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BENSHAW
ADVANCED CONTROLS & DRIVES

RSi GX Series

Sensorless Vector Drive
Hardware Manual

1.0 to 5.0HP - 230V
1.0 to 5.0HP - 460V

The Leader In

Solid State Motor Control

Technology

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Safety Precautions

WARNING

1. Do not remove the front cover when input power is connected. Doing so can result in electric shock.
2. Do not operate the drive with the front cover removed. Electric shock can occur due to the exposed high voltage terminals and capacitor.
3. Do not remove the cover except for routine inspections or wiring, even if the input power is not applied. The capacitor will remain charged for a long time even when the power is not applied.
4. This drive contains high voltage which can cause electric shock resulting in personal injury or loss of life.
5. Be sure all AC power is removed from the drive before servicing.
6. Wait at least 10 minutes after turning off the AC power for the bus capacitor to discharge. Measure the DC Bus charge between B+ and B- terminals, ensure DC voltage is below 45V before proceeding.
7. Do not connect or disconnect the wires to or from drive when power is applied.
8. Do not operate the switches with wet hands. Doing so can result in electric shock.
9. Electric shock can occur if the cable coating is damaged or if heavy objects than can cause excess stressare put on the cable.

CAUTION

1. Service only by qualified personnel.
2. Install the drive on a non-flammable surface. Do not place flammable material nearby. Otherwise, fire could occur.
3. Make sure power-up restart is off to prevent any unexpected operation of the motor.
3. Do not use a higher grounding method than the Type 3 grounding method.
4. Disconnect the input power if the drive gets damaged. Otherwise, it could result in a secondary accident and fire.
5. Make certain proper shield installation is in place.
6. Never connect the input power leads to the output terminals of drive.
7. Risk of Electric Shock - More than one disconnect switch may be required to de-energize the equipment before servicing.
8. Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the drive. Otherwise, fire or accident could occur.
9. Incorrectly connecting the polarity (+/-) of the terminals can damage the drive.

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1 Introduction

Using This Manual

Layout

This manual is divided into 7 sections. Each section contains topics related to the section. The sections are as follows:

- Introduction
- Technical Specifications
- Installation
- Connection
- Troubleshooting & Maintenance
- Interference Suppression Measures
- Appendices

Symbols

There are 2 symbols used in this manual to highlight important information. The symbols appear as the following:

Electrical Hazard that warns of situations in which a high voltage can cause physical injury, death and/or damage equipment.

Caution that warns of situations in which physical injury and/damage to equipment may occur by means other than electrical.

Highlight marking an important point in the documentation.

Benshaw Services

General Information

Benshaw offers its customers the following:
- Start-up services
- On-site training services
- Technical support
- Detailed documentation
- Replacement parts

⌘ **NOTE:** Information about products and services is available by contacting Benshaw, refer to page 4.

Start-Up Services

Benshaw technical field support personnel are available to do startup and conduct on-site training on the starter operations and troubleshooting.

On-Site Training Services

Benshaw technical field support personnel are available to conduct on-site training on starter operations and troubleshooting.

Technical Support

Benshaw technical support personnel are available (at no charge) to answer customer questions and provide technical support over the telephone. For more information about contacting technical support personnel, refer to Contacting Benshaw on page 4.

Documentation

Benshaw provides all customers with:
- Hardware Manual - Production # 890030-01-xx

On-Line Documentation

All documentation is available on-line at **http://www.benshaw.com**.

Replacement Parts

Spare and replacement parts can be purchased from Benshaw.

Publication History

Refer to the Revision History in the appendices.

Contacting Benshaw

Contacting Benshaw

Information about Benshaw products and services is available by contacting Benshaw at one of the following offices:

Benshaw Inc. Corporate Headquarters
1659 E. Sutter Road
Glenshaw, PA 15116
United States of America
Phone: (412) 487-8235
Fax: (412) 487-4201

Benshaw Canada Controls Inc.
550 Bright Street. E.
Listowel, Ontario N4W 3W3
Canada
Phone: (519) 291-5112
Fax: (519) 291-2595

Benshaw West
14715 North 78th Way, Suite 600
Scottsdale, AZ 85260
United States of America
Phone: (480) 905-0601
Fax: (480) 905-0757

E-mail: usatechsupport@benshaw.com
cantechsupport@benshaw.com

Technical support for RSi GX Series is available at no charge by contacting Benshaw's customer service department at one of the above telephone numbers. A service technician is available Monday through Friday from 8:00 a.m. to 5:00 p.m. EST.

⌘ **NOTE:** An on-call technician is available after normal business hours and on weekends by calling Benshaw and following the recorded instructions.

To help assure prompt and accurate service, please have the following information available when contacting Benshaw:

- Name of Company
- Telephone number where the caller can be contacted
- Fax number of caller
- Benshaw product name
- Benshaw model number
- Benshaw serial number
- Name of product distributor
- Approximate date of purchase
- System Voltage
- FLA of motor attached to Benshaw product
- A brief description of the application

Inspection

1.1 Inspection

Before storing or installing the RSi GX, thoroughly inspect the device for possible shipping damage. Upon receipt:

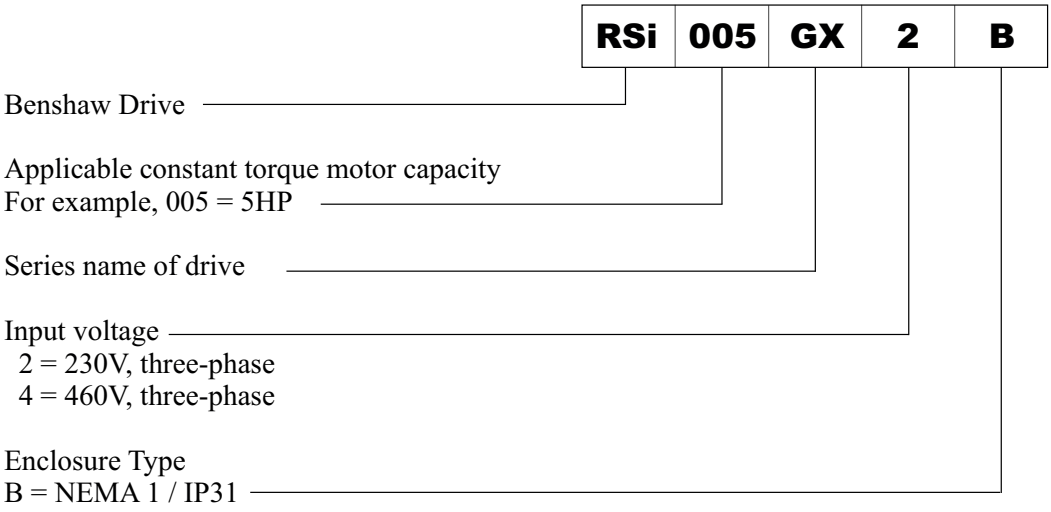
- Remove the starter from its package and inspect exterior for shipping damage. If damage is apparent, notify the shipping agent and your sales representative.
- Open the enclosure and inspect the starter for any apparent damage or foreign objects. Ensure that all of the mounting hardware and terminal connection hardware are properly seated, securely fastened, and undamaged.
- Ensure all connections and wires are secured.
- Read the technical data label affixed to the starter and ensure that the correct horsepower and input voltage for the application has been purchased.
- If you will store the drive after receipt, place it in its original packaging and store in a clean, dry place free from direct sunlight or corrosive fumes, where the ambient temperature is not less than -20°C (-4°F) or greater than +65°C (+149°F).
- Depending on the type of unit you have purchased, check that you have received all the necessary parts. The delivery package should include the unit itself, this manual and a Quick Start Guide. The Quick Start Guide gives a summary of the installation instructions. It is not meant to be a substitute for the User Manual, rather it is meant to be a supplement to the manual.

Interpreting Model Numbers

1.2 Model Numbers

The model number of the RSi GX drive appears on the shipping carton label and on the technical data label affixed to the model. Read the technical data label affixed to the drive and ensure that the correct horsepower and input voltage for the application has been purchased. The numbering system for a Benshaw RSi GX drive is shown below.

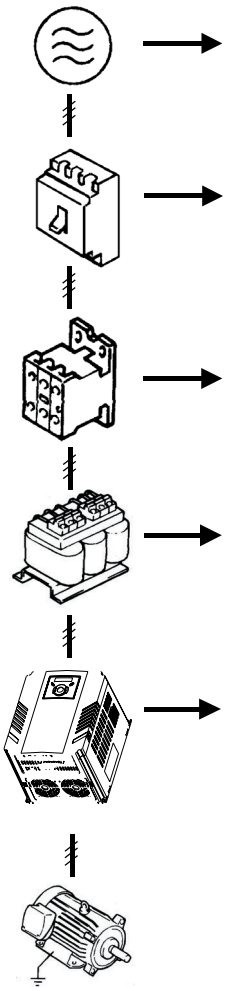
Figure 1: RSi GX Drive Model Numbers



Basic Configuration

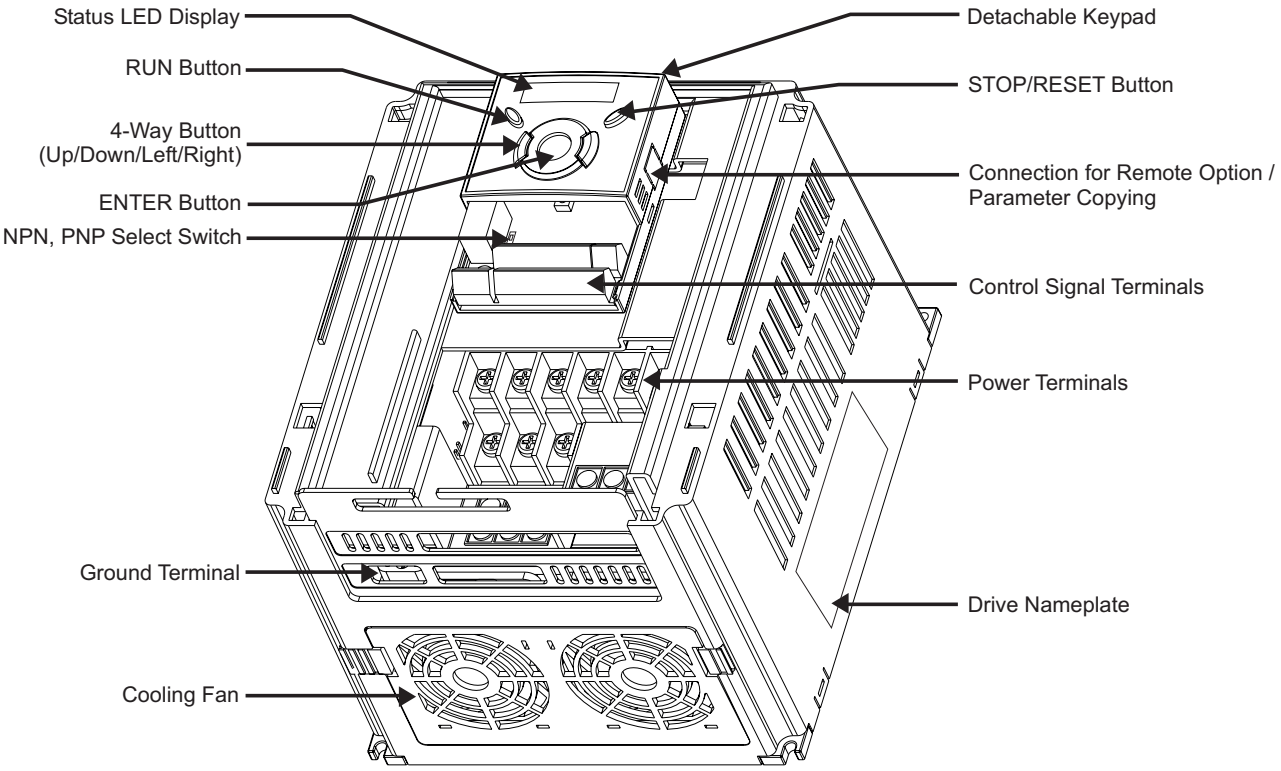
1.3 Connection of Peripheral Devices to the Drive

The following devices are required to operate the drive. Proper peripheral devices must be selected and correct connections made to ensure proper operation. An incorrectly applied or installed drive can result in system malfunction or reduction in product life as well as component damage. You must read and understand this manual thoroughly before proceeding.



AC Source Supply	Use the power supply within the permissible range of drive input power rating (Refer to page 10).
MCCB or Earth leakage circuit breaker (ELB)	Select circuit breakers with care. A large inrush current may flow in the drive at power on.
Magnetic Contactor	Install it if necessary. When installed, do not use it for the purpose of starting or stopping. Otherwise, it could lead to reduction in product life.
Reactors	The reactors must be used when the power factor is to be improved or the drive is installed near a large power supply system (1000kVA or more and wiring distance within 10m).
Installation and wiring	To operate the drive with high performance for a long time, install the drive in a proper place in the correct direction and with proper clearances. Incorrect terminal wiring could result in the equipment damage.
To motor	Do not connect a power factor capacitor, surge suppressor or radio noise filter to the output side of the drive.

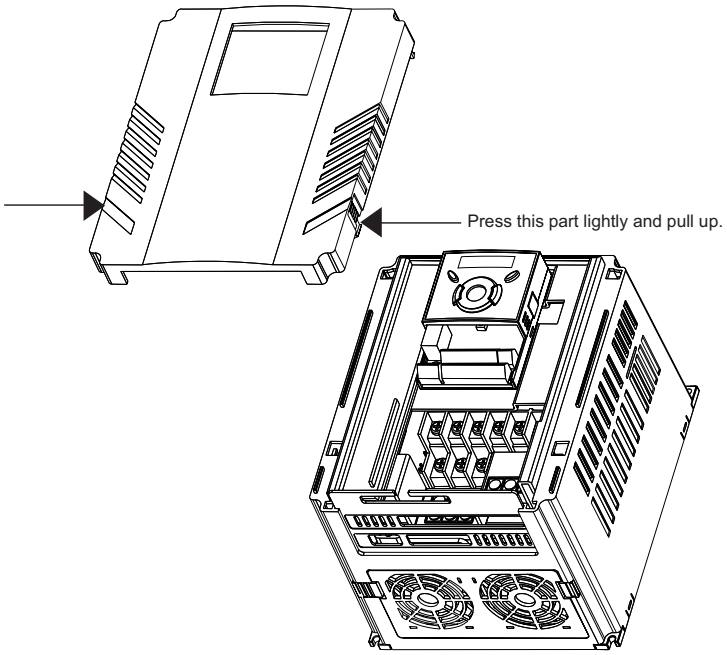
1.4 Drive Components



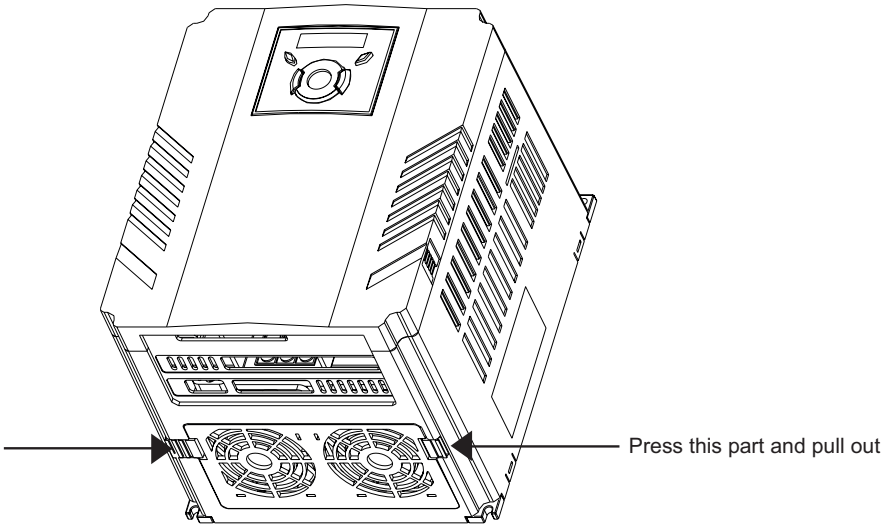
Product Assembly/Disassembly

1.5 Product Assembly/Disassembly

To remove the front cover, press both of the indented sides of the cover lightly and pull up.



To change the drive fan, press both sides of the bottom cover lightly and pull out to the side. Disconnect the fan wire.



2 Technical Specifications

Technical Data

2.1 Technical Data

230V Class (1.0 - 5.0HP)

Drive Type (RSixxxGX-2)		001	002	003	005
Motor Rating[1]	HP	1	2	3	5
	KW	0.75	1.5	2.2	3.7
Output Ratings	Capacity[kVA][2]	1.9	3.0	4.5	6.1
	FLA [A][3]	5	8	12	16
	Max. Frequency	400 [Hz][4]			
	Max. Voltage	3ϕ 200 - 230V[5]			
Input Ratings	Rated Voltage	3ϕ 200 - 230 VAC (+10%, -15%)			
	Rated Frequency	50 - 60 [Hz] (±5%)			
Cooling Method		Forced Cooling			
Weight [kg]		0.77	1.12	1.84	1.89

400V Class (1.0 - 5.0HP)

Drive Type (RSixxxGX-4)		001	002	003	005
Motor Rating[1]	HP	1	2	3	5
	KW	0.75	1.5	2.2	3.7
Output Ratings	Capacity[kVA][2]	1.9	3.0	4.5	6.1
	FLA [A][3]	2.5	4	6	8
	Max. Frequency	400 [Hz][4]			
	Max. Voltage	3ϕ 380 - 480V[5]			
Input Ratings	Rated Voltage	3ϕ 380 - 480 VAC (+10%, -15%)			
	Rated Frequency	50 - 60 [Hz] (±5%)			
Cooling Method		Forced Cooling			
Weight [kg]		0.77	1.12	1.84	1.89

1) Indicates the maximum applicable motor capacity when using a 4-pole motor.
2) Rated capacity is based on 220V for 200V class and 440V for 400V class.
3) Refer to when Carrier frequency setting (H39) is above 3kHz.
4) Max frequency setting range is extended to 300Hz when H40 (Control mode select) is set to 3 (SVC).
5) Maximum output voltage cannot be higher than the input voltage. It can be programmable below input voltage.

Control

Control Method		V/F, Sensorless vector control
Frequency Setting Resolution		Digital command: 0.01Hz Analog command: 0.06Hz (Max freq.: 60Hz)
Frequency Accuracy		Digital command: 0.01% of Max output frequency Analog command: 0.1% of Max output frequency
V/F Pattern		Linear, Squared, User V/F
Overload Capacity		150% per 1 min.
Torque Boost		Manual/Auto torque boost
Dynamic Braking	Max braking torque	20% 1)
	Time / %ED	150% 2) when using optional DB resistor

1) Means average braking torque during Decel to stop of a motor.
2) Refer to Chapter 9 for DB resistor specification.

Operation

Operation Mode		Keypad/ Terminal/ Communication option/ Remote keypad selectable	
Frequency Setting		Analog: 0 ~ 10[V], -10 ~ 10[V], 0 ~ 20[mA] Digital: Keypad	
Operation Features		PID, Up-down, 3-wire	
Input	Multi-function terminal P1 ~ P8	NPN / PNP selectable (See page 3-6)	
		FWD/REV RUN, Emergency stop, Fault reset, Jog operation, Multi-step Frequency-High, Mid, Low, Multi-step, Accel/Decel-High, Mid, Low, DC braking at stop, 2nd motor select, Frequency UP/Down, 3-wire operation, External trip A, B, PID-drive (v/f) operation bypass, Option-drive (v/f) operation bypass, Analog Hold, Accel/Decel stop	
Output	Open collector terminal	Fault output and drive status output	Less than DC 24V 50mA
	Multi-function relay		(N.O., N.C.) Less than AC250V 1A, Less than DC 30V 1A
	Analog output	0 - 10 Vdc (less than10mA): Output Freq, Output Current, Output Voltage, DC link selectable	

Protection Function

Trip	Over Voltage, Under Voltage, Over Current, Ground Fault current detection, drive Overheat, Motor Overheat, Output Phase Open, Overload Protection, Communication Error, Loss of Speed Command, Hardware Fault, Fan trip
Alarm	Stall prevention, overload
Momentary Power Loss	Below 15 msec: Continuous operation (should be within rated input voltage, rated output power.) Above 15 msec: Auto restart enable

Environmental Specifications

2.2 Environmental Specifiactions

Table 1

Protection degree	IP 20, NEMA TYPE 1 (Option)
Ambient temperature	-10°C to +50°C (non-freezing)
Storage temperature	-20°C to +65°C (-4°F to 149°F)
Humidity	0% to 95% RH (non-condensing)
Altitude	Max. 1,000m (3300ft) without derating
Maximum vibration	5.9 m/s^2 (19.2 ft/s^2) [0.6G] or less
Cooling	Natural convection (1HP models) Fan cooling (2HP and larger models)
Atmospheric pressure	70 to 106 kPa
Location	Protected from corrosive gas, combustible gas, oil mist or dust

Electrical Specifications

2.3 Electrical Specifications

Table 2

	200VAC Models	**400VAC Models**
Voltage input	3ϕ 200 - 230VAC -10%, -15%	3ϕ 380 - 480VAC +10%, -15%
Line frequency	50 / 60Hz ±5%	
DC bus voltage for: Overvoltage trip Dynamic Brake activation Nominal undervoltage (UV) trip	407VDC 391VDC 202VDC	805VDC 780VDC 510VDC
Control system	Voltage Vector pulse width modulation (PWM) Carrier frequency = 4, 6, 8, 12, and 16kHz	
Output voltage	0 to 100% of line voltage, Three-phase	
Overload capacity	150% of rated rms for 60 seconds	
Rated output frequency	50/60Hz ±5%	
Frequency range	0 to 1000Hz	
Frequency stability	±0.02Hz from 0 to 300Hz (digital) ±0.01Hz from 300 to 1000Hz (digital) 0.1% (analog) over 24 hours ±10°C change	
Frequency setting	Digital: keypad (0 to 10VDC, -10 to 10VDC, 0 to 20mA)	
Agency listings	UL and cUL Listed, CE Mark	

2.4 Altitude Derating

Benshaw VFDs are capable of operating at altitudes up to 3,300 feet (1000 meters) without requiring an altitude derate. Table 3 provides the derating percentage to be considered when using a drive above 3,300 feet (1000 meters).

