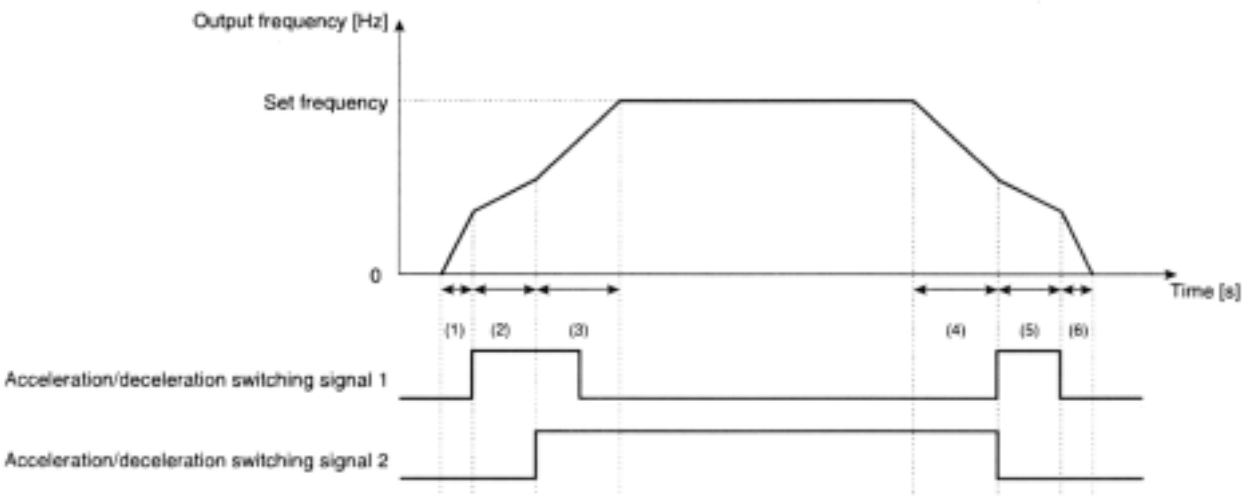
Note: Acceleration/deceleration patterns are changed from pattern 1 to pattern 2 and from pattern 2 to pattern 3 in increasing order of frequency, regardless of the order in which frequencies are changed. (For example, if F505 is larger than f513, F513 pattern 1 is selected in the frequency range below the frequency set with F505.)



(1) Acceleration at the gradient corresponding to acceleration time ACC
(2) Acceleration at the gradient corresponding to acceleration time F500
(3) Acceleration at the gradient corresponding to acceleration time F510
(4) Deceleration at the gradient corresponding to deceleration time F511
(5) Deceleration at the gradient corresponding to deceleration time F501
(6) Deceleration at the gradient corresponding to deceleration time dEC

6

3) Switching using external terminals - Switching the acceleration/deceleration time via external terminals



(1) Acceleration at the gradient corresponding to acceleration time ACC
(2) Acceleration at the gradient corresponding to acceleration time F500
(3) Acceleration at the gradient corresponding to acceleration time F510
(4) Deceleration at the gradient corresponding to deceleration time F511
(5) Deceleration at the gradient corresponding to deceleration time F501
(6) Deceleration at the gradient corresponding to deceleration time dEC

■ How to set parameters

a) Operating method: Terminal input
Set the operation control mode selection CMOd to 0.

b) Use the DFM and DFH terminals for switching. (Instead, other terminals may be used.)

DFM: Acceleration/deceleration switching signal 1
DFH: Acceleration/deceleration switching signal 2

Title	Function	Adjustment range	Setting value
F115	Input terminal selection #5 (DFM)	0-64	5 (the second acceleration/deceleration mode selection)
F116	Input terminal selection #6 (DFH)	0-64	58 (the third acceleration/deceleration mode selection)

■ Acceleration/ deceleration pattern

Acceleration/deceleration patterns can be selected individually, using the acceleration/deceleration 1, 2 and 3 parameters.

1) Linear acceleration/deceleration
2) S-pattern acceleration/deceleration 1
3) S-pattern acceleration/deceleration 2

Title	Function	Adjustment range	Setting value
F502	Acceleration/ deceleration 1 pattern	0: Linear, 1: S-pattern 1, 2: S-pattern 2	0
F503	Acceleration/ deceleration 2 pattern	0: Linear, 1: S-pattern 1, 2: S-pattern 2	0
F512	Acceleration/ deceleration 3 pattern	0: Linear, 1: S-pattern 1, 2: S-pattern 2	0

★ For an explanation of acceleration/deceleration patterns, see 6.18.1.

★ Both the settings of the S-pattern lower-limit and upper-limit adjustment parameters (F506 and F507) are applied to any acceleration/deceleration S-pattern.

6.19 Protection functions

6.19.1 Setting motor electronic thermal protection

[tHr]: Motor electronic thermal protection level 1

[F607]: Motor 150%-overload time limit

- Function
  This parameter allows selection of the appropriate electronic thermal protection characteristics according to the particular rating and characteristics of the motor.

■ Parameter setting

Title	Function	Adjustment range	Default setting
tHr	Motor electronic thermal protection level 1	10-100 (%)	100
F607	Motor 150%-overload time limit	10-2400 [sec]	60

For more details, see 5.13.

6.19.2 Setting current stall

[F601]: Stall prevention level 1

[F185]: Stall prevention level 2

Caution	
Prohibited	• Do not set the stall prevention level (F601) extremely low. If the stall prevention level parameter (F601) is set at or below the no-load current of the motor, the stall preventive function will be always active and increase the frequency when it judges that regenerative braking is taking place. Do not set the stall prevention level parameter (F601) below 30% under normal use conditions.

- Function
  This parameter adjusts the output frequency by activating a current stall prevention function against a current exceeding the F601-specified level.

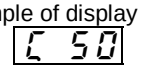
■ Parameter setting

Title	Function	Adjustment range	Default setting
F601	Stall prevention level 1	10-199 (%), 200: Deactivated	150
F185	Stall prevention level 2		

[Display during operation of the stall prevention]

During an oC alarm status, (that is , when there is a current flow in excess of the stall prevention level), the output frequency changes. At the same time, to the left of this value, "C" is displayed flashing on and off.

Example of display



★ The switching from $F601$ to $F185$ can be performed by entering a command through terminals. For more details, see 6.4.1.

6.19.3 Inverter trip retention

$F602$: Inverter trip retention selection

- Function
  If the inverter trips, this parameter will retain the corresponding trip information. Trip information that has thus been stored into memory can be displayed, even after power has been reset.

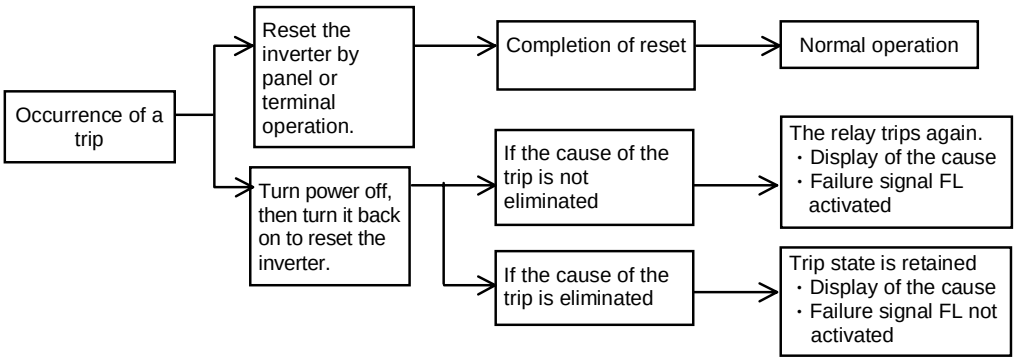
[Parameter setting]

Title	Function	Adjustment range	Default setting
$F602$	Inverter trip retention selection	0: Cleared if power is turned off 1: Retained even if power is turned off	0

★ The causes of up to four trips that occurred in the past can be displayed in status monitor mode.

★ Data (current, voltage, etc) displayed in status monitor mode when the inverter is tripped is cleared when power is turned off. (Past trip records can be displayed.)

■ Flow of operation when $F602=1$



6.19.4 Emergency stop

F603: Emergency stop

F604: Emergency DC braking time

- Function
  These parameters allow you to specify how to stop operation using an external control device when an external trip occurs. When operation is stopped, the trip E and the FL relay also are activated.
  When setting F603 to 2 (emergency DC braking), set also F251 (DC braking rate) and F604 (emergency braking time)

1) External trip stop via terminals

The external trip stop function can be executed via the a-contact. Proceed as follows to assign an external stopping terminal and select the stopping method:

[Parameter setting]

Title	Function	Adjustment range	Default setting
F603	Emergency stop selection	0: Coast stop 1: Slowdown stop 2: Emergency DC braking	0
F604	Emergency DC braking time	0.0 ~ 20.0 [sec]	1.0
F251	DC braking current	0-100 (%)	50

(Example of terminal assignment): Assigning the trip stop function to the RST terminal

Title	Function	Adjustment range	Setting
F113	Input terminal selection 3 (RST)	0-64	11 (External trip stop)

Note 1) Emergency stopping via the specified terminal is possible, even during panel operation.

Note 2) If DC braking is not needed to bring the motor to a stop under normal conditions, although F603 is set to 2 (emergency DC braking), set the DC braking starting frequency (F250) at 0.0 Hz.

2) Emergency stopping from the operation panel

Emergency stopping from the operation panel is possible
by pressing the STOP key on the panel twice while the inverter is not in the panel control mode.

(1) Press the STOP key..... "EOFF" will blink.

(2) Press the STOP key once again ..... Operation will come to a trip stop in accordance with the setting of the F603 parameter.
After this, "E" will be displayed and a failure detection signal generated (FL relay deactivated).

6.19.5 Output phase failure detection

F605: Output phase failure detection mode selection

- Function
  This parameter detects inverter output Phase failure. If the Phase failure status persists for one second or more, the tripping function and the FL relay will be activated. At the same time, a trip information EPHO will also be displayed.
  Set F605 to 5 to open the motor-inverter connection by switching commercial power operation to inverter operation.
  Detection errors may occur for special motors such as high-speed motors.

F605=0: No tripping (FL relay deactivated).
F605= 1: With the power on, the phase failure detection is enabled only at the start of the first operation. The inverter will trip if the Phase failure status persists for one second or more.
F605=2: The inverter checks for output phase failures each time it starts operation. The inverter will trip if the Phase failure status persists for one second or more.
F605=3: The inverter checks for output phase failures during operation. The inverter will trip if the Phase failure status persists for one second or more.
F605=4: The inverter checks for output phase failures at the start of and during operation. The inverter will trip if the Phase failure status persists for one second or more.
F605=5: If it detects an all-phase failure, it will restart on completion of reconnection. The inverter does not check for output phase failures when restarting after a momentary power failure.

Note: A check for output phase failures is made during auto-tuning, regardless of the setting of this parameter.

Title	Function	Adjustment range	Default setting
F605	Output phase failure detection mode selection	0: Disabled 1: At start-up (Only one time after power is turned on) 2: At start-up (each time) 3: During operation 4: At start-up + during operation 5: Detection of cutoff on output side	0

6.19.6 Input phase failure detection

F608: Input phase failure detection mode selection

- Function
  This parameter detects inverter input Phase failure. If the abnormal voltage status of main circuit capacitor persists for few minutes or more, the tripping function and the FL relay will be activated. Therefore, input phase failures cannot always be detected. A trip information EPH 1 will be displayed.
  If the power capacity is larger than the inverter capacity (more than 200kVA or more than 10 times), detection errors may occur. If this actually happens, install an AC or DC reactor .

F608=0: No tripping (Failure signal FL not activated)
F608= 1: Phase failure detection is enabled during operation. The inverter will trip if the abnormal voltage status of main circuit capacitor persists for ten minutes or more. (Failure signal FL activated)

Title	Function	Adjustment range	Default setting
F608	Input phase failure detection mode selection	0: Disabled, 1: Enabled	1

Note: Setting F608 to 0 (input phase failure detection: disabled) may result in a breakage of the capacitor in the inverter main circuit if operation is continued under a heavy load in spite of the occurrence of an input phase failure.

6.19.7 Control mode for small current

F610: Small current trip/alarm selection

F611: Small current detection current

F612: Small current detection time

- Function
  The f610 parameter allows the inverter to be tripped if a current smaller than the F611-specified value flows for more than the F612-specified time. When tripping is selected, enter the detection time to tripping. Trip information is displayed as "UC".

F610=0: No tripping (Failure signal FL not activated).
A small current alarm can be put out by setting the output terminal function selection parameter.

F610= 1: The inverter will trip (Failure signal FL activated) if a current below the current set with F611 flows for the period of time specified with F612.

Title	Function	Adjustment range	Default setting
F610	Small current trip/alarm selection	0: Alarm only 1: Tripping	0
F611	Small current detection current	0-100 (%)	0
F612	Small current detection time	0-255 [sec]	0

6.19.8 Detection of output short-circuit

F613: Detection of output short-circuit during start-up

- Function
  This parameter detects inverter output short-circuit. It can be usually detected in the length of the standard pulse. When operating low-impedance motor such as high-speed motor, however, the short-time pulse should be selected.

F613=0: Detection is executed in the length of the standard pulse every time you start up the inverter.
F613=1: Detection is executed in the length of standard pulse only during the first start-up after putting on the power or after resetting.
F613=2: Detection is executed with the short-time pulse every time you start up the inverter.
F613=3: Detection is executed with the short-time pulse only for the first time after putting power on or after resetting.

Title	Function	Adjustment range	Default setting
F613	Detection of output short-circuit during start-up	0: Each time (standard pulse) 1: Only one time after power is turned on (standard pulse) 2: Each time (short-time pulse) 3: Only one time after power is turned on (short-time pulse)	0

6.19.9 Over-torque trip

F615: Over-torque trip/alarm selection

F616: Over-torque detection level

F618: Over-torque detection time

F619: Over-torque detection level hysteresis

- Function
  Use the 615 parameter to trip the inverter or to output the alarm if a torque currrent exceeding the F616-specified level flows for more than the F618-specified time. Trip information is displayed as "0L".

F615=0: ..... No tripping (FL relay deactivated).
An over-torque alarm can be put out by setting the output terminal function selection parameter.

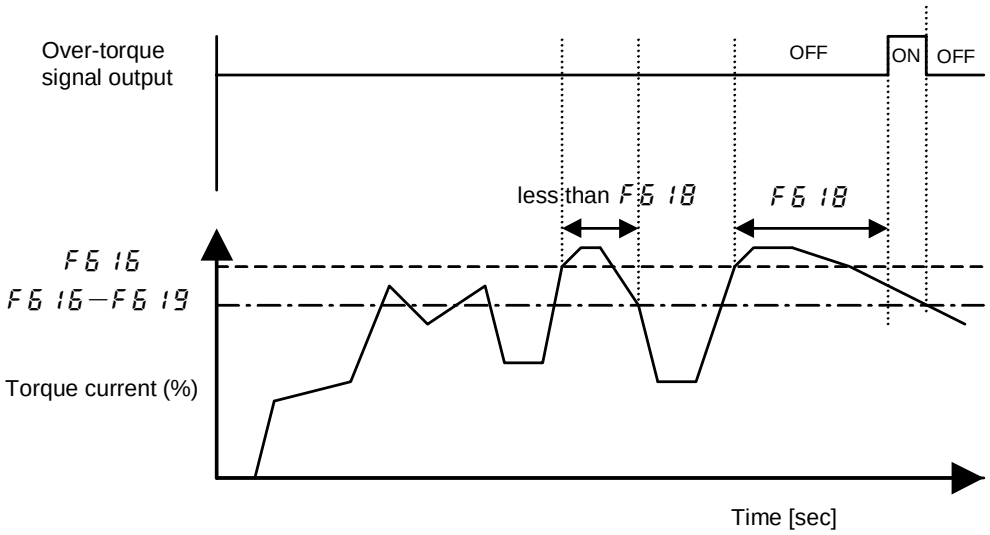
F615= 1: ..... The inverter is tripped (FL relay activated) only after a torque current exceeding the F616-specified level has been detected for more than the F618-specified time.

Title	Function	Adjustment range	Default setting
F615	Over-torque trip/alarm selection	0: Alarm only 1: Tripping	0
F616	Over-torque detection level	0-250 (%)	150
F618	Over-torque detection time	0.0-10.0 [sec]	0.5
F619	Over-torque detection level hysteresis	0-100 (%)	10

<Example of operation>

1) Output terminal function: 12 (OT) Over-torque detection

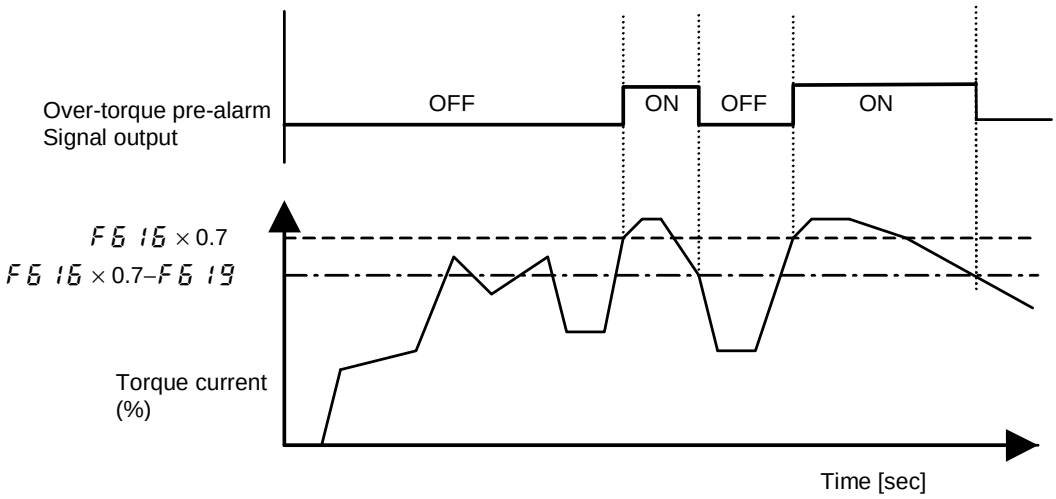
F615=0 (Alarm only)



6

When F615 = 1 (tripping), the inverter will trip if over-torque lasts for the period of time set with F618. In such a case, the over-torque signal remains ON.

2) Output terminal function: 20 (POT) Over-torque detection pre-alarm



6.19.10 Cumulative operation time alarm setting

F621: Cumulative operation time alarm setting

- Function
  This parameter allows you to set the inverter so that it will put out an alarm signal after a lapse of the cumulative operation time set with F621.

* "0.1" displayed on the monitor refers to 10 hours, and therefore "1" denotes 100 hours.
Ex.: 38.5 displayed on the monitor = 3850 (hours)

Title	Function	Adjustment range	Default setting
F621	Cumulative operation time alarm setting	0.0-9.999	610.0

■ Setting of output signal l

Ex.: When assigning the cumulative operation alarm signal output function to the DRV terminal

Title	Function	Adjustment range	Setting
F131	Output terminal selection 2A (DRV-OM)	0-255	42 (negative logic 43)

6.19.11 Over-voltage stall protection level

F626: Over-voltage stall protection level

* For more details, see 6.13.5.

6.19.12 Undervoltage trip

F627: Undervoltage trip/alarm selection

- Function
  This parameter is used for selecting the control mode when an undervoltage is detected. Trip information is displayed as "UP 1".

F627=0: The inverter is stopped. However, it is not tripped (Failure signal FL not activated).
The inverter is stopped when the voltage does not exceed 60 % or less of its rating.

F627= 1: Inverter is stopped. It is also tripped (Failure signal FL activated), only after detection of a voltage not exceeding 60% or less of its rating.

F627=2: Inverter is stopped. However, it is not tripped (Failure signal FL not activated). The inverter stop (Failure signal FL not activated)., only after detection of a voltage not exceeding 50% of its rating. Be sure to connect the DC reactor specified in 10.4.

Title	Function	Adjustment range	Default setting
F627	Undervoltage trip/alarm selection	0: Alarm only (detection level below 60%) 1: Tripping (detection level below 60%) 2: Alarm only (detection level below 50%, DC reactor needed)	1

6.19.13 Trip at VRF low level input mode

F633: Trip at VRF low level input mode

- Function
  The inverter will trip if the VRF value remains below the specified value for about 0.3 seconds. In such a case, "E - 18" is displayed.

F633=0: Disabled ..... The detection function is disabled.
F633=1-100 ..... The inverter will trip if the VRF value remains below the specified value for about 0.3 seconds.

Title	Function	Adjustment range	Default setting
F633	Trip at VRF low level input mode	0: Disabled 1-100%	0

Note : The VRF input value may be judged earlier to be abnormal, depending on the degree of deviation of the analog data detected.

6.19.14 Calculation for life alarms

F634: Annual average ambient temperature (calculation for life alarms)

- Function
  You can set the inverter so that it will calculate the remaining useful lives of the cooling fan, main circuit capacitor and on-board capacitor from the ON time of the inverter, the operating time of the motor, the output current (load factor) and the setting of F634, and that it will display and send out an alarm through output terminals when each component is approaching the end of its useful life.

Title	Function	Adjustment range	Default setting
F634	Annual average ambient temperature (calculation for life alarms)	1: -10 to +10°C 2: 11-20°C 3: 21-30°C 4: 31-40°C 5: 41-50°C 6: 51-60°C	3

Note 1: Using F634, enter the annual average temperature around the inverter. Be careful not to enter the annual highest temperature.
Note 2: Set F634 at the time of installation of the inverter, and do not change its setting after the start of use. Changing the setting may cause a life alarm calculation error.

6.20 Adjustment parameters

6.20.1 Pulse train output for meters

F669: Logic output/pulse train output selection (DRV-OM)

F676: Pulse train output function selection (DRV-OM)

F677: Maximum nembers of pulse train

- Function
  Pulse trains can be sent out through the DRV-OM output terminals.
  To do so, it is necessary to select a pulse output mode and specify the number of pulses.

Ex.: When operations frequencies (0 to 60Hz) are put out by means of 0 to 600 pulses
FH=60.0, F669=1, F676=0, F677=600

Title	Function	Adjustment range	Default setting
F669	Logic output/pulse train output selection (DRV-OM)	0: Logic output 1: Pulse train output	0
F676	Pulse train output function selection (DRV-OM)	0: Output frequency 1: Output current 2: Set frequency 3: DC voltage 4: Output voltage command value 5: Input power 6: Output power 7: Torque 8: Torque current 9: Motor cumulative load factor 10: Inverter cumulative load factor 11: Braking reactor cumulative load factor 12: Frequency setting value (after PID) 13: VRF Input value 14: VRF2 Input value 15: Fixed output 1 (Output current: 100%) 16: Fixed output 2 (Output current: 50%) 17: Fixed output 3 (Other than the output current: 100%)	0
F677	Maximum numbers of pulse train	500-1600 (pps)	800

Note 1: The pulse length is fixed. Therefore, the duty is variable.
Note 2: The minimum pulse output rate is 38 PPS. Keep in mind that no pulses can be put out at any rate smaller than 38 PPS.

6.20.2 Calibration of analog outputs

F691: Inclination characteristic of analog output

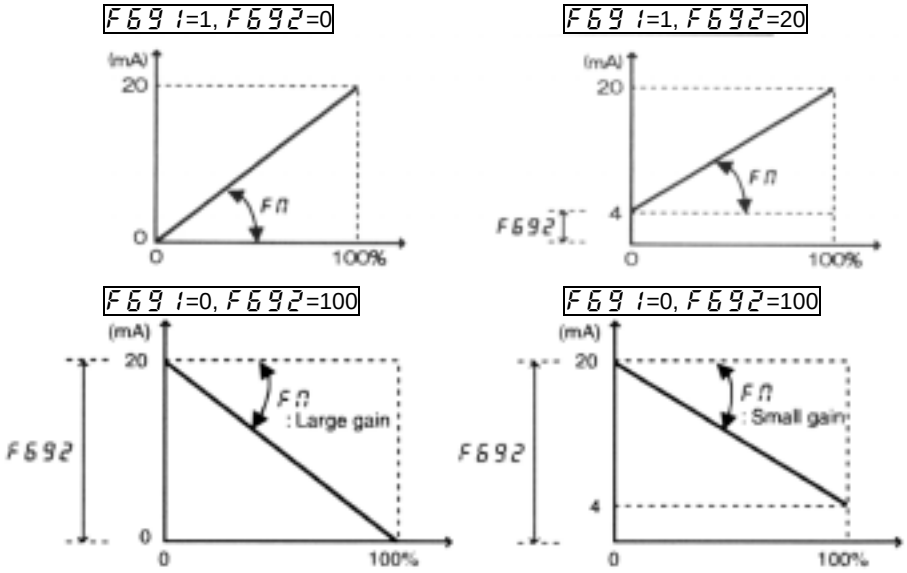
F692: Bias of analog output

- Function
  Output signals from FRQ terminals are analog voltage signals. Their standard setting range is from 0 to 7.5Vdc.
  Using the FRQ slide switch in the inverter, you can switch to 0-20mA output. Also, using these parameters, you can calibrate the output to 4-20mAdc or 20-4mAdc.

Title	Function	Adjustment range	Default setting
F691	Inclination characteristic of analog output	0: Negative inclination (downward slope) 1: Positive inclination (upward slope)	1
F692	Bias of analog output	0-100%	0

Note: To switch to 0-20mAdc (4-20mAdc), turn the FRQ slide switch to the I position.

■ Example of setting



☆ The analog output inclination can be adjusted using the parameter FM.

6.21 Operation panel parameter

6.21.1 Prohibition of key operations and parameter settings

F700: Prohibition of change of parameter setting

F730: Prohibition of panel operation (FC)

F733: Prohibition of panel operation (RUN/STOP keys)

F734: Prohibition of panel emergency stop operation

F735: Prohibition of panel reset operation

F736: Prohibition of change of CN0d/FN0d during operation

- Function
  These parameters allow you to prohibit the operation of the RUN and STOP keys on the operation panel and the change of parameters. Using these parameters, you can also prohibit various key operations.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F700	Prohibition of change of parameter setting	0: Permitted, 1: Prohibited	0
F730	Panel operation prohibition (FC)	0: Permitted, 1: Prohibited	0
F733	Prohibition of panel operation (RUN/STOP keys)	0: Permitted, 1: Prohibited	0
F734	Prohibition of panel emergency stop operation	0: Permitted, 1: Prohibited	0
F735	Prohibition of panel reset operation	0: Permitted, 1: Prohibited	0
F736	Prohibition of change of CN0d/FN0d during operation	0: Permitted, 1: Prohibited	1

■ Resetting method

Only the F700 parameter is designed so that its setting can be modified even if 1 (prohibited) is selected.