Table 3: Altitude Derating

Altitude		Percent Derating (Amps)
3,300 feet	1,006 meters	0.0%
4,300 feet	1,311 meters	3.0%
5,300 feet	1,615 meters	6.0%
6,300 feet	1,920 meters	9.0%
7,300 feet	2,225 meters	12.0%
8,300 feet	2,530 meters	15.0%
9,300 feet	2,835 meters	18.0%

⌘ **Note:** *For derating above 10,000ft consult Benshaw.*

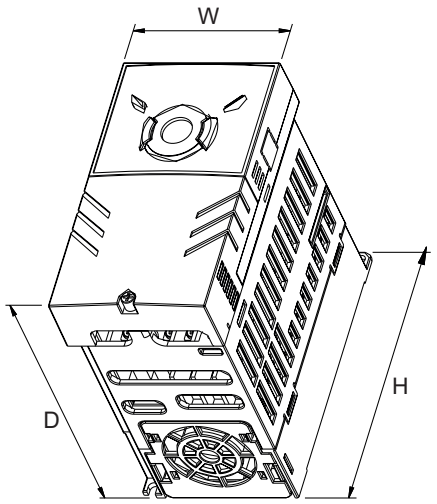
2.5 Thermal Derating

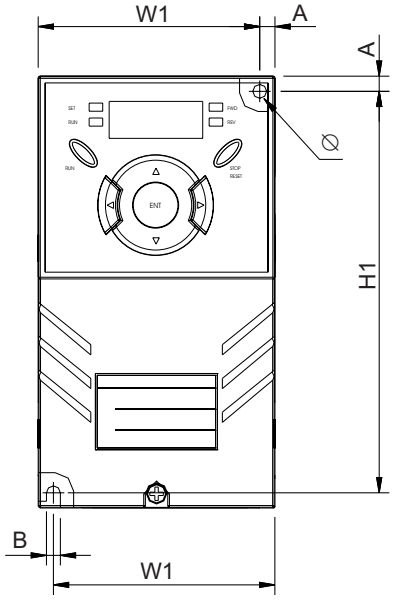
The ambient operating temperature range of the RSi GX is as follows:

- NEMA 1 0-40°C

Dimensions

2.6 RSi001GX (200/400V)



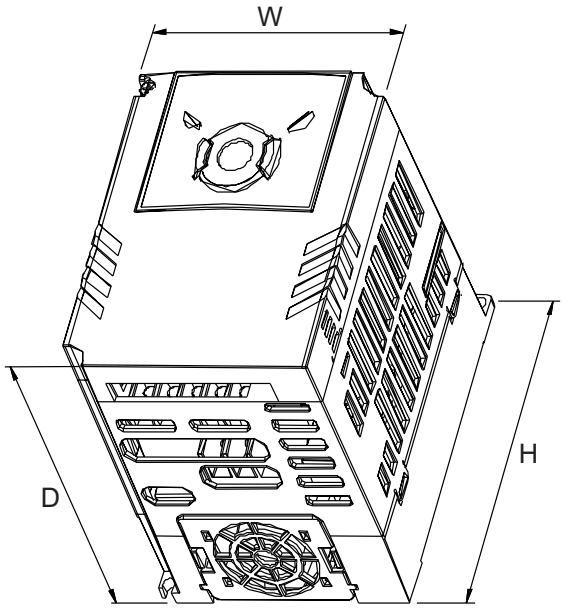


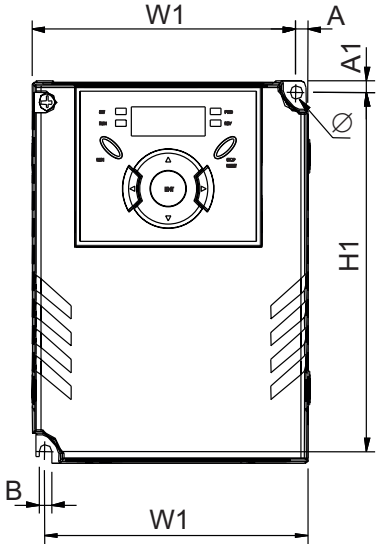
Unit: mm (inches)

Model	[HP]	[kW]	W [mm]	W1 [mm]	H [mm]	H1 [mm]	D [mm]	F	A [mm]	B [mm]	[Kg]
RSi001GX-2/4	1.0	0.75	70 (2.76)	65.5 (2.58)	128 (5.04)	119 (4.69)	130 (5.12)	4.0	4.5 (0.18)	4.0 (0.16)	0.77 (1.70lb)

⌘ **Note:** For single phase operation consult factory.

2.7 RSi002GX (200/400V)



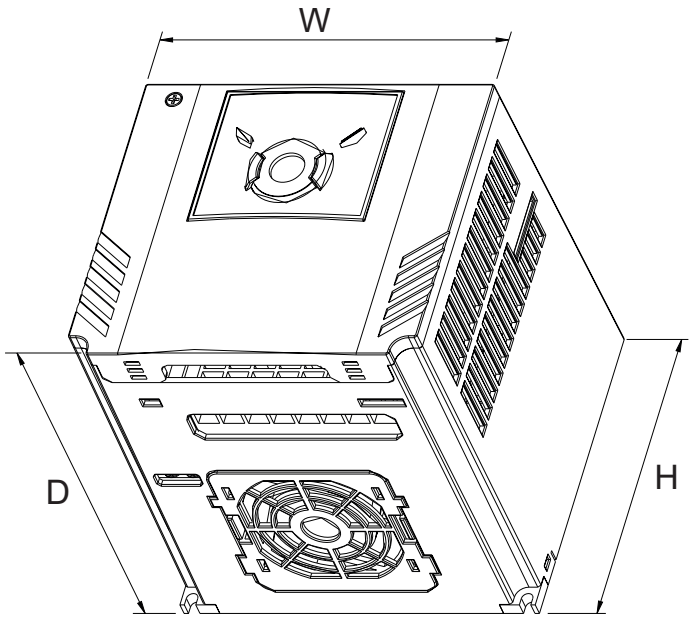


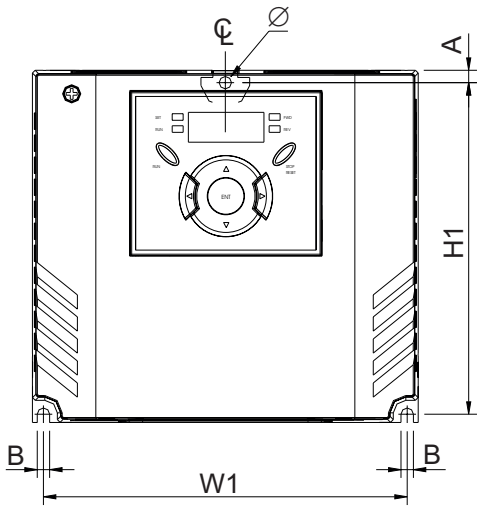
Unit: mm (inches)

Model	[HP]	[kW]	W [mm]	W1 [mm]	H [mm]	H1 [mm]	D [mm]	F	A [mm]	B [mm]	[Kg]
RSi002GX-2/4	2.0	1.5	100 (3.94)	95.5 (3.76)	128 (5.04)	120 (4.72)	130 (5.12)	4.5	4.5 (0.18)	4.5 (0.18)	1.12 (2.47lb)

⌘ **Note:** For single phase operation consult factory.

2.8 RSi003GX (200/400V)



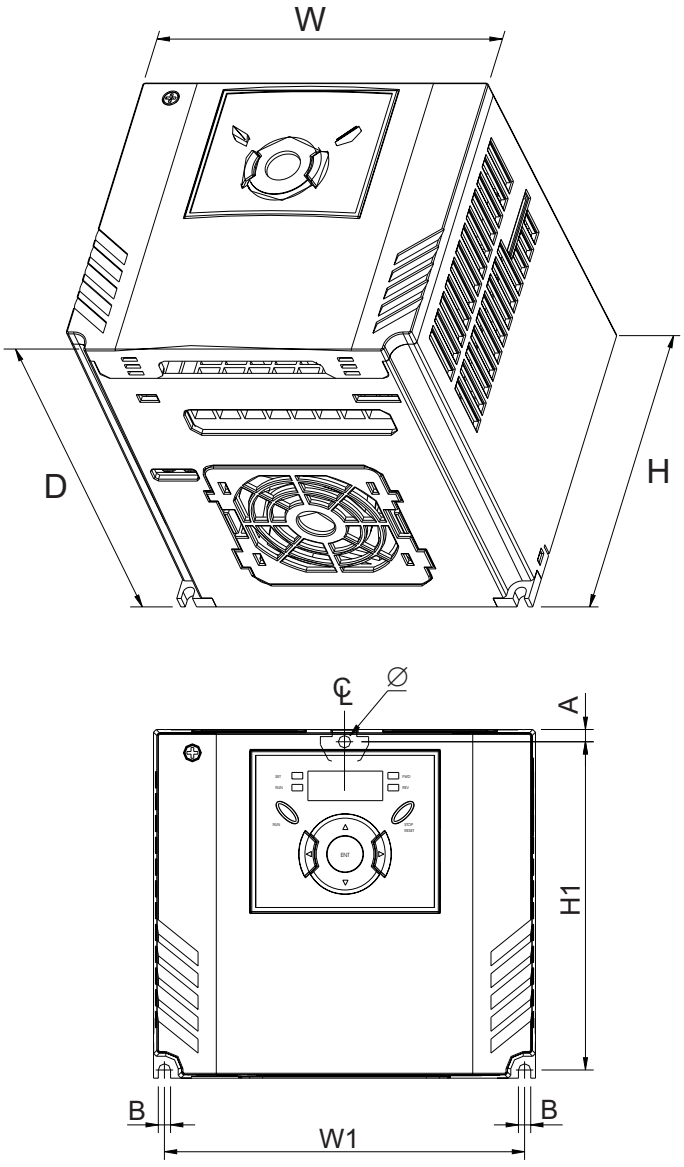


Unit: mm (inches)

Model	[HP]	[kW]	W [mm]	W1 [mm]	H [mm]	H1 [mm]	D [mm]	F	A [mm]	B [mm]	[Kg]
RSi003GX-2/4	3.0	2.2	140 (5.51)	132 (5.20)	128 (5.04)	120.5 (4.74)	155 (6.10)	4.5	4.5 (0.18)	4.5 (0.18)	1.84 (4.06lb)

⌘ **Note:** For single phase operation consult factory.

2.9 RSi005GX (200/400V)



Unit: mm (inches)

Model	[HP]	[kW]	W [mm]	W1 [mm]	H [mm]	H1 [mm]	D [mm]	F	A [mm]	B [mm]	[Kg]
RSi005GX-2/4	5.0	3.7	140 (5.51)	132 (5.20)	128 (5.04)	120.5 (4.74)	155 (6.10)	4.5	4.5 (0.18)	4.5 (0.18)	1.89 (4.17lb)

⌘ **Note:** For single phase operation consult factory.

Notes:

3 Receiving and Installation

Preliminary Inspection

3.1 Preliminary Inspection

Before storing or installing the RSi GX Drive, thoroughly inspect the device for possible shipping damage. Upon receipt:

- Remove the drive from its package and inspect exterior for shipping damage. If damage is apparent, notify the shipping agent and your sales representative.
- Remove the cover and inspect the drive for any apparent damage or foreign objects. Ensure that all mounting hardware and terminal connection hardware is properly seated, securely fastened, and undamaged.
- Read the technical data label affixed to the drive and ensure that the correct horsepower and input voltage for the application has been purchased.

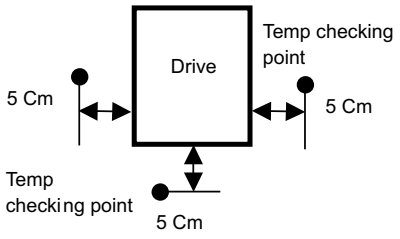
If you will store the drive after receipt, place it in its original packaging and store in a clean, dry place free from direct sunlight or corrosive fumes, where the ambient temperature is not less than -20°C (-4°F) or greater than +65°C (+149°F).

Installation Precautions

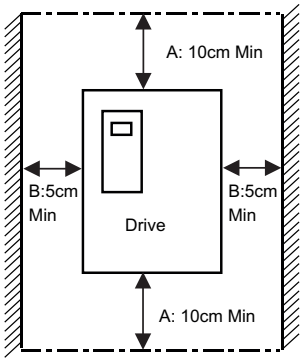
3.2 Installation Precautions

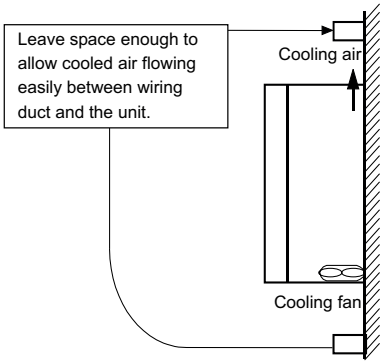
Improper installation of the RSi GX Microdrive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location. **Failure to observe these precautions may void the warranty!**

- Handle the drive with care to prevent damage to the plastic components. Do not hold the drive by the front cover. It may fall off.
- Do not mount the drive in a location where excessive vibration (5.9 m/s^2 or less) is present such as installing the drive on a press or other moving equipment.
- Install in a location where temperature is within the permissible range (-10~50°C).
- The drive will be very hot during operation. Install it on a non-combustible surface.

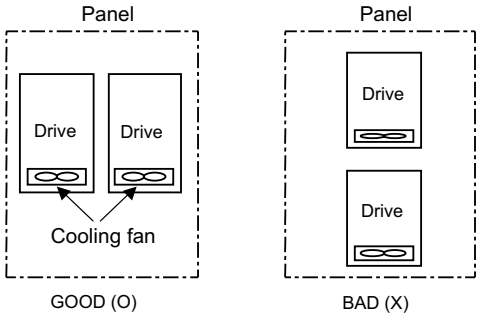


- Mount the drive on a flat, vertical and level surface. The drive orientation must be vertical (top up) for proper heat dissipation. Also leave sufficient clearances around the drive.

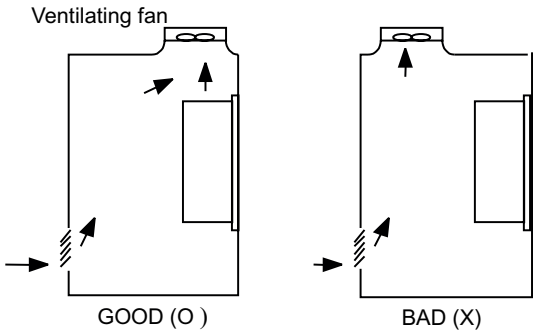




- Protect from moisture and direct sunlight.
- Do not install the drive in any environment where it is exposed to waterdrops, oil mist, dust, etc. Install the drive in a clean place or inside a “totally enclosed” panel any suspended matter is not entered.
- When two or more drives are installed or a cooling fan is mounted in a panel, the drives and fan must be installed in proper positions with extreme care to keep the ambient temperature below the permissible range.
- Install the drive using appropriate sized screws or bolts to insure the drive is firmly fastened.



[When installing several drives in a panel]



[When installing ventilating fan in a panel]

⌘ **Note:** Take caution on proper heat ventilation when installing drives and fans in a panel.

CAUTION

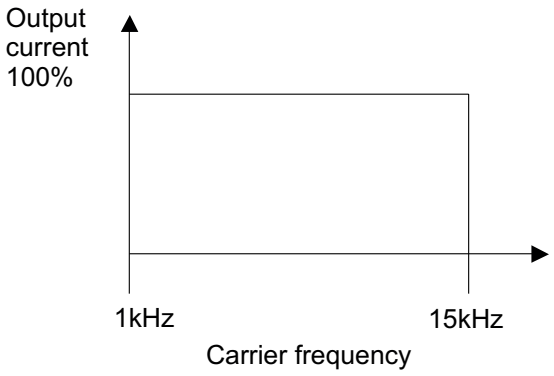
Risk of Electrical Shock
More than one source of power may be present. More than one disconnect switch may be required to de-energize the equipment before servicing.

Temperature Derating Information

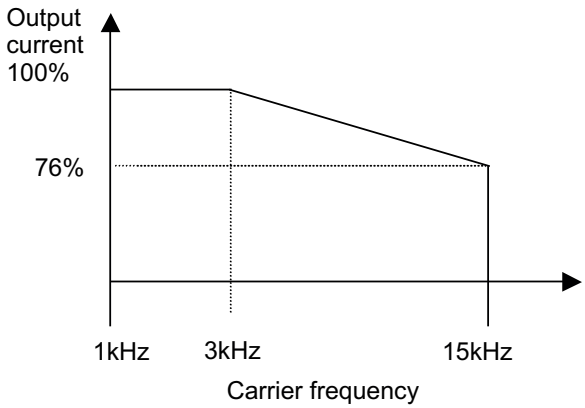
3.3 Temperature Derating Information

- Load current according to parameter [Carrier frequency].

Changing Carrier Freq. at temperature rise (Default)



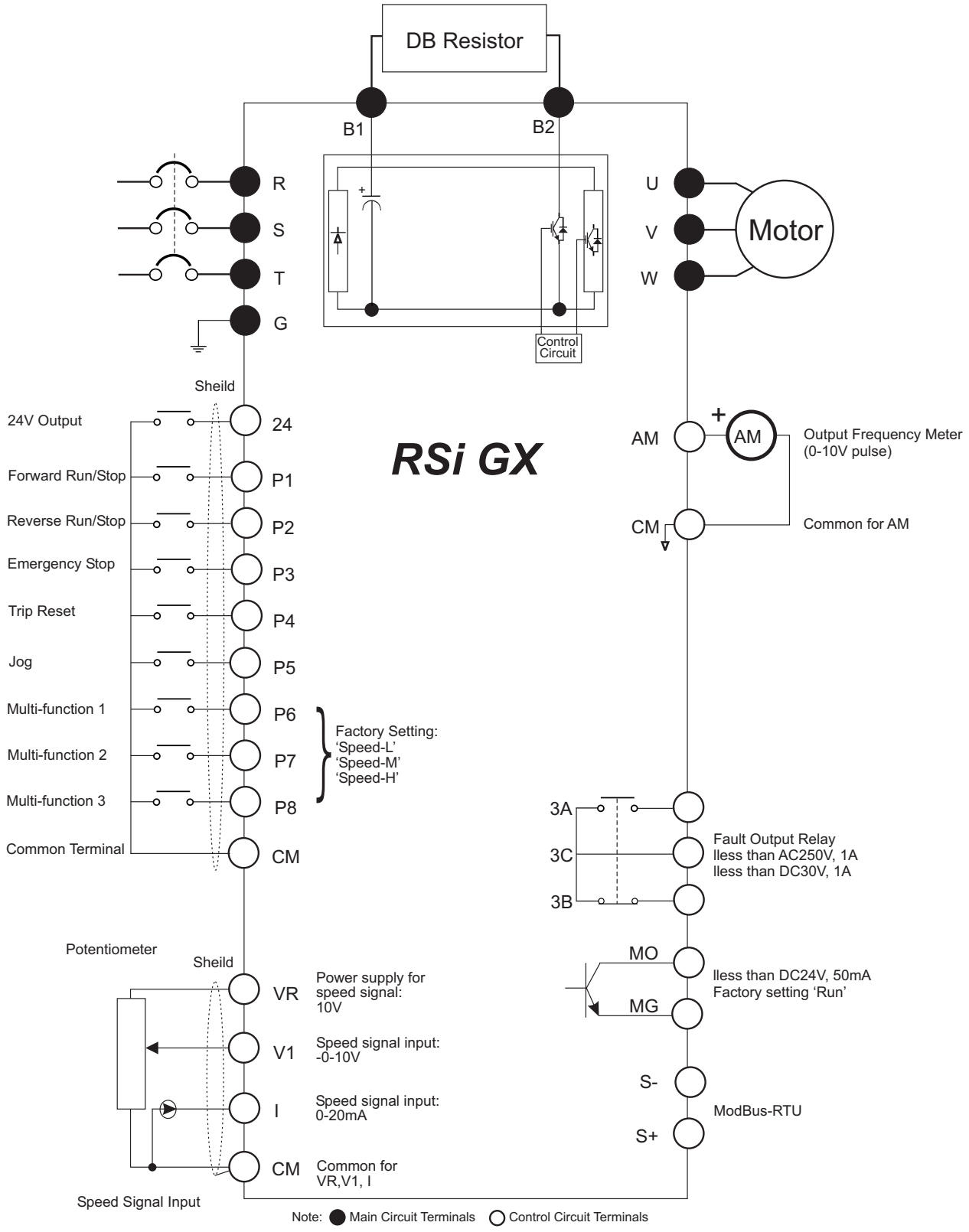
Using fixed Carrier Frequency



CAUTION:

1) The above graph is applied when drive is in use within the permissible ambient temperature. If the unit is installed in a panel, install it where heat dissipation is properly made to keep the panel ambient temp within the permissible range.
2) This derating curve is based on drive rated current when the rated motor for the drive is connected.

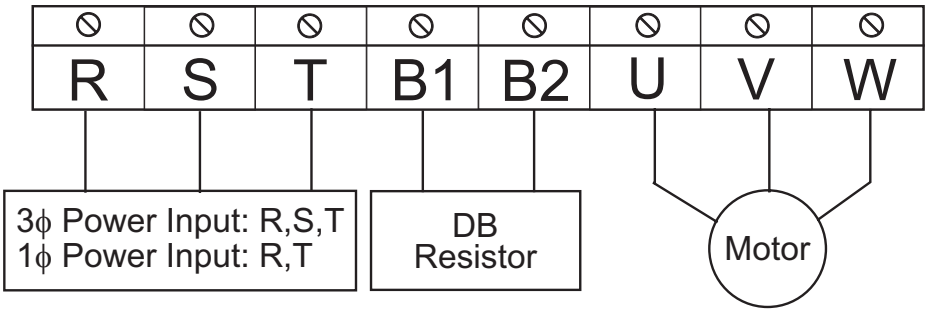
3.4 Basic Wiring Diagram



Power Terminals

3.5 Power Terminals

Figure : RSi GX Power Terminals

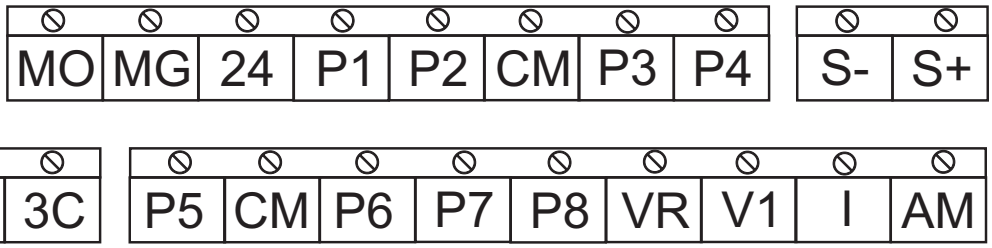


Symbol	Description
R	AC Line Input Terminal 3(1) phase, 200-230V AC for 200V class units and 380-460V AC for 400V class units. 1 Phase input terminals: R and T
S	
T	
U	3 Phase Power Output Terminals to Motor
V	
W	
B1	Dynamic Braking Resistor Connection Terminal
B2	

WARNING

Normal stray capacitance between drive chassis and the power devices inside the drive and AC line can provide a high impedance shock hazard. Do not apply power to the drive if the drive frame (Power terminal G) is not grounded.

3.6 Control Circuit Terminals



Terminal	Name	Description
P1-P8	Multi-function input terminal 1-8	Used for multi-function input.
CM	Common Terminal	Used for input signal common.
VR	Power Supply for external potentiometer	Used as power for the analog frequency setting. Maximum output is +12V, 100mA, Potentiometer 1-5kohm.
V1	Input terminal for voltage operation	Used for frequency reference and uses 0-10V for input. Maximum input voltage: -12~+12V input.
I	Input terminal for current operation	Used for frequency reference and uses 0-20mA input. Internal resistor:500Ω.
AM	Multi-function analog output terminal	Analog/digital output (For external monitoring) Max. output voltage: 11V, Max. output current: 100mA
MO	Multi-function open collector output	Use after defining the multi-function output terminal. DC24V, 50mA,or less.
MG	Ground terminal for external power supply	
24	24V external Power supply	Maximum output current: 100mA
3A	Multi-function relay output A contact	Activates when the protective function is operating. AC250V 1A or less. Fault: 3A-3C short (3B-3C open) Normal: 3B-3C short (3A-3C open)
3B	Multi-function relay output B contact	
3C	Common for multi-function relays	
S+, S-	Communication port	Communication port for MODBUS-RTU communication.

⌘ **Note:**

- Tie the control wires no more than 15cm away from the control terminals. Otherwise, it interferes with front cover reinstallation.
- Use copper wires rated 600V, 75Ω and higher.
- Use the recommended tightening torque when securing terminal screws.
- When you use external power supply (24V) for multi-function input terminal (P1-P8), terminals will be active above 12V level. Take caution not to drop the voltage below 12V.

3.6.1 Wiring Input and Output Power Terminals

General Precautions on Wiring:

- Apply the rated torque to terminal screws. Loosened screws can cause a short circuit and malfunction. Tightening the screws too much can damage the terminals and cause a short circuit and malfunction as well.
- Use copper wires with only a 600V, 75Ω rating for wiring.
- When a power supply is connected and applied to the output terminals (U,V,W), the internal circuits of the drive will be damaged.
- Use ring terminals with insulated caps when wiring the input power and the motor.
- Do not leave wire fragments inside the drive. Wire fragments can cause faults, breakdowns, and malfunctions.
- Use wires for input and output with sufficient thickness to ensure the voltage drop is less than 2%. If the wire length between the drive and the motor is long, and the drive is operating at low frequencies, the motor torque drops due to the voltage drop caused by the wire.
- The total wire length should be less than 500m. The overcurrent protective function can operate or the equipment connected to the output side can malfunction due to the increased leakage capacitance between the wiring when the motor is far away from the drive. The total wiring length should also be less than 500m when more than one motor is connected to the drive. Do not use a 3-wire cable for long distances.
- Connect only the recommended braking resistor between the B1, B2 terminals. Never short the B1 and B2 terminal. Shorting the terminals may cause internal damages to the drive.
- The main circuit of the drive contains high frequency noise, and can hinder communication equipment near the drive. Installing radio noise filters, line noise filter on the input side of the drive can reduce the hindrance.
- Do not use a phase advancing capacitor, surge suppressor, or radio noise filters on the output side of the drive. Doing so may damage these components.
- Always check the charge lamp of the power terminal is OFF before wiring the terminals. The capacitor is charged with high-voltage even after the power is disconnected, and can be dangerous.

WARNING

Power supply must be connected to the R,S, and T Terminals.
Connecting it to the U,V, W terminals causes internal damage to the drive. Arranging the phase sequence is not necessary.

Motor should be connected to the U,V,and W Terminals.
If the forward command (FX) is on, the motor should rotate counter clockwise when viewed from the load side of the motor. If the motor rotates in the reverse direction, switch the U and V terminals.

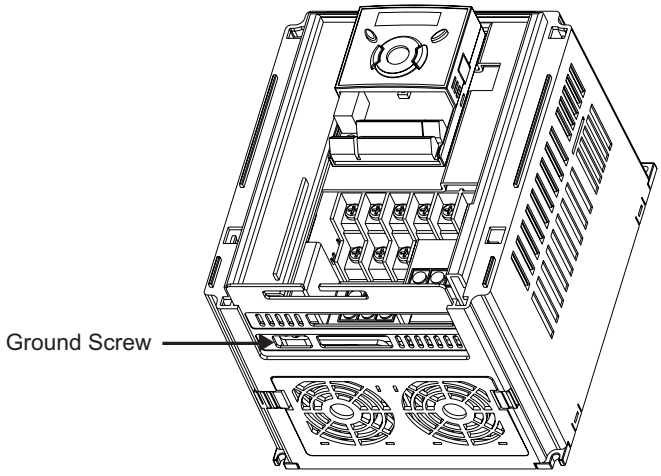
Grounding:

- The drive contains high power and high frequency switching devices, leakage current may flow between the drive and ground. Ground the drive to avoid electrical shock.
- If multiple drives are installed near each other, each must be connected to ground directly. Take care not to form a ground loop between the drives and the grounding location.
- The protective earth conductor must be the first one in being connected and the last one in being disconnected.
- The grounding wire shall comply with all local regulations. As a minimum,The grounding wire should be at least the thickness that is listed in the following table and as short as possible. Connect the grounding point as near to the drive as possible.
- Use the Type 3 grounding method (Ground impedance: Below 100Ω) for 230V class drives.
- Use the Special Type 3 grounding method (Ground impedance: Below 10Ω) for 460V class drives.
- Use the dedicated ground terminal to ground the drive. Do not use the screw in the case or chassis, etc. for grounding.

Grounding Procedure:

- Remove the front cover.
- Connect the grounding wire to the ground terminal through the opening for ground terminal as shown above. Enter the screw driver from vertical to the terminal and secure the screw tightly.

Motor Capacity	Grounding wire dimensions, AWG (mm_)	
	200V class	400V class
1.0-5.0 HP	12 (3.5)	14 (2)



Use of Isolation Transformers and Line Reactors
In most cases the RSi GX drive may be directly connected to a power source. However in the following cases a properly sized isolation transformer or a 3% or 5% line reactor should be used to minimize the risk of drive malfunction.

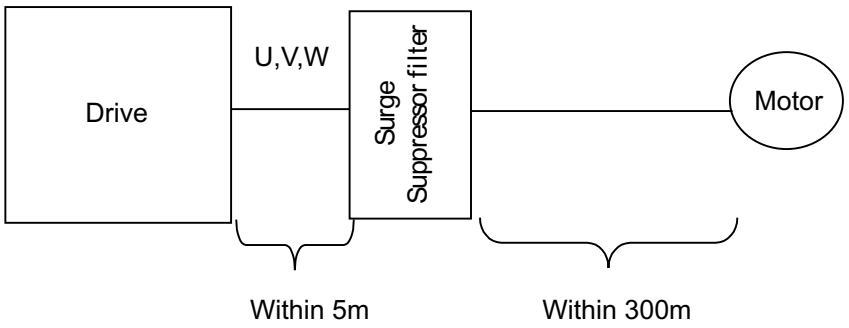
- When the source capacity exceeds ten (10) times the KVA rating of the drive.
- When power factor capacitors are located on the input source supplying the drive.
- When the power source experiences frequent power transients and/or voltage spikes.
- When the power source supplying the RSi GX drive also supplies other large electrical devices such as DC drives that contain rectifiers or other switching devices.
- When the drive is powered from an ungrounded (floating) Delta connected source. In this case a drive isolation transformer utilizing a grounded secondary should be used.

Motor Lead Length Specifictations
Excessive motor lead lengths may adversely effect the performance of the motor. The voltage of the pulses at the motor terminals can be almost double the input voltage of the drive. This in turn can cause additional stress on the motor insulation and shorten the life of the motor. The motor manufacturer should be consulted regarding the specifications of the motor insulation.

Lead lengths from the drive to the motor in excess of those listed below may require filters to be added to the output of the drive. Contact Benshaw for application assistance when using lead lengths in excess of those listed.
If an output filter is used it is recommended that the output filter is wired as follows:

Drive Voltage Rating	PWM Carrier Frequency	Suggested Max. Motor Lead Length
230V	All	300m (1000 ft)
460V	Less than or equal 5KHz	180m (600 ft)
	Greater than 5KHz	90m (300 ft)

- Wiring distance from drive output to filter input should not exceed 5 meters (16.4 feet).
- Wiring distance from filter to motor should not exceed 300 meters (984 feet).



3.6.2 Interference Supression Measures

Electrical and electronic devices are capable of influencing or disturbing each other through their connection cables or other intended and unintended metallic connections. Interference suppression measures (electromagnetic compatibility) consist of two elements: raising interference resistance and suppressing interference emission.

Correct installation of the drive in conjunction with local interference suppression measures has a crucial effect on minimizing or suppressing mutual interference.

The following guidelines assume a power source that is not already contaminated by high frequency interference. Other measures may be necessary to reduce or suppress interference if the power source is already contaminated. Please consult Benshaw's Electrical Application Engineering Department if the following recommended interference suppression measures do not produce the desired result. Refer to Appendix C for more information.

- When dealing with RFI (radio frequency interference), the surface area of the conductors is a more critical consideration than its cross sectional area. Since high frequency interference currents tend to stay towards the outer surface (skin effect), braided copper tapes of equal cross section should be used.
- A central grounding (or earthing) point should be used for interference suppression. Route the ground cables radially from this point (star connection). Avoid making any ground loops that may lead to increased interference. The drive and all components used for interference suppression, particularly the shield of the motor cable, should be connected over as large a surface area as possible when connecting it to ground. Remove the paint from contact surfaces if necessary to ensure a good electrical connection.
- Take care not to damage the shield's cross section and verify the continuity of the shield when splicing wires. Splices raise the RF resistance of the shield and can cause RF to radiate rather than continue in the shield. Shields, particularly those on control cables, must not be routed through pin contacts (pluggable connectors). When shielded cables must pass through a plug connection, use the metallic hand guard of the plug for the continuation of the shield. It is strongly recommended that the shield be uninterrupted whenever possible.
- Use a shielded motor cable that is grounded over a large surface area at both ends. The shield on this cable should be uninterrupted. If a shielded motor cable can not be used, the unshielded motor lines should be laid in a metal conduit or duct which is uninterrupted and grounded at both ends.

When selecting shielded cable for use as motor leads it is important to select a cable that is designed for operation at the frequencies and power levels involved with a variable frequency drive. Improper selection of motor cables can cause high potential to exist on the shield. This could cause damage to the drive or other equipment and can pose a safety hazard.

Many cable manufactures have shielded drive cable available. The following cables are acceptable for this purpose: OLFlex Series 150CY, 110CY, 110CS, 100CY, 100CS, and 540CP. Siemens CordaflexSM is also acceptable. Some of these cables are VDE-approved only; others carry VDE, UL, CSA, or a combination of these ratings. Be sure to confirm that the cables meet the appropriate local regulatory requirements.

OLFlex cables are available from OLFlex Wire & Cable, 30 Plymouth Street, Fairfield NJ 07004, 800-774-3539

Cordaflex cables are available from Siemens Energy and Automation, Inc., Power Cables, 3333 State Bridge Road, Atlanta GA 30202, 800-777-3539

- If the installation requires the use of an output reactor, the reactor, as with a line filter, should be placed as close as possible to the drive.
- Low voltage control wires longer than 1 meter (3ft) must use shielded cable and the shield must be terminated at the proper CM connection. Note that the connection to the CM rather than earth ground is allowed because the RSi SG drive has isolated control inputs. If the signal run exceeds 9 meters (30ft), a 0-20mA or 4-20mA signal should be used as it will have better noise immunity than a low-level voltage signal.
- Other loads connected to the power source may produce voltage transients (spikes) that may interfere with or damage the drive. Input line reactors or input filters can be used to protect the drive from these transients.
- If the drive is operated from switchgear devices or is in close proximity to switchgear devices (in a common cabinet), the following procedures are recommended as a precaution to prevent these devices from interfering with the drives operation.
- Wire the coils of DC devices with freewheeling diodes. The diodes should be placed as close as possible to the physical coil of the device.
- Wire the coils of AC devices with RC type snubber networks. Place the snubber as close as possible to the physical coil of the device.
- Use shielded cables on all control and monitoring signals.
- Route distribution cables (for example, power and contactor circuits) separately from the drive's control and monitoring signal cables.

3.6.3 Wires and Terminal lugs

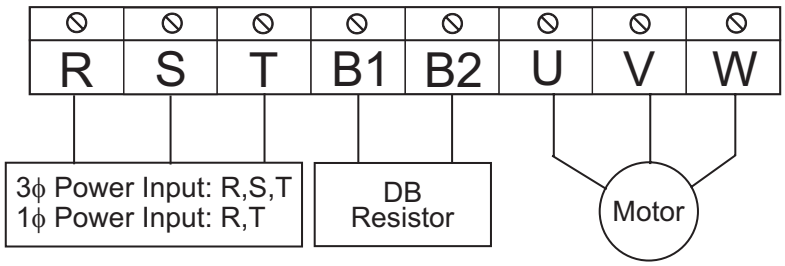
The input power and motor cables must be of the appropriate type and dimensions according to the applicable national and local (NEC, etc) regulations to carry the rated current of the drive. It is recommended that the cables be at least the size listed below in the following table.

⌘ **Note:** Strip the sheaths of the wire insulation 7mm when a ring terminal is not used for power connection.

Drive Capacity		Terminal Screw Size	Screw Torque[1] Kgf•cm / lb-in	Grounding Method	Wire[2]			
					mm^2		AWG	
					R,S,T	U,V,W	R,S,T	U,V,W
200V	1.0HP	M3	10/8.7	Type 3	2	2	14	14
	2.0HP	M3	10/8.7		2	2	14	14
	3.0HP	M3	15/13		2	2	14	14
	5.0HP	M3	15/13		3.5	3.5	12	12
400V	1.0HP	M3	10/8.7	Special Type 3	2	2	14	14
	2.0HP	M3	15/13		2	2	14	14
	3.0HP	M3	15/13		2	2	14	14
	5.0HP	M3	15/13		2	2	14	14

1) Apply the rated torque to terminal screws. Loose terminal screws can cause a short circuit or other malfunction. Over tightening the terminal screws/bolts may permanently damage the terminals.

3.6.4 Power and Motor Connection



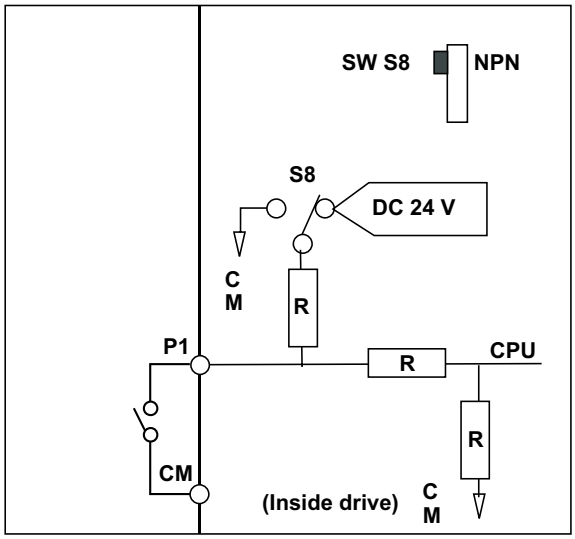
Power supply must be connected o the R,ST terminals.
Connecting it to the U,V,W terminals causes internal damages to the drive Arrangng the phase sequence is not necessary.

Motor should be connected to the U,V,W terminals.
If the forward swich (FX) is on, the motor should rotate counter clockwise when viewed rom the load side of the motor. If the mtor rotates in the reverse direction, switch the U and V terminals.

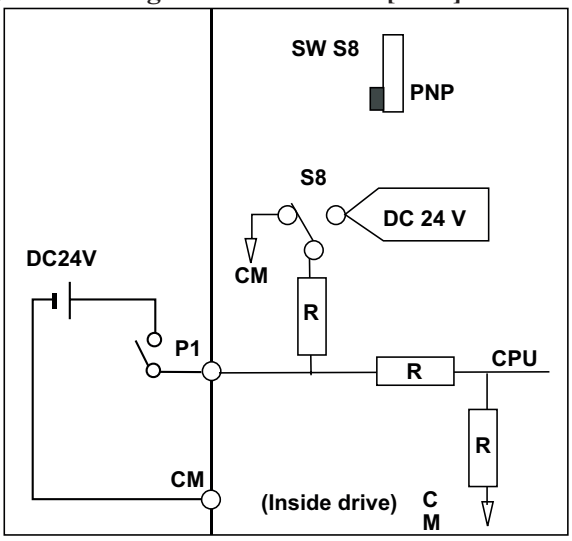
3.7 PNP/NPN selection and connector for communication option

The RSi GX provides PNP/NPN modes for sequence input terminal on the control circuit. Connection method is shown below.

1) When using DC 24V inside the drive [NPN]



2) When using external DC 24V [PNP]



3.8 Recommended Breakers

Model 230V	Breaker	
	Current[A]	Voltage[V]
1HP	30	220
2HP	30	220
3HP	30	220
5HP	30	220

Model 460V	Breaker	
	Current[A]	Voltage[V]
1HP	30	460
2HP	30	460
3HP	30	460
5HP	30	460

3.9 Recommended AC Reactors

Model	External Fuse		AC Reactor
	Current[A]	Voltage[V]	
RSi001GX2B	10A	500	2.13mH, 5.7A
RSi002GX2B	15A	500	1.20mH, 10A
RSi003GX2B	25A	500	0.88mH, 14A
RSi005GX2B	40A	500	0.56mH, 20A
RSi001GX4B	10A	500	8.63mH, 1.3A
RSi002GX4B	10A	500	4.81mH, 4.8A
RSi003GX4B	20A	500	3.23mH, 7.5A
RSi005GX4B	20A	500	2.34mH, 10A

- Short Circuit Rating
  "Suitable For Use ON a Circuit Capable of Delivering Not More Than 5,000RMS Symmetrical Amperes. 240V drives or 480V drives Volts Maximum."
- Short Circuit FUSE/BREAKER Marking
  Use Class H or K5 UL Kisted Input Fuse and UL Listed Breaker Only. See the table above for the voltage and current rating of the fuse and the breaker.

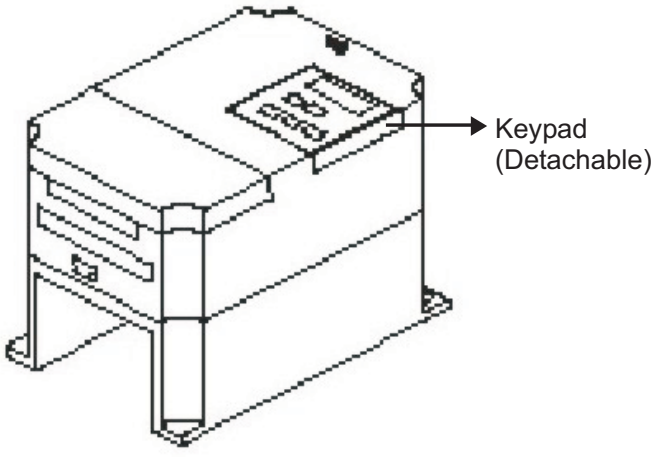
3.9.1 Keypad

Wiring the Keypad

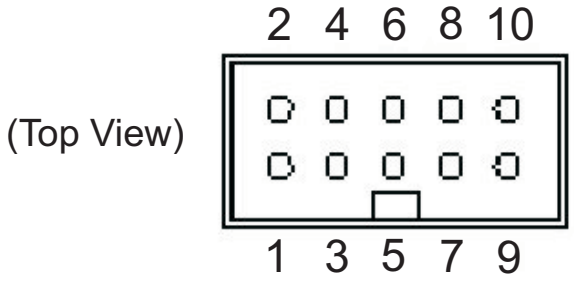
Keypad is installed before shipping for standard type models as shown below. When using an optional remote cable, install the buffer cover and connect the remote cable. If the keypad is not connected properly, the letters will not be displayed.

⌘ **Note**: Do not connect the keypad and remote cable while the drive power is introduced.

⌘ **Note:** Do not touch the live part of the keypad connector. Doing this may cause personal injury or electric shock.



Keypad Connector Pin Configuration (Drive side)



Pin No.	Pin Name	Keypad	Description
1	5V	Used	5V DC power supply (Isolated from VR, V1, I of control terminal)
2	GND	Used	5V DC power ground (Isolated from CM of control terminal)
3	RES	Used	Used for writing the flash ROM inside drive.
4	VPP	Used	
5	LAT	Used	Latch signal for transmitting/receiving
6	TXD	Used	Transmitting signal pin
7	CLK	Used	Clock signal pin
8	RXD	Used	Receiving signal pin
9		Not Used	
10		Not Used	

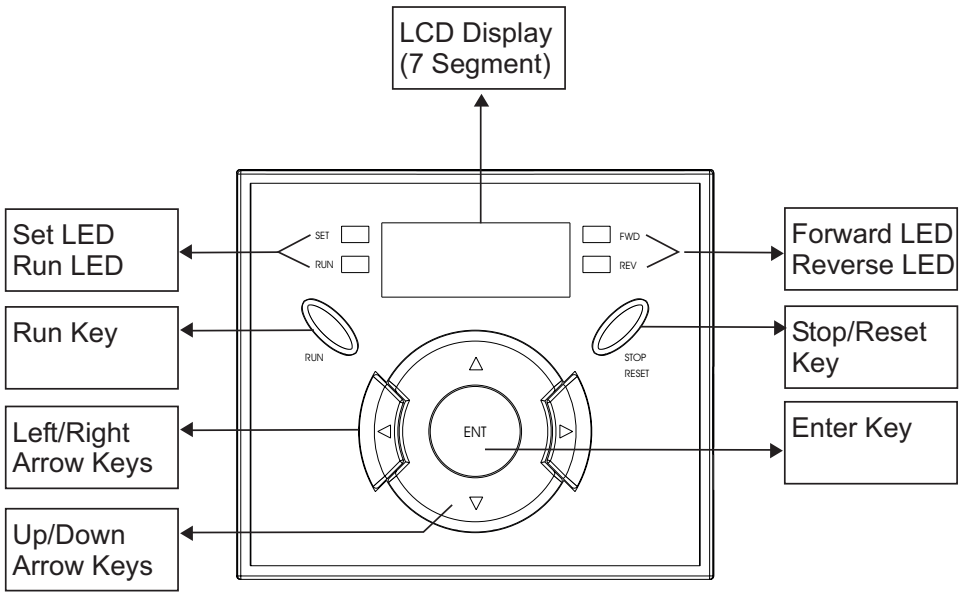
4 Operation

Keypad and Parameter Group Setting

4.1 Keypad and Parameter Group Setting

4.1.1 Keypad Description

The RSi-GX 7-segment keypad displays up to 4 english letters and numbers, and the user can directly check various settings of the drive.The following is an illustration of the keypad and the functions of each part.



Class	Display	Name	Description
LED	FWD	Forward Run Display	Lit during forward run. Blinks when a fault occurs.
	REV	Reverse Run Display	Lit during reverse run. Blinks when a fault occurs.
	RUN	Operating.	Lit during operation. Blinks when a fault occurs.
	SET	Setting.	Lit during parameter setting. Blinks when a fault occurs.
	7 Segment	7 Segment LED	Displays operation status and parameter information.
Keys	RUN	Run Key	Run command.
	STOP/RESET	Stop/Reset key	Stop: Stop command during operation. Reset: Reset command when fault occurs.
	▲	Up Arrow Key	Used to scroll through codes or increase parameter value.
	▼	Down Arrow Key	Used to scroll through codes or decrease parameter value.
	◀	Left Arrow Key	Used to jump to other parameter groups or move cursor to the left to change the parameter value.
	▶	Right Arrow Key	Used to jump to other parameter groups or move cursor to the right to change the parameter value.
	●	Enter Key	Used to set the parameter value or save the changed parameter value.

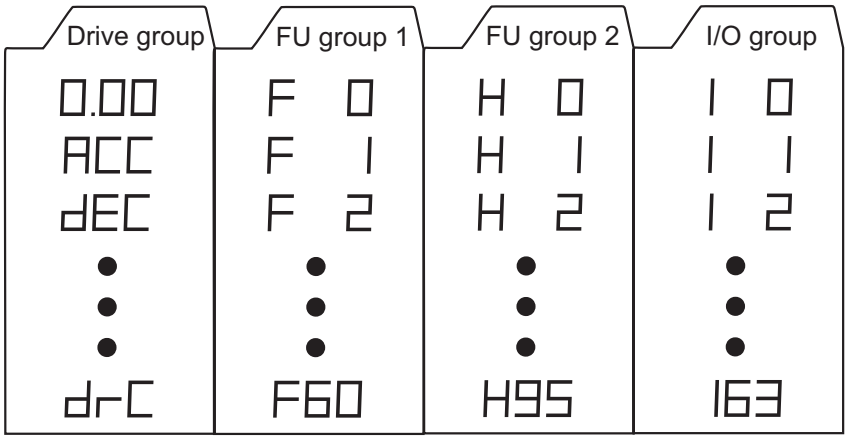
4.2 Parameter Setting and Adjustment

Numerous parameters are built into the drive. The keypad allows the operator to operate the drive by setting the required parameters, and entering the proper value according to the load and operating conditions. Refer to chapter 6 for a detailed description of the functions.

4.2.1 Moving to other Groups

There are 4 different parameter groups in the RSi GX series as shown below. Moving to other parameter groups is only available in the first code of each parameter group. To do this press the (◀) left or (▶) right arrow key.

- Target frequency can be set at **0.0** (the 1st code of the drive group). Even though the preset value is 0.0, it is user-settable. The changed frequency will be displayed after it is changed.



Drive Group	Basic parameters necessary for the drive to run. Parameters such as Target frequency, Accel/Decel time settable.
Function Group 1	Basic function parameters to adjust output frequency and voltage.
Function Group 2	Advanced function parameters to set parameters for such as PID Operation and second motor operation.
I/O (Input/Output) Group	Parameters necessary to change I/O functions.