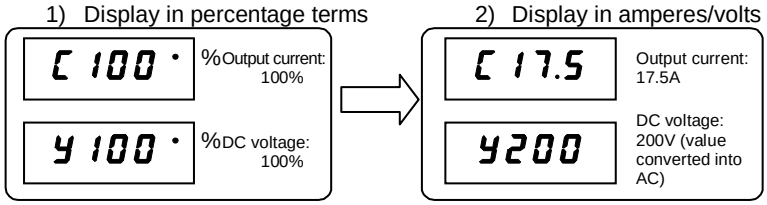
6.21.2 Changing the display unit to A/V/min^{-1}

F701:Current/voltage display mode

- Function
  These parameters are used to change the unit of monitor display.
  % ⇔ A (ampere)/V (volt)

■ Example of setting

During the operation of the HF3212-3A7 (rated current: 17.5A) at the rated load (100% load), units are displayed as follows:



Title	Function	Adjustment range	Default setting
F701	Current/voltage display mode	0: % 1: A (ampere)/V (volt)	1

* The F701 converts the following parameter settings:

- A display Current monitor display
  Motor electronic-thermal protection level 1 and 2 tHr, F173
  DC braking current F251
  Stall prevention level 1 and 2 F601, F185
  Small current detection current F611
- V display Voltage monitor display

Note) Base frequency voltage 1 and 2 I(uLu, F171)s always displayed in the unit of V.

6.21.3 Displaying the rotational speed of the motor or the line speed

F702: Frequency free unit magnification

F705: Inclination characteristic of free unit display

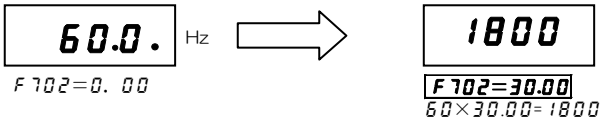
F706: Bias of free unit display

- Function
  The frequency or any other item displayed on the monitor can be converted freely into the rotational speed of the motor, the operating speed of the load, and so on.

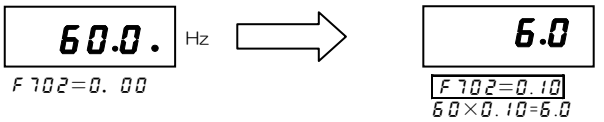
The value obtained by multiplying the displayed frequency by the F702-set value will be displayed as follows:

Value displayed = Monitor-displayed or parameter-set frequency × F702

1) Displaying the motor speed
   To switch the display mode from 60Hz (default setting) to 1800min^{-1} (the rotating speed of the 4P motor)



2) Displaying the speed of the loading unit
   To switch the display mode from 60Hz (default setting) to 6m/min^{-1} (the speed of the conveyer)



Note: This parameter displays the inverter output frequency as the value obtained by multiplying it by a positive number. Even when the actual speed of the motor changes according to the particular changes in load, the output frequency will always be displayed.

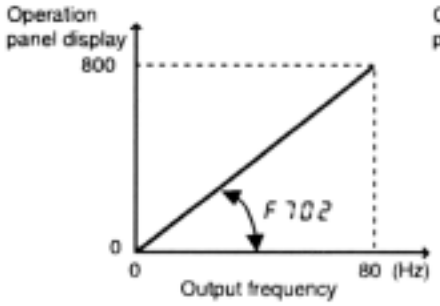
Title	Function	Adjustment range	Default setting
F702	Frequency free unit magnification	0.00: Free unit display disabled (display of frequency) 0.01-200.0	0.00
F705	Inclination characteristic of free unit display	0: Negative inclination (downward slope) 1: Positive inclination (upward slope)	1
F706	Bias of free unit display	0.00-FH	0.00

* The F702 converts the following parameter settings:

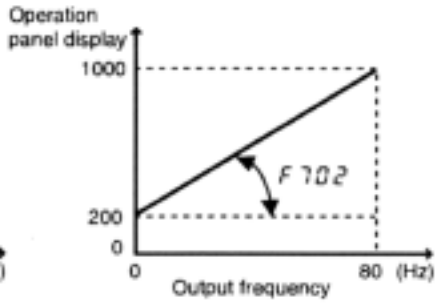
- Free unit Frequency monitor display
  Frequency-related parameters FH, UL, LL, Sr, 1-Sr 7, F100, F101, F102, F167, F202, F204, F211, F213, F240, F241, F242, F250, F260, F265, F267, F268, F270-F275, F287-F294, F343, F345, F505, F513, F812, F814

■ An example of setting when FH is 80 and F702 is 10.00

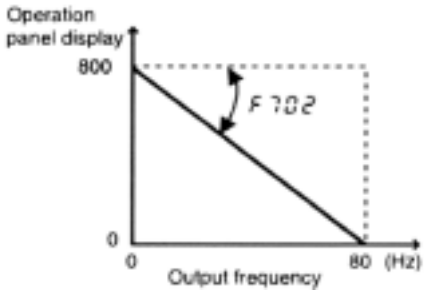
F705=1, F706=0.00



F705=1, F706=20.00



F705=0, F706=80.00



6.21.4 Changing the steps in which the value displayed changes

F707: Free step 1 (pressing a panel key once)

F708: Free step 2 (panel display)

- Function
  These parameters are used to specify steps in which the command value or standard monitor output frequency displayed on the panel changes each time you press the up or down key to set a frequency on the operation panel.

Note 1: The settings of these parameters have no effect when the free unit selection (F702) is enabled.

Note 2: If you press the Up key on the panel repeatedly to increase the frequency while F707 is set to any value other than 0, the "H I" alarm will appear immediately before the frequency exceeds the FH (maximum frequency) and the frequency will stop increasing. Similarly, if you press the Down key on the panel repeatedly to decrease the frequency, the "L 0" alarm will appear immediately before the frequency decreases below the LL (lower-limit frequency) and the frequency will stop decreasing.

■ When F707 is not 0.00, and F708 is not 0 (disabled)

Under normal conditions, the frequency command value from the operation panel increases in steps of 0.1 Hz each time you press the ▲ key. If F707 is not 0.00, the frequency command value will increase by the value with F707 each time you press the ▲ key. Similarly, it will decrease by the value set with F707 each time you press the ▼ key.

In this case, the output frequency displayed in standard monitor mode changes in steps of 0.1 Hz, as usual.

■ When F707 is not 0.00, and F708 is not 0 (disabled)

The value displayed on the panel also can also be changed in steps.

$$\boxed{\text{Output frequency displayed in standard monitor mode}} = \boxed{\text{Internal output frequency}} \times \frac{F708}{F707}$$

Title	Function	Adjustment range	Default setting
F707	Free step 1 (pressing a panel key once)	0.00: Disabled 0.01-FH (Hz)	0.00
F708	Free step 2 (panel display)	0: Disabled 1-255	0

■ Example of setting 1

When F707=10.00 (Hz):

The frequency (FC) set on the operation panel changes in steps of 10.0 Hz: 0.0 → 20.0 → ... 60.0 (Hz), each time you press the ▲ key. This function comes in very handy when operating the load at limited frequencies that change in steps of 1Hz, 5Hz, 10Hz, and so on.

■ Example of setting 2

When F707=1.00 (Hz), and F708=1:

Each time you press the ▲ key, the frequency setting FC changes in steps of 1Hz: 0→ 1 → 2 → ... → 60 (Hz) and also the value displayed on the operation panel changes in steps of 1. Use these settings to hide decimal fractions and also the value displayed on the operation panel changes in steps of 1. Use these settings to hide decimal fractions.

6.21.5 Changing the item displayed by default

F710: Standard monitor display selection

- Function
  This parameter specifies display format while power is on.

■ Changing the display format while power is on

When the power is on, the standard monitor mode displays the operation frequency (default setting) in the format of "0.0" or "OFF". This format can be changed to any other monitor display format by setting F710. This new format, however, will not display an assigned prefix such as b or C.

■ Parameter setting

Title	Function	Adjustment range	Default setting
F710	Standard monitor display selection	0: Operation frequency (Hz/free unit/step) 1: Frequency command (Hz/free unit/step) 2: Output current (%/A) 3: Inverter rated current (A) 4: Inverter load factor (%) 5: Output power (kW) 6: Frequency command after PID control (Hz/free unit/step) 7: Optional item specified from an external control unit	0

☆ For more information on the F710 option "7," refer to "Communications Function Instruction Manual."

6.21.6 Canceling the operation command

F719: Canceling of operation command when standby terminal (ST) is turned off

- Function
  When the standby (ST) terminal is turned off during panel operation, the inverter will restart operation if the ST terminal is turned back on. Using this parameter, you can also set the inverter so that, even if the ST is turned back on, it will not restart operation until you press the RUN key.

Title	Function	Adjustment range	Default setting
F719	Canceling of operation command when standby terminal (ST) is turned off	0: Operation command canceled (cleared) 1: Operation command retained	1

6.21.7 Selection of operation panel stop pattern

F721: Selection of operation panel stop pattern

- Function
  This parameter are used to select a mode in which the motor started by pressing the (RUN) key on the operation panel is stopped when the (STOP) key is pressed.

1) Slowdown stop
   The motor slows down to a stop in the deceleration time set with dEC (or F501 or F511).
2) Coast stop
   The inverter cuts off power supply to the motor. The motor comes to a stop after coasting for a while by inertia. Depending on the load, the motor may keep running for a good long time.

[Parameter setting]

Title	Function	Adjustment range	Default setting
F721	Selection of operation panel stop pattern	0: Slowdown stop 1: Coast stop	0

6.22 Communication function (Common serial)

6.22.1 Setting of common function

F800: Data transfer speed
F801: Parity
F802: Inverter number
F803: Communication error trip time
F805: Communication waiting time
F806: Inter-drive communication
F811: Point # 1 setting
F812: Point # 1 frequency
F813: Point # 2 setting
F814: Point # 2 frequency
F829: Selection of communication protocol
F870: Block write data 1
F871: Block write data 2
F875: Block read data 1
F876: Block read data 2
F877: Block read data 3
F878: Block read data 4
F879: Block read data 5
F880: Free notes

Refer to the COMMUNICATIONS EQUIPMENT USER'S MANUAL (under preparation) details.

- Function

  Function The HF-320 α Series allows a data communication network to be constructed for exchanging data between a host computer or controller (referred to collectively as the computer) and the inverter by connecting an optional RS232C or RS485 communication conversion unit. (Under preparation)

  <Computer-linking functions>

  The following functions are enabled by data communication between the computer and inverter

  (1) Monitoring inverter status (such as the output frequency, current, and voltage)

  (2) Sending RUN, STOP and other control commands to the inverter

  (3) Reading, editing and writing inverter parameter settings

  <RS232C communication>

  Data can be exchanged between one computer and one inverter.

  <RS485 communication>

  Data can be exchanged between the computer and each of the inverters connected.

☆ The following are available as common serial optional units: (Under preparation)

- RS232C communications conversion cable
- RS485 communication conversion unit with terminal board
  Communication cable
- Internal RS485 conversion circuit board
  This product requires no interconnect cables, because it is of a built-in type.

Note 1.: Limit the distance between the common serial optional units and the inverter to 5m.

2.: Set Data transfer speed to 9600 bps or less if data exchange between RS485 communication conversion unit and the inverter.

■ Communication function parameters (Common serial options)

The data transfer speed, parity type, inverter number, and communication error trip time can be set/edited by operation panel operation or communication function.

Title	Function	Adjustment range	Default setting
F800	Communication band speed	0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps	3
F801	Parity (Common serial)	0: NON (No parity) 1: EVEN (Even parity) 2: ODD (Odd parity)	1
F802	Inverter number	0-255	0
F803	Communication error trip time	0: Disabled (*) 1-100 (s)	0
F805	Communication waiting time	0.00: Regular communication 0.01-2.00 (s)	0.00

Title	Function	Adjustment range	Default setting
F806	Setting of master and slave inverters for communications between inverters	0: Slave inverter (0 Hz command issued in case the master inverter fails) 1: Slave inverter (Operation continued in case the master inverter fails) 2: Slave inverter (Emergency stop tripping in case the master inverter fails) 3: Master inverter (transmission of frequency commands) 4: Master inverter (transmission of output frequency signals)	0
F811	Point # 1 setting	0-100 (%)	0
F812	Point # 1 frequency	0-500.0 (Hz)	0.0
F813	Point # 2 setting	0-100 (%)	100
F814	Point # 2 frequency	0-500.0 (Hz)	60.0
F829	Selection of communication protocol	0: Standard protocol 1: ModbusRTU protocol	0
F870	Block write data 1	0: No selection 1: Command 1 2: Command 2 3: Frequency command 4: Output data on the terminal board 5: Analog output for communications	0
F871	Block write data 2		0
F875	Block read data 1	0: No selection 1: Status information 2: Output frequency 3: Output current 4: Output voltage 5: Alarm information 6: PID feedback value 7: Input terminal board monitor 8: Output terminal board monitor 9: VRF terminal board monitor 10: VRF2 terminal board monitor	0
F876	Block read data 2		0
F877	Block read data 3		0
F878	Block read data 4		0
F879	Block read data 5		0
F880	Free notes	0-65535	0

* Disabled ..... Indicates that the inverter will not be tripped even if a communication error occurs.
Trip ..... The inverter trips when a communication time-over occurs.
In this case a trip information Err5 flashes on and off on the operation panel.

6.22.2 Using the RS232C/RS485

■ Setting the communication functions

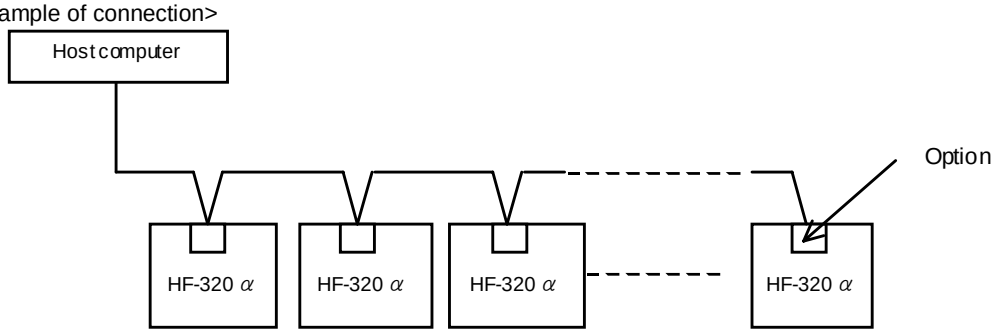
Setting commands and frequencies by communications has priority over sending commands from the operation panel or the terminal board. Command/frequency setting by communications can therefore be enabled, irrespective of the setting in the command mode (Cmd) or the frequency setting mode (Fmd). When inverters are connected to each others, however, in order for slave inverters to recognize frequency signals from the master inverter as frequency commands, the frequency setting mode selection 1 parameter (Fmd) provided for each slave inverter needs to be set to 4 (serial communications). Refer to the COMMUNICATIONS EQUIPMENT USER'S MANUAL (Under preparation) for details.
However, when the input terminal function selection parameter is set to 48: SC/LC (Serial/Local selection), the inverter can be operated with the settings of the command mode (Cmd) or the frequency setting mode (Fmd) by external input.

■ Transmission specifications

Item	Specifications
Transmission scheme	Half-duplex
Connection scheme	Centralized control
Synchronization scheme	Asynchronous
Transmission rate	Default: 9600 baud (parameter setting) Option: Either 1200, 2400, 4800, 9600, or 19200baud
Character transmission	ASCII code: JIS X 0201 8, 8-bit (fixed) Binary code: Binary, 8-bit (fixed)
Stop bit length	Inverter receiving: 1 bit, Inverter sending: 2 bits
Error detection	Parity: Even, Odd, or None selectable by parameter setting; check sum method
Character transmission format	Receiving: 11-bit, Sending: 12-bit
Order of bit transmission	Least significant bit first
Frame length	Variable to a maximum of 17 bytes

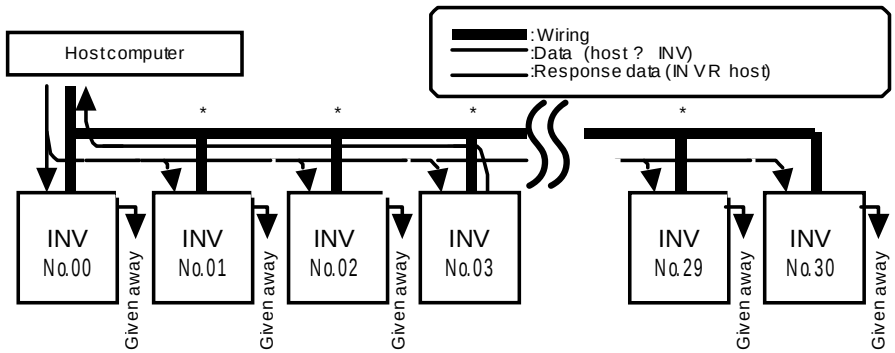
■ Example of connection for RS485-communication

<Example of connection>



<Independent communication>

Perform computer-inverter connection as follows to send operation frequency commands from the host computer to inverter No. 3:



"Given away": Only the inverter with the selected inverter number conducts data processing. All other inverters, even if they have received the data, give it away and stand by to receive the next data.

* : Use the terminal board to branch the cable.

(1) Data is sent from the host computer.
(2) Data from the computer is received at each inverter and the inverter numbers are checked.
(3) The command is decoded and processed only by the inverter with the selected inverter number.
(4) The selected inverter responds by sending the processing results, together with its own inverter number, to the host computer.
(5) As a result, only the selected inverter starts operating in accordance with the operation frequency command by communicating independently.

6.23 Parameters for options

F890: Parameter for option 1

F891: Parameter for option 2

F892: Parameter for option 3

F893: Parameter for option 4

F894: Parameter for option 5

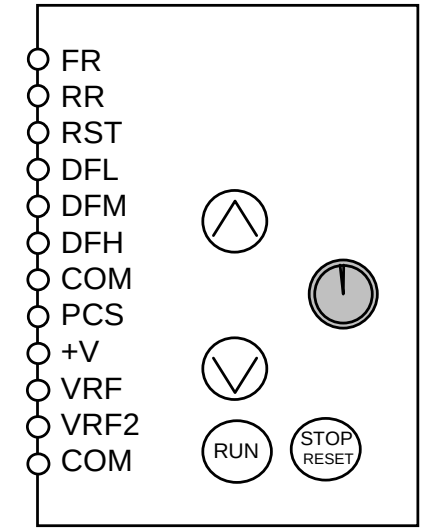
These parameters can be used only when specific optional parts are installed. Do not use these parameters unless such parts are installed.

7. Applied operation

7.1 Setting the operation frequency

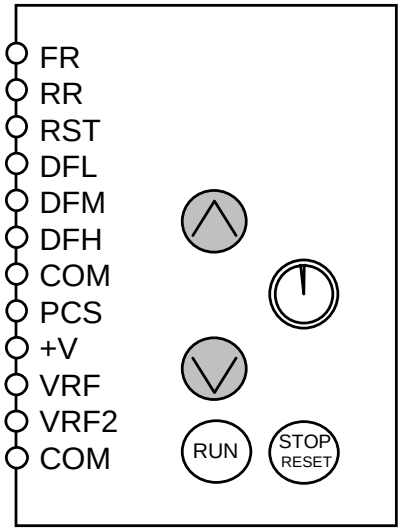
Applied operation can be performed by selecting the inverter frequency setting. To make settings for applied operation, use the basic parameter F00d (selection of frequency setting mode 1), and the extended parameters F200 (frequency priority selection) and F207 (selection of frequency setting mode 2).

(1) Internal potentiometer setting



F00d:0
F200:0

(2) Operation panel key setting

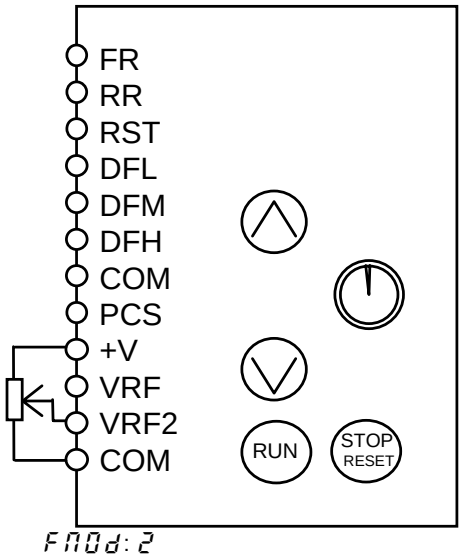


F00d:3
F200:0

Enter the number with the operation panel keys, then press the STR key to conform. (Save the setting)

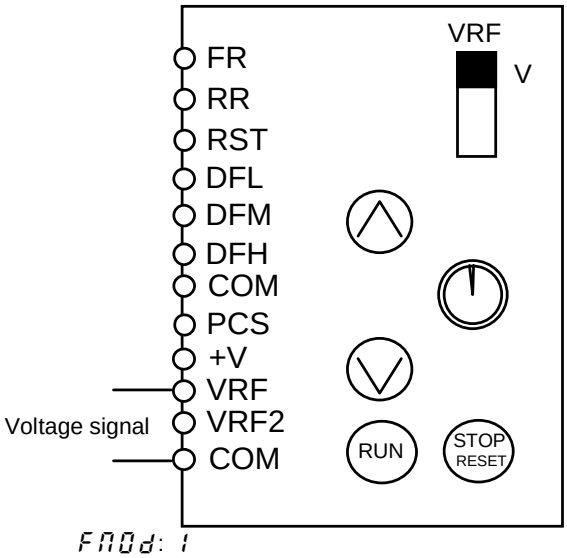
7

(3) External potentiometer setting



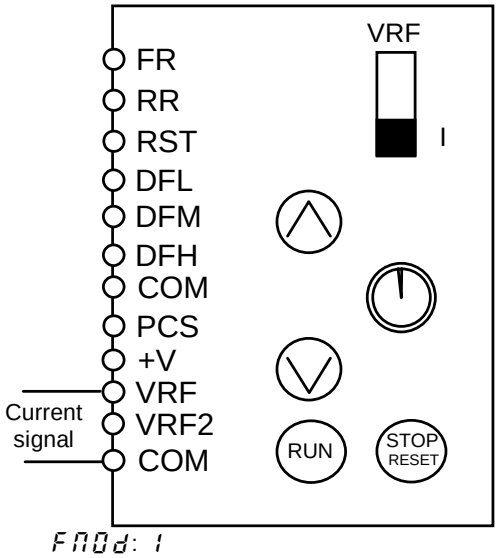
F N0d: 2
F200: 0
Use the parameters F210 to F213 for this setting.

(4) Input voltage setting (0 to 10 Vdc)



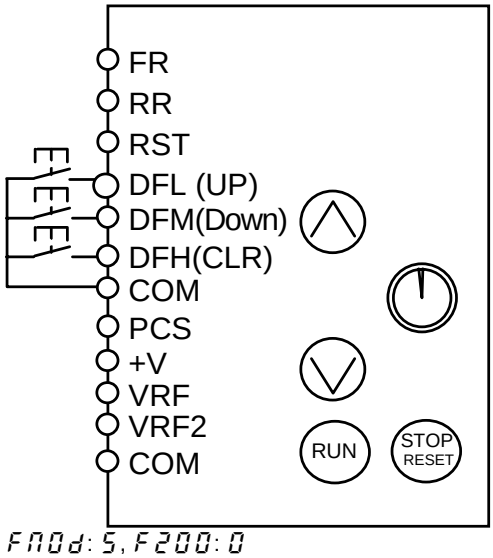
F N0d: 1
F200: 0
Use the parameters F201 to F204 for this setting.
(To use VRF2, set F N0d at 2)

(5) Input current setting (4 to 20 mAdc)



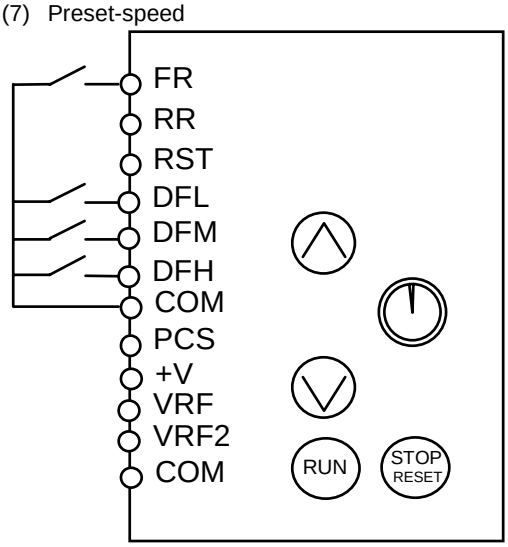
F N0d: 1
F200: 0
Use parameters F201 to F204 for this setting.
(F201: 20%)

(6) External contact UP/DOWN



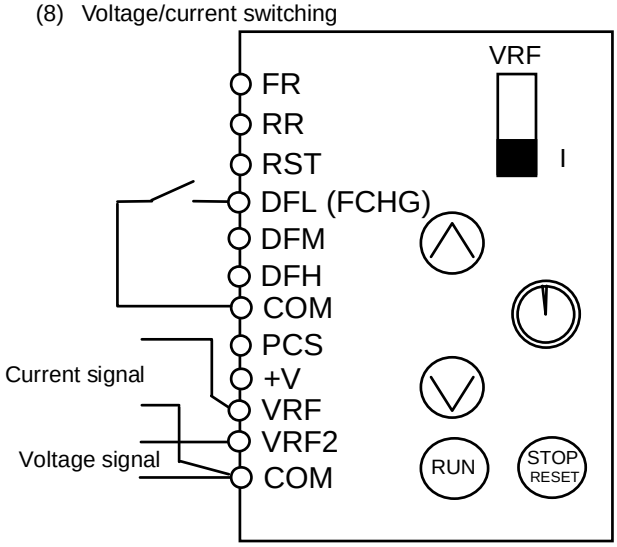
F N0d: 5, F200: 0
Use the parameters F264 to F268 for this setting.
To change the frequency when power is off, set F269: 1 (Rewriting of F268 when power is turned off.)
F114: 41 (Allocation of UP)
F115: 42 (Allocation of DOWN)
F116: 43 (Allocation of CLR)

(7) Preset-speed



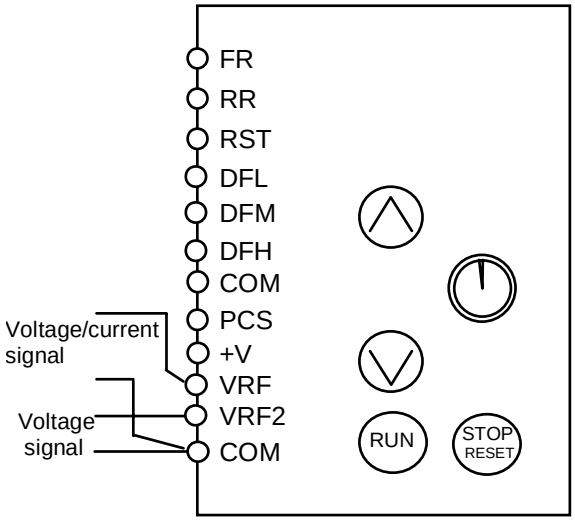
CMOd: 0 (Terminal board)
Sr 1 to Sr 7: 1-7-speed run
F287 to F294: 8-15-speed run
To select 7-speed run, use the terminals DFL to DFH. To select 15-speed run, allocate the input terminal function DFHH.