- **How to move to groups at the 1st code of each group**

1	0.00	The 1st code in Drive group “0.00” will be displayed when AC input power is applied. Press the right arrow (▶) key once to go to Function group 1.
2	F 0	The 1st code in Function group 1 “F 0” will be displayed. Press the right arrow (▶) key once to go to Function group 2.
3	H 0	The 1st code in Function group 2 “H 0” will be displayed. Press the right arrow (▶) key once to go to I/O group.
4	I 0	The 1st code in I/O group “I 0” will be displayed. Press the right arrow (▶) key once again to return to Drive group.
5	0.00	Return to the 1st code in Drive group “0.00”.

⌘ **Note:** If the left arrow key (◀) is used, the above will be executed in the reverse order.

- **To move from the F15 to function group 2**

1	F 15	In F15, press the left (◀) or right (▶) key. Pressing the key goes to the first code of the group.
2	F 0	The 1st codein function group 1 "F0" is displayed. Press the right arrow (▶) key.
3	H 0	The 1st code in function group 2 “H 0” will be displayed.

4.2.2 How to Change the Codes in a Group

- **Code change in Drive group**

1	0.00	In the 1st code in Drive group “0.00”, press the Up (▲) key once.
2	ACC	The 2nd code in Drive group “ACC” is displayed. Press the Up (▲) key once.
3	dEC	The 3rd code “dEC” in Drive group is displayed. Keep pressing the Up (▲) key until the last code appears.
4	drC	The last code in Drive group “drC” is displayed. Press the Up (▲) key again.
5	0.00	Return to the first code of Drive group.

⌘ **Note:** Use Down (▼) key for the opposite order.

- **Code Jump**

When moving from parameter "F 0" to "F23" directly.

1	F 0	Press the Ent (●) key in “F 0”.
2	1	1 (the code number of F1) is displayed. Use the Up (▲) key to set to 3.
3	03	“03” is displayed by pressing the Left (◀) key once to move the cursor to the left. The numeral having a cursor is displayed brighter. In this case, 0 is active. Use the Up (▲) key to set to 2.
4	23	3 is set. Press the Ent (●) key once.
5	F 23	Moving to F 23 has been complete.

⌘ **Note:** Function group 2 and I/O group are settable with the same setting.

• **Navigating codes in a group**
When moving from F 1 to F15 in Function group 1

1	F 1	In F 1, continue pressing the Up (▲) key until F15 is displayed.
2	F 15	Moving to F15 has been complete.

⌘ **Note:** The same applies to Function group 2 and I/O group.

⌘ **Note:** Some codes will be skipped in the middle of increment (▲)/decrement (▼) for code change. That is because it is programmed that some codes are intentionally left blank for future use or the codes user does not use are invisible.

For example, when F24 [High/low frequency limit select] is set to "O (No) ", F25 [High frequency limit] and F26 [Low frequency limit] are not displayed during code change. But When F24 is set to "1(Yes)", F25 and F26 will appear on the display.

4.2.3 Parameter Setting

• **Changing parameter values in Drive group**
When changing ACC time from 5.0 sec to 16.0 sec.

1	0.00	In the first code "0.00", press the Up (▲) key once to go to the second code.
2	ACC	ACC [Accel time] is displayed. Press the Ent key (●) once.
3	5.0	Preset value is 5.0, and the cursor is in the digit 0. Press the Left (◀) key once to move the cursor to the left.
4	5.0	The digit 5 in 5.0 is active. Then press the Up (▲) key once.
5	6.0	The value is increased to 6.0. Press the Left (◀) key to move the cursor to the left.
6	06.0	0.60 is displayed. The first 0 in 0.60 is active. Press the Up (▲) key once.
7	16.0	16.0 is set: Press the Ent (●) key once. 16.0 is blinking: Press the Ent (●) key once again to return to the parameter name.
8	ACC	ACC is displayed. Accel time is changed from 5.0 to 16.0 sec.

⌘ **Note:** In step 7, pressing the Left (◀) or Right (▶) key while 16.0 is blinking will disable the setting.

⌘ **Note:** Pressing the Left (◀)/ Right (▶) /Up (▲) /Down (▼) key while cursor is blinking will cancel the parameter value change. Pressing the Enter key (●) in this status will enter the value into memory.

• **Frequency Setting**

When changing run frequency to 30.05 Hz in Drive group.

1	0.00	In “0.00”, press the Ent (●) key once.
2	0.00	The second decimal 0 becomes active. Press the UP (▲) key until 5 is displayed.
3	0.05	Press the Left (◀) key once.
4	0.05	The first decimal 0 becomes active. Press the Left (◀) key once.
5	0.05	Press the Left (◀) key once.
6	00.05	Set 3 using UP (▲) key.
7	30.05	Press the Ent (●) key. 30.05 is blinking. Press the Ent (●) key.
8	30.05	30.05 is entered into memory.

⌘ **Note:** The RSi-GX display can be extended to 5 digits using left (◀)/right (▶) keys.
⌘ **Note:** The parameter setting is disabled when pressing other than Enter Key in step 7.

• **Changing parameter value in Function group**

When changing the parameter value of F28 from 2 to 5.

1	F 0	In F0, press the Ent (●) key once.
2	1	Check the present code number. Increase the value to 8 by pressing the Up (▲) key.
3	8	When 8 is set, press the Left (◀) key once.
4	08	0 in 08 is active. Increase the value to 2 by pressing the Up (▲) key.
5	28	28 is displayed Press the Ent (●) key once.
6	F 28	The parameter number F28 is displayed. Press the Ent (●) key once to check the set value.
7	2	The preset value 2 is displayed. Increase the value to 5 using UP key (▲).
8	5	Press the Ent (●) key.
9	F 28	Code number will appear after 5 is blinking. Parameter change is complete. Press either Left (◀) or Right (▶) keys.
10	F 0	Moving to first code of Function group 1 is complete.

⌘ **Note:** The above setting is also applied to change parameter values in function group 2 and I/O group.

4.2.4 Monitoring of Operation Status

• **Output current display**

Monitoring output current in Drive group.

1	0.00	In [0.0], continue pressing the Up (▲) or Down (▼) key until [CUr] is displayed.
2	CUr	Monitoring output current is provided in this parameter. Press the Enter (●) key once to check the current.
3	5.00	Present output current is 5 A. Press the Enter (●) key once to return to the parameter name.
4	CUr	Return to the output current monitoring code.

⌘ **Note:** Other parameters in Drive group such as dCL (Drive DC link current) or vOL (Drive output voltage) can be monitored via the same method.

• **Fault display**

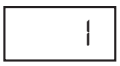
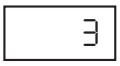
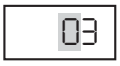
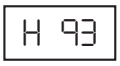
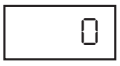
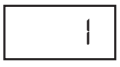
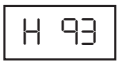
1	OCt	This message appears when an Overcurrent fault occurs. Press the Enter (●) key or UP/Down key once.
2	30.00	The run frequency at the time of fault (30.0) is displayed. Press the Up (▲) key once.
3	5.0	The output current at the time of fault is displayed. Press the Up (▲) key once.
4	ACC	Operating status is displayed. A fault occurred during acceleration. Press the STOP/RST key once.
5	nOn	A fault condition is cleared and “nOn” is displayed.

• **How to monitor fault condition in Drive group**

The fault type is displayed at the DRV group when a fault occurs, and the frequency, current, operating status (accelerating, decelerating, in constant speeds) can be monitored by using the UP, DOWN key. (Ex: Fault occurred when the drive was accelerating at 40.28 Hz, 20.5A) 4 LED is blinking in this situation. Fault status can be removed by using the STOP/RESET key, and the LED turns off. (The drive must be turned OFF and turned ON again to remove HW fault status.) When more than one fault occurs at the same time the information can only be displayed for a maximum of three faults.

• **Parameter Initialize**

How to initialize parameters of all four groups in H93

1		In H0, press the Enter (●) key once.
2		Code number of H0 is displayed. Increase the value to 3 by pressing the Up (▲) key.
3		In 3, press the Left (◀) key once to move the cursor to the left.
4		03 is displayed. 0 in 03 is active. Increase the value to 9 by pressing the Up (▲) key.
5		93 is set. Press the Enter (●) key once.
6		The parameter number is displayed. Press the Enter (●) key once.
7		Present setting is 0. Press the Up (▲) key once to set to 1 to activate parameter initialize.
8		Press the Enter (●) key once.
9		Return to the parameter number after blinking. Parameter initialize has been complete. Press the either Left (◀) or Right (▶) key.
10		Return to H0.

⌘ **Note:** This parameter is used to reset the drive to its factory defaults.

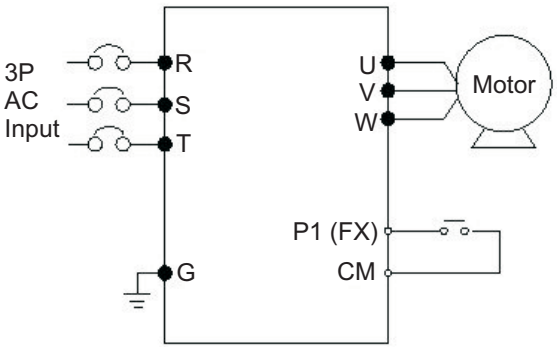
4.3 Frequency Setting and Basic Operation

CAUTION

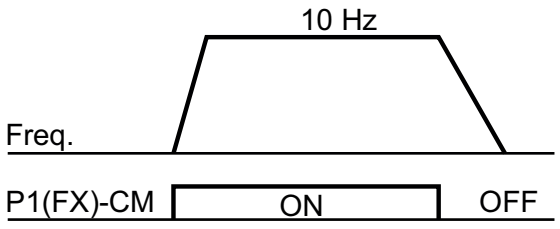
The following instructions are given based on the fact that all parameters are set to factory defaults. Results could be different if parameter values are changed. In this case, initialize parameter values back to factory defaults and follow the instructions below.

- **Frequency Setting via keypad and operating via terminals**

1		Apply AC input power to the drive.
2	0.00	When 0.00 appears, press the Ent (●) key once.
3	0.00	The second digit in 0.00 is lit as shown left. Press the Left (◀) key three times.
4	00.00	00.00 is displayed and the first 0 is lit. Press the Up (▲) key.
5	10.00	10.00 is set. Press the Ent (●) key once. 10.00 is blinking. Press the Ent (●) key once.
6	10.00	Run frequency is set to 10.00 Hz when the blinking stops. Turn on the switch between P1 (FX) and CM terminals.
7	10.00	RUN lamp begins to blink with FWD (Forward Run) lit and accelerating frequency is displayed on the LED. When target run frequency 10Hz is reached, 10.00 is displayed. Turn off the switch between P1 (FX) and CM terminals.
8	10.00	RUN lamp begins to blink and decelerating frequency is displayed on the LED. When run frequency is reached to 0Hz, Run and FWD lamp turn off and 10.00 is displayed.



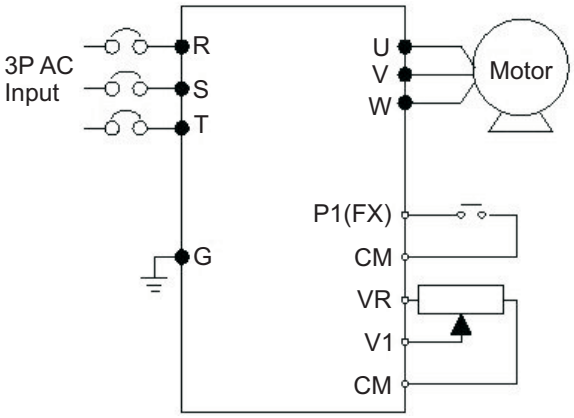
Wiring



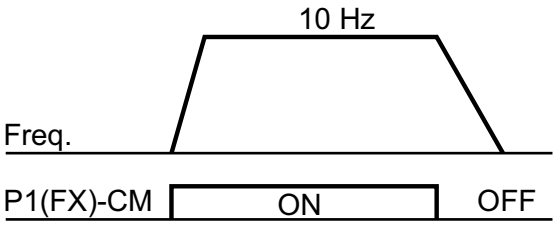
Operating pattern

- **Frequency setting via potentiometer & operating via terminals**

1		Apply AC input power to the drive.
2	0.00	When 0.00 appears Press the Up (▲) key four times.
3	Fr9	Frq is displayed. Frequency setting mode is selectable. Press the Ent (●) key once.
4	0	Present setting method is set to 0 (frequency setting via keypad). Press the Up (▲) key three times.
5	3	After 3 (Frequency setting via potentiometer) is set, press the Ent (●) key once.
6	Fr9	Frq is redisplayed after 3 stops blinking. Turn the potentiometer to set to 10.00 Hz in either Max or Min direction.
7	10.00	Turn on the switch between P1 (FX) and CM (See Wiring below). RUN lamp begins to blink with FWD lamp lit and the accelerating frequency is displayed on the LED. When run frequency 10Hz is reached, the value is displayed as shown left. Turn off the switch between P1 (FX) and CM terminals.
8	10.00	RUN lamp begins to blink and decelerating frequency is displayed on the LED. When run frequency is reached to 0Hz, Run and FWD lamp turn off and 10.00 is displayed.



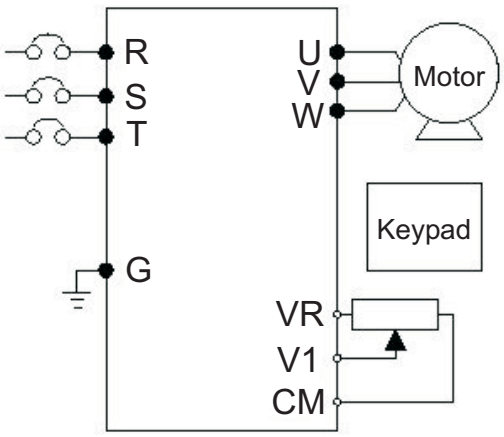
Wiring



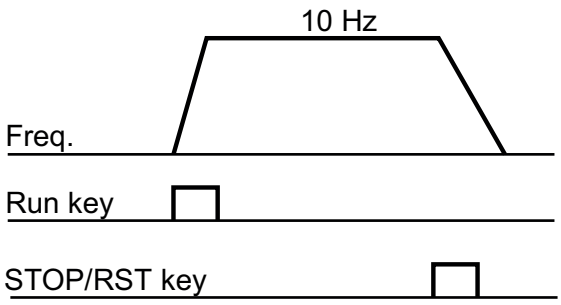
Operating pattern

- **Frequency setting via potentiometer & operating via the Run key**

1		Apply AC input power to the drive.
2	0.00	When 0.00 is displayed, press the Up (▲) key three times.
3	drv	"drv" is displayed. Operating method is selectable. Press the Ent (●) key.
4	1	Check the present operating method ("1": Run via control terminal). Press the Ent (●) key and then Down (▼) key once.
5	0	After setting "0", press the Ent (●) key. When 0 is blinking, press the Ent again.
6	drv	"drv" is displayed after "0" is blinking. Operation method is set via the Run key on the keypad. Press the Up (▲) key once.
7	Fr9	Different frequency setting method is selectable. Press the Ent (●) key.
8	0	Check the present frequency setting method ("0" is run via keypad). Press the Up (▲) key three times.
9	3	After checking "3" (frequency setting via potentiometer), press the Ent (●) key.
10	Fr9	"Frq" is displayed after "3" is blinking. Frequency setting is set via the potentiometer on the keypad. Turn the potentiometer to set to 10.0 Hz in either Max or Min direction.
11	10.00	Press the Run key on the keypad. RUN lamp begins to blink with FWD lamp lit and accelerating frequency is displayed on the LED. When run frequency 10Hz is reached, 10.00 is displayed as shown left. Press the STOP/RST key.
12	10.00	RUN lamp begins to blink and decelerating frequency is displayed on the LED. When run frequency is reached to 0Hz, Run and FWD lamp turn off and 10.00 is displayed.



Wiring



Operating pattern

Operation with Keypad and Control Terminal

4.4 Operation with the Keypad and Control terminal

When the operation reference signal is given to the control terminal and the frequency setting is given by the keypad, set the DRV-03 [Drive mode] to Fx/Rx-1, and set the DRV-04 [Frequency mode] to the Keypad. The frequency reference signal is set from the control terminal, and the forward, reverse, stop key of the keypad will be invalid.

1. Turn the power ON and set the operation and the frequency setting.
2. Set the drv [Operation Reference Source Selection] to Fx/Rx-1, and the Frq [Frequency Reference Source Selection] to Keypad.
3. Turn ON the operation reference signal FX (or RX). Keypad LED (FWD key or REV key) will turn ON.
4. Set the operating frequency with the keypad. Use the arrow keys and set the frequency to 50.00Hz.
   The motor will rotate at 50Hz. The LED (RUN) of the keypad will blink when the drive is accelerating or decelerating.
5. Turn the operation reference signal FX (or RX) OFF. The LED (FWD of REV) of the keypad will turn ON.

4.4.1 Operation with Control terminal

1. Turn the power ON and set the operation and the frequency reference to the control terminal mode.
2. Set the drv [Operation Reference Source Selection] to Fx/Rx-1, and the Frq [Frequency Reference Source Selection] to V1.
3. Set the analog frequency reference by turning the volume (frequency volume) slowly to the right. The keypad will display the output frequency (50.00 Hz).
4. By slowly turning the volume (frequency volume) to the left will decrease the output frequency. The drive will stop operating and the motor will come to a halt when the frequency reaches 0.00Hz.
5. Turn OFF the operation reference signal FX (or RX).

4.4.2 Operation with Keypad

1. Turn the power ON and set the operation and the frequency reference to the keypad operating mode.
2. Set the drv [Operation Reference Source Selection] to Keypad, and the Frq [Frequency Reference Source Selection] to Keypad-1.
3. Use the arrow keys to set the operating frequency to 50.00Hz. When the drive is not running the command frequency is displayed.
4. Press the RUN key. The motor will rotate and the keypad will display the output frequency.
5. Press the STOP/RESET key. The motor will decelerate and come to a halt, and the keypad will display the command frequency.

⌘ **Note:** The user can also operate the drive by setting the operation reference signal from the Keypad, and sending the frequency reference signal to the control terminal. (Set DRV-03 [Drive mode] to “Keypad”, and the DRV-04 [Frequency mode] to “V1”.)

5 Parameter List

Parameter List

5.1 Drive Group

CODE	Parameter Name	Keypad Display	Setting Range	Factory Default	Adj. during run	Page
DRV-00	Frequency command	0.00	0-400 [Hz]	0.00	Yes	58
DRV-01	Acceleration Time	ACC	0-6000 [sec]	5.0 [sec]	Yes	58
DRV-02	Deceleration Time	dEC	0-6000 [sec]	10.0 [sec]	Yes	58
DRV-03	Drive Mode (Run/Stop method)	drv	0 (Keypad) 1 (Fx/Rx-1) 2 (Fx/Rx-2) 3 (RS485)	1 (Fx/Rx-1)	No	59
DRV-04	Frequency Mode (Freq. setting method)	Frq	0 (Keypad-1) 1 (Keypad-2) 2 (V1 1) 3 (V1 2) 4 (Term. I) 5 (Term.V1 1 + Term.I) 6 (Term.V1 2 + Term. I) 7 (RS485)	0	No	60
DRV-05	Step Frequency 1	Stl	0-400 [Hz]	10.00 [Hz]	Yes	61
DRV-06	Step Frequency 2	St2		20.00 [Hz]		
DRV-07	Step Frequency 3	St3		30.00 [Hz]		
DRV-08	Output Current	CUr	*[A]	-[A]	-	62
DRV-09	Motor RPM	rPM	*[rpm]	-[rpm]	-	62
DRV-10	DC link Voltage	dCL	*[V]	-[V]	-	62
DRV-11	User Display Selection	vOL	vOL Por tOr	vOL	-	62
DRV-12	Fault Display	nOn	-	None nOn	-	63
DRV-13	Motor Direction Set	drC	F (Forward) r (Reverse)	F	Yes	63
DRV-14	Drive Mode 2	drv2[1]	0-2	1	No	64
DRV-15	Frequency Mode (Freq. setting method 2)	Frq2	0-6	0	No	64

[1] Only displayed when one of the multi-function input terminals 1-8 [I17-I24] is set to "22".

5.2 Function Group 1 [FU1]

Code [FU1]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
F0	Jump Code	1-60	1	Yes	65
F1	Run Prevention	0 (Fwd/Rev Run Disable) 1 (Forward Run Disable) 2 (Reverse Run Disable)	0 None	No	65
F2	Acceleration Pattern	0 (Linear) 1 (S-Curve)	0 Linear	No	66
F3	Deceleration Pattern	0 (Linear) 1 (S-Curve)	0 Linear	No	
F4	Stop Mode Select	0 (Decel to Stop) 1 (DC-brake to Stop) 2 (Free-run to Stop)	0 Decel to Stop	No	67
F8	DC Brake Start Frequency	0.1-60 [Hz]	5.00 [Hz]	No	68
F9	DC Brake Wait Time	0-60 [sec]	0.1 [sec]	No	68
F10	DC Brake Voltage	0-200 [%]	50 [%]	No	68
F11	DC Brake Time	0-60 [sec]	1.0 [sec]	No	69
F12	DC Brake Start Voltage	0-200 [%]	50 [%]	No	69
F13	DC Brake Start Time	0-60 [sec]	0.0 [sec]	No	70
F14	DC Pulse at Start	0-60 [sec]	1.0 [sec]	No	70
F20	Jog Frequency	0-400 [Hz]	10.00 [Hz]	Yes	71
F21[2]	Maximum Frequency	40-400 [Hz]	60.00 [Hz]	No	71
F22	Base Frequency	30-400 [Hz]	60.00 [Hz]	No	72
F23	Starting Frequency	0-10 [Hz]	0.50	No	72
F24	Frequency Limit Selection	0 (No) 1 (Yes)	0 (No)	No	72
F25[3]	High Limit Frequency	0.1-400 [Hz]	60.00 [Hz]	No	73
F26	Low Limit Frequency	0.1-400 [Hz]	0.50 [Hz]	No	73
F27	Torque Boost Select	0 (Manual) 1 (Auto)	0 (Manual)	No	74
F28	Torque Boost in Forward	0-15 [%]	2.0%	No	75
F29	Torque Boost in Reverse		2.0%	No	75
F30	V/F Pattern	0 (Linear) 1 (Square) 2 (User V/F)	0 (Linear)	No	75

Code [FU1]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
F31[4]	User V/F Frequency 1	0-400 [Hz]	15.00 [Hz]	No	76
F32	User V/F Voltage 1	0-100 [%]	25 [%]	No	
F33	User V/F Frequency 2	0-400 [Hz]	30.00 [Hz]	No	
F34	User V/F Voltage 2	0-100 [%]	50 [%]	No	
F35	User V/F Frequency 3	0-400 [Hz]	45.00 [Hz]	No	
F36	User V/F Voltage 3	0-100 [%]	75 [%]	No	
F37	User V/F Frequency 4	0-400 [Hz]	60.00 [Hz]	No	
F38	User V/F Voltage 4	0-100 [%]	100 [%]	No	
F39	Output Voltage Adjustment	40-110 [%]	100 [%]	No	77
F40	Energy Save Level	0-30 [%]	0 [%]	Yes	78
F50	Electronic Thermal Selection	0 (No) 1 (Yes)	0 (No)	Yes	78
F51[1]	Electronic Thermal Level for 1 minute	50-200 [%]	150 [%]	Yes	79
F52	Electronic Thermal Level for continuous		100 [%]	Yes	79
F53	Electronic Thermal Characteristic selection (Motor Type)	0 (Self-cool) 1 (Forced-cool)	0 Self-cool	Yes	80
F54	Overload Warning Level	30-150 [%]	150 [%]	Yes	80
F55	Overload Warning Hold Time	0-30 [sec]	10 [sec]	Yes	81
F56	Overload Trip Select	0 (No) 1 (Yes)	1 (Yes)	Yes	81
F57	Overload Trip Level	30-200 [%]	180 [%]	Yes	81
F58	Overload Trip Time	0-60 [sec]	60 [sec]	Yes	82
F59	Stall Prevention Mode Select	000-111 (bit set) Bit 0: during Accel. Bit 1: during steady speed Bit 2: during decel	000	No	82
F60	Stall Prevention Level	30-150 [%]	150 [%]	No	83