(8) Voltage/current switching



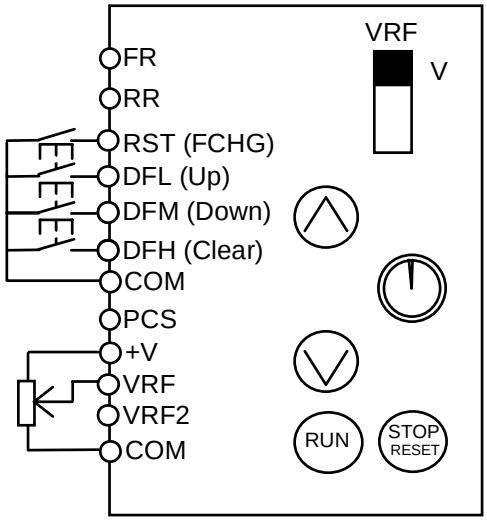
F200: 1 (Automatic switching)
F200: 0 (Forced switching of FCHG)
F114: 38 (Allocation of FCHG)
FMOd: 2
F207: 1

(9) Analog addition setting



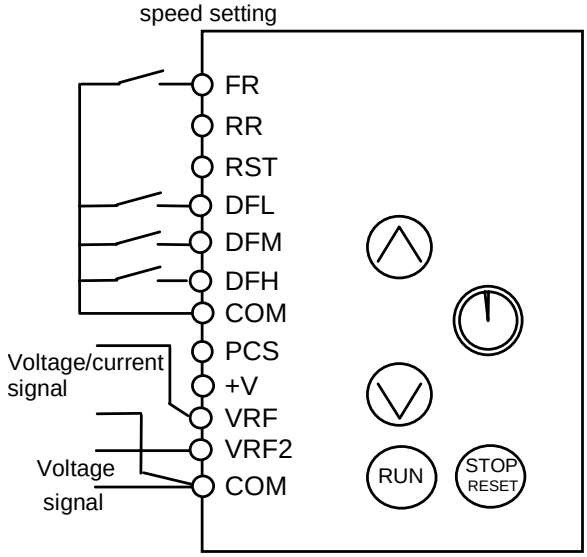
FMOd: 6 (VRF+VRF2)
F200: 0

(10) Switching between external contact UP/DOWN and VRF input



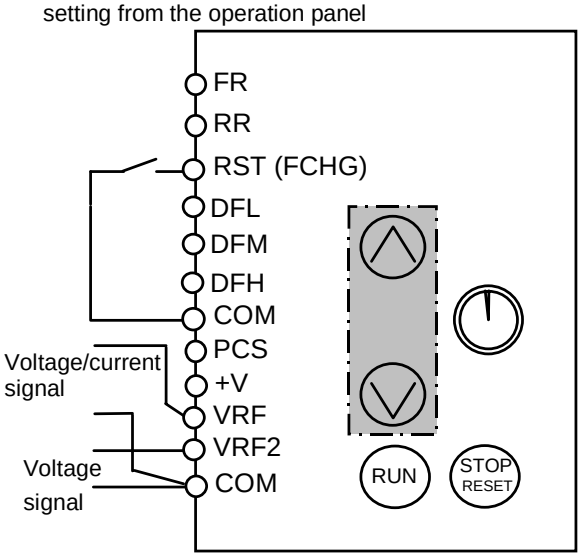
FMOd: 5, F200: 0, F207: 1
F113: 38 (Allocation of FCHG)
To switch to VRF setting, enter the command through FCHG.
F114: 41 (Allocation of UP)
F115: 42 (Allocation of DOWN)
F116: 43 (Allocation of CLR)

(11) Switching between analog setting and preset speed setting



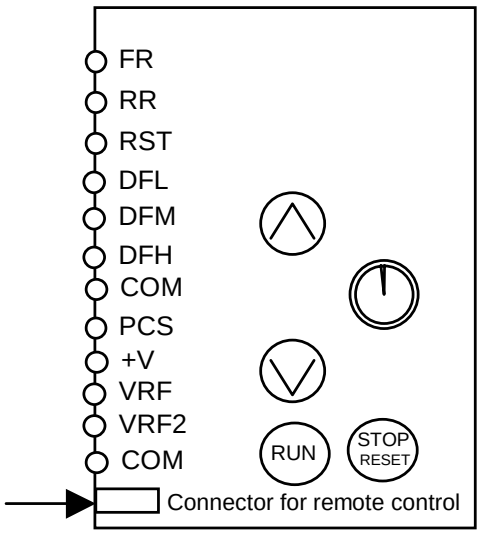
FNOd: 1 (VRF) or 2 (VRF2)
CNOd: 0 (Terminal board)
F200: 0
To switch to preset-speed setting, use the external terminals DFL to DFH.

(12) Switching between analog setting and terminal setting from the operation panel



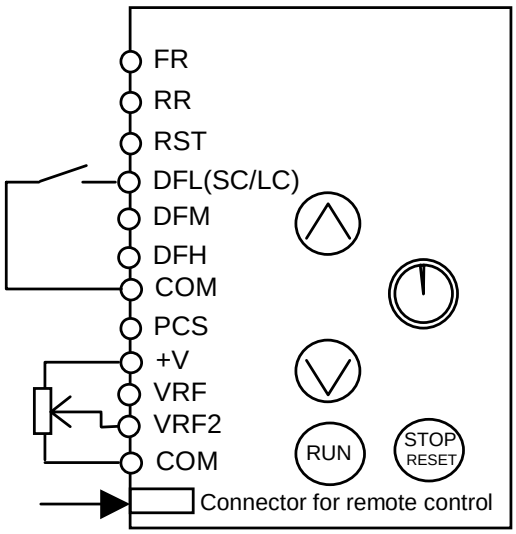
FNOd: 3 (Operation panel)
F113: 38 (Allocation of FCHG)
To switch to F207 setting, enter the command through FCHG.
F200: 0
F207: 1(VRF) or 2 (VRF2)

(13) Setting by means of a remote input device



Communication command fa00h 14bit: 1
Priority on remote input device
(FNOd : 4)

(14) Switching between remote control and local control

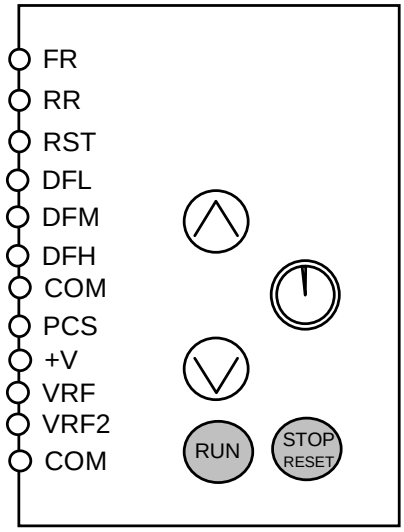


Communication command fa00h 14bit: 1
F114: 48 (Allocation of SL/LC)
Switched to local when a command is entered through SC and LC during operation by means of a remote input device
Activated if the parameter FNOd, F200 or F207 is so set

7.2 Setting the operation mode

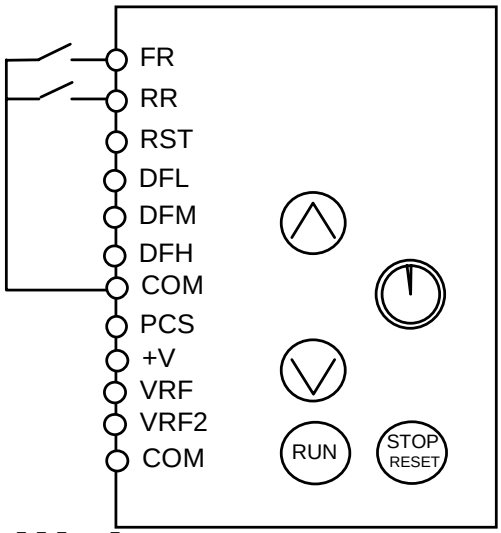
Applied operation can be performed by selecting the operation mode. To set the operation mode, use the basic parameter Cmod (command mode selection) and the input terminal selection parameter.

(1) Operation panel operation



Cmod: 1 (Operation panel)

(2) Terminal board operation

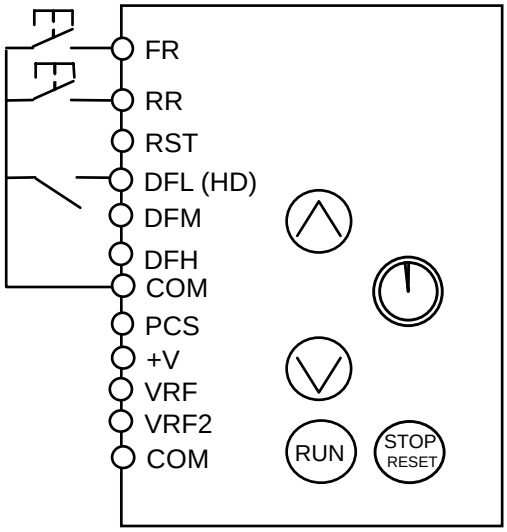


Cmod: 0 (Terminal board)

7

(3) Three-wire operation (one-touch operation)

You can carry out operation by simply pressing the ON/OFF button.



Selecting HD (operation holding) with the input terminal selection parameter

Select HD (operation holding) using the input terminal selection parameter, and turn HD on to get the inverter ready for operation or turn HD off to stop operation.

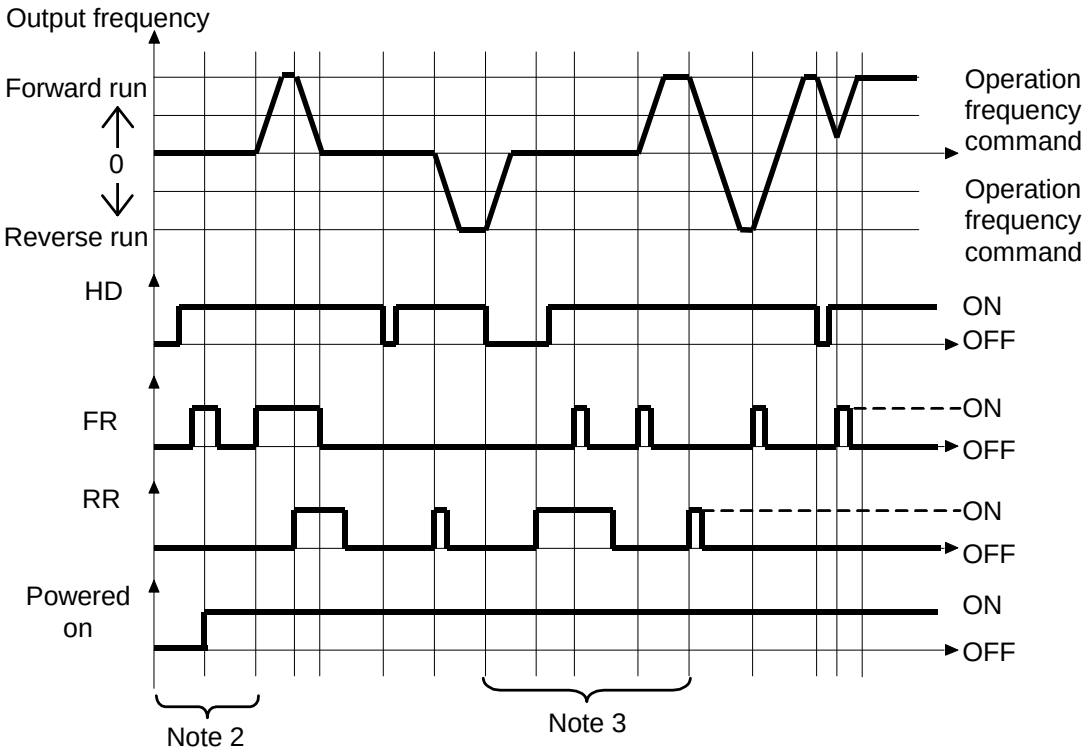
Note 1 : To carry out three-wire operation, set F 110 to 1 (ST) and CNOd to 0 (terminal board).
Select one input terminal, and set to HD (operation holding). For example, set F 114 to 49 (operation holding) to assign HD to the S1 terminal.

Note 2 : Even if each terminal is ON, any command entered through a terminal is ignored when power is turned on (to prevent the load from starting to move unexpectedly). Enable to turn the input terminal on at power on.

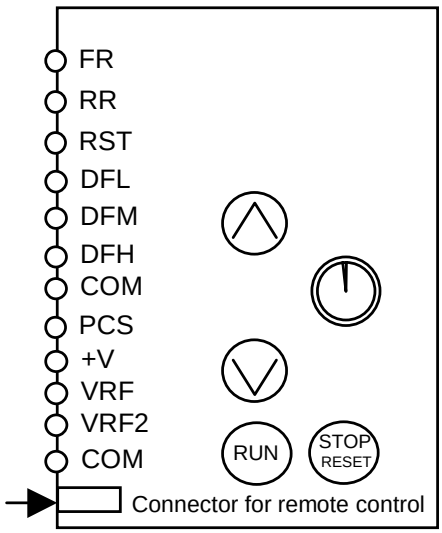
Note 3 : When HD is OFF, any attempt to turn on FR or RR is ignored. When RR is ON, you cannot start operation by turning on HD. Even when both RR and HD are ON, you cannot start operation by turning on FR. To start operation, turn off FR and RR temporarily, then turn them back on.

Note 4 : If select Jog run command during three-wire operation, inverter stops.

Note 5 : Sending out a RUN signal during DC braking has no effect in stopping DC braking.

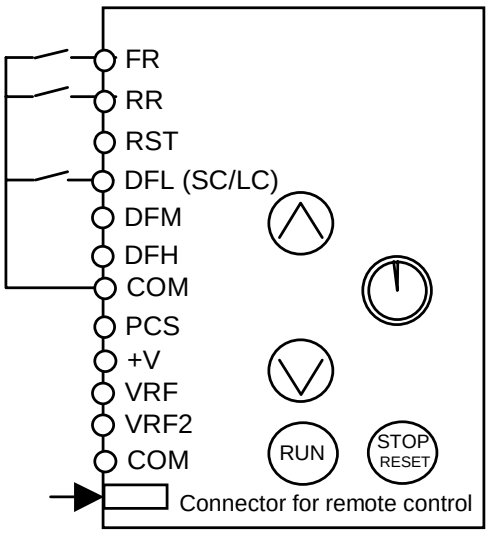


(4) Operation from an external input device



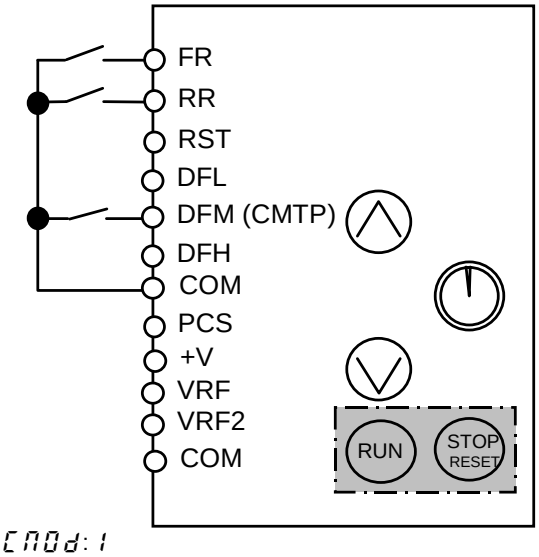
Priority is given to an external input device when the remote command fa00h 15-bit is set at 1.

(5) Switching from an external input device to the terminal board



CMOd: 0 (Terminal board)
F114: 48 (Allocation of SL/LC)
Remote control can be switched forcefully to local control from the external SC/LC by setting the remote command fa00h 15-bit at 1. Operation is controlled from the terminal board.

(6) Switching from the operation panel to the terminal board



C n0d : 1
F 115 : 50 (Allocation of CMTP)
To switch to terminal board operation, use the external CMTP input.

8. Monitoring the operation status

8.1 Status monitor mode

8.1.1 Status monitor under normal conditions

In this mode, you can monitor the operation status of the inverter.

To display the operation status during normal operation:

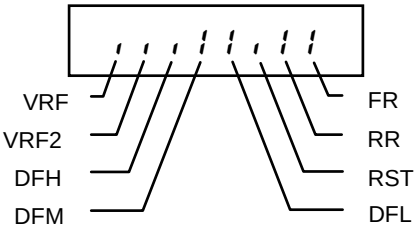
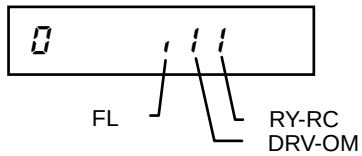
Press the (MON) key twice.

Setting procedure (eg. operation at 60Hz)

	Item displayed	Key operated	LED display	Communication No.	Description
			60.0		The operation frequency is displayed (Operation at 60Hz). (When standard monitor display selection F710 is set at 0 [operation frequency])
	Parameter setting mode	MON	AUH		The first basic parameter "AUH" (history function) is displayed.
	Direction of rotation	MON	Fr-F	FE01	The direction of rotation is displayed. (Fr-F: forward run, Fr-r: reverse run)
Note 1	Operation frequency command	▲	F60.0	FE02	The operation frequency command value (Hz/free unit) is displayed.
Note 2	Load current	▲	C 80	FE03	The inverter output current (load current) (%/A) is displayed.
Note 3	Input voltage	▲	y100	FE04	The inverter input (DC) voltage (%/V) is displayed.
	Output voltage	▲	P100	FE05	The inverter output voltage (%/V) is displayed.
	Torque	▲	9 60	FE18	The torque (%) is displayed.
	Torque current	▲	c 90	FE20	The torque current (%/A) is displayed.
	Inverter load factor	▲	L 70	FE27	The inverter load factor (%) is displayed.
	DBR cumulative load factor	▲	r 50	FE25	The cumulative load factor of the braking resistor (%) is displayed.
	Input power	▲	h 80	FE29	The inverter input power (kW) is displayed.
	Output power	▲	H 75	FE30	The inverter output power (kW) is displayed.
	Operation frequency	▲	o60.0	FD00	The operation frequency (Hz/free unit) is displayed.

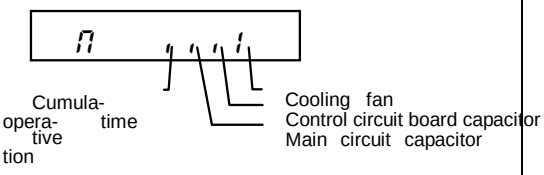
(Continued overleaf)

(Continued)

	Item displayed	Key operated	LED display	Communication No.	Description
Note 4	Input terminal	▲	0 0 0 1 1 0 1 1	FE06	The ON/OFF status of each of the control signal input terminals (FR, RR, RST, DFL, DFM, DFH, VRF2 and VRF) is displayed in bits. ON: 1 OFF: 0 
Note 5	Output terminal	▲	0 0 1 1	FE07	The ON/OFF status of each of the control signal output terminals (RY, DRV and FL) is displayed in bits. ON: 1 OFF: 0 
	CPU1 version	▲	u 1 0 1	FE08	The version of the CPU1 is displayed.
	CPU2 version	▲	u c 0 1	FE73	The version of the CPU2 is displayed.
	Memory version	▲	u E 0 1	FE09	The version of the memory mounted is displayed.
	PID feedback	▲	d 5 0	FE22	The PID feedback value is displayed. (Default setting: unit Hz)
	Frequency command value (PID-computed)	▲ ▲ ▲	b 7 0	FE15	The PID-computed frequency command value is displayed. (Default setting: unit Hz)
Note 6	Integral input power	▲	k 8 5	FE76	The integrated amount of power (kWh) supplied to the inverter is displayed. (0.01=1kWh, 1.00=100kWh)
Note 6	Integral output power	▲	H 7 5	FE77	The integrated amount of power (kWh) supplied from the inverter is displayed. (0.01=1kWh, 1.00=100kWh)
	Rated current	▲	A 1 6.5	FE70	The rated current of the inverter (A) is displayed.
Note 7	Past trip 1	▲	0 C 3 ⇔ 1	FE10	Past trip 1 (displayed alternately)
Note 7	Past trip 2	▲	0 H ⇔ 2	FE11	Past trip 2 (displayed alternately)
Note 7	Past trip 3	▲	0 P 3 ⇔ 3	FE12	Past trip 3 (displayed alternately)

(Continued overleaf)

(Continued)

	Item displayed	Key operated	LED display	Communication No.	Description
Note 7	Past trip 4	▲	nErr ⇔4	FE13	Past trip 4 (displayed alternately)
Note 8	Life alarm information	▲	0 ,,,1	FE79	The ON/OFF status of each of the cooling fan, circuit board capacitor, main circuit capacitor or life alarm of cumulative operation time is displayed in bits. ON: 1 OFF: , 
Note 9	Cumulative operation time	▲	t0.10	FE14	The cumulative operation time is displayed. (0.01=1 hour, 1.00=100 hours)
	Default display mode	MON	60.0		The operation frequency is displayed (Operation at 60Hz).

Note 1: Press the ▲ or ▼ key to change items displayed in the status monitor mode.

Note 2: You can switch between % and A (ampere)/V (volt), using the parameter F701 (current/voltage unit selection).

Note 3: The input (DC) voltage displayed is $1\sqrt{2}$ times as large as the rectified d.c. input voltage.

Note 4: The number of bars displayed varies depending on the setting of F109 (analog input/logic input function selection). The bar representing VRF or VRF2 is displayed only when the logic input function is assigned to the VRF or VRF2 terminal, respectively.
If F109 = 0: Neither the bar representing VRF nor the bar representing VRF2 is displayed.
If F109 = 1 or 2: The bar representing VRF is not displayed.
The bar representing VRF2 is displayed.
If F109 = 3 or 4: Both the bar representing VRF and VRF2 are displayed.

Note 5: The number of bars displayed varies depending on the setting of F669 (logic output/pulse train output selection). The bar representing the DRV-OM terminal is displayed only when logic output function is assigned to it.
If F669 = 0: The bar representing DRV-OM is displayed.
If F669 = 1: The bar representing DRV-OM is not displayed.

Note 6: The integrated amounts of input and output power will be reset to zero, if you press and hold down the STR key for 3 seconds or more when power is off or when the input terminal function CKWH (input terminal function: 51) is turned on or displayed.

Note 7: Past rip records are displayed in the following sequence: 1 (latest trip record) ⇔2⇔3⇔4 (oldest trip record). If no trip occurred in the past, the message "nErr" will be displayed. Details on past trip record 1, 2, 3 or 4 can be displayed by pressing the STR key when past trip 1, 2, 3 or 4 is displayed. For more information, see 8.1.2.

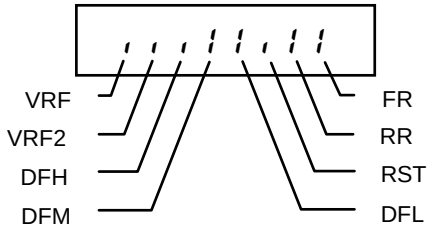
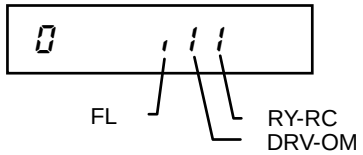
Note 8: The life alarm is displayed based on the value calculated from the annual average ambient temperature, operation time and load current specified using F634. Use this alarm as a guide only, since it is based on a rough estimation.

Note 9: The cumulative operation time increments only when the machine is in operation.

8.1.2 Display of detailed information on a past trip

Details on a past trip (of trips 1 to 4) can be displayed, as shown in the table below, by pressing the STR key when the trip record is selected in the status monitor mode.

Unlike the "Display of detailed trip information at the occurrence of a trip" in 8.2.2, details on a past trip can be displayed, even after the inverter is turned off or reset.

	Item displayed	Key operated	LED display	Description
Note 7	Past trip 1		OC 1 ⇔ 1	Past trip 1 (displayed alternately)
	Continuous trips	STR	n 2	The number of time the same trip occurred in succession is displayed. (Unit: times)
Note 1	Operation frequency	▲	60.0	The operation frequency when the trip occurred is displayed.
	Direction of rotation	▲	Fr-F	The direction of rotation when the trip occurred is displayed. (Fr-F: Forward run, Fr-r: Reverse run)
	Operation frequency command	▲	F80.0	The operation command value when the trip occurred is displayed.
Note 2	Load current	▲	C 150	The inverter output current when the trip occurred is displayed. (%/A)
Note 3	Input voltage	▲	V 120	The inverter input voltage (DC) when the trip occurred is displayed. (%/V).
	Output voltage	▲	P 100	The inverter output voltage when the trip occurred is displayed. (%/V)
Note 4	Input terminal	▲	, , , 1 1 , 1 1	The ON/OFF statuses of the control input terminals (FR, RR, RST, DFL, DFM, DFH, VRF2 and VRF) are displayed in bits. ON: 1 OFF: , 
Note 5	Output terminal	▲	0 , 1 1	The ON/OFF statuses of the control output terminals (RY, OUT and FL) are displayed in bits. ON: 1 OFF: , 
Note 9	Cumulative operation time	▲	t 8.56	The cumulative operation time when the trip occurred is displayed. (0.01=1 hour, 1.00=100 hours)
	Past trip 1	MON	OC 1 ⇔ 1	Press this key to return to past trip 1.

Note 1: Press the (▲) or (▼) key to change items displayed in the status monitor mode.

Note 2: You can switch between % and A (ampere)/V (volt), using the parameter F701 (current/voltage unit selection).

Note 3: The input (DC) voltage displayed is $1\sqrt{2}$ times as large as the rectified d.c. input voltage.

Note 4: The number of bars displayed varies depending on the setting of F109 (analog input/logic input function selection). The bar representing VRF or VRF2 is displayed only when the logic input function is assigned to the VRF or VRF2 terminal, respectively.

If F109 = 0: Neither the bar representing VRF nor the bar representing VRF2 is displayed.

If F109 = 1 or 2: The bar representing VRF is not displayed.
The bar representing VRF2 is displayed.

If F109 = 3 or 4: Both the bar representing VRF and VRF2 are displayed.

Note 5: The number of bars displayed varies depending on the setting of F669 (logic output/pulse train output selection). The bar representing the DRV-OM terminal is displayed only when logic output function is assigned to it.

If F669 = 0: The bar representing DRV-OM is displayed.

If F669 = 1: The bar representing DRV-OM is not displayed.

Note 6: The integrated amounts of input and output power will be reset to zero, if you press and hold down the (STR) key for 3 seconds or more when power is off or when the input terminal function CKWH (input terminal function: 51) is turned on or displayed.

Note 7: If there is no trip record, nErr is displayed.

Note 9: The cumulative operation time increments only when the machine is in operation.

8.2 Display of trip information

8.2.1 Trip code display

If the inverter trips, an error code is displayed to suggest the cause. Since trip records are retained, information on each trip can be displayed anytime in the status monitor mode.

■ Display of trip information

Error code	Failure code	Description
nErr (*)	0000	No error
OC 1	0001	Overcurrent during acceleration
OC2	0002	Overcurrent during deceleration
OC3	0003	Overcurrent during constant speed operation
OCL	0004	Load-side overcurrent during start-up
OCA	0005	Armature-side overcurrent during start-up
EPH 1	0008	Input phase failure or exhaustion of main circuit capacitor
EPHO	0009	Output phase failure
OP 1	000A	Overvoltage during acceleration
OP2	000B	Overvoltage during deceleration
OP3	000C	Overvoltage during constant-speed operation
OL 1	000D	Inverter overload trip
OL2	000E	Motor overload trip
OLr	000F	Dynamic braking resistor overload trip
OH	0010	Overheating trip or thermal detector failure
E	0011	Emergency stop
EEP 1	0012	E^2PROM fault 1 (writing error)
EEP2	0013	E^2PROM fault 2 (initialization error) or power-off during the setting of tYP
EEP3	0014	E^2PROM fault 3 (reading error)
Err2	0015	Inverter RAM fault
Err3	0016	Inverter ROM fault
Err4	0017	CPU fault trip 1
Err5	0018	Communication error
Err7	001A	Current defector fault
Err8	001B	Optional circuit board format error
UC	001D	Small-current trip
UP 1	001E	Undervoltage trip
Ot	0020	Over-torque trip
EF2	0022	Ground fault

(Continued overleaf)

(Continued)

Error code	Failure code	Description
0C 1P	0025	Overcurrent flowing in element during acceleration
0C2P	0026	Overcurrent flowing in element during deceleration
0C3P	0027	Overcurrent flowing in element during constant-speed operation
EtN 1	0054	Auto-tuning error
EtYP	0029	Inverter type error
0H2	002E	External thermal input
E- 18	0032	VRF cable break
E- 19	0033	Communication error between CPUs
E-20	0034	V/F control error
E-21	0035	CPU fault 2
SOUt	002F	Step-out (for PM motors only)

(Note) Past trip records (trip records retained or trips that occurred in the past) can be called up.
(Refer to 8.1 "Status monitor mode" for the call-up procedure.)
(*) Strictly speaking, this code is not an error code; this code is displayed to show the absence of error when the past trip monitor mode is selected.

8.2.2 Display of trip information at the occurrence of a trip

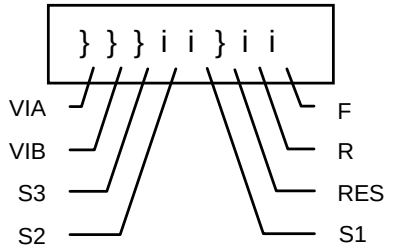
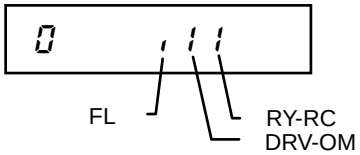
At the occurrence of a trip, the same information as that displayed in the mode described in 8.1.1, "Status monitor under normal conditions," can be displayed, as shown in the table below, if the inverter is not turned off or reset. To display trip information after turning off or resetting the inverter, follow the steps described in 8.1.2, "Display of detailed information on a past trip."

■ Example of call-up of trip information

	Item displayed	Key operated	LED display	Communication No.	Description
	Cause of trip		0P2		Status monitor mode (The code blinks if a trip occurs.) The motor coasts and comes to a stop (coast stop).
	Parameter setting mode	MON	AUH		The first basic parameter "AUH" (history function) is displayed.
	Direction of rotation	MON	Fr-F	FE01	The direction of rotation at the occurence of a trip is displayed. (Fr-F: forward run, Fr-r: reverser run).
Note 1	Operation frequency command	▲	F60.0	FE02	The operation frequency command value (Hz/free unit) at the occurrence of a trip is displayed.
Note 2	Load current	▲	C 130	FE03	The output power of the inverter at the occurrence of a trip (%/A) is displayed.
	Input voltage	▲	Y 141	FE04	The inverter input (DC) voltage (%/V) at the occurrence of a trip is displayed.
	Output voltage	▲	P 100	FE05	The output voltage of the inverter at the occurrence of a trip (%/V) is displayed.

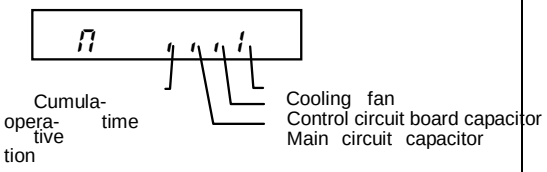
(Continued overleaf)

(Continued)

	Item displayed	Key operated	LED display	Communication No.	Description
	Torque	▲	9 60	FE18	The torque at the occurrence of a trip (%) is displayed.
	Torque current	▲	c 90	FE20	The torque current (%/A) at the occurrence of a trip is displayed.
	Inverter load factor	▲	L 70	FE27	The inverter load factor (%) at the occurrence of a trip is displayed.
	DBR cumulative load factor	▲	r 50	FE25	The cumulative load factor (%) of the resistor at the occurrence of a trip is displayed.
	Input power	▲	P 80	FE29	The inverter input power (kW) at the occurrence of a trip is displayed.
	Output power	▲	H 75	FE30	The inverter output power (kW) at the occurrence of a trip is displayed.
	Operation frequency	▲	o60.0	FE00	The inverter output frequency (Hz/free unit) at the occurrence of a trip is displayed.
Note 4	Input terminal	▲	,,,11,11	FE06	The ON/OFF statuses of the control input terminals (FR, RR, RST, DFL, DFM, DFH, VRF2 and VRF) are displayed in bits. ON: 1 OFF: , 
Note 5	Output terminal	▲	0 ,11	FE07	The ON/OFF status of each of the control signal output terminals (RY, DRV and FL) at the occurrence of a trip is displayed in bits. ON: 1 OFF: , 
	CPU1 version	▲	u101	FE08	The version of the CPU1 is displayed.
	CPU2 version	▲	uc01	FE73	The version of the CPU2 is displayed.
	Memory version	▲	uE01	FE09	The version of the memory mounted is displayed.
	PID feedback	▲	d 50	FE22	The PID feedback value at the occurrence of a trip is displayed. (Default setting: unit Hz)
	Frequency command value (PID-computed)	▲	b 70	FE15	The PID-computed frequency command value at the occurrence of a trip is displayed. (Default setting: unit Hz)

(Continued overleaf)

(Continued)

	Item displayed	Key operated	LED display	Communication No.	Description
	Integral input power	▲	5 85	FE76	The integrated amount of power (kWh) supplied to the inverter is displayed. (0.01=1kWh, 1.00=100kWh)
	Integral output power	▲	H 75	FE77	The integrated amount of power (kWh) supplied from the inverter is displayed. (0.01=1kWh, 1.00=100kWh)
	Rated current	▲	A 16.5	FE70	The inverter rated current (A) at the occurrence of a trip is displayed.
Note 7	Past trip 1	▲	OP2 ⇔ 1	FE10	Past trip 1 (displayed alternately)
Note 7	Past trip 2	▲	OH ⇔2	FE11	Past trip 2 (displayed alternately)
Note 7	Past trip 3	▲	OP3 ⇔3	FE12	Past trip 3 (displayed alternately)
Note 7	Past trip 4	▲	nErr ⇔4	FE13	Past trip 4 (displayed alternately)
Note 8	Life alarm information	▲	n ,,,1	FE79	The ON/OFF status of each of the cooling fan, circuit board capacitor, main circuit capacitor or life alarm of cumulative operation time is displayed in bits. ON: 1 OFF: , 
Note 9	Cumulative operation time	▲	t0.10	FE14	The cumulative operation time is displayed. (0.01=1 hour, 1.00=100 hours)
	Default display mode	MON	OP2		The cause of the trip is displayed.

Note 1: Items displayed when a trip occurs can be changed by pressing ▲ or ▼ key.

Note 2: You can switch between % and A (ampere)/V (volt), using the parameter F701 (current/voltage unit selection).

Note 3: The input (DC) voltage displayed is $1\sqrt{2}$ times as large as the rectified d.c. input voltage.

Note 4: The number of bars displayed varies depending on the setting of F109 (analog input/logic input function selection). The bar representing VRF or VRF2 is displayed only when the logic input function is assigned to the VRF or VRF2 terminal, respectively.
If F109 = 0: Neither the bar representing VRF nor the bar representing VRF2 is displayed.
If F109 = 1 or 2: The bar representing VRF is not displayed.
The bar representing VRF2 is displayed.
If F109 = 3 or 4: Both the bar representing VRF and VRF2 are displayed.

Note 5: The number of bars displayed varies depending on the setting of F669 (logic output/pulse train output selection). The bar representing the DRV-OM terminal is displayed only when logic output function is assigned to it.

If F669 = 0: The bar representing DRV-OM is displayed.
If F669 = 1: The bar representing DRV-OM is not displayed.

Note 6: The integrated amounts of input and output power will be reset to zero, if you press and hold down the STR key for 3 seconds or more when power is off or when the input terminal function CKWH (input terminal function: 51) is turned on or displayed.

Note 7: Past rip records are displayed in the following sequence: 1 (latest trip record) ⇔2⇔3⇔4 (oldest trip record). If no trip occurred in the past, the message "nErr" will be displayed. Details on past trip record 1, 2, 3 or 4 can be displayed by pressing the STR key when past trip 1, 2, 3 or 4 is displayed. For more information, see 8.1.2.

Note 8: The life alarm is displayed based on the value calculated from the annual average ambient temperature, operation time and load current specified using F634. Use this alarm as a guide only, since it is based on a rough estimation.

Note 9: The cumulative operation time increments only when the machine is in operation.

Note 10: At the occurrence of a trip, maximum values are not always recorded and displayed for reasons of detecting time.

9. Taking measures to satisfy the CE directive

9.1 How to cope with the CE directive

In Europe, the EMC directive and the low-voltage directive, which took effect in 1996 and 1997, respectively, make it obligatory to put the CE mark on every applicable product to prove that it complies with the directives. Inverters do not work alone but are designed to be installed in a control panel and always used in combination with other machines or systems which control them, so they themselves are not considered to be subject to the EMC directive. However, the CE mark must be put on all inverters because they are subject to the low-voltage directive.

The CE mark must be put on all machines and systems with built-in inverters because such machines and systems are subject to the above directives. It is the responsibility of the manufacturers of such final products to put the CE mark on each one. If they are "final" products, they might also be subject to machine-related directives. It is the responsibility of the manufacturers of such final products to put the CE mark on each one. In order to make machines and systems with built-in inverters compliant with the EMC directive and the low-voltage directive, this section explains how to install inverters and what measures should be taken to satisfy the EMC directive.

We have tested representative models with them installed as described later in this manual to check for conformity with the EMC directive. However, we cannot check all inverters for conformity because whether or not they conform to the EMC direction depends on how they are installed and connected. In other words, the application of the EMC directive varies depending on the composition of the control panel with a built-in inverter(s), the relationship with other built-in electrical components, the wiring condition, the layout condition, and so on. Therefore, please verify yourself whether your machine or system conforms to the EMC directive.

9.1.1 About the EMC directive

Inverters themselves are not subject to approval for CE marking.

The CE mark must be put on every final product that includes an inverter(s) and a motor(s). The HF-320α series of inverters complies with the EMC directive if an EMI filter recommended by Sumitomo is connected to it and wiring is carried out correctly.

- EMC directive 89/336/EEC

The EMC standards are broadly divided into two categories; immunity- and emission-related standards, each of which is further categorized according to the operating environment of each individual machine. Since inverters are intended for use with industrial systems under industrial environments, they fall within the EMC categories listed in Table 1 below. The tests required for machines and systems as final products are almost the same as those required for inverters.

Table 1 EMC standards

Category	Subcategory	Product standards	Test standard and level
Emission	Radiation noise	IEC 61800-3	CISPR/B/276/DC Class A Group 1
	Transmission noise		CISPR/B/276/DC Class A Group 1
Immunity	Static discharge		IEC61000-4-2
	Radioactive radio-frequency magnetic contactor field		IEC61000-4-3
	First transient burst		IEC61000-4-4
	Lightning surge		IEC61000-4-5
	Radio-frequency induction/transmission interference		IEC61000-4-6
	Voltage dip/Interruption of power		IEC61000-4-11

Emission standards other than the above are applied to inverters when used in a commercial environment but not an industrial environment.

Category	Subcategory	Product standards	Test standard and level
Emission	Radiation noise	IEC 61800-3	CISPR/B/276/DC Class B Group 1
	Transmission noise		CISPR/B/276/DC Class B Group 1

9.1.2 Measures to satisfy the EMC directive

This subsection explains what measures must be taken to satisfy the EMC directive.

(1) Insert a recommended EMI filter (Table 2) on the input side of the inverter to reduce and transmission noise and radiation noise from input cables.
In the combinations listed in Table 2, Inverters are tested in these combination to see if they comply with transmission noise standards.
Table 2 lists noise filters recommended for the inverters.

Table 2 Combinations of inverter and EMI filter

Three-phase 200V class

Combination of inverter and filter		
Inverter	Transmission noise CISPR/B/276/DC Class A Group 1 Applicable filters (Length of motor connecting cable: Max. 5 m)	Transmission noise EN55011 Class B Group 1 Applicable filters (Length of motor connecting cable: Max. 1 m)
HF3212-A20	Under preparation	
HF3212-A40	Under preparation	
HF3212-A75	Under preparation	
HF3212-1A5	Under preparation	
HF3212-2A2	Under preparation	
HF3212-3A7	Under preparation	
HF3212-5A5	Under preparation	
HF3212-7A5	Under preparation	
HF3212-011	Under preparation	
HF3212-015	Under preparation	

Three-phase 400V class

Combination of inverter and filter			
Inverter	Transmission noise CISPR/B/276/DC Class A Group 1 Applicable filters (Length of motor connecting cable: Max. 5 m)	Transmission noise EN55011 Class B Group 1 Applicable filters (Length of motor connecting cable: Max. 20 m)	Transmission noise EN55011 Class A Group 1 Applicable filters (Length of motor connecting cable: Max. 50 m)
HF3214-A40	With a built-in filter	Under preparation	
HF3214-A75	With a built-in filter	Under preparation	
HF3214-1A5	With a built-in filter	Under preparation	
HF3214-2A2	With a built-in filter	Under preparation	
HF3214-3A7	With a built-in filter	Under preparation	
HF3214-5A5	With a built-in filter	Under preparation	
HF3214-7A5	With a built-in filter	Under preparation	
HF3214-011	With a built-in filter	Under preparation	
HF3214-015	With a built-in filter	Under preparation	

Single-phase 200V class

Combination of inverter and filter			
Inverter	Transmission noise CISPR/B/276/DC Class A Group 1 Applicable filters (Length of motor connecting cable: Max. 5 m)	Transmission noise EN55011 Class B Group 1 Applicable filters (Length of motor connecting cable: Max. 20 m)	Transmission noise EN55011 Class A Group 1 Applicable filters (Length of motor connecting cable: Max. 50 m)
HF321S-A20	With a built-in filter	Under preparation	
HF321S-A40	With a built-in filter	Under preparation	
HF321S-A75	With a built-in filter	Under preparation	
HF321S-1A5	With a built-in filter	Under preparation	
HF321S-2A2	With a built-in filter	Under preparation	

(2) Use shielded power cables, such as inverter output cables, and shielded control cables. Route the cables and wires so as to minimize their lengths. Keep a distance between the power cable and the control cable and between the input and output wires of the power cable. Do not route them in parallel or bind them together, instead cross at right angle.

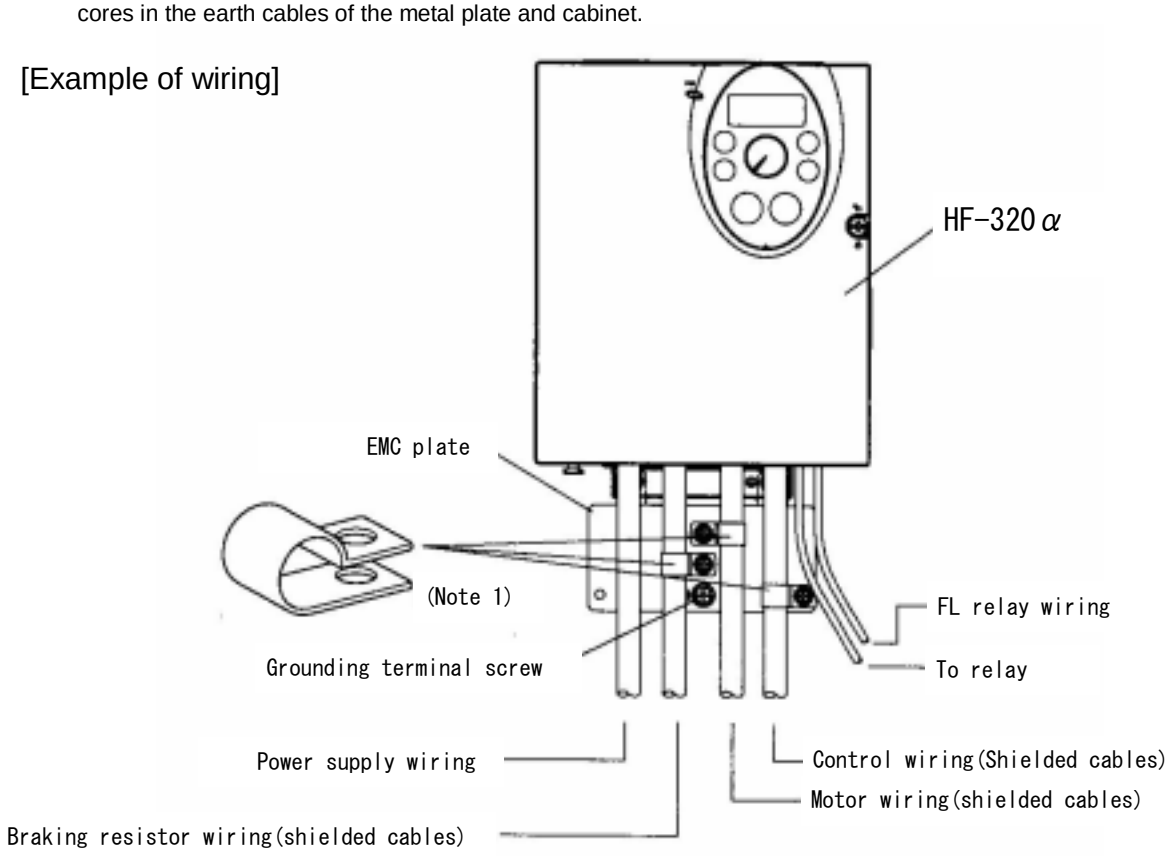
(3) Install the inverter and the filter on the same metal plate. It is more effective in limiting the radiation noise to install the inverter in a sealed steel cabinet. Using wires as thick and short as possible, earth the metal plate and the control panel securely with a distance kept between the earth cable and the power cable.

(4) Route the EMI filter input and output wires apart from each other.

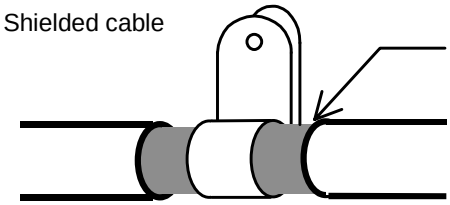
(5) To suppress radiation noise from cables, ground all shielded cables through a noise cut plate.
It is effective to earth shielded cables in the vicinity of the inverter, cabinet and filter (within a radius of 10cm from each of them). Inserting a ferrite core in a shielded cable is even more effective in limiting the radiation noise.

(6) To further limit the radiation noise, insert a zero-phase reactor in the inverter output line and insert ferrite cores in the earth cables of the metal plate and cabinet.

[Example of wiring]



Note 1: Strip and earth the shielded cable, following the example shown in Fig.



Strip the cable and fix it to the metal plate by means of a metal saddle for electrical work or equivalent.

9.1.3 About the low-voltage directive

The low-voltage directive provides for the safety of machines and systems. The HF-320 α series of inverters are CE-marked in accordance with the standard EN 50178 specified by the low-voltage directive, and can therefore be installed in machines or systems and imported without problem to European countries.

Applicable standard: EN50178
Electronic equipment for use in power installations
Electronic equipment for use in power installations
Pollution level: 2 (5.2.15.2)
Overvoltage category: 3
200V class - 3.0mm (5.2.16.1)
400V class - 5.5mm (5.2.16.1)

EN 50178 applies to electrical equipment intended specially for use in power installations, and sets out the conditions to be observed for electric shock prevention when designing, testing, manufacturing and installing electronic equipment for use in power installations.

9.1.4 Measures to satisfy the low-voltage directive

When incorporating the inverter into a machine or system, it is necessary to take the following measures so that the inverter satisfies the low-voltage directive.

(1) Install the inverter in a cabinet and ground the inverter enclosure. When doing maintenance, be extremely careful not to put your fingers into the inverter through a wiring hole and touch a charged part, which may occur depending on the model and capacity of the inverter used.
(2) Do not connect two or more wires to the main circuit earth terminal of the inverter. If necessary, install an additional earth terminal on the metal plate on which the inverter is installed and connect another cable to it. Or install the EMC plate (attached as standard) and another cable connect to earth terminal on the EMC plate. Refer to the table 10.1 for earth cable sizes.
(3) Install a non-fuse circuit breaker or a fuse on the input side of the inverter.

10. Peripheral devices

Danger	
Mandatory	• When using switchgear for the inverter, it must be installed in a cabinet. Failure to do so can lead to risk of electric shock and can result in death or serious injury.
Prohibited	• Connect earth cables securely. Failure to do so can lead to risk of electric shock or fire in case of a failure or short-circuit or electric leak.

10.1 Selection of wiring materials and devices

Voltage class	Capacity of applicable motor (kW)	Inverter model	Wire size (See Note 4)			
			Main circuit (mm^2) (See Note 1.)	DC reactor (optional) (mm^2)	Braking resistor/ Braking unit (optional) (mm^2)	Earth cable (mm^2)
Single-phase 200V class	0.2	HF321S-A20	2.0	2.0	2.0	3.5
	0.4	HF321S-A40	2.0	2.0	2.0	3.5
	0.75	HF321S-A75	2.0	2.0	2.0	3.5
	1.5	HF321S-1A5	2.0	2.0	2.0	3.5
	2.2	HF321S-2A2	2.0	3.5	2.0	3.5
Three-phase 200V class	0.2	HF3212-A20	2.0	1.25	2.0	3.5
	0.4	HF3212-A40	2.0	1.25	2.0	3.5
	0.75	HF3212-A75	2.0	2.0	2.0	3.5
	1.5	HF3212-1A5	2.0	2.0	2.0	3.5
	2.2	HF3212-2A2	2.0	2.0	2.0	3.5
	3.7	HF3212-3A7	5.5	5.5	2.0	3.5
	5.5	HF3212-5A5	5.5	8.0	5.5	5.5
	7.5	HF3212-7A5	8.0	14	5.5	8.0
	11	HF3212-011	14	14	5.5	14
	15	HF3212-015	14×2	14×2	5.5	22
Three-phase 400V class	0.4	HF3214-A40	2.0	2.0	2.0	3.5
	0.75	HF3214-A75	2.0	2.0	2.0	3.5
	1.5	HF3214-1A5	2.0	2.0	2.0	3.5
	2.2	HF3214-2A2	2.0	2.0	2.0	3.5
	3.7	HF3214-3A7	2.0	2.0	2.0	3.5
	5.5	HF3214-5A5	2.0	3.5	2.0	3.5
	7.5	HF3214-7A5	3.5	5.5	2.0	3.5
	11	HF3214-011	5.5	8.0	2.0	5.5
	15	HF3214-015	8.0	14	2.0	8.0

Note 1: Sizes of the wires connected to the input terminals R, S and T and the output terminals U, V and W when the length of each wire does not exceed 30m.

Note 2: For the control circuit, use shielded wires 0.75 mm^2 or more in diameter.

Note 3: For grounding, use a cable with a size equal to or larger than the above.

Note 4: The wire sizes specified in the above table apply to HIV wires (cupper wires shielded with an insulator with a maximum allowable temperature of 75°C) used at an ambient temperature of 50°C or less.

■ Selection of wiring devices

Voltage class	Capacity of applicable motor (kW)	Inverter model	Non-fuse circuit breaker (MCCB) Note 3) made by Mitsubishi Elec.		Earth leakage breaker (ECLB) made by Mitsubishi Elec.		Magnetic contactor (MC) made by Fuji Elec.
			Rated current (A)	Type	Rated current (A)	Type	Type
Single-phase 200V class	0.2	HF321S-A20	10	NF-30	10	NV-30	SC-03
	0.4	HF321S-A40	15	NF-30	15	NV-30	SC-03
	0.75	HF321S-A75	20	NF-30	20	NV-30	SC-03
	1.5	HF321S-1A5	30	NF-30	30	NV-30	SC-1N
	2.2	HF321S-2A2	40	NF-50	40	NV-50	SC-2N
Three-phase 200V class	0.2	HF3212-A20	5	NF-30	5	NV-30	SC-03
	0.4	HF3212-A40	5	NF-30	5	NV-30	SC-03
	0.75	HF3212-A75	10	NF-30	10	NV-30	SC-03
	1.5	HF3212-1A5	15	NF-30	15	NV-30	SC-1N
	2.2	HF3212-2A2	20	NF-30	20	NV-30	SC-1N
	3.7	HF3212-3A7	30	NF-30	30	NV-30	SC-2N
	5.5	HF3212-5A5	50	NF-50	50	NV-50	SC-2N
	7.5	HF3212-7A5	60	NF-100	60	NV-100	SC-2N
	11	HF3212-011	100	NF-100	100	NV-100	SC-3N
	15	HF3212-015	125	NF-225	125	NV-225	SC-3N
Three-phase 400V class (Note 5)	0.4	HF3214-A40	5	NF-30	5	NV-30	SC-03
	0.75	HF3214-A75	5	NF-30	5	NV-30	SC-03
	1.5	HF3214-1A5	10	NF-30	10	NV-30	SC-03
	2.2	HF3214-2A2	15	NF-30	15	NV-30	SC-1N
	3.7	HF3214-3A7	20	NF-30	20	NV-30	SC-1N
	5.5	HF3214-5A5	30	NF-30	30	NV-30	SC-1N
	7.5	HF3214-7A5	30	NF-30	30	NV-30	SC-1N
	11	HF3214-011	50	NF-50	50	NV-50	SC-1N
	15	HF3214-015	60	NF-100	60	NV-100	SC-2N

Note 1: Be sure to attach a surge killer to the exciting coil of the relay and the magnetic contactor.

Note 2 When using the auxiliary contacts 2a of the magnetic contactor MC for the control circuit, connect the contacts 2a in parallel to increase reliability.

Note 3: Select an MCCB with a current breaking rating appropriate to the capacity of the power supply, because short-circuit currents vary greatly depending on the capacity of the power supply and the condition of the wiring system. The MCCB, MC, THR and ECLM in this table were selected, on the assumption that a power supply with a normal capacity would be used.

Note 4: 400V class: For the operation and control circuits, regulate the voltage at 200V or less with a step-down transformer.

10.2 Installation of a magnetic contactor

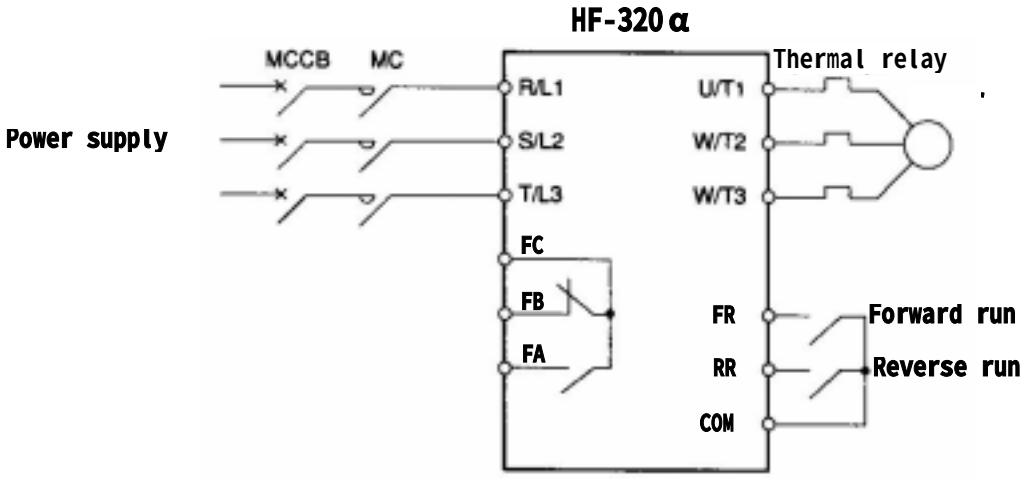
If using the inverter without installing a magnetic contactor (MC) in the primary circuit, use an MCCB (with a power cutoff device) to open the primary circuit when the inverter protective circuit is activated.
If using a braking resistor or braking resistor unit, install a magnetic contactor (MC) or non-fuse circuit breaker with a power cutoff device to the power supply of the inverter, so that the power circuit opens when the failure detection relay (FL) in the inverter or the external overload relay is activated.