5.3 Function Group 2 [FU2]

Code [FU2]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
H0	Jump Code	1-95	1	Yes	83
H1	Fault History 1	-	nOn	-	84
H2	Fault History 2				
H3	Fault History 3				
H4	Fault History 4				
H5	Fault History 5				
H6	Reset Fault History	0 (No) 1 (Yes)	0 (No)	Yes	84
H7	Dwell Frequency	0.1 - 400 [Hz]	5.00 [Hz]	No	84
H8	Dwell Time	0-10 [sec]	0.0 [sec]	No	84
H10	Skip Frequency Select	0 (No) 1 (Yes)	0 (No)	No	85
H11[1]	Skip Frequency 1 Low	0.1 - 400 [Hz]	10.00 [Hz]	No	85
H12	Skip Frequency 1 High		15.00 [Hz]		
H13	Skip Frequency 2 Low		20.00 [Hz]		
H14	Skip Frequency 2 High		25.00 [Hz]		
H15	Skip frequency low limit 3		30.00 [Hz]		
H16	Skip frequency high limit 3		35.00 [Hz]		
H17	S-Curve accel/decel start side	1~100 [%]	40		85
H18	S-Curve accel/decel end side	1~100 [%]	40		85
H19	Input/Output Phase Loss Protection	0 (Disabled) 1 (Output phase protection 2 (Input phase protection) 3 (Input/Output phase protection)	0 (Disabled)	Yes	86
H20	Power ON Start Select	0 (No) 1 (Yes)	0 (No)	Yes	87
H21	Restart after Fault Reset Select	0 (No) 1 (Yes)	0 (No)	Yes	87
H22[2]	Speed Search Select	0000-1111 (bit set) Bit 0: during Accel Bit 1: after fault reset Bit 2: after instant power failure restart Bit 3: when H20 is set to 1 (Yes)	0000	Yes	88

Code [FU2]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
H23	Current Limit Level during Speed Search	80-200 [%]	100 [%]	Yes	90
H24	P Gain during Speed Search	0-9999	100	Yes	90
H25	I Gain during Speed Search	0-9999	200	Yes	
H26	Number of Auto Restart Attempt	0-10	0	Yes	91
H27	Auto Restart Time	0-60 [sec]	1.0 [sec]	Yes	91
H30	Rated Motor Selection	0.2-7.5	7.5[1]	No	92
H31	Number of Motor Poles	2-12	4	No	92
H32	Rated Slip Frequency	0-10 [Hz]	2.33[2] [Hz]	No	92
H33	Motor Rated Current	0.5-50 [A]	26.3 [A]	No	92
H34	No Load Motor Current	0.1-20 [A]	11 [A]	No	93
H36	Motor Efficiency	50-100 [%]	87 [%]	No	93
H37	Load Inertia Rate	0-2	0	No	94
H39	Carrier Frequency Select	1-15 [kHz]	3 [kHz]	Yes	77
H40	Control Mode Select	0 (V/F) 1 (Slip Comp.) 2 (PID Feedback) 3 (SVC)	0 (V/F)	No	95
H41	Auto Tuning	0-1	0	No	96
H42	Stator Resistance (Rs)	0-14 [Ω]	-	No	96
H44	Leakage inductance (Lσ)	0-300.0 [mH]	-	No	97
H45[1]	P Gain for PID Control	0-32767	1000	Yes	97
H46	I Gain for PID Control	0-32767	100	Yes	97
H50[2]	PID Feedback Select	0-1	0	No	98
H51	P Gain for PID Controller	0-999.9 [%]	300.0 [%]	Yes	98
H52	I Gain for PID Controller	0.1-32.0 [sec]	1.0 [sec]	Yes	98
H53	D Gain for PID Controller	0-30.0 [sec]	0.0 [sec]	Yes	98
H54	F Gain for PID Controller	0-999.9 [%]	0.0 [%]	Yes	99
H55	PID Output Frequency Limit	0.1-400 [Hz]	60.00 [Hz]	Yes	99
H60	Self-Diagnostic Select	0-3	0	No	100
H70	Frequency Reference for Accel/Decel	0-1	0	No	101
H71	Accel/Decel Time Scale	0-2	1	Yes	102
H72	Power on Display	0-13	0	Yes	102
H73	Monitoring Item Select	0-Output Voltage 1-Output Power 2-Torque	0	Yes	103
H74	Gain for Motor RPM Display	1-1000 [%]	100 [%]	Yes	103
H75	DB Resistor Operating Rate Limit Select	0-1	1	Yes	103

Code [FU2]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
H76	DB Resistor Operating Rate	0-30 [%]	10 [%]	Yes	104
H77[1]	Cooling Fan Control	0-1	0	Yes	105
H78	Operating method with cooling fan malfunction	0-1	0	Yes	106
H79	Software Version	0-10.0	1.0	No	106
H81	2nd Acceleration Time	0-6000 [sec]	5.0 [sec]	Yes	107
H82	2nd Deceleration Time		10.0 [sec]	Yes	
H83	2nd Base Frequency	30-400 [Hz]	60.00 [sec]	No	
H84	2nd V/F Pattern	0 (Linear) 1 (Square) 2 (User V/F)	0 (Linear)	No	
H85	2nd Forward Torque Boost	0-15 [%]	5.0 [%]	No	107
H86	2nd Reverse Torque Boost		5.0 [%]	No	
H87	2nd Stall Prevention Level	30-150 [%]	150 [%]	No	
H88	2nd Electronic Thermal Level for 1 minute	50-200 [%]	150 [%]	Yes	
H89	2nd Electronic Thermal Level for continuous		100 [%]	Yes	
H90	2nd Rated Motor Current	0.1-50 [A]	26.3 [A]	No	
H91	Parameter Read	0 (No) 1 (Yes)	0 (No)	No	108
H92	Parameter Write	0 (No) 1 (Yes)	0 (No)	No	
H93	Parameter Initialize	0-5	0	No	109
H94	Password Register	0-FFFF	0	Yes	109
H95	Parameter Lock	0-FFFF	0	Yes	110

5.4 Input/Output Group [I/O]

Code [I/O]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
I0	Jump code	0-64	1	Yes	111
I1	Filter time constant for NV input	0-9999	10	Yes	111
I2	NV Input Minimum Voltage	0 ~ -10 [V]	0.00 V	Yes	
I3	Frequency Corresponding to I2	0-400 [Hz]	0.00 Hz	Yes	
I4	NV Input Maximum Voltage	0 ~ -10 [V]	10.0 V	Yes	
I5	Frequency corresponding to I4	0-400 [Hz]	60.00 Hz	Yes	
I6	Filter time constant for V1 input	0-9999	10	Yes	112
I7	V1 Input Minimum Voltage	0-10 [V]	0 V	Yes	
I8	Frequency corresponding to I7	0-400 [Hz]	0.00 Hz	Yes	
I 9	V1 input max voltage	0-10 [V]	10 V	Yes	
I10	Frequency corresponding to I9	0-400 [Hz]	60.00 Hz	Yes	
I11	Filter time constant for I input	0-9999	10	Yes	113
I12	I input minimum current	0-20 [mA]	4.00 mA	Yes	
I13	Frequency corresponding to I12	0-400 [Hz]	0.00 Hz	Yes	
I14	I input max current	0-20 [mA]	20.00 mA	Yes	
I15	Frequency corresponding to I14	0-400 [Hz]	60.00 Hz	Yes	
I16	Criteria for Analog Input Signal loss	0: Disabled 1: activated below half of set value. 2: activated below set value.	0 Disabled	Yes	113
I17	Multi-function input terminal P1 define	0 FWD Run Cmd 1 REV Run Cmd 2 Emergency Stop Trip 3 (RST) 4 Jog operation command 5 Step freq - Low 6 Step freq - Mid 7 Step freq - High 8 Accel/Decel - Low 9 Accel/Decel - Mid 10 Multi Accel/Decel-High 11 DC brake 12 2nd motor 13 (-Reserved-) 14 (-Reserved-) 15 (UP) command 16 (DOWN) command 17 (3-wire) 18 External Trip A 19 External Trip B 20 Self-diagnostic function 21 PID Enable 22 Exchange between Option and drive 23 Analog Hold 24 Accel/Decel Disable	0	Yes	114
I18	Multi-function input terminal P2 define		1		
I19	Multi-function input terminal P3 define		2		
I20	Multi-function input terminal P4 define		3		
I21	Multi-function input terminal P5 define		4		
I22	Multi-function input terminal P6 define		5		
I23	Multi-function input terminal P7 define		6		
I24	Multi-function input terminal P8 define		7		

Code [I/O]	Parameter Name	Setting Range	Factory Default	Adj. during run	Page
I25	Input terminal status display	00000000-11111111 (bit set)	0	Yes	115
I26	Output terminal status display	0-1 (bit set)	0	Yes	115
I27	Filtering time constant for Multi-function Input terminals	1-7	4	Yes	116
I30	Multi-Step frequency 4	0-400 [Hz]	30.00	Yes	116
I31	Multi-Step frequency 5		25.00	Yes	
I32	Multi-Step frequency 6		20.00	Yes	
I33	Multi-Step frequency 7		15.00	Yes	
I34	Multi-Accel time 1	0-6000 [sec]	3.0	Yes	117
I35	Multi-Decel time 1		3.0		
I36	Multi-Accel time 2		4.0		
I37	Multi-Decel time 2		4.0		
I38	Multi-Accel time 3		5.0		
I39	Multi-Decel time 3		5.0		
I40	Multi-Accel time 4		6.0		
I41	Multi-Decel time 4		6.0		
I42	Multi-Accel time 5		7.0		
I43	Multi-Decel time 5		7.0		
I44	Multi-Accel time 6		8.0		
I45	Multi-Decel time 6		8.0		
I46	Multi-Accel time 7		9.0		
I47	Multi-Decel time 7		9.0		
I50	Analog output item select	0-3	0	Yes	118
I51	Analog output level adjustment	10-200 [%]	100	Yes	118
I52	Frequency detection level	0-400 [Hz]	30.00	Yes	119
I53	Frequency detection bandwidth		10.00	Yes	
I54	Multi-function output terminal select	0-18	12	Yes	119
I55	Multi-function relay output		17	Yes	126
I56	Fault relay output	0-7	2	Yes	126
I57	Fault Output Terminal Select	0-3	0	Yes	127
I59	Communication protocol select	0-Modbus RTU	0	No	127
I60	Inverter number	1-32	1	Yes	127
I61	Baud rate	0-4	3	Yes	128
I62	Drive mode select after loss of frequency command	0-2	0	Yes	128
I63	Wait time after loss of frequency command	0.1-120 [sec]	1.0	Yes	128
I64	Communication time setting	2-100 [ms]	5	Yes	128

Notes:

6 Parameter Descriptions

6.1 Drive Group

0.00: Frequency Command

Range: 0 - 400 Hz. (Default 0.00)

Description: This parameter sets the frequency that the drive is commanded to output, when the drive is operating from the keypad. Frequency setting mode must be set to 1.

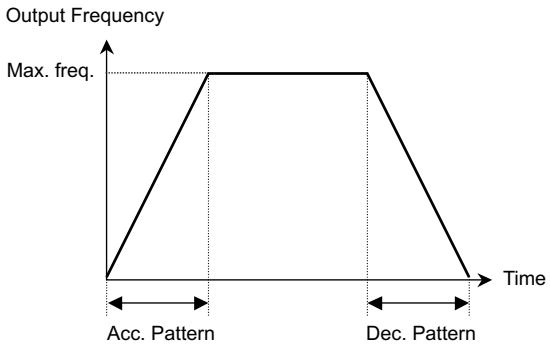
Drive Mode:	Parameter Display:
During Stop	Frequency Command
During Run	Output Frequency
Multi-step operation	Multi-step frequency 0.

It cannot be set greater than F21- [Max frequency].

ACC/dEC: Accel/Decel Time

Range: 0-6000 sec. (Default: Accel -5.0 s., Decel -10.0s.)

Description: The acceleration time sets the amount of time to reach the maximum frequency upon a start command. The deceleration time sets the amount of time to stop from the maximum frequency. During Multi-Accel/Decel operation, this parameter serves as Accel/Decel time 0.



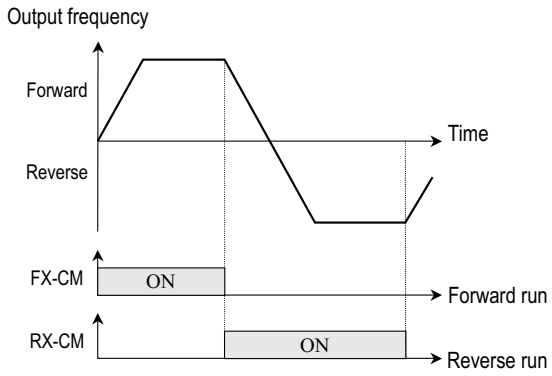
Related functions:
FU1-20 [Max freq]
FU2-70 [Ref freq for accel/decel]
FU2-71 [Accel/decel time scale]
I/O-12 to I/O-14 [Multi-function input terminal P1, P2, P3]
I/O-25 to I/O-38 [Acc/dec time for step frequency]
FU-70: select the frequency to be targeted for acceleration and deceleration [Max freq, Delta freq]
FU2-71: select the time scale. [0.01, 0.2, 1]
I/O-12 to I/O-14: set the terminal function of P1,P2,P3 terminal outputs
I/O-25 to I/O-38: preset the accel/decel time activated via multi-function inputs (P1,P2,P3)

drv: Drive Mode (run/stop method)

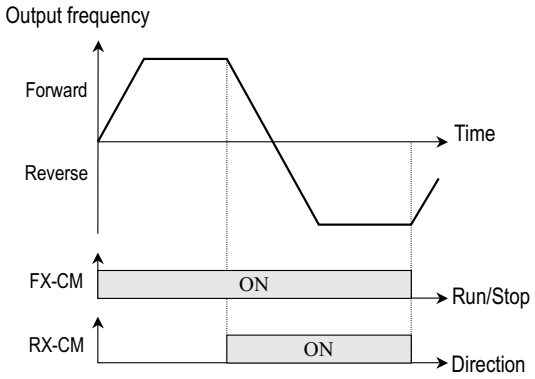
Range: 0 - 3 (Default: 1)

Description: This parameter sets the method for starting and stopping the drive.

Display:	Function:
0	Run/Stop via Run/Stop key on the keypad
1	P1 (FX): Motor forward run, P2 (RX): Motor reverse run
2	P1 (FX): Run/Stop enable, P2 (RX): Reverse rotation select
3	RS485 communication



[Drive Mode: 'Fx/Rx-2']



[Drive Mode: 'Fx/Rx-1']

Frq: Frequency Setting Method

Range: 0 - 7 (Default: 0)

Description: This parameter selects the method of speed control for the drive.

Keypad Frequency Mode 0
- Set Frq [Frequency Mode] to 0 (Frequency setting via Keypad 1).
- Set the desired frequency in 0.00 and press the Prog/Ent key to enter the value into memory.
- The value is settable less than parameter F21 (Max. Frequency).

Keypad Frequency Mode 1
- Set Frq [Frequency Mode] to 1 (Frequency setting via Keypad 2).
- The desired frequency in 0.00 is changed upon pressing the Up/Down key. In this case Up/Down keys serve as a potentiometer.
- The value is settable less than parameter F21 (Max. Frequency).

⌘ **Note**: When remote keypad is connected, keypad keys on the body are deactivated.

Frequency Setting Mode 2
- Set Frq [Frequency Mode] to 2 (Frequency Setting via -10V - +10V Input).
- The set frequency can be monitored in 0.00 [Frequency Command].
- See I1 through I10.

Frequency Setting Mode 3
- Set Frq code [Frequency Mode] of Drive group to 3 (Frequency setting via 0-10V Input/Terminal Potentiometer).
- 0-10V can be directly applied from an external controller or potentiometer connected on terminals VR, V1 and CM.
- See I6 through I10.

Frequency Setting Mode 4
- Set Frq code (Frequency Mode] of Drive Group to 4 (Frequency setting via 0-20mA input).
- Frequency is set via 0-20mA input between I and CM terminal.
- See I11 through I15.

Frequency Setting Mode 5
- Set Frq code (Frequency Mode] of Drive Group to 5 (Frequency setting via -10 ~ +10V voltage input + 0 ~ 20mA input)
- Override function available using Main/Auxiliary speed adjustment
- Related code: I1 - I5, I6 - I10, I11 - I15

Frequency Setting Mode 6

- Set Frq code (Frequency Mode] of Drive Group to 6 (Frequency setting via 0 ~ 10V + 0 ~ 20mA input).
- Related code: I6 - I10, I11 - I15
- Refer to Frequency setting via -10 ~ +10V voltage input + 0 ~ 20mA input.

Frequency Setting Mode 7

- Set Frq code (Frequency Mode] of Drive Group to 7 (Frequency setting via RS 485 communication).
- Related code: I59, I60, I61
- Refer to Chapter 7, RS485 communication.

St1 - St3: Multi-Step Frequency 1-3

Range: 0 - 400 Hz

Description: The drive outputs preset frequencies set in these codes according to the multi-function terminals configured as 'Speed-L', 'Speed-M' and 'Speed-H'. The output frequencies are decided by the binary combination of P1,P2,P3 configured in I/O-12 to I/O-17. Refer to the following table for the preset frequency outputs.

Display:	Function:
St1	Sets multi-step frequency 1 during multi-step operation (Default: 10.00Hz).
St2	Sets multi-step frequency 2 during multi-step operation (Default: 20.00Hz).
St3	Sets multi-step frequency 3 during multi-step operation (Default: 30.00Hz).

- Select a terminal to give Multi-step frequency command among P1-P8 terminals.
- If terminals P6-P8 are selected, set I22-I24 to 5-7 to give Multi-step frequency command.
- Multi-step frequency 0 is settable in Frq - [Frequency mode] and 0.00 - [Frequency command].
- Multi-step frequency 1-3 are set at St1-St3 in Drive group, while Step frequency 4-7 are set at I30-I33 in I/O group.

Binary combination of P1, P2, P3			Output frequency	Step speed
Speed-L	Speed-M	Speed-H		
0	0	0	DRV-00	Speed 0
1	0	0	DRV-05	Speed 1
0	1	0	DRV-06	Speed 2
1	1	0	DRV-07	Speed 3

CUr: Output Current

Range:

Description: Displays the output current to the motor.
- Drive output current can be monitored in CUr.

rPM: Motor RPM

Range:

Description: This code displays the output current of the drive in RPM while the motor is running.

Use the following equation to scale the mechanical speed using H74 [Gain for Motor Speed display] if you want to change the motor speed display to rotation speed (r/min) or mechanical speed (m/min).

Motor speed = 120* (F/P) * FU2-74
Where, F: output frequency and P: the number of motor pole

dCL: Inverter DC Link Voltage

Range:

Description: Displays DC link voltage inside the drive.
- Inverter DC link voltage can be monitored in dCL.
- $\sqrt{2}$ times the value of input voltage is displayed while motor is stopped.

vOL: User Display Select

Range: vOL, POr, tOr (Default: vOL)

Description: This parameter displays the value of the parameter selected in H73 (Monitoring item select).

nOn: Current Fault Display

Range:

Description: This parameter displays the current fault (trip) status of the drive. Refer to page 39 for keypad setting.

⌘**Note:** The drive will not reset when H/W fault occurs.Repair the fault before turning on the power.

⌘**Note**: When multiple faults occur, only the highest level fault will be displayed.

[Fault Contents]

Fault (Trip)	Keypad Display	Fault (Trip)	Keypad Display
Overcurrent	OCt	Self-diagnostic malfunction	COL
Ground Fault Current	GFt	Parameter save error	FLtL
Inverter Overload	I OL	Inverter Hardware Fault	EEP
Overload Trip	OLt	Communication Error	H'_'t
Inverter Overheat	OHt	Remote keypad communication error	rErr
Output Phase Loss	POt	Keypad error	COM
Over Voltage	Ovt	Cooling fan fault	FAn
Electronic Thermal	Lvt	Instant cut off	ESt
Input Phase Loss	EtH	External fault A	EtA
External Fault B	Etb	Frequency Command Lost	__L

drC: Direction of Motor Rotation Select

Range: F (Forward), r (Reverse) (Default: F)

Description: Sets the direction of motor rotation when DRV (Drive Mode) is set to either 0 or 1.

drv2: Drive Mode 2

Range: 0 - 2 (Default:1)

Description: <Active condition>
Option-Inverter Exchange is activated and drv2 and Frq2 in Drive group is displayed when drv and Frq are set to “RS485” and one of the multi-function input terminals is set to 22.

When the defined terminal is turned ON, setting values in drv2 and Frq2 are applied without changing any parameters. However, change to the drive mode and frequency mode is not available while this terminal is ON.

- Run/Stop via Run/Stop key on the keypad.
- Only displayed when one of the multi-function input terminals 1-8 [I17-I24] is set to "22".
- Select the one terminal among P1-P8 to use this function.

Display:	Function:
0	Operation via Run/Stop key on the keypad.
1	FX: Forward/Run command, RX: Reverse/Run command
2	FX: Run/Stop command, RX: Forward/Reverse command

⌘ **Note:** 1 and 2 are Operation via Terminal (see I17 - I24, and Frq2).

Frq2: Frequency Setting Method 2

Range: 0 - 6 (Default: 0)

Description: <Active condition>
Option-Inverter Exchange is activated and drv2 and Frq2 in Drive group is displayed when drv and Frq are set to "RS485” and one of the multi-function input terminals is set to “22”.

When the defined terminal is turned ON, setting values in drv2 and Frq2 are applied without changing any parameters. However, change to the drive mode and frequency mode is not available while this terminal is ON.

- Only displayed when one of the multi-function input terminals 1-8 [I17-I24] is set to "22".
- Select the one terminal among P1-P8 to use this function.

Display:	Function:
0	Keypad setting 1 (Digital).
1	Keypad setting 2 (Digital).
2	V1 1: -10 to +10V (Analog)
3	V1 2: 0 to +10V (Analog)
4	Terminal I: 0 to 20mA (Analog)
5	Terminal VI setting 1 + Terminal I (Analog)
6	Terminal V1 setting 2+ Terminal I (Analog)

See I17 - I24, and drv2.

6.2 Function Group 1

F0: Jump Code

Range: 0 - 60 (Default: 1)

Description: This parameter allows the user to "jump" to any parameter without scrolling through the group. Enter the desired parameter number, and the drive will "jump" to that parameter.

F1: Forward/Reverse Run Disable

Range: 0 - 2 (Default: 0)

Description: This function allows the user to lockout forward or reverse operation of the motor. This function may be used for loads that rotate only in one direction such as fans and pumps.

Display:	Function:
0	Forward and reverse run enable
1	Forward run disable
2	Reverse run disable

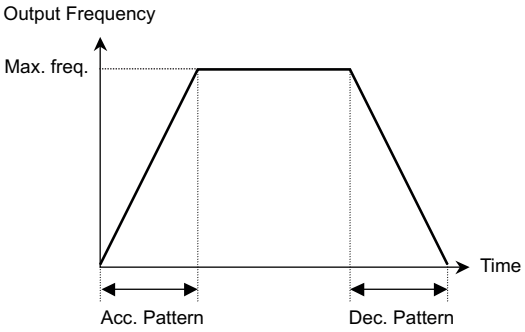
F2 & F3: Accel/Decel Pattern

Range: 0 (Linear), 1 (S-curve), (Default 0)

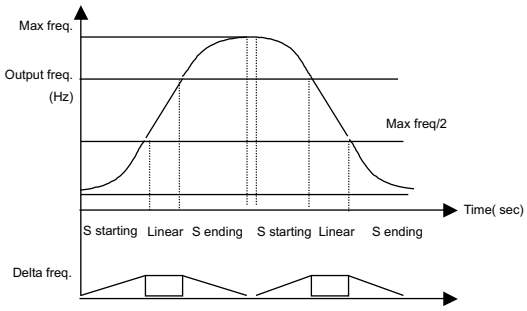
Description: This parameter determines the shape of the accel/decel ramp. Different combinations of acceleration and deceleration patterns can be selected according to the applications.

Display:	Function:
Linear	The shape of the ramp is a straight line and is a general pattern for constant torque applications.
S-curve	This pattern allows the motor to accelerate and decelerate smoothly. The actual acceleration and deceleration time takes longer - about 40% than time set by user. This setting prevents shock during acceleration and deceleration, and prevents objects from swinging on conveyors or other moving equipment.

⌘ **Note**: Depending on the setting of this parameter the exact values in DRV-01 (Accel Time) and DRV-02 (Decel Time) may not represent the actual accel or decel times.



[Accel/Decel Pattern:'Linear']



[Accel/Decel Pattern:'S-curve']

F4: Stop Mode Select

Range: 0 - 2 (Default: 0)

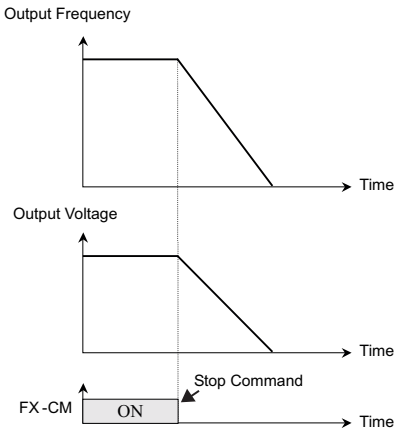
Description: This parameter sets the stopping method for the drive.

Display:	Function:
0	Decelerate to stop
1	DC brake to stop
2	Free run to stop

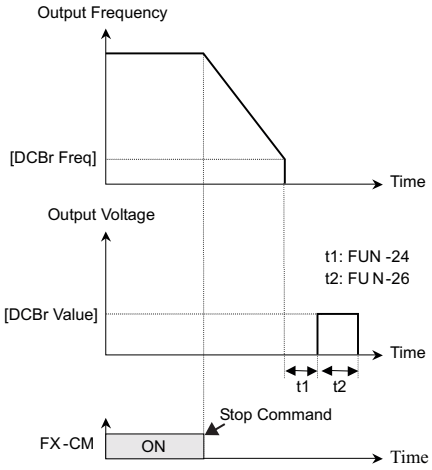
Decel: The drive stops using the deceleration pattern. Select 0 in F30.

DC-brake: The drive stops with DC injection braking. The drive will output a DC voltage when the frequency goes below the DC injection braking frequency during deceleration (see F8-F11, page 68-69).

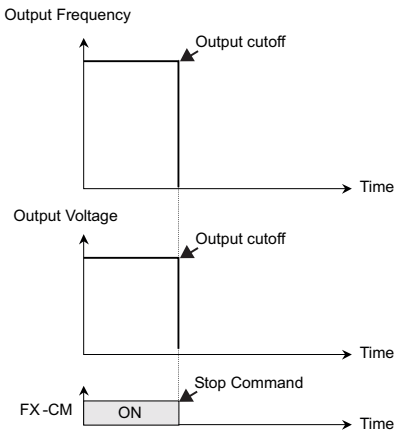
Free-run (Coast to stop): The drive stops outputting voltage immediately when the stop signal is commanded.



[Stop Mode: 'Decel']



[Stop Mode: 'DC-brake']



[Stop Mode: 'Free-run']

F8: DC Brake Start Frequency

Range: 0.1 - 60 Hz (Default: 5.00Hz)

Description: This parameter sets DC brake start frequency at which the drive starts to output DC voltage during deceleration. It cannot be set below F23 (Start Frequency, page 72).

- To stop motor by DC brake, set F4 (Stop mode select) to 1.
- Only displayed when F4 is set to 1 (DC Brake to stop).

F9: DC Brake Wait Time

Range: 0 - 60 sec. (Default: 0.1sec)

Description: This is the amount of time the drive waits before outputting voltage after the VFD has gone below the frequency in F8 (DC Brake start frequency) before applying F10 (DC Brake voltage).

- When load inertia is large or F8 (DC Brake Start Frequency) is high, over current trip may occur. It can be prevented using F9 (DC Brake Wait Time).
- To stop motor by DC brake, set F4 (Stop mode select, page 67) to 1.

F10: DC Brake Voltage

Range: 0 - 200 % (Default: 50%)

Description: This parameter sets the amount of DC voltage applied to the motor. It is set in percent of H33 (Motor Rated Current).

- Setting F10 or F11 to 0 will disable DC Brake.
- To stop motor by DC brake, set F4 (Stop mode select, page 67) to 1.

F11: DC Brake Time

Range: 0 - 60 sec. (Default: 1.0sec.)

Description: This parameter sets the time taken to apply DC current to a motor while motor is at a stop. It sets the time for F10 (DC Brake Voltage) to be applied to the motor after F9 (DC Brake Wait Time).

- To stop the motor by DC brake, set F4 (Stop mode select, page 67) to 1.
- Setting F10 or F11 to 0 will disable DC Brake.

⚠ CAUTION

If excessive DC Brake voltage is set or DC Brake time is set too long, it may cause motor overheating and damage to the motor.

- In case of DC brake at high load inertia and frequency, change the DC brake controller gain according to H37 (Load inertia ratio, page 94) set value.

F12: DC Brake Start Voltage

Range: 0 - 200 % (Default: 50%)

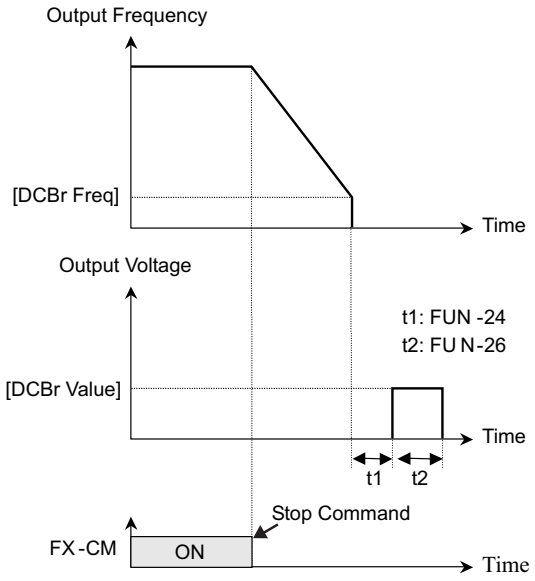
Description: This parameter sets the amount of DC voltage before a motor starts to run. It is set in percent of H33 (Motor Rated Current), (see parameter F13).

F13: DC Brake Start Time

Range: 0 - 60 sec (Default: 0sec)

Description: This parameter sets the amount of time that the drive will eject DC to the motor before starting. This is often used to stop free wheeling fans/pumps.

DC voltage is applied to the motor for DC Brake start time before motor accelerates.



[Stop Mode: 'DC-brake']

F14: Time for Magnetizing a Motor

Range: 0 - 60 sec. (Default: 1.0sec.)

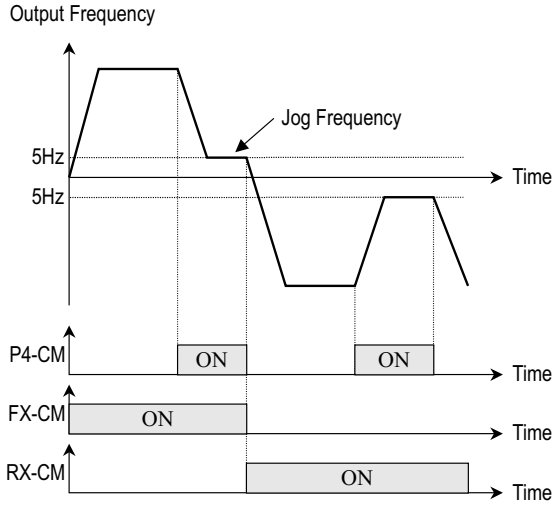
Description: This parameter applies current to the motor for a set time before the motor accelerates during Sensorless Vector Control. It accelerates the motor after pre-energizing it for the set time. The amount of the pre-energizing current is set in H34 (Motor No Load Current, page 93). (Note that motor stator resistance is not calculated for the SVC if the value of this parameter is less than 1s).

F20: Jog Frequency

Range: 0 - 400 Hz (Default: 10.00Hz)

Description: This parameter sets the frequency for Jog operation. It cannot be set above F21 (Max. frequency). Jog operation overrides all other applications except Dwell operation. Therefore, if Jog frequency command is entered in the middle of Multi-step, Up-Down or 3-wire operation, operation is executed at Jog frequency.

- Set the desired jog frequency in F20.
- Select a terminal from P1 - P8 to use for this setting.
- If P5 is set for Jog operation, set I21 to 4 (Jog).
- Jog frequency can be set within the range of F21 (Max. frequency) and F22 (Start frequency).
- See I21 (Multi-function input terminal P5 define, page 114)



F21: Maximum Frequency

Range: 40 - 400 Hz (Default: 60.00Hz)

Description: This parameter sets the highest frequency the drive can output. It is frequency reference for Accel/Decel (See H70, page 101).

CAUTION: Any frequency cannot be set above F21 (Max. frequency) except F22 (Base frequency).

- If H40 (page 95) is set to 3 (sensorless vector), Max. frequency is settable up to 300Hz.

F22: Base Frequency

Range: 30 - 400 Hz (Default: 60.00Hz)

Description: The drive outputs its rated voltage to the motor at this frequency (see motor nameplate).

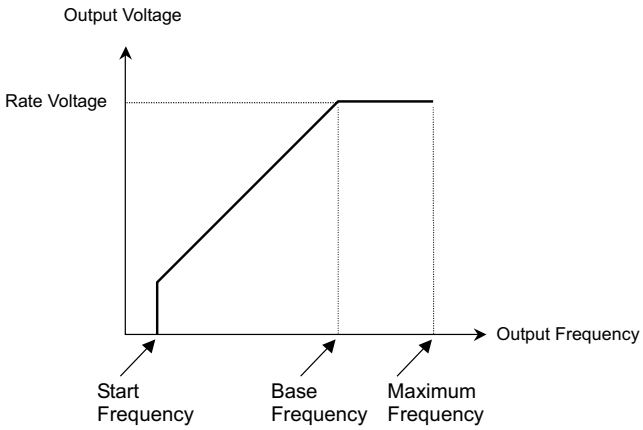
CAUTION

Consult with the motor manufacturer before exceeding the base speed of the motor. Verify that the driven equipment can operate at the maximum speed set.

F23: Start Frequency

Range: 0 - 10Hz (Default: 0.50 Hz)

Description: The drive starts to output its voltage at this frequency. If a frequency is set lower than this, 0.00 Hz is automatically set. For example, if F23 is set to 5Hz, the drive starts running when the reference frequency is 5Hz.



F24: Frequency High/Low Limit Select

Range: 0 - 1 (Default: 0)

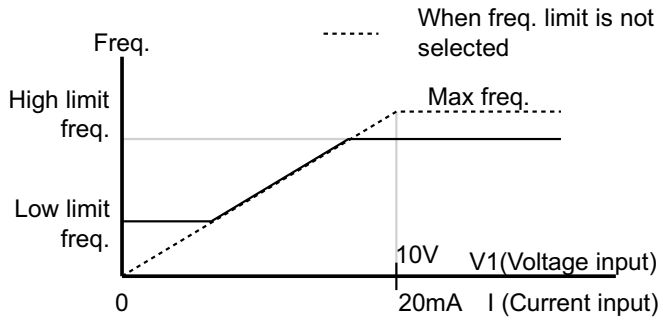
Description: This parameter activates the high and low frequency (see F25 & F26).

F25: Frequency High Limit

Range: 0 - 400 Hz (Default:60.00)

Description: This parameter sets the high limit frequency. It cannot be set above F21 (Max. Frequency). It is only displayed when F24 (Frequency high/low limit select) is set to 1. This setting is also valid when frequency setting is done via keypad. When frequency setting is done via Analog input (voltage or current input), the drive operates within the range of high and low limit frequency as shown below.

- Set F24 to 1.
- Active run frequency can be set within the range of F25 and F26.



F26: Frequency Low Limit

Range: 0.1 - 400 Hz (Default: 0.50Hz)

Description: This parameter sets the low frequency (see parameter F25 for more information).

F27: Torque Boost Select

Range: 0 - 1 (Default: 0)

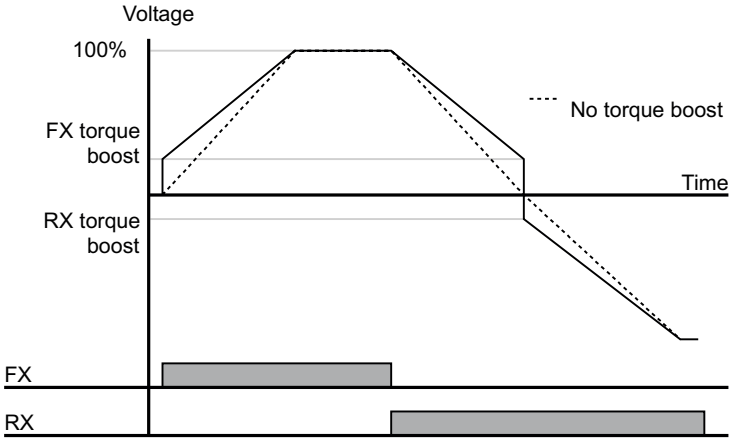
Description: This function is used to increase the starting torque at a low speed by increasing the output voltage of the drive. If boost value is set higher than required, it may cause the motor flux to saturate causing an overcurrent trip. Increase the boost value when the distance between the drive and motor is long.

Display:	Function:
0	Manual Torque Boost
1	Auto Torque Boost

Manual Torque Boost:
Set F27 to 0 (Manual torque boost).
The values of Torque boost in foward/reverse direction are set separately in F28 and F29.

Auto Torque Boost:
Before Auto Torque Boost setting, H34 and H42 should be set correctly (see page 93 and 96).
Select 1 (Auto Torque Boost) in F27.

The drive automatically calculates torque boost value using motor parameters and outputs the corresponding voltage.



CAUTION

If the boost value is set much higher than required, it may cause motor overheating due to over-energizing, or overcurrent trips.

F28: Torque Boost in Forward Direction

Range: 0 - 15% (Default: 2%)

Description: This parameter sets the amount of torque boost applied to a motor during forward run. It is set in percent of Max output voltage.

F29: Torque Boost in Reverse Direction

Range: 0 - 15% (Default: 2%)

Description: This parameter sets the amount of torque boost applied to a motor during reverse run. It is set as a percent of Max output voltage.

F30: V/F Pattern

Range: 0 - 2

Description: This is the pattern of voltage / frequency ratio. Select the proper V/F pattern according to the load. The motor torque is dependent on this V/F pattern.

Display:	Function:
0	Linear Pattern
1	Square Pattern
2	User V/F Pattern

Linear Patterrn:
The Linear pattern is used where constant torque is required. This pattern maintains a linear volts/hertz ratio from zero to base frequency. This pattern applies to conveyors, extruders, etc. This pattern maintains a linear Volts/frequency ration from F23 (Start frequency, page 72) to F22 (Base frequency, 72).

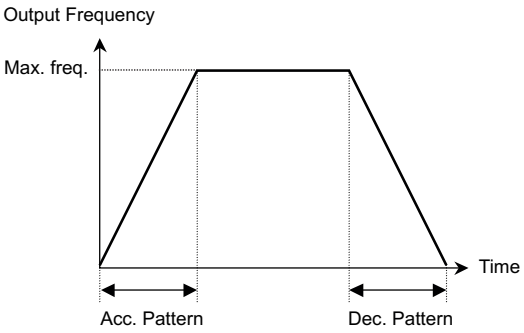
Square Pattern:
The Square pattern is used where variable torque is required. This pattern maintains squared volts/hertz ratio. This pattern applies to fan, pump etc.

User V/F Pattern:
The User V/F pattern is used for special applications.

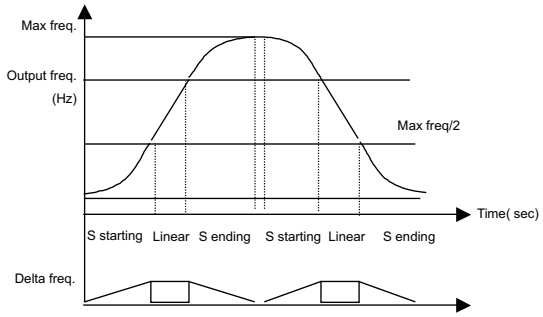
Users can adjust the volts/hertz ratio according to applications. This is done by setting the voltage and hertz, respectively, at four points between starting frequency and base frequency.

The four points of voltage and hertz are set in F31 ~ F38, (page 76). The

user can adjust the Volt/Frequency ratio according to V/F pattern of specialized motors and load characteristics.



[V/F Pattern: 'Linear']



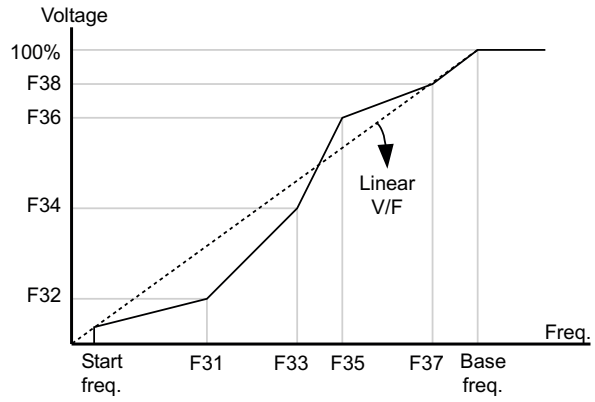
[V/F Pattern: 'Square']

F31-F38: User V/F Frequency and Voltage

Range: Voltage: 0-100% (Default:25,50,75100), Frequency: 0-400Hz (Default: 15,30,45,60)

Description: These functions are available only when 'User V/F' is selected in F30 [V/F pattern]. Users can make the custom V/F pattern by setting four points between F23 [Starting Frequency] and F22 [Base Frequency]. The four points of voltage and hertz are set in percent of H70 – [Motor rated voltage]. It cannot be set above F21 – [Max frequency].

The values of the lower-numbered parameters cannot be set above those of higher-numbered.

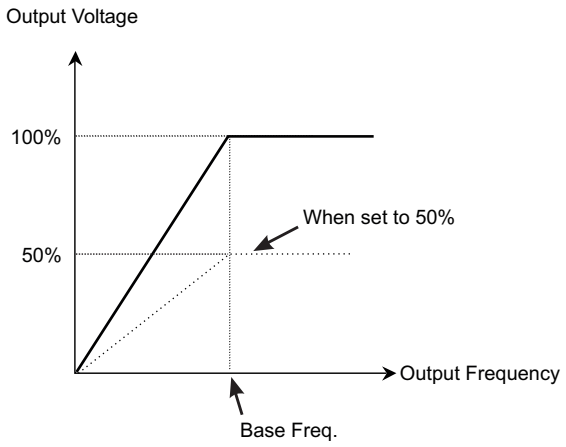


⌘ **Note**: When the 'User V/F' is selected, the torque boost of of F27 ~ F29 (page 74-75) is ignored.

F39: Output Voltage Adjustment

Range: 40-110% (Default: 100%)

Description: This function is used to adjust the output voltage of the drive. The set value is a percentage of input voltage. This is useful when using a motor that has lower rated voltage than the main input voltage. When this is set at 100%, drive outputs its rated voltage.

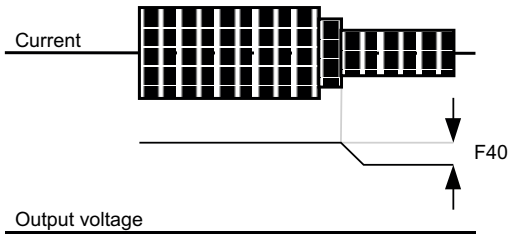


⌘ **Note**: the drive output voltage does not exceed the main input voltage, even though F39 is set at 110%.

F40: Energy Save Level

Range: 0-30% (Default: 0%)

Description: This function is used to reduce the output voltage in applications that do not require high torque and current at its steady speed. If the energy save level is set at 20%, drive reduces its output voltage after accelerating to the reference frequency (steady speed). This function may cause over-current trip due to the lack of output torque in a fluctuated load. This function does not work with 0% set value.



⌘ **Note:** This function is not recommended for a large load or for an application that need frequent acceleration and deceleration.

⌘ **Note:** This function does not work when 'Sensorless' is selected in H40 [Control Mode, page 95].

F50: Electronic Thermal Selection [ETH]

Range: 0 (No), 1 (Yes), (Default: 0)

Description: This function provides motor overload protection. The drive calculates the temperature of the motor using several parameters. The drive faults and displays a trip message when the electronic thermal function is activated.

Parameters F51-53 must be set for proper operation.

F51: Electronic Thermal Level for 1 minute

Range: 50 ~ 200 [%] (Default: 150%)

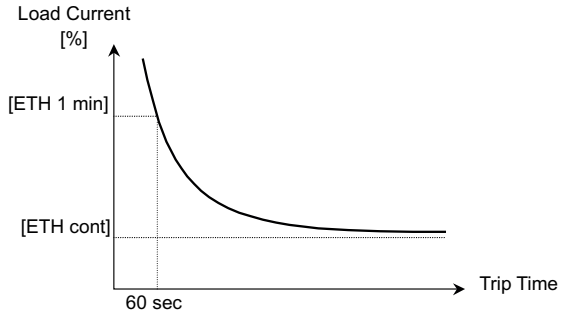
Description: This parameter sets the maximum current capable of flowing to the motor continuously for 1 minute. The set value is the percentage of H33 [Motor rated current, page 92]. It cannot be set below F52 [Electronic thermal level for continuous, page 79]. The drive is tripped in 1 minute when 150% of rated motor current set in H33 [Motor Rated Current] flows for 1 minute.

⌘ **Note:** The set value is the percentage of H33 [Motor rated current, page 92].

F52: Electronic Thermal Level for Continuous

Range: 50 -200% (Default: 100%)

Description: This parameter is the current at which the motor can run continuously. Generally, this value is set to '100%' and which means the rated motor current set in H33. This value cannot be set higher than F51 [ETH 1min].



⌘ **Note:** The set value is the percentage of H33 [Rated Motor Current).

F53: Electronic Thermal Characteristic Selection (Motor Type)

Range: 0 - 1 (Default: 0)

Description: To make the ETH function (Motor Type) work correctly, motor cooling method must be selected correctly according to the motor.

Display:	Function:
0	Self-cool
1	Forced-cool

Self-cool:
This is a motor that has a cooling fan connected directly to the motor shaft. The cooling effects of this type of motor decrease when the motor is running at low speed. The motor current is derated as the motor speed decrease.
Forced-cool:
This is a blower cooled motor/drive duty motor. The cooling effects of this type of motor do not change as the motor speed changes.

⌘ **Note:** Even though the motor current changes frequently due to load fluctuation or acceleration and deceleration, drive calculates the Motor Type and accumulates the value to protect the motor.

Related functions: H33 [Rated Motor Current, page 92]

F54: Overload Warning Level

Range: 30-150% (Default: 150%)

Description: This parameter sets the amount of current to issue an alarm signal when the output current has fallen below the level in F54 [Overload Warning Level]. The alarm signal persists for parameter F55 [Overload Warning Time] even though the current has become the level below parameter F54 (see I54, I55 - page 119). The set value is a percentage of H33 [Motor rated current].

Multi-function output terminal (MO-MG) is used as the alarm signal output. To output the alarm signal, set I54 [Multifunction Output Define, page 119] to ‘OL’.

⌘ **Note:** The drive is not tripped by this function, it is only a warning.

Related functions: H33 [Rated Motor Current], I54 [Multi-function Output Define]

- Select one output terminal for this function between MO and 3AC.
- If selecting MO as output terminal, set I54 to 5 [Overload:OL].