■ Magnetic contactor in the primary circuit

To detach the inverter from the power supply in any of the following cases, insert a magnetic contactor (primary-side magnetic contactor) between the inverter and the power supply.

(1) If the motor overload relay is tripped
(2) If the protective detector (FL) built into the inverter is activated
(3) In the event of a power failure (for prevention of auto-restart)
(4) If the resistor protective relay is tripped when a braking resistor or braking resistor unit is used

When using the inverter with no magnetic contactor (MC) on the primary side, install a non-fuse circuit breaker with a voltage tripping coil instead of an MC and adjust the circuit breaker so that it will be tripped if the protective relay referred to above is activated. To detect a power failure, use an undervoltage relay or the like.



Example of connection of a magnetic contactor in the primary circuit

Notes on wiring

- When frequently switching between start and stop, do not use the magnetic contactor on the primary side as an on-off switch for the inverter.
  Instead, stop and start the inverter by using terminals FR and COM (forward run) or RR and COM (reverse run).
- Be sure to attach a surge killer to the exciting coil of the magnetic contactor (MC).

■ Magnetic contactor in the secondary circuit

A magnetic contactor may be installed on the secondary side to switch controlled motors or supply commercial power to the load when the inverter is out of operation.

Notes on wiring

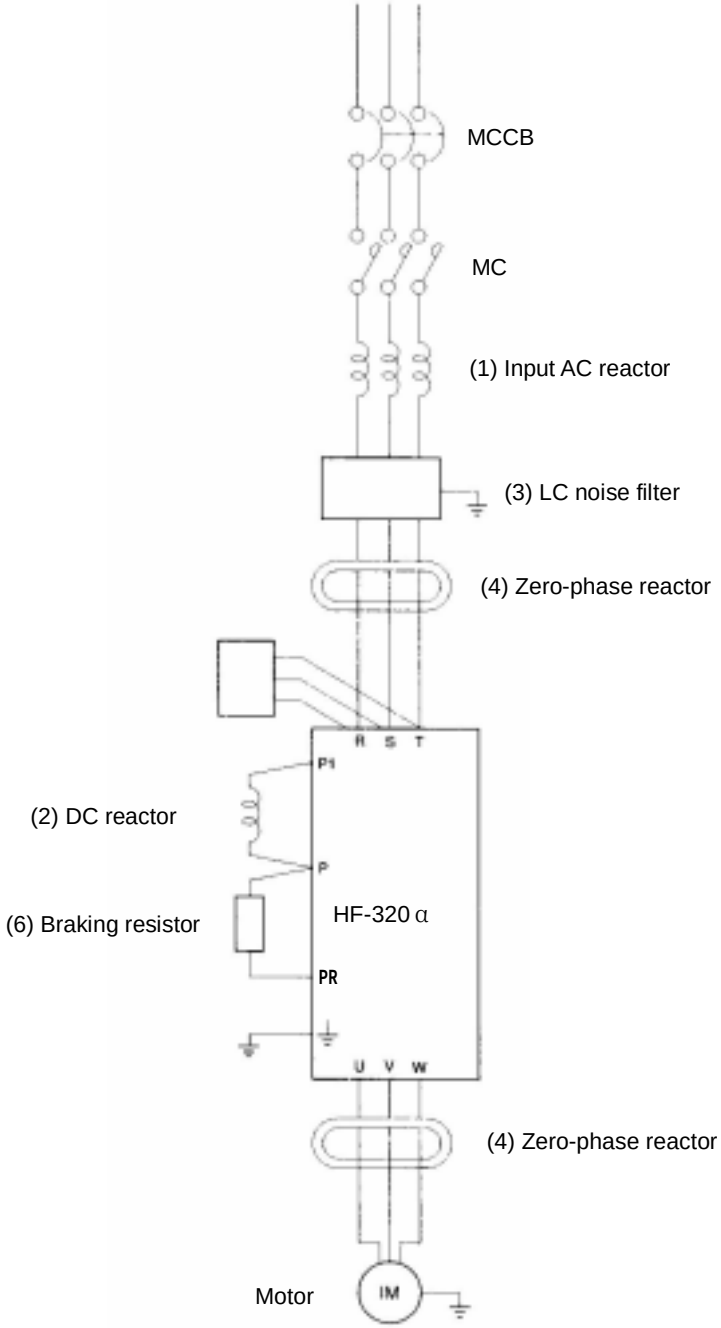
- Be sure to interlock the magnetic contactor on the secondary side with the power supply to prevent commercial power from being applied to the inverter output terminals.
- When installing a magnetic contactor (MC) between the inverter and the motor, avoid turning the magnetic contactor on or off during operation. Turning the magnetic contactor on or off during operation causes a current to rush into the inverter which could lead to malfunction.

10.3 Installation of an overload relay

1) The HF-320α inverter has an electronic-thermal overload protective function.
   In the following cases, however, an overload relay suitable for the adjustment of the motor electronic thermal protection level (Ł Hr) and appropriate to the motor used should be installed between the inverter and the motor.
   - When using a motor with a current rating different to that of the corresponding Sumitomo general-purpose motor
   - When operating a single motor with an output smaller than that of the applicable standard motor or more than one motor simultaneously.
2) When using the HF-320α inverter to operate a constant-torque motor, such as the Sumitomo AF motor, adjust the protection characteristic of the electronic thermal protection unit (0Ł m) to the AF motor use.
3) It is recommended to use a motor with a thermal relay embedded in the motor coil to give sufficient protection to the motor, especially when it runs in a low-speed range.

10.4 Optional external devices

The following external devices are optionally available for the HF-320 α series of inverters.



Optional external devices

<table>
<tr><th>No.</th><th colspan="2">Device</th><th>Function and purpose</th></tr>
<tr><td>(1)</td><td colspan="2">Input AC reactor</td><td>Used to improve the input power factor, reduce the harmonics, and suppress external surge on the inverter power source side. Install when the power capacity is 200 kVA or more and 10 times or more than the inverter capacity or when a distorted wave generation source such as a thyristor unit or a large-capacity inverter is connected in the same distribution system.
<table>
<tr><th rowspan="3">Reactor type</th><th colspan="3">Effect</th></tr>
<tr><th rowspan="2">Improvement of power factor</th><th colspan="2">Suppression of harmonic</th><th rowspan="2">Suppression of external surge</th></tr>
<tr><th>200V-3.7kW or less</th><th>Other model</th></tr>
<tr><td>Input AC reactor</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>DC reactor</td><td>○ Large</td><td>○</td><td>○ Large</td><td>×</td></tr>
</table>
○ Large : Large effective. ○ : effective. × : ineffective</td></tr>
<tr><td>(2)</td><td colspan="2">DC reactor</td><td>Improves the power factor more than the input reactor. When the facility applying the inverter requires high reliability, it is recommended to use the DC reactor with an input reactor effective for external surge suppression.
* An inverter unit of 200V-3.7kW or less is connected to a optional reactor to conform "Guides of limits for harmonics current emissions on general purpose inverter having an input current up to and including 20A per phase" by the Japan Electrical Manufacturers' Association.</td></tr>
<tr><td>(3)</td><td rowspan="3">Radio noise reduction filter</td><td>LC noise filter</td><td>These types of filters are not necessary because all single-phase 200V or 3-phase 400V models have a built-in EMI noise filter, conforming to Class A, as standard. But install these filters if necessarily of noise reduction move and more.
• Effective to prevent interference in audio equipment used near the inverter.
• Install on the input side of the inverter.
• Provided with wide-range attenuation characteristics from AM radio bands to near 10MHz.
• Use when equipment readily affected by noise is installed in the peripheral area.</td></tr>
<tr><td>(4)</td><td>Zero-phase reactor (inductive filter) ferrite core-type</td><td>• Effective to prevent interference in audio equipment used near the inverter.
• Effective in noise reduction on both input and output sides of the inverter.
• Provided with attenuation characteristics of several dB in frequencies from AM radio bands to 10MHz.
• For noise countermeasures, insert on the secondary side of the inverter.</td></tr>
<tr><td>(5)</td><td>Foot-mounted noise filter
(Under preparation)</td><td>High-attenuation EMI noise filter requiring only small space; mounted on the rear side of the inverter. The installation of this filter reduces transmission noise below the level required for the inverter to comply with the following standard.
3-phase 200V model : CISPR/B/276/DC Class A Group 1
(Length of motor connecting cable: Max. 5 m)
1-phase 200V/3-phase 400V models : EN55011 Class B Group 1
(Length of motor connecting cable: Max. 20 m)</td></tr>
<tr><td>(6)</td><td colspan="2">Braking resistor</td><td>Use when rapid deceleration or stop is frequently required or when it is desired to reduce the deceleration time with large load. This resistor consumes regenerative energy during power generation braking.</td></tr>
</table>

No.	Device	Function and purpose
(7)	Copy unit Note 1)	Use this unit for batch read, batch copy, and batch writing of setting parameters. (Model: OS-33)
(8)	Remote operator Note 1)	Extended operation panel kit provided with LED indication section, RUN/STOP key, UP/DOWN key, Monitor key, and Enter key. (Model: OS-32)
(9)	Internal RS485 communication circuit board (Under preparation)	This unit allows you to connect a personal computer to multiple inverters for data transfer.
(10)	RS485 communication converter unit Note 1) (Under preparation)	This unit allows you to connect a personal computer to multiple inverters for data transfer.
(11)	RS232C communication converter unit (Under preparation)	This unit allows you to connect a personal computer to inverters for data communications.

Note 1: Dedicated cables are needed to connect inverters to a personal computer.

Cable models: ICS-1 (1m)

ICS-3 (3m)

11. Table of parameters and data

11.1 User parameters

Title	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
FC	Operation frequency of operation panel	Hz	0.1/0.01	LL-UL	0.0		3.2

11.2 Basic parameters

- Four automatic functions or basic parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
AUH	-	History function	-	-	Displays parameters in groups of five in the reverse order to that in which their settings were changed. * (Possible to edit)	-		4.1.4
AU1	0000	Automatic acceleration/deceleration	-	-	0: Disabled (manual) 1: Automatic 2: Automatic (only at acceleration)	0		5.1.1
AU2	0001	Automatic torque boost	-	-	0: Disabled 1: Automatic torque boost + auto-tuning 2: Vector control + auto-tuning 3: Energy saving + auto-tuning	0		5.2
AU4	0040	Automatic function setting	-	-	0: Disabled 1: Coast stop 2: 3-wire operation 3: External input UP/DOWN setting 4: 4-20 mA current input operation	0		5.3
CNOd	0003	Command mode selection	-	-	0: Terminal board 1: Operation panel	1		5.4
FNOd	0004	Frequency setting mode selection 1	-	-	0: Built-in potentiometer 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact 6: VRF + VRF2 (Override)	0		5.4 6.5.1

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
FMSL	0005	Meter selection	-	-	0: Output frequency 1: Output current 2: Set frequency 3: DC voltage 4: Output voltage command value 5: Input power 6: Output power 7: Torque 8: Torque current 9: Motor cumulative load factor 10: Inverter cumulative load factor 11: DBR (braking reactor) cumulative load factor 12: Frequency setting value (after PID) 13: VRF Input value 14: VRF2 Input value 15: Fixed output 1 (Output current: 100%) 16: Fixed output 2 (Output current: 50%) 17: Fixed output 3 (Other than the output current: 100%) 18: Serial communication data 19: For adjustments (FM set value is displayed.)	0		5.5
FM	0006	Meter adjustment	-	-	-	-		5.5
tYP	0007	Default setting	-	-	0: - 1: 50Hz default setting 2: 60Hz default setting 3: (Use is impossible) 4: Trip record clear 5: Cumulative operation time clear 6: Initialization of type information 7: (Use is impossible) 8. Default setting (Initialization) 9. Cumulative fan operation time record clears	0		5.6
Fr	0008	Forward/reverse run selection (Operation panel)	-	-	0: Forward run 1: Reverse run 2: Forward run (F/R switching possible) 3: Reverse run (F/R switching possible)	0		5.7
ACC	0009	Acceleration time 1	S	0.1/0.1	0.0-3200	10.0		5.1.2
dEC	0010	Deceleration time 1	S	0.1/0.1	0.0-3200	10.0		5.1.2
FH	0011	Maximum frequency	Hz	0.1/0.01	30.0-500.0	60.0		5.8
UL	0012	Upper limit frequency	Hz	0.1/0.01	0.5- FH	60.0		5.9
LL	0013	Lower limit frequency	Hz	0.1/0.01	0.0- UL	0.0		5.9
uL	0014	Base frequency 1	Hz	0.1/0.01	25-500.0	60.0		5.10
uLu	0409	Base frequency voltage 1	V	1/0.1	50-330 (200V class) 50-660 (400V class)	200/ 400		5.10 6.13.6

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
PE	0015	V/F control mode selection 1	-	-	0: V/F constant 1: Variable torque 2: Automatic torque boost control 3: Sensorless vector control 4: Automatic energy-saving 5: Dynamic automatic energy-saving (for fans and pumps) 6: (Use is impossible)l	0		5.11
ub	0016	Torque boost 1	%	0.1/0.1	0.0-30.0	* 1		5.12
EHr	0600	Motor electronic-thermal protection level 1	% (A)	1/1	10-100	100		5.13 6.19.1
OLn	0017	Electronic-thermal protection characteristic selection *2	-	-	Setting / Overload protection / OL stall 0 Standard motor ○ × 1 Standard motor ○ ○ 2 Standard motor × × 3 Standard motor × ○ 4 AF motor ○ × 5 AF motor ○ ○ 6 AF motor × × 7 AF motor × ○	0		5.13
Sr1	0018	Preset-speed operation frequency 1	Hz	0.1/0.01	LL-UL	5.0		5.14
Sr2	0019	Preset-speed operation frequency 2	Hz	0.1/0.01	LL-UL	10.0		
Sr3	0020	Preset-speed operation frequency 3	Hz	0.1/0.01	LL-UL	15.0		
Sr4	0021	Preset-speed operation frequency 4	Hz	0.1/0.01	LL-UL	20.0		
Sr5	0022	Preset-speed operation frequency 5	Hz	0.1/0.01	LL-UL	30.0		
Sr6	0023	Preset-speed operation frequency 6	Hz	0.1/0.01	LL-UL	40.0		
Sr7	0024	Preset-speed operation frequency 7	Hz	0.1/0.01	LL-UL	50.0		
F---	-	Extended parameters	-	-	-	-	-	4.1.2
Gr.U	-	Automatic edit function	-	-	-	-	-	4.1.3

*1 : Default values vary depending on the capacity. See the table of the page K-14.

*2 : ○ : valid, × : invalid

11.3 Extended parameters

- Input/output parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F100	0100	Low-speed signal output frequency	Hz	0.1/0.01	0.0-FH	0.0		6.1.1
F101	0101	Speed reach setting frequency	Hz	0.1/0.01	0.0-FH	0.0		6.1.3
F102	0102	Speed reach detection band	Hz	0.1/0.01	0.0-FH	2.5		6.1.2
F105	0105	Priority selection (Both F-CC and R-CC are ON)	-	-	0: Reverse 1: Slowdown Stop	1		6.2.1
F109	0109	Analog/contact input function selection (VRF/VRF2 terminal)	-	-	0: Analog input for communications VRF2 - analog input 1: VRF - analog input VRF2 - contact input (Sink) 2: VRF - analog input VRF2 - contact input (Source) 3: VRF - contact input (Sink) VRF2 - contact input (Sink) 4: VRF - contact input (Source) VRF2 - contact input (Source)	0		6.2.2
F110	0110	Always-active function selection	-	-	0-64 (ST)	1		6.3.1
F111	0111	Input terminal selection 1 (FR)	-	-	0-64 (FR)	2		6.3.2
F112	0112	Input terminal selection 2 (RR)	-	-	0-64 (RR)	3		
F113	0113	Input terminal selection 3 (RST)	-	-	0-64 (RST)	10		
F114	0114	Input terminal selection 4 (DFL)	-	-	0-64 (DFL)	6		
F115	0115	Input terminal selection 5 (DFM)	-	-	0-64 (DFM)	7		
F116	0116	Input terminal selection 6 (DFH)	-	-	0-64 (DFH)	8		
F117	0117	Input terminal selection 7 (VRF2)	-	-	5-17 (DFHH)	9		
F118	0118	Input terminal selection 8 (VRF)	-	-	5-17 (AD2)	5		
F130	0130	Output terminal selection 1A (RY-RC)	-	-	0-255 (Always OFF)	254		6.3.3
F131	0131	Output terminal selection 2A (DRV-OM)	-	-	0-255 (DRV)	14		
F132	0132	Output terminal selection 3 (FL)	-	-	0-255 (FL)	10		
F137	0137	Output terminal selection 1B (RY-RC)	-	-	0-255 (always ON)	255		
F138	0138	Output terminal selection 2B (DRV-OM)	-	-	0-255 (always ON)	255		

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F139	0139	Output terminal logic selection (RY-RC, OUT-NO)	-	-	0: F130 and F137 F131 and F138 1: F130 or F137 F131 and F138 2: F130 and F137 F131 or F138 3: F130 or F137 F131 or F138	0		6.3.3
F167	0167	Frequency command agreement detection range	Hz	0.1/0.01	0.0-FH	2.5		6.3.4
F170	0170	Base frequency 2	Hz	0.1/0.01	25.0-500.0	60.0		6.4.1
F171	0170	Base frequency voltage 2	Hz	1/0.1	50-330 (200V class) 50-660 (400V class)	200/ 400		
F172	0172	Torque boost 2	%	0.1/0.1	0.0-30.0	* 1		
F173	0173	Motor electronic-thermal protection level 2	% (A)	1/1	10-100	100		
F185	0185	Stall prevention level 2	% (A)	1/1	10-199 200 (disabled)	150		

*1 : Default values vary depending on the capacity. See the table of page K-14.

- Frequency parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F200	0200	Frequency priority selection	-	-	0: FMOd (Switchable to F207 by terminal input) 1: FMOd (Switchable to F207 at less than 1.0Hz of designated frequency)	0		6.5.1
F201	0201	VRF input point 1 setting	%	1/1	0-100	0		6.5.2
F202	0202	VRF input point 1 frequency	Hz	0.1/0.01	0.0-500.0	0.0		
F203	0203	VRF input point 2 setting	%	1/1	0-100	100		
F204	0204	VRF input point 2 frequency	Hz	0.1/0.01	0.0-500.0	60.0		
F207	0207	Frequency setting mode selection 2	-	-	0: Built-in potentiometer 1: VRF 2: VRF2 3: Operation panel 4: Serial communication 5: UP/DOWN from external contact 6: VRF + VRF2 (Override)	1		6.5.1

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F210	0210	VRF2 input point 1 setting	%	1/1	0-100	0		6.5.2
F211	0211	VRF2 input point 1 frequency	Hz	0.1/0.01	0.0-500.0	0.0		
F212	0212	VRF2 input point 2 setting	%	1/1	0-100	100		
F213	0213	VRF2 input point 2 frequency	Hz	0.1/0.01	0.0-500.0	60.0		
F240	0240	Starting frequency setting	Hz	0.1/0.01	0.5-10.0	0.5		6.6.1
F241	0241	Operation starting frequency	Hz	0.1/0.01	0.0-FH	0.0		6.6.2
F242	0242	Operation starting frequency hysteresis	Hz	0.1/0.01	0.0-FH	0.0		6.6.2
F250	0250	DC braking starting frequency	Hz	0.1/0.01	0.0-FH	0.0		6.7.1
F251	0251	DC braking current	%(A)	1/1	0-100	50		
F252	0252	DC braking time	s	0.1/0.1	0.0-20.0	1.0		
F254	0254	Motor shaft fixing control	-	-	0: Disabled 1: Enabled (after DC braking)	0		6.7.2
F256	0256	Time limit for lower-limit frequency operation	s	0.1/0.1	0: None 0.1-600.0	0.0		6.8
F260	0260	Jog run frequency	Hz	0.1/0.01	F240—20.0	5.0		6.9
F261	0261	Jog run stopping pattern	-	-	0: Slowdown stop 1: Coast stop 2: DC braking	0		
F262	0262	Panel jog run operation mode	-	-	0: Disabled 1: Panel jog run operation mode enabled	0		
F264	0264	Input from external contacts - UP response time	s	0.1/0.1	0.0-10.0	0.1		6.5.2
F265	0265	Input from external contacts - UP frequency step width	Hz	0.1/0.01	0.0-FH	0.1		
F266	0266	Input from external contacts - DOWN response time	s	0.1/0.1	0.0-10.0	0.1		
F267	0267	Input from external contacts - DOWN frequency step width	Hz	0.1/0.01	0.0-FH	0.1		
F268	0268	Initial value of UP/DOWN frequency	Hz	0.1/0.01	LL-UL	0.0		
F269	0269	Saving of changed value of UP/DOWN frequency	-	-	0: Not changed 1: Setting of F268 changed when power is turned off	1		
F270	0270	Jump frequency 1	Hz	0.1/0.01	0.0-FH	0.0		6.10
F271	0271	Jumping width 1	Hz	0.1/0.01	0.0-30.0	0.0		
F272	0272	Jump frequency 2	Hz	0.1/0.01	0.0-FH	0.0		

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F273	0273	Jumping width 2	Hz	0.1/0.01	0.0-30.0	0.0		
F274	0274	Jump frequency 3	Hz	0.1/0.01	0.0-FH	0.0		6.10
F275	0275	Jumping width 3	Hz	0.1/0.01	0.0-30.0	0.0		
F287	0287	Preset-speed operation frequency 8	Hz	0.1	LL-UL	60.0		5.14
F288	0288	Preset-speed operation frequency 9	Hz	0.1	LL-UL	0.0		
F289	0289	Preset-speed operation frequency 10	Hz	0.1	LL-UL	0.0		
F290	0290	Preset-speed operation frequency 11	Hz	0.1	LL-UL	0.0		
F291	0291	Preset-speed operation frequency 12	Hz	0.1	LL-UL	0.0		
F292	0292	Preset-speed operation frequency 13	Hz	0.1	LL-UL	0.0		
F293	0293	Preset-speed operation frequency 14	Hz	0.1	LL-UL	0.0		
F294	0294	Preset-speed operation frequency 15 (Fire-speed)	Hz	0.1	LL-UL	0.0		6.11.2

- Operation mode parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F300	0300	PWM carrier frequency	kHz	0.1/0.01	2.0 - 16.0	4.0		6.12
F301	0301	Auto-restart control selection	-	-	0: Disabled 1: At auto-restart after momentary stop 2: ST terminal on or off 3: At auto-restart or when turning ST-CC on or off 4: At start-up	0		6.13.1
F302	0302	Regenerative power ride-through control (Deceleration stop)	-	-	0: Disabled 1: Automatic setting 2: Slowdown stop	0		6.13.2
F303	0303	Retry selection (number of times)	Times	1/1	0: Disabled 1-10	0		6.13.3
F304	0304	Dynamic braking selection	-	-	0: Dynamic braking disabled 1: Dynamic braking enabled, overload protection enabled	0		6.13.4
F305	0305	Overvoltage limit operation (Slowdown stop mode selection)	-	-	0: Automatic setting 1: Disabled 2: Enabled (Quick deceleration) 3: Enabled (Dynamic quick deceleration)	2		6.13.5

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F307	0307	Supply voltage correction (limitation of output voltage)	-	-	0: Supply voltage uncorrected, output voltage limited 1: Supply voltage corrected, output voltage limited 2: Supply voltage uncorrected, output voltage unlimited 3: Supply voltage corrected, output voltage unlimited	3		6.13.6
F308	0308	Dynamic braking resistance	Ω	0.1/0.1	1.0-1000	* 1		6.13.4
F309	0309	Dynamic braking resistor capacity	kW	0.01/0.01	0.01-30.00	* 1		6.13.4
F311	0311	Reverse-run prohibition	-	-	0: Forward/reverse run permitted 1: Reverse run prohibited 2: Forward run prohibited	0		6.13.7
F312	0312	Random mode	-	-	0: Disabled 1: Automatic setting	1		6.12
F316	0316	Carrier frequency control mode selection	-	-	0: Carrier frequency not reduced automatically 1: Carrier frequency reduced automatically 2: Carrier frequency not reduced automatically Support for 400V models 3: Carrier frequency reduced automatically Support for 400V models	1		6.12
F320	0320	Drooping gain	%	1/1	0-100	0		6.14
F323	0323	Drooping insensitive torque band	%	1/1	0-100	10		6.14
F342	0342	Braking mode selection	-	-	0: Disabled 1: Enabled (forward run) 2: Enabled (reverse run) 3: Enabled (operating direction)	0		6.15
F343	0343	Release frequency	Hz	0.1/0.01	F240-20.0	3.0		
F344	0344	Release time	s	0.01/0.01	0.00-2.50	0.05		
F345	0345	Creeping frequency	Hz	0.1/0.01	F240-20.0	3.0		
F346	0346	Creeping time	s	0.01/0.01	0.00-2.50	0.10		
F359	0359	PID control waiting time	s	1/1	0-2400	0		6.16
F360	0360	PID control	-	-	0: Disabled, 1: Enabled	0		
F362	0362	Proportional gain	-	0.01/0.01	0.01-100.0	0.30		
F363	0363	Integral gain	-	0.01/0.01	0.01-100.0	0.20		
F366	0366	Differential gain	-	0.01/0.01	0.00-2.5	0.00		

*1 : Default values vary depending on the capacity. See the table on K-14.

- Torque boost parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F400	0400	Auto-tuning	-	-	0: Auto-tuning disabled 1: Initialization of F402 (reset to 0) 2: Auto-tuning enabled (after execution: 0)	0		6.17
F401	0401	Slip frequency gain	%	1/1	0-150	* 1		
F402	0402	Motor constant #1 (primary resistance)	%	0.1/0.1	0.0-30.0	* 1		
F415	0415	Motor rated current	A	0.1/0.1	0.1-100.0	* 1		
F416	0416	Motor no-load current	%	1/1	10-90	* 1		
F417	0417	Motor rated speed	min-1	1/1	100-32000	* 1		
F418	0418	Speed control response coefficient	-	1/1	1-150	40		
F419	0419	Speed control stability coefficient	-	1/1	1-100	20		
F480	0480	Exciting strength-ening coefficient	%	1/1	100-130	100		
F485	0485	Stall cooperation gain at field weakening zone 1	-	1/1	10-250	100		
F492	0492	Stall cooperation gain at field weakening zone 2	-	1/1	50-150	100		
F494	0494	Motor adjustment factor	-	1/1	0-200	* 1		

*1 : Default values vary depending on the capacity. See the table of page K-14.