F55: Overload Warning Hold Time

Range: 0 - 30sec. (Default: 10sec)

Description: This parameter issues an alarm signal when the current has fallen below the level in F54-[Overload warning level]. The alarm signal persists for parameter F55-[Overload warning time] even though the current has become the level below F54 (see I54, I55). The set value is a percentage of H33 [Motor rated current, page 92].

Multi-function output terminal (MO-MG) is used as the alarm signal output. To output the alarm signal, set I54 [Multifunction Output Define, page 119] to 'OL'.

⌘ **Note:** The drive is not tripped by this function, it is only a warning.

Related Functions: H33 [Rated Motor Current], I54 [Multi-function Output Define]

- Select one output terminal for this function between MO and 3AC.
- If selecting MO as output terminal, set I54 to 5 [Overload:OL].

F56: Overload Trip Select

Range: 0 - 1 (Default: 1)

Description: This parameter turns off the drive output when motor is overloaded.
- Set F56 to 1.
- Drive output is turned off when the motor is overloaded.
- Drive output is turned off when excessive current flows to the motor for F58 [Overload Trip Time].

F57: Overload Trip Level

Range: 30-200% (Default: 180%)

Description: This parameter sets the amount of overload current. The value is the percentage of H33- [Motor rated current].

The drive cuts off its output and displays fault message when the output current persists over the F57 [Overload Trip Level] for the time of F58 [Overload Trip Time]. This function protects drive and motor from abnormal load conditions.

Related Functions: H33 [Rated Motor Current, page 92].

F58: Overload Trip Time

Range: 0-60 sec. (Default: 60sec.)

Description: This parameter turns off the drive output when the F57 [Overload trip level] of current flows to the motor for F58 [Overload trip time].

F59: Stall Prevention Mode Select

Range: 000-111 (bit set) (Default: 000)

Description: This parameter stops accelerating during acceleration, decelerating during constant speed run and stops decelerating during deceleration, to prevent the drive from faulting.

F59 follows the conventions used in I25 (Input Terminal Status Display) and I26 (Input Terminal Status Display, page 115) to show the ON (bit set) status with the 7-segment keypad throughout this manual.

- Stall Prevention (F9) can be set as the table below:

		Setting	During Deceleration	During Constant Speed	During Acceleration
			Bit 2	Bit 1	Bit 0
F29	Stall Prevention	0	-	-	-
		1	-	-	✓
		2	-	✓	-
		3	-	✓	✓
		4	✓	-	-
		5	✓	-	✓
		6	✓	✓	-
		7	✓	✓	✓

- For example, set F59 to 3 to make stall prevention active during Acceleration and constant run.
- When stall prevention is executed during acceleration or deceleration, Accel/Decel time may take longer than the user-setting time.
- When stall prevention is activated during constant run, t1, t2 executed in accordance with the value set in ACC - [Accel time] and dEC - [Decel time], (see F60).

F60: Stall Prevention Level

Range: 30-150% (Default: 150%)

Description: This parameter sets the amount of current to activate stall prevention function during Accel, Constant or Decel run.

The set value is the percentage of the H33 [Motor rated current].

F60 is used to prevent the motor from stalling by reducing the drive output frequency until the motor current decreases below the stall prevention level. This function can be selected for each mode of acceleration, steady speed and deceleration via bit combination.

- During acceleration: Motor starts deceleration when current exceeding the value set in F60 flows.
- During constant run: Motor decelerates when current exceeding the value set in F60 flows.
- During deceleration: Motor deceleration is stopped when drive DC link voltage rises above a certain voltage level.
- F60: The value is set as the percent of motor rated current (H33).

⌘ **Note:** The set value is the percentage of H33 [Rated Motor Current].

6.3 Function Group 2

H0: Jump Code]

Range: 0-95 (Default:1)

Description: This parameter allows the user to "jump" to any parameter without scrolling through the group. Enter the desired parameter number, and the drive will "jump" to that parameter.

H1-H5: Previous Fault History 1 - 5

Range: (Default: nOn)

Description: This code displays the status of the five previous faults. Use the [FUNC], [▲] and [▼] key before pressing the [RESET] key to check the fault content(s), output frequency, output current, and whether the drive was accelerating, decelerating, or at constant speed at the time the fault occurred. Press the [FUNC] key to exit. The fault content will be stored in H1 through H5 when the [RESET] key is pressed. H6 erases all fault histories of H1 to H5 from the memory.

When a fault occurs during operation, it can be monitored in the nOn.

H6: Reset Fault History

Range: 0(No), 1(Yes), (Default: 0)

Description: Clears the fault history saved in H1-5.

H7: Dwell Frequency

Range: 0.1-400Hz (Default: 5.00Hz)

Description: When run command is issued, the drive will output the dwell frequency for the amount of time in H8 before accelerating. [Dwell frequency] can be set within the range of F21- [Max frequency]. This function is used to output a torque into an intended direction. This is useful in a hoisting applications to get enough torque before releasing the mechanical brake. If the dwell time is set at '0', this function does not work.

H8: Dwell Time

Range: 0-10sec. (Default: 0.0sec.)

Description: Sets the time for dwell operation. In dwell operation, the drive outputs AC voltage not DC voltage.

⌘ **Note:** DC Injection Braking does not output a torque to an intended direction. It is just to hold the motor.

H10: Skip Frequency Select

Range: 0 - 1 (Default: 0)

Description: This parameter activates the skip frequencies (see H11-H16).

H11-H16: Frequency Jump

Range: 0.1-400Hz

Description: To prevent undesirable resonance and vibration on the structure of a machine, this function locks out the resonance frequencies from operation. Three different jump frequency ranges can be set. This jumping of frequencies does not occur while accelerating or decelerating. It only occurs during continuous operation.

Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of F21 and F23.

⌘ **Note**: When the reference frequency is set inside the jump frequency, the output frequency goes to the frequency marked by "_" symbol.

⌘ **Note**: If one frequency jump range is required, set all ranges to the same one range.

H17: S-Curve Accel/Decel Start Side

Range: 1-100% (40%)

Description: When F2 is set to S-curve, this parameter shapes the beginning of the S-curve for smooth acceleration and deceleration.

H18: S-Curve Accel/Decel End Side

Range: 1-100% (40%)

Description: When F2 is set to S-curve, this parameter shapes the end of the S-curve for smooth acceleration and deceleration.

H19: Input/Output Phase Loss Protection

Range: 0-3 (Default: 0 Disabled)

Description: This function is used to fault the drive output in case of input/output phase loss of power input or drive output.

Display:	Function:
0	Disabled
1	Output Phase protection
2	Input Phase protection
3	Input/Output Phase Protection

Output Phase Loss Protection
- Set H19 value to 1.
- Output phase loss: The drive faults if there is a phase loss on the U,V and W terminals.
- Input phase loss: The drive faults if there is a phase loss in the R, S and T input terminals.

Related Functions: H22-H25 [Speed Search]

Setting Range		H19	Description
2nd Bit	1st bit		
0	0	00	Phase loss protection does not work.
0	1	01	Protect drive from output phase loss.
1	0	10	Protect drive from input phase loss.
1	1	11	Protect drive from input and output phase loss.

CAUTION

Set H33 [Motor rated current] correctly. If the actual motor rated current and the value of H33 are different, output phase loss protection function may not function.

H20: Power ON Start Select

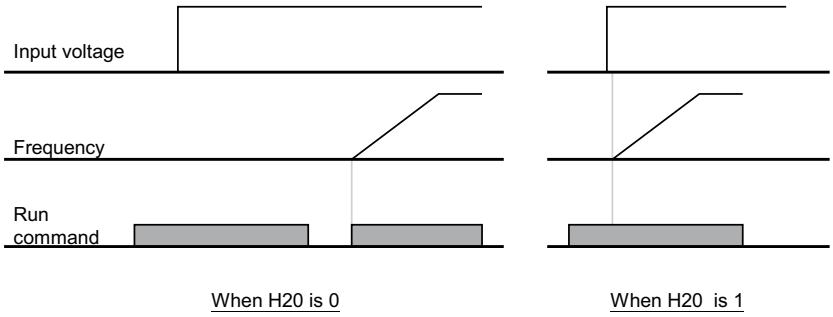
Range: 0-1 (Default: 0)

Description: This parameter is activated when DRV is set to 1 or 2 (Run/Stop via Control terminal).

Display:	Function:
0	The drive requires the start command to open and reclose upon power loss.
1	The drive will restart upon return of power if run command is still active.

CAUTION

Particular attention must be directed to this function due to potential hazard as motor starts to run suddenly upon applying AC input power.



H21: Restart After Fault Reset Selection

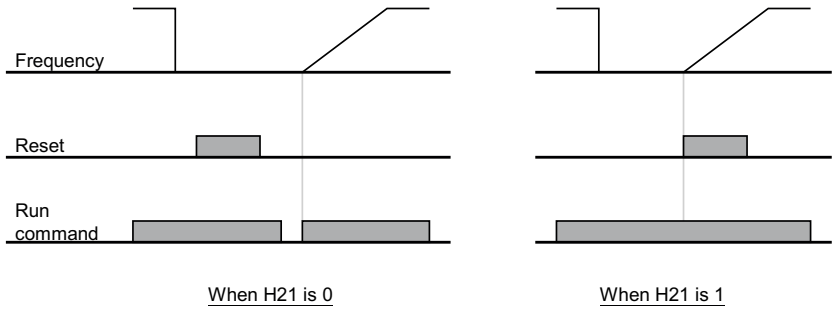
Range: 0 - 1 (Default:0)

Description: This parameter is activated when DRV is set to 1 or 2 (Run/Stop via Control terminal).

Display:	Function:
0	The drive requires the start command to open and reclose upon a fault reset.
1	The drive will restart upon a fault reset if run command is still active.

CAUTION

Particular attention must be directed to this function due to potential hazard as motor starts to run suddenly upon applying AC input power.



H22: Speed Search Select

Range: 0-15 (Default: 0)

Description: This function is used to catch a spinning motor after Power ON, Fault Reset and Instant Power Failure without waiting for the motor to stop. The speed search gain should be set after considering the inertia moment (GD2) and magnitude of torque of the load. F37 [Load Inertia] must be set to the correct value to make this function operate properly.

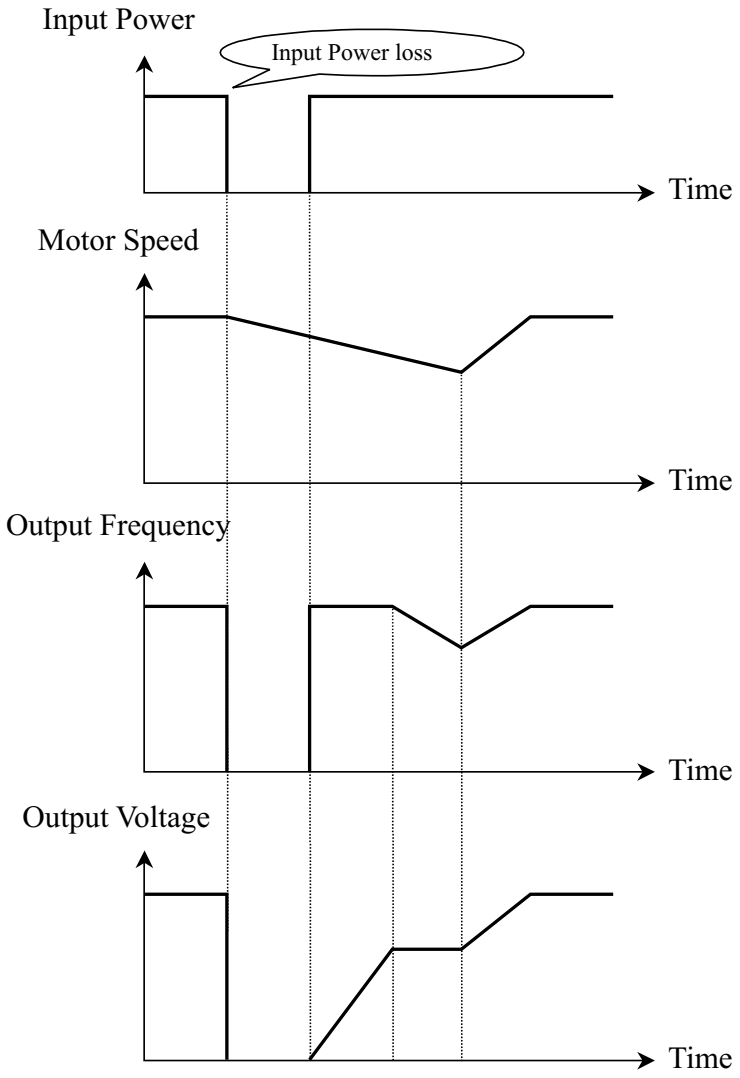
This parameter will estimate the motor speed and try to match it's speed rather than starting at 0Hz.

The following table shows 4 types of Speed Search Selections.

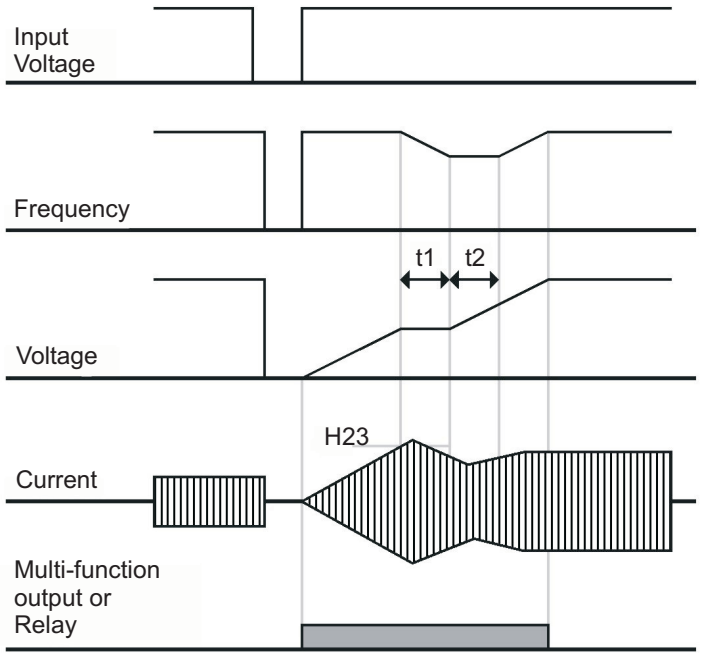
		Speed Search during H20 [Power ON Start]	Speed Search during Instant Power Failure Restart	Speed Search during H21 [Restart after fault reset]	Speed Search during Acceleration
		Bit 3	Bit 2	Bit 1	Bit 0
H22	0	-	-	-	-
	1	-	-	-	✓
	2	-	-	✓	-
	3	-	-	✓	✓
	4	-	✓	-	-
	5	5	✓	-	✓
	6	-	✓	✓	-
	7	-	✓	✓	✓
	8	✓	-	-	-
	9	✓	-	-	✓
	10	✓	-	✓	-
	11	✓	-	✓	✓
	12	✓	✓	-	-
	13	✓	✓	-	✓
	14	✓	✓	✓	-
	15	✓	✓	✓	✓

- H22 [Speed Search selection] selects the speed search function - set to 1.
- H23: Limits current during Speed search. Set as the percent of H33.
- H24 & H25: Speed search is activated via PI control. Adjust P gain and I gain corresponding to the load characteristics. Set this value considering the load inertia set in H37.
- I54 & I55: Signal that is active via multi-function output terminal (MO) and multi-function relay output (3AC).

Related Functions: H20 [PowerON Start]
H21 [Restart after Fault Reset]
H26 - H27 [Auto Restart]
H30 - H37 [Motor Parameters]



EX) Speed search during Instant Power Failure restart:



H23: Current Limit Level during Speed Search

Range: 80-200% (Default: 100%)

Description: This parameter limits the amount of current during speed search. The set value is the percentage of the H33- [Motor rated current]. See H22 [Speed Search Select].

H24 & H25: PI Gain During Speed Search

Range: 0-9999

Description: H24 [P Gain] is the proportional gain used for speed searching. Set this value condsidering the load inertia set in H37. The default for this parameter is 100.

H25 [I Gain] is the integral gain used for Speed search PI controller. Set this value condsidering the load inertia set in H37. The default for this parameter is 200.

H26: Number of Auto Restart Attempt

Range: 0-10 (Default: 0)

Description: This parameter sets the number of restart tries after a fault occurs. The auto restart will not reset faults such as OHT, LVT, EXT, HWT, etc. This function is active when [DRV] is set to 1 or 2 {Run/Stop via control terminal}.

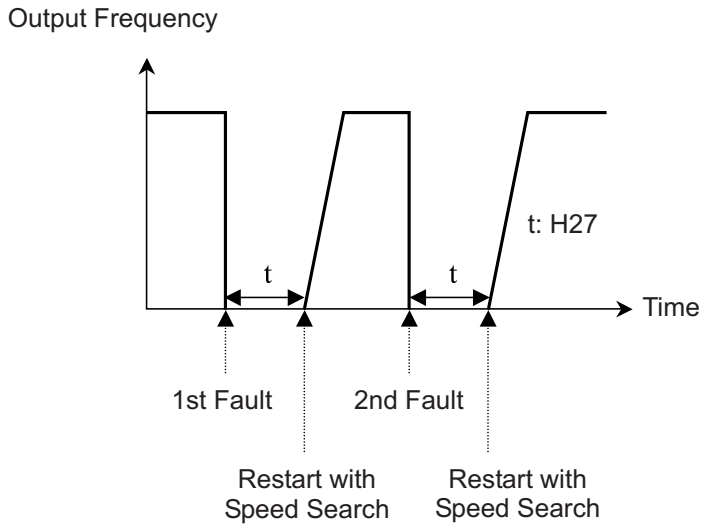
H27: Auto Restart Time

Range: 0-60sec. (Default: 1.0sec.)

Description: This parameter sets the time between restart tries.

The drive has the ability to automatically reset itself after a fault occurs. The drive will reset itself up to the amount of times set in H26. The drive will wait the amount of time set in AFN 26 after a fault before attempting a restart. The motor may be coasting when the restart occurs. To catch the spinning load use the speed search function. Set H22 to 'xx1x'. See H22 ~ H25.

This function is disabled when a low voltage (LV) trip, drive disable (BX) or Arm short occurs.



⌘ **Note:** The drive decreases the retry number by one after each fault occurs. When restarted without a fault the drive increases the retry number by one after 30 seconds.

H30: Motor Type Select

Range: 0.2-7.5kW (Default: 7.5kW - This value is set automatically according to the drive model.)

Description: This parameter sets the motor capacity. H32 [Rated Motor Slip], H33 [Rated Motor Current], H34 [No Load Motor Current], H42 [Stator Resistance], and H44 [Leakage Inductance] are automatically changed according to motor capacity.

If H34 [Motor No-load Current] is not correct, run the drive without the load in V/F mode and check the current. Enter this value into H34 [No load current].

H31: Number of Motor Poles

Range: 2-12 (Default: 4)

Description: This is used to display the motor speed. If you set this value to 2, the drive will display 3600 rpm instead of 1800rpm at 60Hz output frequency. (See motor nameplate).

H32: Rated Slip Frequency

Range: 0-10Hz (2.33Hz)

Description: This is used in 'Slip Compensation' control. If you set this value incorrectly, the motor may stall during slip compensation control (See motor nameplate).
Motor rated slip freq [Hz] = (Rated input freq. [Hz] – (Motor rpm * P/120)
P = Number of motor poles

(Ex) In the case of 60Hz, 4 pole, 1730 rpm motor
Motor rated slip freq [Hz]= (60[Hz]-(1750[rpm] * 4/120))
= 60[Hz]-58.67[Hz]=1.33[Hz]

H33: Motor Rated Current

Range: 0.5 - 50A (Default: 26.3A)

Description: This is a very important parameter that must be set correctly. This value is referenced in many functions of the drive. Enter motor rated current on the nameplate.

H34: No Load Motor Current

Range: 0.1-20A (Default: 11A)

Description: This is the no load current of the motor and can be measured when no load is connected to the motor.

Enter the 50% of the rated current value when it is difficult to measure H34 - [No Load Motor Current].

H34 is only displayed when ‘Slip Compen’ is selected in H40 [Control Method].
(This value is set according to the motor capacity set in H30)

Slip compensation is used to maintain the motor speed constantly. To keep the motor speed constant, the output frequency varies within the limit of slip frequency set in H32 according to the load current. For example, when the motor speed decreases below the reference speed (frequency) due to a heavy load, the drive increases the output frequency higher than the reference frequency to increase the motor speed. The drive increases or decreases the output by delta frequency shown below.

$$\text{Delta Freq.} = \frac{\text{Output current - No load current}}{\text{Rated current - No load current}} - \text{Rated slip}$$

Output frequency = Reference freq. + Delta freq.

H36: Motor Efficiency

Range: 50-100% (Default: 87%)

Description: This parameter is used for caculating the output wattage when H72 is set to 'Watt'. (This value is set according to the motor capacity set in H30).

H37: Load Inertia Rate

Range: 0 - 2 (Default: 0)

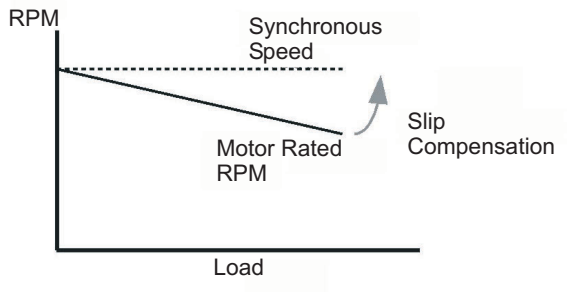
Description: This parameter is used by many drive functions such as Sensorless Vector control and Speed Search.

During Speed Search operation if overvoltage trips occur increase the value of this parameter and retest.

For better control performance, this value must be set as exact as possible.

Set '0' for loads that having load inertia less than 10 times of motor inertia.
Set '1' for loads that having load inertia about 10 times of motor inertia.
Set '2' for loads that having load inertia larger than 10 times of motor inertia.

If the application requires more rapid deceleration, use dynamic braking unit or resistor.
As the loads get heavier, the speed gap between rated RPM and synchronous speed is widens (see figure below). This function compensates for the inherent slip.



H39: Carrier Frequency Select

Range: 1-15kHz (Default: 3kHz)

Description: This parameter affects the audible sound of the motor, noise emission from the drive, drive temp, and leakage current. If the set value is higher, the motor sound is quieter but the noise from the drive and leakage current will become greater.

If this paramter is set above 10kHz, reduce the rated output current by 5% for each 1kHz above 10kHz. Do not set the carrier frequency below 1.5kHz when H40 [Control mode selection] is set to Sensorless Vector., otherwise poor performance can result.

H40: Control Mode Select

Range: 0 -3 (Default: 0)

Description: This is to select the control method of the drive.

Setting Range		Description
Display	Select	
0	V/F Control	V/F Control
1	Slip compensation operation	Slip compensation operation
2	PID Feedback control	PID Feedback control
3	Sensorless Vector Control	Sensorless Vector Control

[V/F]: This is to control the voltage/frequency ratio linearly. It is recommended to use torque boost function when a larger starting torque is required.

Related functions: H26 ~ H27 [Torque Boost]

[Slip compen]: This is used for motor speed regulation. To keep the motor speed constant, the output frequency varies within the limit of slip frequency set in FU2-32 according to the load current. For example, when the motor speed decreases below the reference speed (frequency) due to a heavy load, the drive increases the output frequency higher than the reference frequency to increase the motor speed. The drive increases or decreases the output by delta frequency shown below.
Output frequency = Reference freq. + Delta freq.

$$\text{Delta Freq.} = \frac{\text{Output current - No load current}}{\text{Rated current - No load current}} - \text{Rated slip}$$

⌘ **Note:** Motor parameters must be set correctly for better performance of control.