- Acceleration/deceleration time parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F500	0500	Acceleration time 2	s	0.1/0.1	0.0-3200	10.0		6.18
F501	0501	Deceleration time 2	s	0.1/0.1	0.0-3200	10.0		
F502	0502	Acceleration/deceleration 1 pattern	-	-	0: Linear 1: S-pattern 1 2: S-pattern 2	0		
F503	0503	Acceleration/deceleration 2 pattern	-	-		0		
F504	0504	Acceleration/deceleration selection (1, 2 , 3)	-	-	1: Acceleration/deceleration 1 2: Acceleration/deceleration 2 3: Acceleration/deceleration 3	1		
F505	0505	Acceleration/deceleration 1 and 2 switching frequency	Hz	0.1/0.01	0.0-UL	0.0		
F506	0506	S-pattern lower-limit adjustment amount	%	1/1	0-50	10		

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F507	0507	S-pattern upper-limit adjustment amount	%	1/1	0-50	10		6.18
F510	0510	Acceleration time 3	s	0.1/0.1	0.0-3200	10.0		
F511	0511	Deceleration time 3	s	0.1/0.1	0.0-3200	10.0		
F512	0512	Accelera-tion/deceleration 3 pattern	-	-	0: Linear 1: S-pattern 1 2: S-pattern 2	0		
F513	0513	Accelera-tion/deceleration 2 and 3 switching frequency	Hz	0.1/0.01	0.0-UL	0.0		

- Protection parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F601	0601	Stall prevention level 1	% (A)	1/1	10-199, 200 (disabled)	150		6.19.2
F602	0602	Inverter trip retention selection	-	-	0: Canceled with the power off 1: Still retained with the power off	0		6.19.3
F603	0603	Emergency stop selection	-	-	0: Coast stop 1: Slowdown stop 2: Emergency DC braking	0		6.19.4
F604	0604	Emergency DC braking time	s	0.1/0.1	0.0-20.0	1.0		6.19.4
F605	0605	Output phase failure detection mode selection	-	-	0: Disabled 1: At start-up (only one time after power is turned on) 2: At start-up (each time) 3: During operation 4: At start-up + during operation 5: Detection of cutoff on output side	0		6.19.5
F607	0607	Motor 150%-overload time limit	s	1/1	10-2400	60		6.19.1
F608	0608	Input phase failure detection mode selection	-	-	0: Disabled, 1: Enabled	1		6.19.6
F610	0610	Low current trip/alarm	-	-	0: Alarm only 1: Tripping	0		6.19.7
F611	0611	Small current detection current	%	1/1	0-100	0		
F612	0612	Small current detection time	s	1/1	0-255	0		
F613	0613	Detection of output short-circuit during start-up	-	-	0: Each time (standard pulse) 1: At start-up (only one time after power is turned on) (standard pulse) 2: Each time (short-time pulse) 3: At start-up (only one time after power is turned on) (short-time pulse)	0		6.19.8
F615	0615	Over-torque trip/alarm selection	-	-	0: Alarm only 1: Tripping	0		6.19.9
F616	0616	Over-torque detection level	%	1/1	0-250	150		
F618	0618	Over-torque detection time	s	0.1/0.1	0.0-10.0	0.5		

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F619	0619	Over-torque detection level hysteresis	%	1/1	0-100	10		6.19.9
F621	0621	Cumulative operation time alarm setting	100 Time	0.1/0.1 (=10 hours)	0.0-999.9	610		6.19.10
F626	0626	Over-voltage stall protection level	%	1/1	100-150	*1		6.13.5
F627	0627	Undervoltage trip/alarm selection	-	-	0: Alarm only (detection level below 60%) 1: Tripping (detection level below 60%) 2: Alarm only (detection level below 50%, DC reactor necessary)	1		6.19.12
F633	0633	Trip at VRF low level input mode	%	1/1	0: Disabled, 1-100	0		6.19.13
F634	0634	Annual average ambient temperature (calculation for life alarms)	-	-	1: -10 to +10° C 2: 11-20° C 3: 21-30° C 4: 31-40° C 5: 41-50° C 6: 51-60° C	3		6.19.14

- Output parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F669	0669	Logic output/pulse train output selection (DRV-OM)	-	-	0: Logic output 1: Pulse train output	0		6.20.1
F676	0676	Pulse train output function selection (DRV-OM)	-	-	0: Output frequency 1: Output current 2: Set frequency 3: DC voltage 4: Output voltage command value 5: Input power 6: Output power 7: Torque 8: Torque current 9: Motor cumulative load factor 10: Inverter cumulative load factor 11: DBR (braking reactor) cumulative load factor 12: Frequency setting value (after PID) 13: VRF Input value 14: VRF2 Input value 15: Fixed output 1 (Output current: 100%) 16: Fixed output 2 (Output current: 50%) 17: Fixed output 3 (Other than the output current: 100%)	0		6.20.1
F677	0677	Maximum nembers of pulse train	pps	1/1	500-1600	800		6.20.1
F691	0691	Inclination characteristic of analog output	-	-	0: Negative inclination (downward slope) 1: Positive inclination (upward slope)	1		6.20.2
F692	0692	Meter bias	%	1/1	0－100	0		6.20.2

*1 : Default values vary depending on the capacity. See the table of K-14.

- Operation panel parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F700	0700	Prohibition of change of parameter settings	-	-	0: Permitted 1: Prohibited	0		6.21.1
F701	0701	Unit selection	-	-	0: % 1: A (ampere)/V (volt)	1		6.21.2
F702	0702	Free unit selection	Times	0.01/0.01	0.00: Free unit display disabled (display of frequency) 0.01-200.0	0.00		6.21.3
F705	0705	Inclination characteristic of free unit display	-	-	0: Negative inclination (downward slope) 1: Positive inclination (upward slope)	1		
F706	0706	Free unit display bias	Hz	0.01/0.01	0.00-FH	0.00		
F707	0707	Free step 1 (pressing a panel key once)	Hz	0.01/0.01	0.00: Disabled 0.01-FH	0.00		6.21.4
F708	0708	Free step 2 (panel display)	-	1/1	0: Disabled 1-255	0		6.21.4
F710	0710	Standard monitor display selection	-	-	0: Operation frequency (Hz/free unit) 1: Frequency command (Hz/free unit) 2: Output current (%/A) 3: Inverter rated current (A) 4: Inverter load factor (%) 5: Output power (%) 6: Frequency command after PID control (Hz/free unit) 7: Optional item specified from an external control unit	0		6.21.5
F719	0719	Canceling of operation command when standby terminal (ST) is turned off	-	-	0: Operation command canceled (cleared) 1: Operation command retained	1		6.21.6
F721	0721	Panel stop pattern	-	-	0: Slowdown stop 1: Coast stop	0		6.21.7
F730	0730	Prohibition of frequency setting on the operation panel (FC)	-	-	0: Permitted 1: Prohibited	0		6.21.1
F733	0733	Panel operation prohibition (RUN/STOP keys)	-	-	0: Permitted 1: Prohibited	0		
F734	0734	Prohibition of panel emergency stop operation	-	-	0: Permitted 1: Prohibited	0		
F735	0735	Prohibition of panel reset operation	-	-	0: Permitted 1: Prohibited	0		
F736	0736	Prohibition of change of CMOd / FMOd during operation	-	-	0: Permitted 1: Prohibited	1		

- Communication parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F800	0800	Communication band speed	-	-	0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps	3		6.22
F801	0801	Parity	-	-	0: NON (No parity) 1: EVEN (Even parity) 2: ODD (Odd parity)	1		
F802	0802	Inverter number	-	1/1	0-255	0		
F803	0803	Communication error trip time	s	1/1	0: (disabled) 1-100	0		
F805	0805	Communication waiting time	s	0.01/0.01	0.00-2.00	0.00		
F806	0806	Setting of master and slave inverters for communication between inverters (setting of master and slave)	-	-	0: Slave inverter (0 Hz command issued in case the master inverter fails) 1: Slave inverter (Operation continued in case the master inverter fails) 2: Slave inverter (Emergency stop tripping in case the master inverter fails) 3: Master inverter (transmission of frequency commands) 4: Master inverter (transmission of output frequency signals)	0		
F811	0811	Point 1 setting	%	1/1	0-100	0		6.5.2
F812	0812	Point 1 frequency	Hz	0.1/0.01	0.0-500.0	0.0		
F813	0813	Point 2 setting	%	1/1	0-100	100		
F814	0814	Point 2 frequency	Hz	0.1/0.01	0.0-500.0	60.0		
F829	0829	Selection of communication protocol	-	-	0: Standard protocol 1: Modbus RTU protocol	0		6.22
F870	0870	Block write data 1	-	-	0: No selection 1: Command information 1 2: Command information 2 3: Frequency command 4: Output data on the terminal board 5: Analog output for communications	0		
F871	0871	Block write data 2	-	-		0		
F875	0875	Block read data 1	-	-	0: No selection 1: Status information 2: Output frequency 3: Output current 4: Output voltage 5: Alarm information 6: PID feedback value 7: Input terminal board monitor 8: Output terminal board monitor 9: VRF terminal board monitor 10: VRF2 terminal board monitor	0		
F876	0876	Block read data 2	-	-		0		
F877	0877	Block read data 3	-	-		0		
F878	0878	Block read data 4	-	-		0		
F879	0879	Block read data 5	-	-		0		
F880	0880	Free notes	-	1/1	0-65535	0		
F890	0890	Parameter for option 1	-	1/1	0-65535	0		6.23
F891	0891	Parameter for option 2	-	1/1	0-65535	0		

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F892	0892	Parameter for option 3	-	1/1	0-65535	0		6.23
F893	0893	Parameter for option 4	-	1/1	0-65535	0		6.23
F894	0894	Parameter for option 5	-	1/1	0-65535	0		

- Reservation area parameters

Title	Communication No.	Function	Unit	Minimum setting unit Panel/Communication	Adjustment range	Default setting	User setting	Reference
F910	0910	Step-out detection current level (for PM motors)	% (A)	1/1	10-150	100		6.24
F911	0911	Step-out detection time (for PM motors)	s	1/1	0.0: No detection 0.1-25.0	0.0		6.24

■ Default settings by inverter rating

Inverter type	Torque boost	Dynamic braking resistance	Dynamic braking resistor capacity	Slip frequency gain	Motor constant #1 (primary resistance)	Motor rated current	Motor no-load current	Motor rated speed	Motor adjustment factor	Over-voltage stall protection level
	ub/F172 (%)	F308 (Ω)	F309 (kW)	F401 (%)	F402 (%)	F415 (A)	F416 (%)	F.417 (r/min)	F494	F626 (%)
HF321S-A20	6.0	400.0	0.2	100	7.0	1.5	85	1750	90	134
HF321S-A40	6.0	200.0	0.2	80	6.4	2.3	84	1735	90	134
HF321S-A75	6.0	200.0	0.3	70	4.7	3.9	75	1740	80	134
HF321S-1A5	6.0	80.0	0.3	80	5.0	6.6	55	1720	70	134
HF321S-2A2	5.0	70.0	0.4	75	3.8	9.3	55	1745	70	134
HF3212-A20	6.0	400.0	0.2	100	7.0	1.5	85	1750	90	134
HF3212-A40	6.0	200.0	0.2	80	6.4	2.3	84	1735	90	134
HF3212-A75	6.0	200.0	0.3	70	4.7	3.9	75	1740	80	134
HF3212-1A5	6.0	80.0	0.3	80	5.0	6.6	55	1720	70	134
HF3212-2A2	5.0	70.0	0.4	75	3.8	9.3	55	1745	70	134
HF3212-3A7	5.0	40.0	0.6	80	3.6	14.8	44	1740	70	134
HF3212-5A5	4.0	20.0	1.5	75	3.8	21.5	42	1750	70	134
HF3212-7A5	3.0	20.0	1.5	75	4.0	29.1	43	1755	70	134
HF3212-011	2.0	10.0	0.66	50	2.3	40.6	41	1710	60	134
HF3212-015	2.0	7.5	0.88	50	2.0	54.6	38	1710	50	134
HF3214-A40	6.0	750.0	0.2	76	6.4	1.2	82	1735	90	140
HF3214-A75	6.0	750.0	0.3	70	4.2	1.9	75	1740	80	140
HF3214-1A5	6.0	400.0	0.3	80	5.4	3.3	55	1720	70	140
HF3214-2A2	5.0	250.0	0.4	75	3.5	4.7	55	1745	70	140
HF3214-3A7	5.0	260.0	0.6	85	3.2	7.4	44	1740	70	140
HF3214-5A5	4.0	83.0	1.2	65	3.9	10.7	42	1750	70	140
HF3214-7A5	3.0	83.0	1.2	75	3.6	14.6	43	1755	70	140
HF3214-011	2.0	40.0	0.66	50	2.2	20.3	41	1710	60	140
HF3214-015	2.0	30.0	0.88	50	1.9	27.3	38	1710	50	140

■ Table of input terminal functions 1

Function No.	Code	Function	Action
0	-	No function is assigned	Disabled
1	ST	Standby terminal	ON: Ready for operation, OFF: Coast stop (gate off)
2	FR	Forward run command	ON: Forward run OFF: Slowdown stop
3	RR	Reverse run command	ON: Reverse run OFF: Slowdown stop
4	JOG	Jog run mode	ON: Jog run, OFF: Jog run canceled
5	AD2	Acceleration/deceleration 2 pattern selection	ON: Acceleration/deceleration 2 OFF: Acceleration/deceleration 1 or 3
6	DFL	Preset-speed command 1	Selection of 15-speed with DFL to DFHH (4 bits)
7	DFM	Preset-speed command 2	
8	DFH	Preset-speed command 3	
9	DFHH	Preset-speed command 4	
10	RST	Reset command	ON: Acceptance of reset command ON → OFF: Trip reset
11	ES	Trip stop command from external input device	ON: E Trip stop
12	CFMOD	Switching of command mode and frequency setting mode	ON: Forced switching from command mode to terminal input mode, forced switching from frequency setting mode to the mode commanded between F Mod and F207. (If F200 = 0)
13	DB	DC braking command	ON: DC braking
14	PID	PID control prohibited	ON: PID control prohibited OFF: PID control permitted
15	PWENE	Permission of parameter editing	ON: Parameter editing permitted OFF: Parameter editing prohibited (If F700 = 1)
16	ST+RST	Combination of standby and reset commands	ON: Simultaneous input from ST and RST
17	ST+CFMOD	Combination of standby and command/frequency setting mode switching	ON: Simultaneous input from ST and CFMOD
18	FR+JOG	Combination of forward run and jog run	ON: Simultaneous input from FR and JOG
19	RR+JOG	Combination of reverse run and jog run	ON: Simultaneous input from RR and JOG
20	FR+AD2	Combination of forward run and acceleration/deceleration 2	ON: Simultaneous input from FR and AD2
21	RR+AD2	Combination of reverse run and acceleration/deceleration 2	ON: Simultaneous input from RR and AD2
22	FR+DFL	Combination of forward run and preset-speed command 1	ON: Simultaneous input from FR and DFL
23	RR+DFL	Combination of reverse run and preset-speed command 1	ON: Simultaneous input from RR and DFL
24	FR+DFM	Combination of forward run and preset-speed command 2	ON: Simultaneous input from FR and DFM
25	RR+DFM	Combination of reverse run and preset-speed command 2	ON: Simultaneous input from RR and DFM
26	FR+DFH	Combination of forward run and preset-speed command 3	ON: Simultaneous input from FR and DFH
27	RR+DFH	Combination of reverse run and preset-speed command 3	ON: Simultaneous input from RR and DFH
28	FR+DFHH	Combination of forward run and preset-speed command 4	ON: Simultaneous input from FR and DFHH
29	RR+DFHH	Combination of reverse run and preset-speed command 4	ON: Simultaneous input from RR and DFHH
30	FR+DFL+ AD2	Combination of forward run, preset-speed command 1 and acceleration/deceleration 2	ON: Simultaneous input from FR, DFL and AD2
31	RR+DFL+ AD2	Combination of reverse run, preset-speed command 1 and acceleration/deceleration 2	ON: Simultaneous input from RR, DFL and AD2
32	FR+DFM+ AD2	Combination of forward run, preset-speed command 2 and acceleration/deceleration 2	ON: Simultaneous input from FR, DFM and AD2
33	RR+DFM+ AD2	Combination of reverse run, preset-speed command 2 and acceleration/deceleration 2	ON: Simultaneous input from RR, DFM and AD2

■ Table of input terminal functions 2

Function No.	Code	Function	Action
34	FR+DFH+ AD2	Combination of forward run, preset-speed command 3 and acceleration/deceleration 2	ON: Simultaneous input from FR, DFH and AD2
35	RR+DFH+ AD2	Combination of reverse run, preset-speed command 3 and acceleration/deceleration 2	ON: Simultaneous input from RR, DFH and AD2
36	FR+DFHH+ AD2	Combination of forward run, preset-speed command 4 and acceleration/deceleration 2	ON: Simultaneous input from FR, DFHH and AD2
37	RR+DFHH+ AD2	Combination of reverse run, preset-speed command 4 and acceleration/deceleration 2	ON: Simultaneous input from RR, DFHH and AD2
38	FCHG	Frequency command forced switching	ON: F207 (If F200 = 0) OFF: FMOd
39	VF2	No.2 Switching of V/F setting	ON: No.2 V/F setting (Pt=0, F170, F171, F172, F173) OFF: No.1 V/F setting (Set value of Pt, uL, uLv, ub, tHr)
40	MOT2	No.2 motor switching （VF2＋AD2＋OCS2）	ON: No.2 motor (Pt=0, F170, F171, F172, F173, F185, F500, F501, F503) OFF: No.1 motor (Set value of Pt, uL, uLv, ub, tHr, ACC, dEC, F502, F601)
41	UP	Frequency UP signal input from external contacts	ON: Increase in frequency
42	DOWN	Frequency DOWN signal input from external contacts	ON: Reduction in frequency
43	CLR	Frequency UP/DOWN cancellation signal input from external contacts	OFF→ON: Resetting of UP/DOWN frequency by means of external contacts
44	CLR+RST	Combination of frequency UP/DOWN cancellation and reset by means of external contacts	ON: Simultaneous input from CLR and RST
45	ESN	Inversion of trip stop command from external device	OFF: E Trip stop
46	OH	Thermal trip stop signal input from external device	ON: OH2 Trip stop
47	OHN	Inversion of thermal trip stop command from external device	OFF: OH2 Trip stop
48	SC/LC	Forced switching from remote to local control	Enabled when remote control is exercised ON: Local control (setting of FMOd and F207) OFF: Remote control
49	HD	Operation holding (stop of 3-wire operation)	ON: F (forward run)/R: (reverse run) held, 3-wire operation OFF: Slowdown stop
50	CMTP	Forced switching of command mode and terminal board command	ON: Terminal board operation OFF: Setting of CMOd
51	CKWH	Display cancellation of the cumulative power amount (kWh)	ON: Monitor display cancellation of the cumulative power amount (kWh)
52	FORCE	Forced operation (factory configuration required)	ON: Forced operation mode in which operation is not stopped in the event of the occurrence of a soft fault (preset speed operation frequency 15) To use this function, the inverter needs to be so configured at the factory. OFF: Normal operation
53	FIRE	Fire-speed control	ON: Fire-speed operation (preset speed operation frequency 15) OFF: Normal operation

■ Table of input terminal functions 3

Function No.	Code	Function	Action
54	STN	Inversion of ST (coasting)	ON: Coast stop (gate off) OFF: Ready for operation
55	RSTN	Inversion of RES	ON: Acceptance of reset command OFF→ ON: Trip reset
56	FR+ST	Combination of forward run and standby	ON: Simultaneous input from FR and ST
57	RR+ST	Combination of reverse run and standby	ON: Simultaneous input from RR and ST
58	AD3	Acceleration/deceleration 3 selection	ON: Acceleration/deceleration 3 OFF: Acceleration/deceleration 1 or 2
59	FR+AD3	Combination of forward run and acceleration/deceleration 3	ON: Simultaneous input from FR and AD3
60	RR+AD3	Combination of reverse run and acceleration/deceleration 3	ON: Simultaneous input from RR and AD3
61	OCS2	Forced switching of stall prevention level 2	ON: Enabled at the value of F185 OFF: Enabled at the value of F601
62	HDRY	Holding of RY-RC terminal output	ON: Once turned on, RY-RC are held on. OFF: The status of RY-RC changes in real time according to conditions.
63	HDOUT	Holding of OUT-NO terminal output	ON: Once turned on, OUT-NO are held on. OFF: The status of OUT-NO changes in real time according to conditions.
64	PRUN	Cancellation (clearing) of operation command from panel	0: Operation command canceled (cleared) 1: Operation command retained

■ Table of output terminal functions 1

Function No.	Code	Function	Action
0	LL	Frequency lower limit	ON: The output frequency is above the LL set value. OFF: The output frequency is equal to or less than the LL set value.
1	LLN	Inversion of frequency lower limit	Inversion of LL setting
2	UL	Frequency upper limit	ON: Output frequency is equal to or higher than UL value. OFF: Output frequency is lower than UL value.
3	ULN	Inversion of frequency upper limit	Inversion of UL setting
4	LOW	Low-speed detection signal	ON: Output frequency is equal to or higher than F100 value. OFF: Output frequency is lower than F100 value.
5	LOWN	Inversion of low-speed detection signal	Inversion of LOW setting
6	UPF	Designated frequency attainment signal (completion of acceleration/deceleration)	ON: The output frequency is equal to or less than the specified frequency ± frequency set with F102. OFF: The output frequency is above the specified frequency ± frequency set with F102.
7	UPFN	Inversion of designated frequency attainment signal (inversion of completion of acceleration/deceleration)	Inversion of UPF setting
8	UPF2	Set frequency attainment signal	ON: The output frequency is equal to or less than the frequency set with F101 ± frequency set with F102. OFF: The output frequency is above the frequency set with F101 ± frequency set with F102.
9	UPF2N	Inversion of set frequency attainment signal	Inversion of UPF2 setting
10	FL	Failure signal (trip output)	ON: When inverter is tripped OFF: When inverter is not tripped
11	FLN	Inversion of failure signal (inversion of trip output)	Inversion of FL setting

■ Table of output terminal functions 2

Function No.	Code	Function	Action
12	OT	Over-torque detection	ON: Torque current is equal to or larger than F6 16 set value and longer than F6 18 set time. OFF: The torque current is equal to or less than (F6 16 set value - F6 19 set value).
13	OTN	Inversion of over-torque detection	Inversion of OT
14	DRV	Start/Stop	ON: When operation frequency is output or during (db) OFF: Operation stopped
15	DRVN	Inversion of RUN/STOP	Inversion of DRV setting
16	POL	OL pre-alarm	ON: 50% or more of calculated value of overload protection level OFF: Less than 50% of calculated value of overload protection level
17	POLN	Inversion of OL pre-alarm	Inversion of POL setting
18	POHR	Braking resistor overload pre-alarm	ON: 50% or more of calculated value of F308 set overload protection level OFF: Less than 50% of calculated value of F308 set overload protection level
19	POHRN	Inversion of braking resistor overload pre-alarm	Inversion of RCHR setting
20	POT	Over-torque detection pre-alarm	ON: Torque current is equal to or larger than 70% of F6 16 set value. OFF: The torque current is below (F6 16 set value x 70% - F6 19 set value).
21	POTN	Inversion of over-torque detection pre-alarm	Inversion of POT setting
22	PAL	Pre-alarm	One of the following is turned on: ON POL, POHR, POT, MOFF, UC, OT, LL stop, CCT, and momentary power failure slowdown stop. or C, P, Or H issues an alarm All the following are turned off: OFF POL, POHR, POT, MOFF, UC, OT, LL stop, CCT, and momentary power failure slowdown stop. or C, P, Or H issues no alarm
23	PALN	Inversion of pre-alarm	Inversion of PAL setting
24	UC	Small-current detection	ON: The output current is equal to or less than F6 11 set value for F6 12 set time. OFF: The output current is equal to or larger than F6 11 set value + 10%.
25	UCN	Inversion of small-current detection	Inversion of UC setting
26	HFL	Significant failure	ON: OCA, OCL, Ot, E, EEP1, Etn, EPH0, Err2-5, OH2, UP1, EF2, UC, EtyP, Or EPH1) OFF: Failure other than the above
27	HFLN	Inversion of significant failure	Inversion of HFL setting
28	LFL	Insignificant failure	ON: (OC 1-3, OP 1-3, OH, OL 1-2, OLr) OFF: Failure other than the above
29	LFLN	Inversion of insignificant failure	Inversion of LFL setting
30	RDY1	Ready for operation (including ST/RUN)	ON: Ready for operation (ST and RUN are also ON) OFF: Others
31	RDY1N	Inversion of ready for operation (including ST/RUN)	Inversion of RDY1 setting
32	RDY2	Ready for operation (excluding ST/RUN)	ON: Ready for operation (ST and RUN are not ON) OFF: Others
33	RDY2N	Inversion of ready for operation (excluding ST/RUN)	Inversion of RDY2
34	FCVRF2	Frequency VRF2 selection	ON: VRF2 selected as frequency command OFF: Terminal other than VRF2 selected as frequency command

■ Table of output terminal functions 3

Function No.	Code	Function	Action
35	FCVRF2N	Inversion of frequency VRF2 selection	Inversion of FCVRF2
36	FLR	Fault signal (put out also at the time of a retry)	ON: When inverter trips or retries OFF: When inverter does not trip or retry
37	FLRN	Inversion of failure signal (put out also at the time of a retry)	Inversion of FLR
38	OUT0	Specified data output 1	ON: Specified data from remote control FA50: BIT0= 1 OFF: Specified data from remote control FA50: BIT0= 0
39	OUT0N	Inversion of specified data output 1	Inversion of OUT0 setting
40	OUT1	Specified data output 2	ON: Specified data from remote control FA50: BIT1= 1 OFF: Specified data from remote control FA50: BIT1= 0
41	OUT1N	Inversion of specified data output 2	Inversion of OUT1 setting
42	COT	Cumulative operation time alarm	ON: Cumulative operation time is equal to or longer than F621 OFF: Cumulative operation time is shorter than F621
43	COTN	Inversion of cumulative operation time alarm	Inversion of COT
44	LTA	Calculation for life alarm	ON: Calculation for life time is equal to or longer than the preset time ON: Calculation for life time is shorter than the preset time
45	LTAN	Inversion of calculation for life alarm	Inversion of LTA
46	BR	Braking sequence output	ON: Braking retention signal OFF: Braking release signal
47	BRN	Inversion of braking sequence output	Inversion of BR
48	LI1	F terminal input signal	ON: The signal input to F terminal is ON OFF: The signal input to F terminal is OFF
49	LI1N	Inversion of F terminal input signal	Inversion of LI1
50	LI2	R terminal input signal	ON: The signal input to R terminal is ON OFF: The signal input to R terminal is OFF
51	LI2N	Inversion of R terminal input signal	Inversion of LI2
52	PIDF	Signal in accordance of frequency command	ON: Frequency commanded by FMOd or F207 and that by VRF show the same value. OFF: Frequency commanded by FMOd or F207 and that by VRF show different values.
53	PIDFN	Inversion of signal in accordance of frequency command	Inversion of PIDF setting
54	MOFF	Undervoltage detection	ON: Undervoltage detected OFF: Other than undervoltage
55	MOFFN	Inversion of undervoltage detection	Inversion of MOFF
56-253	Disabled	Invalid settings, always OFF (ignored)	Invalid settings, always OFF (ignored)
254	AOFF	Always OFF	Always OFF
255	AON	Always ON	Always ON

■ Order of precedence of combined functions

XX: Impossible combination, X: Invalid, + : Valid under some conditions, O: Valid, @: Priority

Function No. / Function		1	2	3	4	5/58	6/9	10	11	50	13	14	15	46	48	41/42	43	49	38	39	40	52	53
1	Standby		@	@	@	@	@	O	O	O	@	O	O	O	O	O	O	@	O	O	O	O	X
2	Forward run command	+		X	+	O	O	O	X	O	X	O	O	X	O	O	O	O	O	O	O	O	X
3	Reverse run command	+	@		+	O	O	O	X	O	X	O	O	X	O	O	O	O	O	O	O	O	X
4	Jug run command	+	+	+		@	+	O	X	O	X	@	O	X	O	O	O	XX	O	O	O	O	X
5/58	Acceleration/deceleration 2 or 3 selection	+	O	O	X		O	O	X	O	X	O	O	X	O	O	O	O	O	O	X	O	O
6~9	Preset-speed run commands 1 to 4	+	O	O	X	O		O	X	O	X	O	O	X	O	O	O	O	O	O	O	O	X
10	Reset command	O	O	O	O	O	O		X	O	O	O	O	X	O	O	O	O	O	O	O	O	O
11	Trip stop command from external input device	+	@	@	@	@	@	@		O	@	@	O	X	O	@	O	@	O	O	O	@	@
50	Forced switching of command mode and	O	O	O	O	O	O	O	O		O	O	O	O	O	O	O	O	O	O	O	O	O
13	DC braking command	+	@	@	@	@	@	O	X	O		@	O	X	O	@	O	@	O	O	O	O	X
14	PID control prohibited	O	O	O	X	O	O	O	X	O	X		O	X	O	O	O	O	O	O	O	O	X
15	Permission of parameter editing	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O	O	O	O	O	O	O
46	Thermal trip stop command from external	O	@	@	@	@	@	@	@	O	@	@	O		O	@	O	@	O	O	O	X	O
48	Remote/local control forced switching	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O	O	O	O	O
41/42	Frequency UP/DOWN signal input from	O	O	O	O	O	O	O	X	O	X	O	O	X	O		O	O	O	O	O	O	X
43	Clearing of UP/DOWN frequency with external	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O	O	X
49	Operation holding (cancellation of 3-wire	+	O	O	XX	O	O	O	X	O	X	O	O	X	O	O	O		O	O	O	O	X
38	Frequency commands forced switching	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	X
39	No.2 Switching of V/F setting	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		X	O	O
40	No.2 motor switching	O	O	O	O	@	O	O	O	O	O	O	O	O	O	O	O	O	O	@		O	O
52	Forced operation	O	O	O	O	O	O	O	X	O	O	O	O	@	O	O	O	O	O	O	O		O
53	Fire-speed control	@	@	@	@	O	@	O	X	O	@	@	O	O	O	@	@	@	@	O	O	O	

* For the functions of combined terminals (combined functions), refer to the table of their respective functions.

12. Specifications

12.1 Models and their standard specifications

■ Standard specifications (11kW and 15kW models are under development now)

Item		Specification									
Input voltage		3-phase 200V									
Applicable motor (kW)		0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Rating	Type	HF3212-									
	Form	A20	A40	A75	1A5	2A2	3A7	5A5	7A5	011	015
	Capacity (kVA) Note 1)	0.6	1.3	1.8	3.0	4.2	6.7	10	13	21	25
	Rated output/current (A) Note 2)	1.6 (1.5)	3.3 (3.3)	5.0 (4.4)	8.0 (7.9)	11.0 (10.0)	17.5 (16.4)	27.5 (25.0)	33 (33)	54 (49)	66 (60)
	Output voltage Note 3)	3-phase 200V to 240V									
	Overload current rating	150%-60 seconds, 200%-0.5 second (50%-reduction value)									
Power supply	Voltage-frequency	3-phase 200V to 240V - 50/60Hz									
	Allowable fluctuation	Voltage + 10%, -15% Note 4), frequency ±5%									
Protective method		IP20 Enclosed type (JEM1030)									
Cooling method		Self-cooling				Forced air-cooled					
Color		Munsel 5Y+8/0.5									
Built-in filter		Basic filter									

Item		Specification												
Input voltage		1-phase 200V					3-phase 400V							
Applicable motor (kW)		0.2	0.4	0.75	1.5	2.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Rating	Type	HF321S-					HF3214-								
	Form	A20	A40	A75	1A5	2A2	A40	A75	1A5	2A2	3A7	5A5	7A5	011	015
	Capacity (kVA) Note 1)	0.6	1.3	1.8	3.0	4.2	1.1	1.8	3.1	4.2	7.2	11	13	21	25
	Rated output current (A) Note 2)	1.6 (1.5)	3.3 (3.3)	5.0 (4.4)	8.0 (7.9)	11.0 (10.0)	1.5 (1.5)	2.5 (2.1)	4.1 (3.7)	5.5 (5.0)	9.5 (8.6)	14.3 (13.0)	17.0 (17.0)	27.7 (25.0)	33 (30)
	Rated output voltage Note 3)	3-phase 200V to 240V					3-phase 380V to 500V								
	Overload current rating	150%-60 seconds, 200%-0.5 second (50%-reduction value)					150%-60 seconds, 200% -0.5 second (50%-reduction value)								
Power supply	Voltage-current	1-phase 200V to 240V – 50/60Hz					3-phase 380V to 500V - 50/60Hz								
	Allowable fluctuation	Voltage + 10%、-15% Note 4), frequency±5%					Voltage + 10%, -15% Note 4), frequency ±5%								
Protective method,		IP20 Enclosed type (JEM1030)					IP20 Enclosed type (JEM1030)								
Cooling method		Self-cooling			Forced air-cooled		Forced air-cooled								
Color		Munsel 5Y+8/0.5					Munsel 5Y+8/0.5								
Built-in filter		EMI filter					EMI filter								

Note 1. Capacity is calculated at 220V for the 200V models and at 440V for the 400V models.

Note 2. Indicates rated output current setting when the PWM carrier frequency (parameter F300) is 4kHz or less. When exceeding 4kHz, the rated output current setting is indicated in the parentheses. It needs to be further reduced for PWM carrier frequencies above 12 kHz.
The rated output current is reduced even further for 400V models with a supply voltage of 480V or more.
The default setting of the PWM carrier frequency is 4kHz.

Note 3. Maximum output voltage is the same as the input voltage.

Note 4. ±10% when the inverter is used continuously (load of 100%).

■ Common specification

Item		Specification
Principal control functions	Control system	Sinusoidal PWM control
	Rated output voltage	Adjustable within the range of 50 to 600V by correcting the supply voltage (not adjustable above the input voltage)
	Output frequency range	0.5 to 500.0Hz, default setting: 0.5 to 80Hz, maximum frequency: 30 to 500Hz
	Minimum setting steps of frequency	0.1Hz: operation panel setting, 0.2Hz: analog input (when the max. frequency is 100Hz).
	Frequency accuracy	Digital setting: within ±0.01% of the max. frequency (-10 to +60°C) Analog setting: within ±0.5% of the max. frequency (25°C ±10°C)
	Voltage/frequency characteristics	V/f constant, variable torque, automatic torque boost, sensorless vector control, automatic energy-saving, dynamic automatic energy-saving control, PM motor control. Auto-tuning. Base frequency (25 - 500Hz) adjusting to 1 or 2, torque boost (0 - 30%) adjusting to 1 or 2, adjusting frequency at start (0.5 - 10Hz)
	Frequency setting signal	Potentiometer on the front panel, external frequency potentiometer (connectable to a potentiometer with a rated impedance of 1 - 10kΩ), 0 - 10Vdc (input impedance: VIA/VIB=30kΩ, 4 - 20mAdc (Input impedance: 250Ω).
	Terminal board base frequency	The characteristic can be set arbitrarily by two-point setting. Possible to set individually for three functions: analog input (VRF and VRF2) and communication command.
	Frequency jump	Three frequencies can be set. Setting of the jump frequency and the range.
	Upper- and lower-limit frequencies	Upper-limit frequency: 0 to max. frequency, lower-limit frequency: 0 to upper-limit frequency
	PWM carrier frequency	Adjustable within a range of 2.0 to 16.0Hz (default: 4kHz).
	PID control	Setting of proportional gain, integral gain, differential gain and control wait time. Checking whether the amount of processing amount and the amount of feedback agree.
Operation specifications	Acceleration/deceleration time	Selectable from among acceleration/deceleration times 1, 2 and 3 (0.0 to 3200 sec.). Automatic acceleration/deceleration function. S-pattern acceleration/deceleration 1 and 2 and S-pattern adjustable. Control of forced rapid deceleration and dynamic rapid deceleration
	DC braking	Braking start-up frequency: 0 to maximum frequency, braking rate: 0 to 100%, braking time: 0 to 20 seconds, emergency DC braking, motor shaft fixing control
	Dynamic braking	Control and drive circuit is built in the inverter with the braking resistor outside (optional).
	Input terminal function (programmable)	Possible to select from among 65 functions, such as forward/reverse run signal input, jog run signal input, operation base signal input and reset signal input, to assign to 8 input terminals. Logic selectable between sink and source.
	Output terminal functions (programmable)	Possible to select from among 58 functions, such as upper/lower limit frequency signal output, low speed detection signal output, specified speed reach signal output and failure signal output, to assign to FL relay output, open collector output and RY output terminals.
	Forward/reverse run	The RUN and STOP keys on the operation panel are used to start and stop operation, respectively. The switching between forward run and reverse run can be done from one of the three control units: operation panel, terminal board and external control unit.
	Jog run	Jog mode, if selected, allows jog operation from the operation panel or the terminal board.
	Preset speed operation	Base frequency + 15-speed operation possible by changing the combination of 4 contacts on the terminal board.
	Retry operation	Capable of restarting automatically after a check of the main circuit elements in case the protective function is activated. 10 times (Max.) (selectable with a parameter)
	Various prohibition settings	Possible to write-protect parameters and to prohibit the change of panel frequency settings and the use of operation panel for operation, emergency stop or resetting.
	Regenerative power ride-through control	Possible to keep the motor running using its regenerative energy in case of a momentary power failure (default: OFF).
	Auto-restart operation	In the event of a momentary power failure, the inverter reads the rotational speed of the coasting motor and outputs a frequency appropriate to the rotational speed in order to restart the motor smoothly. This function can also be used when switching to commercial power.
	Drooping function	When two or more inverters are used to operate a single load, this function prevents load from concentrating on one inverter due to unbalance.
	Override function	The sum of two analog signals (VRF/VRF2) can be used as a frequency command value.
	Failure detection signal	1c-contact output: (250Vac-0.5A-cosφ=0.4)

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<Continued overleaf>

<Continued>

Item		Specification
Protective function	Protective function	Stall prevention, current limitation, over-current, output short circuit, over-voltage, over-voltage limitation, undervoltage, ground fault, power supply phase failure, output phase failure, overload protection by electronic thermal function, armature over-current at start-up, load side over-current at start-up, over-torque, undercurrent, overheating, cumulative operation time, life alarm, emergency stop, braking resistor over-current/overload, various pre-alarms
	Electronic thermal characteristic	Switching between standard motor and constant-torque AF motor, switching between motors 1 and 2, setting of overload trip time, adjustment of stall prevention levels 1 and 2, selection of overload stall
	Reset function	Function of resetting by closing contact 1a or by turning off power or the operation panel. This function is also used to save and clear trip records.
Display function	Alarms	Stall prevention, overvoltage, overload, under-voltage, setting error, retry in process, upper/lower limits
	Causes of failures	Over-current, overvoltage, overheating, short-circuit in load, ground fault, overload on inverter, over-current through arm at start-up, over-current through load at start-up, CPU fault, EEPROM fault, RAM fault, ROM fault, communication error. (Selectable: Over-current through braking resistor/overload, emergency stop, under-voltage, low voltage, over-torque, motor overload, output open-phase)
	Monitoring function	Operation frequency, operation frequency command, forward/reverse run, output current, voltage in DC section, output voltage, torque, torque current, load factor of inverter, integral load factor of DBR, input power, output power, information on input terminals, information on output terminals, version of CPU1, version of CPU2, version of memory, PID feedback amount, frequency command (after PID), integral input power, integral output power, rated current, causes of past trips 1 through 4, information on life alarm, cumulative operation time
	Past trip monitoring function	Stores data on the past four trips: number of trips that occurred in succession, operation frequency, direction of rotation, load current, input voltage, output voltage, information on input terminals, information on output terminals, and cumulative operation time when each trip occurred.
	Output for frequency meter/ output for ammeter	Analog output: (1mAdc full-scale DC ammeter or 7.5Vdc full-scale DC ammeter / Rectifier-type AC voltmeter, 225% current Max. 1mAdc, 7.5Vdc full-scale), 4 to 20mA/0 to 20mA output
	4-digit 7-segments LED	Frequency: inverter output frequency. Alarm: stall alarm “C”, overvoltage alarm “P”, overload alarm “L”, overheat alarm “H”. Status: inverter status (frequency, cause of activation of protective function, input/output voltage, output current, etc.) and parameter settings. Free-unit display: arbitrary unit (e.g. rotating speed) corresponding to output frequency.
	Indicator	Lamps indicating the inverter status by lighting, such as RUN lamp, MON lamp, PRG lamp, % lamp, Hz lamp, frequency setting potentiometer lamp, UP/DOWN key lamp and RUN key lamp. The charge lamp indicates that the main circuit capacitors are electrically charged.
Environments	Use environments	Indoor, altitude: 1000m (Max.), not exposed to direct sunlight, corrosive gas, explosive gas or vibration (less than 5.9m/s^2) (10 to 55Hz)
	Ambient temperature	-10 to +50°C Note)1
	Storage temperature	-20 to +65°C
	Relative humidity	20 to 93% (free from condensation and vapor).

Note 1: When the ambient temperature is above 40°C, Remove the protective seal from the top of HF-320 α .

12.2 Outside dimensions and mass

■ Outside dimensions and mass

Voltage class	Applicable motor (kW)	Inverter type	Dimensions (mm)							Drawing	Approx. weight (kg)
			W	H	D	W1	H1	H2	D2		
1-phase 200V	0.2	HF321S-A20	72	130	130	60	121.5	15	8	A	1.2
	0.4	HF321S-A40									1.3
	0.75	HF321S-A75			140						1.3
	1.5	HF321S-1A5	105	130	150	93		13		B	1.8
	2.2	HF321S-2A2	140	170	150	126	157	14		C	2.8
3-phase 200V	0.2	HF3212-A20	72	130	120	60	121.5	15	8	A	1.1
	0.4	HF3212-A40									1.2
	0.75	HF3212-A75			130						1.2
	1.5	HF3212-1A5	105	130		93		13		B	1.4
	2.2	HF3212-2A2			150						2.3
	3.7	HF3212-3A7	140	170	150	126	157	14		C	2.5
	5.5	HF3212-5A5	180	220	170	160	210	12		D	6.2
	7.5	HF3212-7A5									6.3
	11	HF3212-011	245	310	190	225	295	19.5		E	9.8
	15	HF3212-015									9.9
3-phase 400V	0.4	HF3214-A40	105	130	150	93	121.5	13	8	B	1.8
	0.75	HF3214-A75									1.8
	1.5	HF3214-1A5									1.9
	2.2	HF3214-2A2	140	170	150	126	157	14		C	2.7
	3.7	HF3214-3A7									2.9
	5.5	HF3214-5A5	180	220	170	160	210	12		D	6.3
	7.5	HF3214-7A5									6.3
	11	HF3214-011	245	310	190	225	295	19.5		E	9.8
	15	HF3214-015									9.8

■ Outline drawing

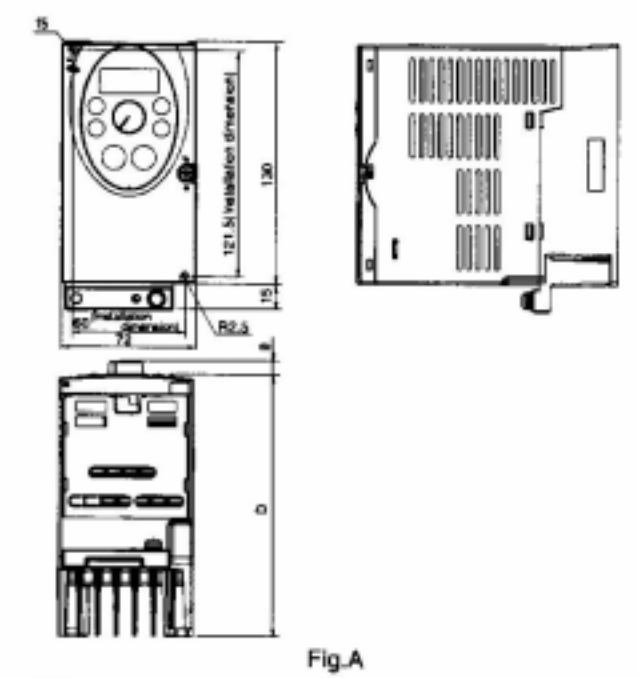

Fig.A

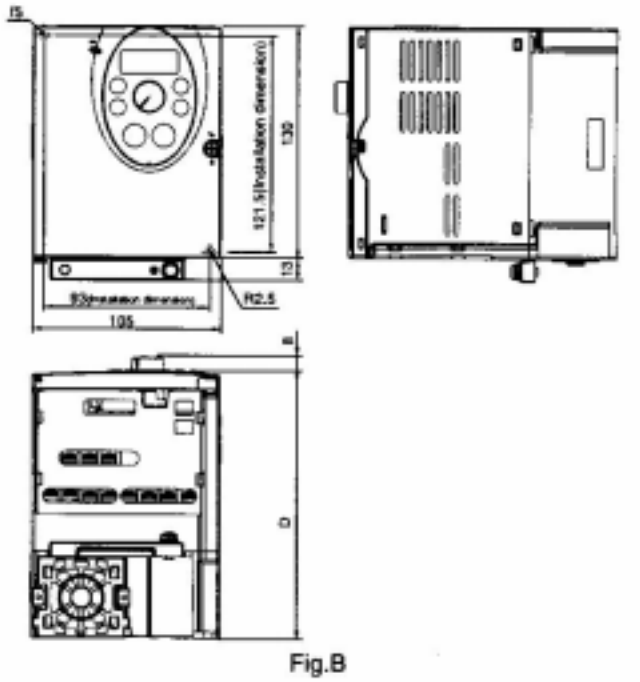

Fig.B

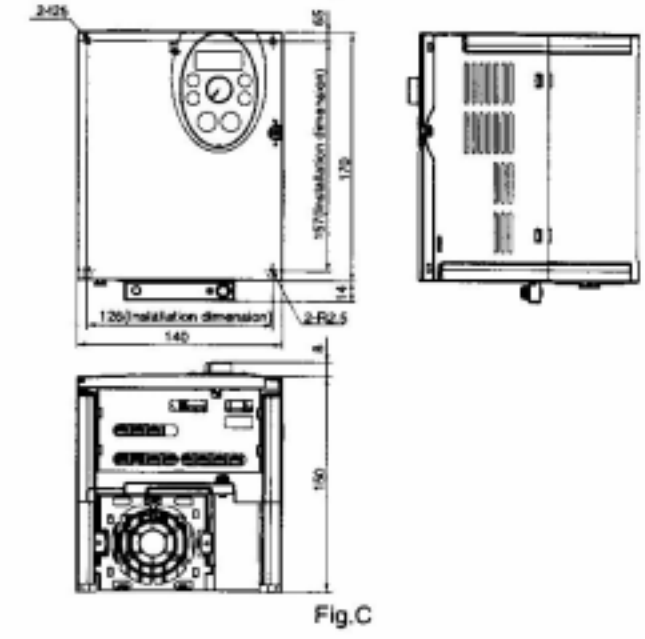

Fig.C

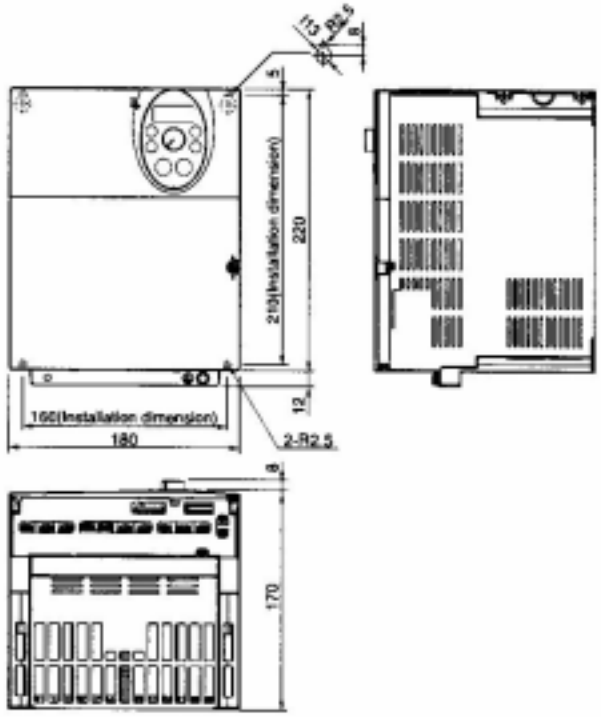
213(Installation dimension)
220
160(Installation dimension)
180
12
2-R2.5
170

Fig.D

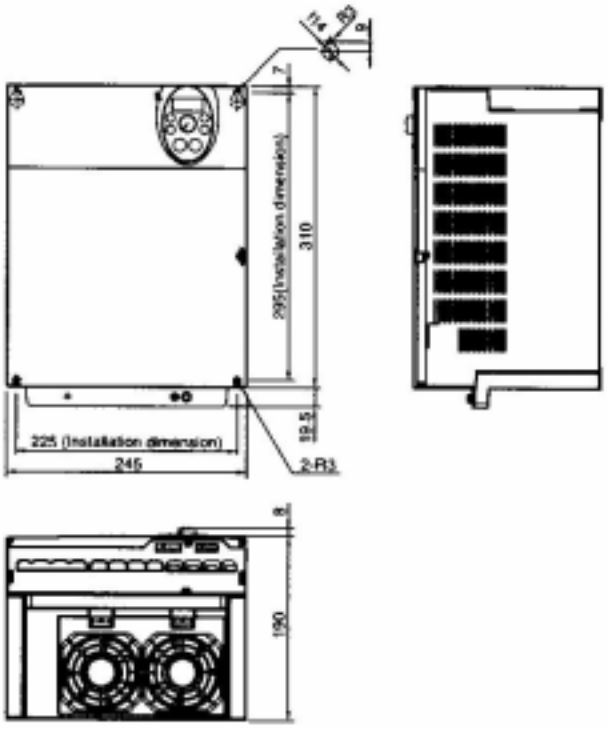
295(Installation dimension)
310
225 (Installation dimension)
245
19.5
2-R3
190

Fig.E

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13. Before making a service call - Trip information and remedies

13.1 Trip causes/warnings and remedies

When a problem arises, diagnose it in accordance with the following table.
If it is found that replacement of parts is required or the problem cannot be solved by any remedy described in the table, contact your dealer.

[Trip information]

Error code	Failure code	Problem	Possible causes	Remedies
OC 1 OC 1P	0001 0025	Overcurrent during acceleration Overcurrent flowing in element during acceleration	• The acceleration time ACC is too short. • The V/F setting is improper. • A restart signal is imput to the rotating motor after a momentary stop, etc. • A special motor (e.g. motor with a small impedance) is used.	• Increase the acceleration time ACC. • Check the V/F parameter. • Use F301 (auto-restart) and F302 (ride-through control). • Increase the carrier frequency F300. • Set the carrier frequency control mode selection parameter f316 to 1 or 3 (carrier frequency decreased automatically).
OC2 OC2P	0002 0026	Overcurrent during deceleration Overcurrent flowing in element during decelearion	• The deceleration time dEC is too short.	• Increase the deceleration time dEC. • Set the carrier frequency control mode selection parameter f316 to 1 or 3 (carrier frequency decreased automatically).
OC3 OC3P	0003 0027	Overcurrent during constant speed operation Overcurrent flowing in element during operation	• The load fluctuates abruptly. • The load is in an abnormal condition.	• Reduce the load fluctuation. • Check the load (operated machine). • Set the carrier frequency control mode selection parameter f316 to 1 or 3 (carrier frequency decreased automatically).
OC 1P OC2P OC3P	0025 0026 0027	Ground fault trip Arm overcurrent at start-up (for 11 and 15 kW models only)	• A current leaked from an output cable or the motor to ground. • A main circuit elements is defective.	• Check cables, connectors, and so on for ground faults. • Make a service call.
OCL	0004	Overcurrent (An overcurrent on the load side at start-up)	• The insulation of the output main circuit or motor is defective. • The motor has too small impedance. • A 11 or 15 kW model was started, although a current is leaked from an output cable or the motor to ground.	• Check the cables and wires for defective insulation. • When using a 11 or 15 kW model, check cables, connectors, and so on for ground faults.
OCA	0005	Arm overcurrent at start-up	• A main circuit elements is defective.	• Make a service call.
* EPH1	0008	Input phase failure	• A phase failure occured in the input line of the main circuit. • The capacitor in the main circuit lacks capacitance.	• Check the main circuit input line for phase failure. • Enable F608 (input phase failure detection). • Check the capacitor in the main circuit for exhaustion.
* EPH0	0009	Output phase failure	• A phase failure occurred in the output line of the main circuit.	• Check the main circuit output line, motor, etc. for phase failure. • Enable F605 (Output phase failure detection).

* You can select a trip ON/OFF by parameters.

(Continued overleaf)

(Continued)

Error code	Failure code	Problem	Possible causes	Remedies
OP1	000A	Overvoltage during acceleration	• The imput voltage fluctuates abnormally. (1) The power supply has a capacity of 200kVA or more. (2) A power factor improvement capacitor is opened or closed. (3) A system using a thyrister is connected to the same power distribution line. • A restart signal is input to the rotating motor after a momentary stop, etc.	• Insert a suitable input reactor. • Use F301 (auto-restart) and F302 (ride-through control).
OP2	000B	Overvoltage during deceleration	• The deceleration time dEC is too short. (Regenerative energy is too large.) • F304 (dynamic braking resistor) is off. • F305 (overvoltage limit operation) is off. • The input voltage fluctuates abnormally. (1) The power supply has a capacity of 200kVA or more. (2) A power factor improvement capacitor is opened and closed. (3) A system using a thyrister is connected to the same power distribution line.	• Increase the deceleration time dEC. • Install a dynamic braking resistor. • Enable F304 (dynamic braking resistor). • Enable F305 (overvoltage limit operation). • Insert a suitable input reactor.
OP3	000C	Overvoltage during constant-speed operation	• The input voltage fluctuates abnormally. (1) The power supply has a capacity of 200kVA or more. (2) A power factor improvement capacitor is opened or closed. (3) A system using a thyrister is connected to the same power distribution line. • The motor is in a regenerative state because the load causes the motor to run at a frequency higher than the inverter output frequency.	• Insert a suitable input reactor. • Install a dynamic braking resistor.
OL1	000D	Inverter overload	• The acceleration time ACC is too short. • The DC braking amout is too large. • The V/F setting is improper. • A restart signal is input to the rotating motor after a momentary stop, etc. • The load is too large.	• Increase the acceleration time ACC. • Reduce the DC braking amount F251 and the DC braking time F252. • Check the V/F parameter setting. • Use F301 (auto-restart) and F302 (ride-through control). • Use an inverter with a larger rating.
OL2	000E	Motor overload	• The V/F setting is improper. • The motor is locked up. • Low-speed operation is performed continuously. • An excessive load is applied to the motor during operation.	• Check the V/F parameter setting. • Check the load (operated machine). • Adjust OLn to the overload that the motor can withstand during operation in a low speed range.
OLr	000F	Dynamic braking resistor overload trip	• The deceleration time is too short. • Dynamic braking is too large.	• Increase the deceleration time dEC. • Increase the capacity of dynamic braking resistor (wattage) and adjust DBR capacity parameter F308.
* Ot	0020	Over-torque trip	• Over-torque reaches to a detection level during operation.	• Enable F615 (over-torque trip selection). • Check system error.
OH	0010	Overheat	• The cooling fan does not rotate. • The ambient temperature is too high. • The vent is blocked up. • A heat generating device is installed close to the inverter. • The thermistor in the unit is broken.	• Restart the operation by resetting the inverter after it has cooled down enough. • The fan requires replacement if it does not rotate during operation. • Secure sufficient space around the inverter. • Do not place any heat generating device near the inverter. • Make a service call.

* You can select a trip ON/OFF by parameters.

(Continued overleaf)

(Continued)

Error code	Failure code	Problem	Possible causes	Remedies
OH2	002E	External thermal trip	• An external thermal trip is input.	• Check the external thermal input.
E	0011	Emergency stop	• During automatic operation or remote operation, a stop command is entered from the operation panel or a remote input device.	• Reset the inverter.
EEP1	0012	EEPROM fault 1	• A data writing error occurs.	• Turn off the inverter, then turn it again. If it does not recover from the error, make a service call.
EEP2	0013	EEPROM fault 2	• Power supply is cut off during tYP operation and data writing is aborted.	• Turn the power off temporarily and turn it back on, and then try tYP operation again.
EEP3	0014	EEPROM fault 3	• A data reading error occurred.	• Turn off the inverter, then turn it again. If it does not recover from the error, make a service call.
Er2	0015	Main unit RAM fault	• The control RAM is defective.	• Make a service call.
Er3	0016	Main unit ROM fault	• The control ROM is defective.	• Make a service call.
Er4	0017	CPU fault 1	• The control CPU is defective.	• Make a service call.
Er5	0018	Remote control error	• An error arises during remote operation.	• Check the remote control device, cables, etc.
Er7	001A	Current detector fault	• The current detector is defective.	• Make a service call.
Er8	001B	Optional circuit board format error	• An optional circuit board in a different format is installed.	• Check again to be sure that the circuit board is connected correctly, and then reset the power supply. • Replace the circuit board with a correctly formatted one.
* UC	001D	Low-current operation Trip	• The output current decreased to a low-current detection level during operation.	• Enable F610 (low-current detection). • Check the suitable detection level for the system (F611, F612). • Make a service call if the setting is correct.
* UP1	001E	Undervoltage trip (main circuit)	• The input voltage (in the main circuit) is too low.	• Check the input voltage. • Enable F627 (undervoltage trip selection). • To cope with a momentary stop due to undervoltage, enable F302 (ride-through control) and F301 (auto-restart).
EF2	0022	Ground fault trip	• A ground fault occurs in the output cable or the motor.	• Check the cable and the motor for ground faults.
Etn1	0054	Auto-tuning error	• Check the motor parameter F401 to F494. • The motor with the capacity of 2 classes or less than the inverter is used. • The output cable is too thin. • The motor is rotating. • The inverter is used for loads other than those of three-phase induction motors.	
EtYP	0029	Inverter type error	• Circuit board is changed. (Or main circuit/drive circuit board)	• Make a service call.
* E-18	0032	Brea in analog signal cable	• The signal input via VRF is below the analog sinal detectio level set with F633.	• Check the cables for breaks. And check the setting of input signal or setting value of F633.
E-19	0033	CPU communications error	• A communications error occurs between control CPUs.	• Make a service call.
E-20	0034	Excessive torque boosted	• The torque boost parameter ub is set too high. • The motor has too small impedance.	• Decrease the setting of the torque boost parameter ub. • If no improvement results, contact your dealer.
E-21	0035	CPU fault 2	• The control CPU is defective.	• Make a service call.
SOUt	002F	Step-out (For PM motor only)	• The motor shaft is locked. • One output phase is open. • An impact load is applied.	• Unlock the motor shaft. • Check the interconnect cables between the inverter and the motor.

* You can select a trip ON/OFF by parameters.

[Alarm information] Each message in the table is displayed to give a warning but does not cause the inverter to trip.

Error code	Problem	Possible causes	Remedies
OFF	ST terminal OFF	• The ST-COM circuit is opened.	• Close the ST-COM circuit.
nOFF	Undervoltage in main circuit	• The supply voltage between R, S and T is under voltage.	• Measure the main circuit supply voltage. If the voltage is at a normal level, the inverter requires repairing.
rtry	Retry in process	• The inverter is n the process of retry. • A momentary stop occurred.	• The inverter is normal if it restarts after several tens of senconds. The inverter restarts automatically. Be careful of the machine because it may suddenly restart.
Err 1	Frequency point setting error alarm	• The frequency setting signals at points 1 and 2 are set too close to each other.	• Set the frequency setting signals at points 1 and 2 apart from each other.
CLr	Clear command acceptable	• This message is displayed when pressing the STOP key while an error code is displayed.	• Press the STOP key again to clear the trip.
EOFF	Emergency stop command acceptable	• The operation panel is used to stop the operation in automatic control or remote control mode.	• Press the STOP key for an emergency stop. To cancel the emergency stop, press any other key.
H !! LO	Setting error alarm / An error code and data are displayed alternately twice each.	• An error is found in a setting when data is reading or writing.	• Check whether the setting is made correctly.
HEAd/ End	Display of first/last data items	• The first and last data item in the RUH data group is displayed.	• Press MON key to exit the data group.
db	DC braking	• DC braking in process	• The message goes off in several tens of seconds if no problem occurs. Note)
dbon	Shaft fixing control	• Motor shaft fixing control is in process.	• Normal if the message disappears when a stop command is entered (or the operation command is canceled).
E1 E2 E3	Flowing out of excess number of digits	• The number of digits such as frequencies is more than 4. (The upper digits have a priority.)	• Lower the fequency free unit magnification F702.
StOP	Momentary power failure slowdown stop prohibition function activated.	• The slowdown stop prohibition function set with F302 (momentary power failure ride-through operation) is activated.	• To restart operation, reset the inverter or input an operation signal again.
LStP	Auto-stop because of continuous operation at the lower-limit frequency	• The automatic stop function selected with F256 was activated.	• To deactivate the automatic stop function, increase the frequency command above the lower-limit frequency (LL) + 0.2 Hz or turn off the operation command.
In It	Parameters in the process of initialization	• Parameters are being initialized to default values.	• Normal if the message disappears after a while (several seconds to several tens of seconds).
E - 17	Operation panel key fault	• The RUN or STOP key is held down for more than 20 seconds. • The RUN or STOP key is faulty.	• Check the operation panel.
Atn 1	Auto-tuning	• Auto-tuning in process	• Normal if it the message disappears after a few seconds.

Note) When the ON/OFF function is selected for DC braking (DB), using the input terminal selection parameter, you can judge the inverter to be normal if "db" disappears when opening the circuit between the terminal and COM.

[Prealarm display]

C	Overcurrent alarm	Same as OC (overcurrent)
P	Overvoltage alarm	Same as OP (overvoltage)
L	Overload alarm	Same as OL 1 and OL 2 (overload)
H	Overheat alarm	Same as OH (overheat)

If two or more problems arise simultaneously, one of the following alarms appears and blinks.
CP, PL, CPL
The blinking alarms C, P, L, h are displayed in this order.

13.2 Restoring the inverter from a trip

Do not reset the inverter when tripped because of a failure or error before eliminating the cause. Resetting the tripped inverter before eliminating the problem causes it to trip again.

The inverter can be restored from a trip by any of the following operations:

(1) By turning off the power (Keep the inverter off until the LED turns off.)
Note) Refer to 6.15.3 (inverter trip retention selection F602) for details.
(2) By means of an external signal (Short circuit between RST and COM on terminal board → Open)
(3) By operation panel operation
(4) By inputting a trip clear signal from a remote input device
(Refer to the remote input device operating manual for details.)

To reset the inverter by operation panel operation, follow these steps.

1. Press the STOP/RESET key and make sure that CLr is displayed.
2. Pressing the STOP/RESET key again will reset the inverter if the cause of the trip has already been eliminated.

☆ When any overload function [OL 1: inverter overload, OL 2: motor overload, OLr: braking resistor overload] is active, the inverter cannot be reset by inputting a reset signal from an external device or by operation panel operation before the virtual cooling time has passed.

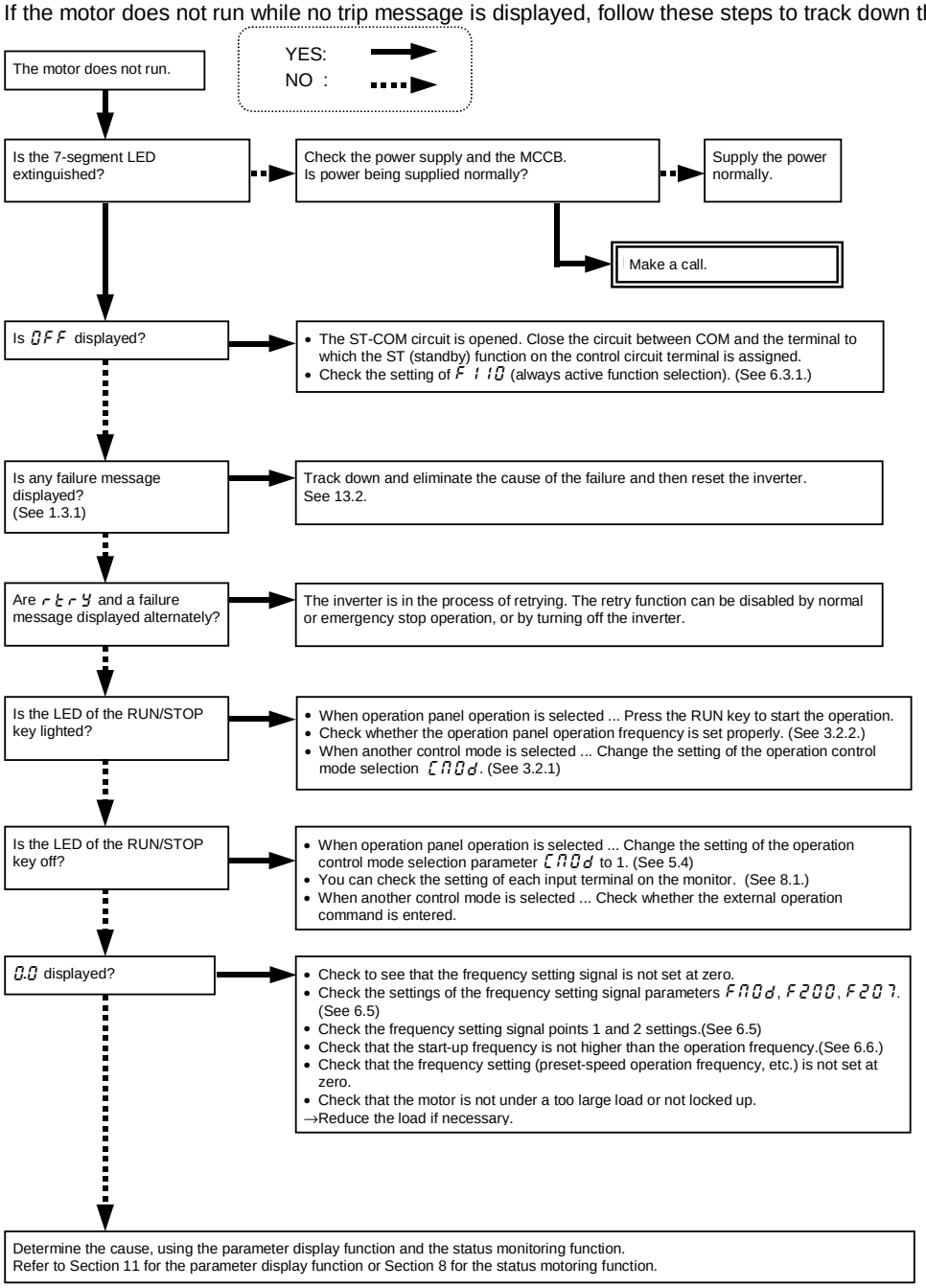
Virtual cooling time ... OL 1 : about 30 seconds after the occurrence of a trip
OL 2 : about 120 seconds after a occurrence of a trip
OLr : about 20 seconds after a occurrence of a trip

☆ In case of a trip due to overheating (OH), the inverter checks the temperature within. Wait until the temperature in the inverter falls sufficiently before resetting the inverter.

[Caution]
Turning the inverter off then turning it on again resets the inverter immediately. You can use this mode of resetting if there is a need to reset the inverter immediately. Note, however, that this operation may damage the system or the motor if it is repeated frequently.

13.3 If the motor does not run while no trip message is displayed ...

If the motor does not run while no trip message is displayed, follow these steps to track down the cause.



13.4 How to determine the causes of other problems

The following table provides a listing of other problems, their possible causes and remedies.

Problems	Causes and remedies
The motor runs in the wrong direction.	• Invert the phases of the output terminals U, V and W. • Invert the forward/reverse run-signal terminals of the external input device. (See 6.3 "Assignment of functions to control terminals".) • Change the setting of the parameter Fr in the case of panel operation.
The motor runs but its speed does not change normally.	• The load is too heavy. Reduce the load. • The soft stall function is activated. Disable the soft stall function. (See 5.14.) • The maximum frequency FH and the upper limit frequency UL are set too low. Increase the maximum frequency FH and the upper limit frequency UL . • The frequency setting signal is too low. Check the signal set value, circuit, cables, etc. • Check the setting characteristics (point 1 and point 2 settings) of the frequency setting signal parameters. (See 6.5.) • If the motor runs at a low speed, check to see that the stall prevention function is activated because the torque boost amount is too large. Adjust the torque boost amount (ub) and the acceleration time (ACC). (See 5.12 and 5.1.)
The motor does not accelerate or decelerate smoothly.	• The acceleration time (ACC) or the deceleration time (dEC) is set too short. Increase the acceleration time (ACC) or the deceleration time (dEC).
A too large current flows into the motor.	• The load is too heavy. Reduce the load. • If the motor runs at a low speed, check whether the torque boost amount is too large. (See 5.12.)
The motor runs at a higher or lower speed than the specified one.	• The motor has an improper voltage rating. Use a motor with a proper voltage rating. • The motor terminal voltage is too low. Check the setting of the base frequency voltage parameter (uLu) . (See 6.13.6.) Replace the cable with a cable larger in diameter. • The reduction gear ratio, etc., are not set properly. Adjust the reduction gear ratio, etc. • The output frequency is not set correctly. Check the output frequency range. • Adjust the base frequency. (See 5.10.)
The motor speed fluctu-ates during operation.	• The load is too heavy or too light. Reduce the load fluctuation. • he inverter or motor used does not have a rating large enough to drive the load. Use an inverter or motor with a rating large enough. • Check whether the frequency setting signal changes. • If the V/F control selection parameter Pt is set at 3, check the vector control setting, operation conditions, etc. (See 5.11.)
Parameter settings cannot be changed.	Change the setting of the parameter F700 (prohibition of change of parameter setting) to 0 (permitted) if it is set at 1 (prohibited). * For reasons of safety, some parameters cannot be reprogrammed while the inverter is running. (see 4.1.5)

How to cope with parameter setting-related problems

If you forget parameters which have been reset	• You can search for all reset parameters and change their settings. * Refer to 4.1.3 for details.
If you want to return all reset parameters to their respective default settings	• You can return all parameters which have been reset to their default settings. * Refer to 4.1.6 for details.

14. Inspection and maintenance

Danger	
Mandatory	• The equipment must be inspected every day. If the equipment is not inspected and maintained, errors and malfunctions may not be discovered which could lead to accidents. • Before inspection, perform the following steps. (1) Shut off all input power to the inverter. (2) Wait at least ten minutes and check to make sure that the charge lamp is no longer lit. (3) Use a tester that can measure DC voltages (800V DC or more), and check that the voltage to the DC main circuits (across P(+)-N(-)) does not exceed 45V. Performing an inspection without carrying out these steps first could lead to electric shock.

Be sure to inspect the inverter regularly and periodically to prevent it from breaking down because of the environment of use, such as temperature, humidity, dust and vibration, or deterioration of its components with aging.

14.1 Regular inspection

Since electronic parts are susceptible to heat, install the inverter in a cool, well-ventilated and dust-free place. This is essential for increasing the service life.

The purpose of regular inspections is to maintain the correct environment of use and to find any sign of failure or malfunction by comparing current operation data with past operation records.

Subject of inspection	Inspection procedure			Criteria for judgement
	Inspection item	Inspection cycle	Inspection method	
1. Indoor environment	1) Dust, temperature and gas	Occasionally	1) Visual check, check by means of a thermometer, smell check	1) Improve the environment if it is found to be unfavorable.
	2) Drop of water or other liquid	Occasionally	2) Visual check	2) Check for any trace of water condensation.
	3) Room temperature	Occasionally	3) Check by means of a thermometer	3) Max. temperature: 50°C
2. Units and components	1) Vibration and noise	Occasionally	Tactile check of the cabinet	Is something unusual is found, open the door and check the transformer, reactors, contactors, relays, cooling fan, etc., inside. If necessary, stop the operation.
3. Operation data (output side)	1) Load current	Occasionally	Moving-iron type AC ammeter	To be within the rated current, voltage and temperature. No significant difference from data collected in a normal state.
	2) Voltage (*)	Occasionally	Rectifier type AC voltmeter	
	3) Temperature	Occasionally	Thermometer	

*) The voltage measured may slightly vary from voltmeter to voltmeter. When measuring the voltage, always take readings from the same circuit tester or voltmeter.

■ Check points

1. Something unusual in the installation environment
2. Something unusual in the cooling system
3. Unusual vibration or noise
4. Overheating or discoloration
5. Unusual odor
6. Unusual motor vibration, noise or overheating
7. Adhesion or accumulation of foreign substances (conductive substances)

14.2 Periodical inspection

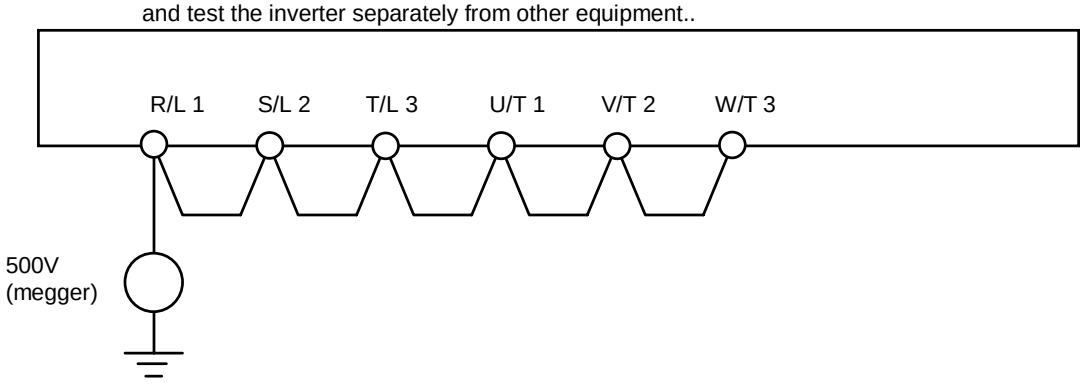
Make a periodical inspection at intervals of 3 or 6 months depending on the operating conditions.

Danger	
 Mandatory	•Before inspection, perform the following steps. (1) Shut off all input power to the inverter. (2) Wait at least ten minutes and check to make sure that the charge lamp is no longer lit. (3) Use a tester that can measure DC voltages (800V DC or more), and check that the voltage to the DC main circuits (across P(+)-N(-)) does not exceed 45V. Performing an inspection without carrying out these steps first could lead to electric shock.
 Prohibited	• Never replace any part. This could be a cause of electric shock, fire and bodily injury. To replace parts, call the local sales agency.

■ Check items

1. Check to see if all screwed terminals are tightened firmly. If any screw is found loose, tighten it again with a screwdriver.
2. Check to see if all caulked terminals are fixed properly. Check them visually to see that there is no trace of overheating around any of them.
3. Check all cables and wires for damage. Check them visually.
4. Remove dirt and dust with a vacuum cleaner. When cleaning, clean the vents and the printed circuit boards. Always keep them clean to prevent an accident due to dirt or dust.
5. If no power is supplied to the inverter for a long time, the performance of its large-capacity electrolytic capacitor declines.
   When leaving the inverter unused for a long time, supply it with electricity once every two years, for 5 hours or more each, to recover the performance of the large-capacity electrolytic capacitor. And also check the function of the inverter. It is advisable not to supply the commercial power directly to the inverter but to gradually increase the power supply voltage with a transformer, etc.
6. If the need arises, conduct an insulation test on the main circuit terminal board only, using a 500V insulation tester. Never conduct an insulation test on control terminals other than terminals on the printed circuit board or on control terminals. When testing the motor for insulation performance, separate it from the inverter in advance by disconnecting the cables from the inverter output terminals U, V and W. When conducting an insulation test on peripheral circuits other than the motor circuit, disconnect all cables from the inverter so that no voltage is applied to the inverter during the test.

(Note) Before an insulation test, always disconnect all cables from the main circuit terminal board and test the inverter separately from other equipment..



7. Never test the inverter for pressure. A pressure test may cause damage to its components.
8. Voltage and temperature check
   Recommended voltmeter
   Input side ... Moving-iron type voltmeter ()
   Output side ... Rectifier type voltmeter ()
   It will be very helpful for detecting a defect if you always measure and record the ambient temperature before, during and after the operation.

■ Replacement of expendable parts

The inverter is composed of a large number of electronic parts including semiconductor devices. The following parts deteriorate with the passage of time because of their composition or physical properties. The use of aged or deteriorated parts leads to degradation in the performance or a breakdown of the inverter. To avoid such trouble, the inverter should be checked periodically.

Note) Generally, the life of a part depends on the ambient temperature and the conditions of use. The life spans listed below are applicable to parts when used under normal environmental conditions.

1) Cooling fan
   The fan, which cools down heat-generating parts, has a service life of about 30,000 hours (about 2 or 3 years of continuous operation). The fan also needs to be replaced if it makes a noise or vibrates abnormally.
2) Smoothing capacitor
   The smoothing aluminum electrolytic capacitor in the main circuit DC section degrades in performance because of ripple currents, etc. It becomes necessary to replace the capacitor after it is used for about 5 years under normal conditions.

<Criteria for appearance check>

- Absence of liquid leak
- Safety valve in the depressed position
- Measurement of electrostatic capacitance and insulation resistance

Note: When it becomes necessary to replace expendable parts, contact your nearest branch office or sales office. For safety's sake, never replace any part on your own.

The operation time is helpful for roughly determining the time of replacement. For the replacement of parts, contact your nearest branch office.

■ Standard replacement cycles of principal parts

As guides, the table below lists part replacement cycles that were estimated based on the assumption that the inverter would be used in a normal use environment under normal conditions (ambient temperature, ventilation conditions, and energizing time). The replacement cycle of each part does not mean its service life but the number of years over which its failure rate does not increase significantly.

Part name	Standard replacement cycle	Replacement mode and others
Cooling fan	2 to 3 years	Replacement with a new one
Main circuit smoothing aluminum electrolytic capacitor	5 years	Replacement with a new one
Relay and contactor	-	Whether to replace or not depends on the check results
Aluminum electrolytic capacitor mounted on a printed circuit board	5 years	Replace with a new circuit board

Note) The life of a part greatly varies depending on the environment of use.

14.3 Making a call for servicing

If defective conditions are encountered, please contact the service section in charge via your dealer.
When making a call for servicing, please inform us of the contents of the rating label on the right panel of the inverter, the presence or absence of optional devices, etc., in addition to the details of the failure.

14.4 Keeping the inverter in storage

Take the following precautions when keeping the inverter in storage temporarily or for a long period of time.

1. Store the inverter in a well-ventilated place away from heat, damp, dust and metal powder.
2. If the printed circuit board in your inverter has an anti-static cover (black cover), do not leave it detached from the circuit board during storage. The cover must be detached before turning on the inverter.
3. If no power is supplied to the inverter for a long time, the performance of its large-capacity electrolytic capacitor declines.
   When leaving the inverter unused for a long time, supply it with electricity once every two years, for 5 hours or more each, to recover the performance of the large-capacity electrolytic capacitor. And also check the function of the inverter. It is advisable not to supply the commercial power directly to the inverter but to gradually increase the power supply voltage with a transformer, etc.

15. Warranty

Warranty policy on inverter

Warranty period	The warranty period is 18 months from date of shipment or 12 months after initial operation, whichever comes first.
Warranty condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agreed upon in writing between the Seller and Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product without charge at a designated facility, except as stipulated in the "Warranty Exclusions" as described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of: removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.
Warranty exclusion	Not withstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by: 1. Installation, connection, combination or integration of the Product in or to the other equipment or machine that rendered by any person or entity other than the Seller. 2. Insufficient maintenance or improper operation by the Buyer or its customers such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller; 3. Improper use or operation of the Product by the Buyer or its customers that is not informed to the Seller, including, without limitation, the Buyer's or its customers' operation of the Product not in conformity with the specifications; 4. Any problem or damage on any equipment or machine to which the Product is installed, connected or combined or any specifications particular to the buyer or its customers; 5. Any changes, modifications, improvements or alterations to the Product or those functions that are rendered on the Product by any person or entity other than the Seller; 6. Any parts in the Product that are supplied or designated by the Buyer or its customers; 7. Earthquake, fire, flood, salt air, gas, lightning, acts of God or any other reasons beyond the control of the Seller; 8. Normal wear and tear, or deterioration of the Product's parts, such as the cooling fan bearings; 9. Any other troubles, problems or damage to the Product that are not attributable to the Seller.
Others	The Seller will not be responsibility for the installation and removal of the inverter. Any inverter transportation cost shall be born by both Seller and Buyer.

16. Disposal of the inverter

Warning	
Mandatory	• When disposing the inverter, have it done by a specialist in industry waste disposal(*). Disposing the inverter by yourself may result in explosion of capacitor or produce noxious gases, resulting in injury. (*) Persons who specialize in the processing of waste and known as "industrial waste product collectors and transporters" or "industrial waste disposal persons. "If the collection, transport and disposal of industrial waste is done by someone who is not licensed for that job, it is a punishable violation of the law. (Laws in regard to cleaning and processing of waste materials)

For safety's sake, do not dispose of the disused inverter yourself but ask an industrial waste disposal agent.
Disposing of the inverter improperly could cause its capacitor to explode and emit toxic gas, causing injury to persons.