Related Functions: H30 ~ H37 [Motor Parameters]

[PID]: For HVAC or Pump applications, PID control can be used to adjust the actual output by comparing a feedback with a 'Set-point' given to the drive. This 'Set-point' can be in form of Speed, Temperature, Pressure, Flow level, etc. Both the 'Set-point' and the feedback signals are provided externally to the drive analog input terminals V1, V2 or I. The drive compares the signals in calculating 'total-error' which is reflected in the drive output.

Please see H50 to H54 for more detail.

[SVC]: Use sensorless vector control when 1) high starting torque is required at low speeds 2) the load fluctuates 3) fast torque response times are needed.

For proper operation, set H42-H46.

Set “Yes” in H41 [Auto tuning] first before using this control.

H41: Auto Tuning

Range: 0 - 1 (Default: 0)

Description: All of the motor parameters can be tuned by setting “YES (1)”. Auto tuning is deactivated when “No (0)” is selected.

The auto tuning function automatically measures the motor parameters needed for the control selected in H40 [Control mode] such as stator resistance, rotor resistance, leakage inductance, no-load current and Encoder feedback frequency.

⌘ **Note**: The rated current, voltage, efficiency and slip described in the motor nameplate should be entered before performing auto tuning. The load should not be connected when performing an auto tune in H41.. If efficiency is not indicated on the nameplate, use the default value.

H42: Stator Resistance (Rs)

Range: 0 - 14 Ω

Description: This is the value of the motor stator resistance.

H44: Leakage Inductance (Lσ)

Range: 0 - 300.0 mH

Description: This is leakage inductance of the stator and rotor of the motor.

- H41: When H41 is set to 1, Auto tuning is activated and "TUn" will appear on the LED keypad. When finished, "H41" will be displayed.
- H42, H44: The values of motor stator resistance and leakage inductance detected in H41 are displayed, respectively. When Auto tuning is skipped or H93 – [Parameter initialize] is done, the default value corresponding to motor type (H30) will be displayed.
- Press the STOP/RST key on the keypad or turn on the EST terminal to stop the Auto Tuning.
- If Auto tuning of H42 and H44 is interrupted, the default value will be set. If H42 and H44 are finished and auto-tuning of leakage inductance is interrupted, the measured value of H42 and H44 are used and the default of leakage inductance is set.

⚠ CAUTION

Do not enter any incorrect value as stator resistance and leakage inductance. Otherwise, the function of Sensorless Vector Control and Auto Torque Boost could be deteriorated.

H45: Sensorless P Gain

Range: 0-32767 (Default: 1000)

Description: P gain for Sensorless control. Set H40 to 3 (Sensorless vector control) to display this parameter).

H46: Sensorless I Gain

Range: 0-32767 (Default: 100)

Description: I gain for Sensorless control

H50: PID Feedback Select

Range: 0 - Terminal I input (0-20mA), 1 - Terminal V1 input (0-10V)

Description: H50 [PID Feedback Select] selects the feedback signal for PID control. This can be set to either 'I', 'V1' according to the feedback signal (current or voltage) and the terminal (V1 or V2).

For HVAC or Pump applications, the PID control can be used to adjust the actual output by comparing a feedback with a 'Set-point' given to the drive. This 'Set-point' can be in form of Speed, Temperature, Pressure, Flow level, etc. Both the'Set-point' and the feedback signals are provided externally to the drive analog input terminals V1, V2 or I. The drive compares the signals in calculating 'total-error' which is reflected in the drive output.

To use this function, H40 must be set to 'PID'.

⌘ **Note:** PID control can be bypassed to manual operation temporarily by defining one of the multifunction input terminals (P1~P3) to "Open-loop". The drive will change to manual operation from PID control when this terminal is ON, and change back to PID control when this terminal is OFF.

H51: P Gain for PID Controller

Range: 0-999.0% (Default: 300.0%)

Description: This parameter sets the proportional gain for PID control.

H52: I Gain for PID Controller

Range: 0.1-32.0 sec. (Default: 1.0 sec.)

Description: This parameter sets the integral gain for PID control.

H53: D Gain for PID Controller

Range: 0-30.0 sec. (Default: 0.0 sec.)

Description: This parameter sets the differential gain for PID control.

H54: F Gain for PID Controller

Range: 0-999.9 % (Default: 0.0%)

Description: This is the Feed forward gain for the PID controller.
[P Control]
This is to compensate for the error of a system proportionally. This is used to make the controller respond quickly to an error. When externally to the drive analog input terminals V1, P control is used alone, the system is easily affected by an drive output.

[I Control]
This is to compensate the error of a system integrally. Using this control alone makes the system unstable.

[PI control]
This control works stable in many systems. If D control added to this control, it becomes the 3rd order system from the 2nd order system. This may make the system unstable.

[D Control]
Since the D control uses the variation ratio of error, it has the merit of controlling the error before the error gets large. The D control requires a large control quantity at start, but has the tendency of increasing the stability of the system. This control does not affect the steady state error directly, but increases the system gain because it has an attenuation effect on the system. As a result, the differential control component has an effect on decreasing the steady state error. Since the D control operates on the error signal itself, it cannot be used alone. Always use it with the P control or PI control.

H55: PID Output Frequency Limit

Range: 0.1-400 Hz (Default: 60.00Hz)

Description: This parameter sets the maximum output frequency while in PID control. The value is settable within the range of F21 – [Max frequency] and H23 – [Start frequency].

H60: Self-Diagnostic Select

Range: 0 - 3 (Default: 0)

Description: This parameter performs a Self-diagnostic check after input/output wiring of the drive is finished.
This function enables the user to safely check for an IGBT fault, open output phase, shorted fault, and Ground fault without disconnecting the drive wiring.

Display:	Function:
0	Self-Diagnostic disabled
1	IGBT fault and Ground fault [2)]
2	Output phase short & open circuit and Ground fault
3	Ground fault (IGBT fault, Output phase short and open circuit)

To use the Self-Diagnostic function:

- Select Self-Diagnostic function in H60, Function group 2.
- Define one terminal among P1-P8 terminals for this function.
- To define P8 for this function, set I24 to "20".
- Ground fault of U phase in 3-5HP drives and ground fault of V phase in other rating drives may not be detected when selecting “1”.
- Select 3 to check for all types of faults.
- When setting H60 to a specific value from 1 to 3 and turn the terminal defined for this function among P1 ~ P8 terminals ON, the corresponding function is conducted, displaying “dIAG” and the previous menu will be displayed when this function is completed.
- To stop this function, press STOP/RESET key on the keypad, turn the defined terminal OFF or turn the EST terminal ON.
- When an error occurs during this function, “FLtL” will be displayed. While this message is displayed, press Enter key (<), the fault type is displayed and pressing the UP(5) or Down(6) key shows. When the fault occurs while this function is being performed, press Stop/Reset key or turn the RESET-defined terminal ON to reset the fault.

  The following table shows the fault type while this function is active.

No.	Display	Fault Type	Diagnosis
1	UPHF	Switch above IGBT's U phase fault	Contact Benshaw sales representatives.
2	UPLF	Switch below IGBT's U phase fault	
3	vPHF	Switch above IGBT's V phase fault	
4	vPLF	Switch below IGBT's V phase fault	
5	WPHF	Switch above IGBT's W phase fault	
6	WPLF	Switch below IGBT's U phase fault	
7	UWSF	Output short between U and W	Check for the short of drive output terminal, motor connection terminal or the proper motor connection.
8	vUSF	Output short between U and V	
9	WvSF	Output short between V and W	
10	UPOF	Ground fault at U phase	Check for the ground faults.
11	vPGF	Ground fault at V phase	
12	WPGF	Ground fault at W phase	
13	UPOF	Output open at U phase	Check for proper connection of the motor.
14	vPOF	Output open at V phase	
15	WPOF	Output open at W phase	

H70: Frequency Reference for Accel/Decel

Range: 0 - 1 (Default:0)

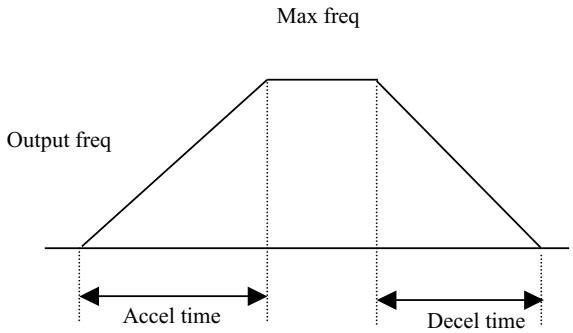
Description: This is the reference frequency for acceleration and deceleration. If a decided accel/decel time from a frequency to a target frequency is required, set this value to 'Delta freq'. For most applications, the Max. freq. setting is appropriate.

Setting Range		Description
Display	Select	
0	Max freq (F21)	The Accel/Decel time is the time that takes to reach the maximum frequency from 0 Hz.
1	Delta Freq	The Accel/Decel time is the time that takes to reach a target frequency from any frequency.

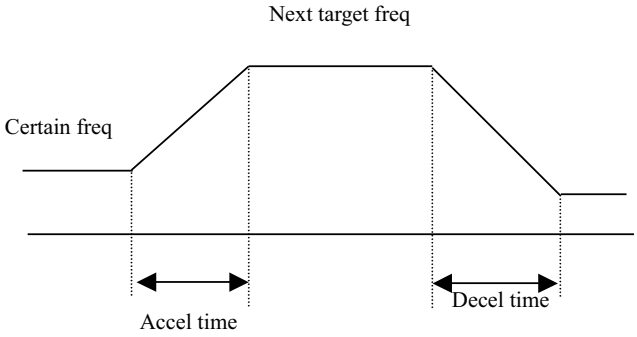
Accel/Decel time setting based on Operating Frequency:

- Accel/Decel time is set at the **ACC/dEC**.
- If you set H70 to 1 {Delta frequency}, Accel/Decel time is the time that it takes to reach a target frequency from a steady state frequency.

H70: Max. Freq



H70: Delta Freq



H71: Accel/Decel Time Scale

Range: 0-2 (Default: 1)

Description: This is used to change the resolution for the acceleration and deceleration times.

Setting Range		Description
Display	Select	
0	0.01 sec.	The Accel/Decel time is changed by 0.01 sec./10msec. The maximum setting range is 60 seconds.
1	0.1 sec.	The Aceel/Decel time is changed by 0.1 sec./100 msec. The maximum setting range is 600 seconds.
2	1 sec.	The Accel/Decel time is changed by 1 second. The maximum setting range is 6000 seconds.

H72: Power on Display

Range: 0 - 13 (Default: 0)

Description: This parameter selects the first parameter to be displayed on the keypad when the input power is first applied.

Display	Description	Display	Description
0	Frequency command (0.00)	7	Multi-Step frequency 3
1	Accel time (ACC)	8	Output current (CUr)
2	Decel time (DEC)	9	Motor rpm (rPM)
3	Drive mode (drv)	10	Inverter DC link voltage (dCL)
4	Frequency mode (Frq)	11	User display select (vOL)
5	Multi-Step frequency 1	12	Fault display 1
6	Multi-Step frequency 2	13	Operating direction select

H73: Monitoring Item Select

Range: 0 - 2 (Default: 0)

Description: The selected item in H73 [Monitoring item select] can be monitored via vOL - [User display select]. If output power or torque is selected, Por or tOr will be displayed. Enter motor efficiency indicated on motor nameplate in H36 to display correct torque.

Display:	Function:
0	Output voltage [V]
1	Output power [kW]
2	Torque [kgf • m]

H74: Gain for Motor RPM Display

Range: 1-1000% (Default: 100)

Description: This parameter is used to change the motor speed display to rotating speed (r/min) or mechanical speed (rpm).

Motor RPM can be monitored in rPM:

- When H40 is set to 0 {V/F control} or 1 {PID control}, the drive output frequency (f) is displayed in RPM using the formula below. Motor slip is not considered.

$$RPM = \left(\frac{120 \times f}{H31}\right) \times \frac{H74}{100}$$

- H31: Enter the number of rated motor poles on the nameplate.
- H74: This parameter is used to change the motor speed display to rotating speed (r/min) or mechanical speed (m/min).

H75: DB Resistor Operating Rate Limit Select

Range: 0 - 1 (Default: 1)

Description: This must be set when using an external DB resistor. The duty is calculated by '%ED=Decel time * 100 / (Accel time + Steady speed time + Decel time + Stop status time)'.

Display:	Function:
0	No Limit
1	ED is limited as the setting in H76

⚠ CAUTION

Take caution when DB resistor is used over its Watt rating. Fire may result from resistor overheat. When using a resistor with a thermal switch, program one of the multi-function outputs to an external trip.

To use this function:
- Set H75 to 1.
- Set %ED (Enable Duty) in H76.

H76: DB Resistor Operating Rate

Range: 0-30% (Default: 10)

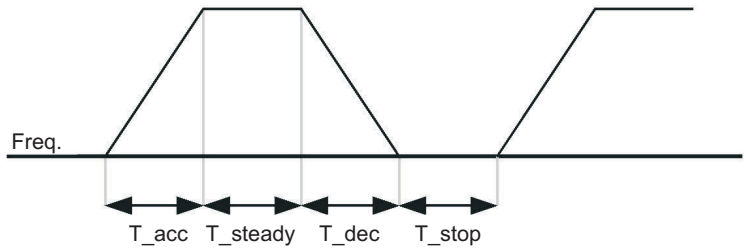
Description: Set the percent of DB resistor operating rate to be activated during one sequence of operation.

To use this Function:
- Set the resistor operating rate(%ED) in one sequence of operation. Continuous usage reate is Max 15 sec and usage signal is not issued over 15 sec.

Example 1)

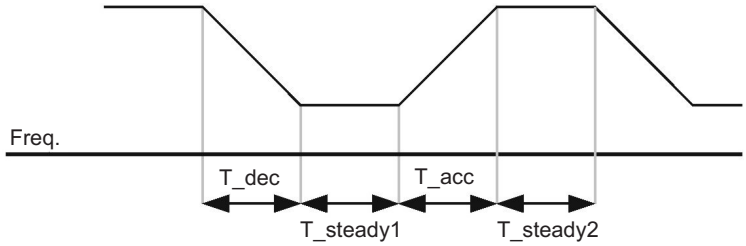
$$H76 = \frac{T_dec}{T_acc + T_dec + T_stop} \times 100[\%]$$

Where,
T_acc: Acceleration time to reach a setting freq.
T_steady: Time for constant speed operation at setting freq.
T_dec: Time to decelerate to lower freq. than that in constant speed. or time to stop from freq. in constant speed.
T_stop: waiting time at a stop before operation is resumed.



Example 2)

$$H76 = \frac{T_dec}{T_dec + T_steady1 + T_acc + T_steady2} \times 100[\%]$$



H77: Cooling Fan Control

Range: 0 - 1 (Default: 0)

Description: This parameter determines the operation of the drives cooling fans.

Display:	Function:
0	Always ON
1	Keeps ON when its temp is higher than drive protection limit temp. Activated only during operation when its temp is below that of drive protection limit.

When it is set to 0:
- Cooling fan begins to operate when power is ON.
- Cooling fan is stopped when drive main circuit voltage becomes low voltage due to power off.

When it is set to 1:
- Cooling fan begins to operate when power is turned ON with a run command.
- Cooling fan is stopped when power is Off.
- Cooling fan keeps operating when the heat sink temperature exceeds a certain limit regardless of the run fan command.
- Used when frequent Run/Stop or quiet stop is required. This may extend the cooling fan life.

H78: Operating Method Select When Cooling Fan Malfunctions

Range: 0 - 1 (Default: 0)

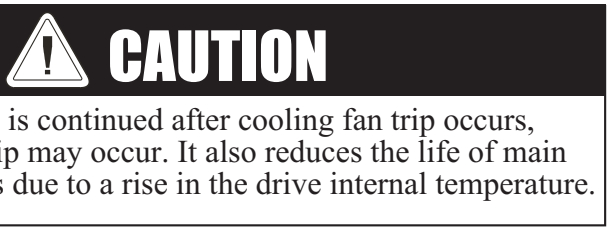
Description: This parameter configures what action is taken, if any, when the drive senses the loss of one of its cooling fans (either external or internal). The following functions may be assigned:

Display:	Function:
0	Continuous operation when cooling fan malfunctions.
1	Operation stopped when cooling fan malfunctions.

- Select 0 or 1 in H78 code.
- If H78 code is set to 0 (continuous operation), alarm can be output in I54 or I55.

0 - Continuous operation when cooling fan trip occurs:
Operation is not stopped regardless of loss of cooling fan.
When I54 or I55 is set to 18 (cooling fan fault alarm), fault alarm signal can be output using Multi-function output terminal or Multi-function relay.

1 - Operation stopped at cooling fan fault:
When cooling fan fault occurs, "FAn" message is displayed on the LED and operation is stopped.
If I54 or I55 is set to 17(Fault output), fault message is displayed.



H79: S/W Version

Range: 0-10.0 (Default:1.0)

Description: This parameter displays the drive software version.

H81 - H90: 2nd Motor Related Functions

These functions are displayed only when one of the multifunction inputs is set at ‘2nd func’ in I7 to I24.

The purpose of these parameters is to provide the user with a second set of motor parameters selected with a digital input. This can be useful on test stands, where a user will be testing different types of applications.

In the table below, the 1st functions are applied if the multifunction terminal is not defined to '2nd Func' or if it is not ON. The 2nd function parameters are applied when the multifunction input terminal is set to '2nd Func' and is ON. Parameters not listed on the table below are applied to the 2nd motor as well as the 1st motor.

The 'User V/F' function of F29 [V/F Pattern] is used for both the 1st motor and the 2nd motor.

Description	1st Functions	2nd Functions
Acceleration Time	ACC [Accel time]	H81 [2nd Acc time]
Deceleration Time	dEC [Decel time]	H82 [2nd Dec time]
Base Frequency	F22 [Base Freq.]	H83 [2nd Base Freq.]
Volts/Hz Pattern	F30 [V/F pattern]	H84 [2nd V/F pattern]
Forward Torque Boost	F28 [FWD Boost]	H85 [2nd Fwd Boost]
Reverse Torque Boost	F29 [Rev Boost]	H86 [2nd Rev Boost]
Stall Prevention Level	F59 [Stall prevention level]	H87 [2nd Stall prevention level]
ETH Level for 1 Minute	F51 [ETH 1 min.]	H88 [2nd ETH 1 min.]
ETH Level for Continuous	F52 [ETH continuous]	H89 [2nd ETH continuous]
Motor Rated Current		H90 [2nd Motor rated current]

⌘ **Note: The exchanging of motors must be performed when the motors are stopped.** An Overvoltage or overcurrent fault can occur when the motor connection is exchanged during operation.

H91 & H92: Parameter Read/Write

Range: 0 - 1 (Default:0)

Description: Used to read/write drive parameters when using an optional remote keypad. This is useful when programming drives to have same parameter settings. The keypad can read (upload) the parameter settings from one drive and can write (download) them to other drives.

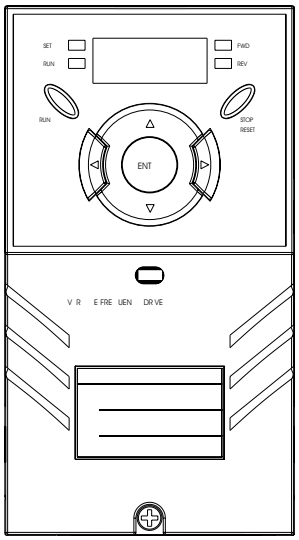
⚠ CAUTION

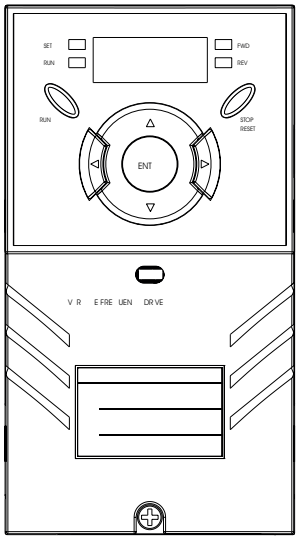
Take caution when Parameter write (H92) is executed. By doing this, parameters in drive are cleared and parameters in remote keypad are copied to the drive.

Parameter Read:
- Move to parameter H91.
- Press Enter (●) key once. Keypad display will be 0.
- Press Up (▲) key once. Keypad display will be 1.
- Press Enter (●) key twice. Keypad display will be 1.
- H91 is displayed when Parameter read is finished.

Parameter Write:
- Move to parameter H92.
- Press Enter (●) key once. Keypad display will be 0.
- Press Up (▲) key once. Keypad display will be 1.
- Press Enter (●) key twice. Keypad display will be 1.
- H92 is displayed when Parameter write is finished.

Set H91 to “Yes” and press Enter key to read the parameters. ➡ Move remote LED keypad to the second drive. ➡ Install the keypad into the next drive and set H92 to “Yes”. Then press Enter to download the parameters.





H93: Parameter Initialize

Range: 0 - 5 (Default: 0)

Description: This parameter is used to initialize parameters back to the factory default value. Each parameter group can be initialized separately or all parameters can be initialized at once.

Setting Range		Description
Selection	Display	
No	0	Displayed after initializing parameters.
All Groups	1	All parameter groups are initialized to factory default value.
DRV	2	Only Drive group is initialized.
F1	3	Only Function group 1 is initialized.
F2	4	Only Function group 2 is initialized.
I/O	5	Only I/O group is initialized.

- Select Enter (●) key after setting in H93. H93 will be displayed again after initialization is complete.

H94: Password Register

Range: 0 - FFFF (Default:0)

Description: Password for H95-[Parameter lock]. Set as Hexa value (0-9, A, B, C, D, E, F). Factory default password is 0. Enter the new password except 0.

CAUTION

Do not forget the registered password. It is used when unlocking the parameters.

- Move to parameter H94 code.
- Press Enter (●) key twice.
- Register password. (Ex: 123).
- Password will blink when Enter (●) key is pressed.
- Press Enter (●) key.

H95: Parameter Lock

Range: 0 - FFFF (Default: 0)

Description: This function is used to lock the parameters from being changed. When the parameters are locked, the display arrow changes from solid to dashed line indicating that the parameters have been locked. This parameter is able to lock or unlock parameters by typing the password registered in H94.

To lock the user-set parameter via the H94 [Password Register]:

Step	Note	Keypad Display
1	Move to H95 code.	H94
2	Press Enter (●) key.	UL
3	Parameter value can be changed in UL (Unlock) status.	UL
4	Press Enter (●) key.	0
5	Enter the password created in H94 (e.g.: 123).	123
6	Press Enter (●) key.	L
7	Parameter value cannot be changed in L (Lock) status.	L
8	Press Enter (●) key.	H95

To unlock the user-set parameter via password:

Step	Note	Keypad Display
1	Move to H95 code.	H94
2	Press Enter (●) key.	L
3	Parameter value cannot be changed in L (Lock) status.	L
4	Press Enter (●) key.	0
5	Enter the password created in H94 (e.g.: 123).	123
6	Press Enter (●) key.	UL
7	Parameter value can be changed in UL (Unlock) status.	UL
8	Press Enter (●) key.	H95

6.4 I/O Group

I0: Jump Code

Range: 0 - 64 (Default: 1)

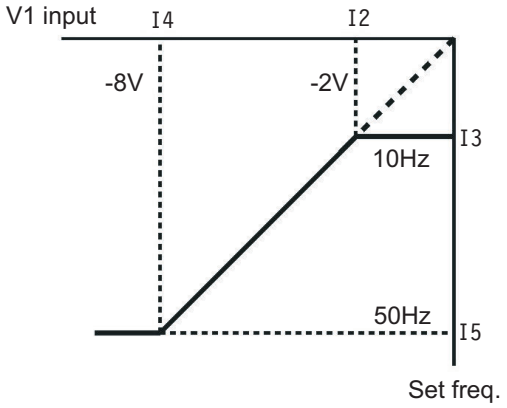
Description: This parameter allows the user to "jump" to any parameter without scrolling through the group. Enter the desired parameter number, and the drive will "jump" to that parameter.

I1 - I5: Bias and Gain of the -10 to 0V Signal

Range: 0 - 9999 (10)

Description: These parameters are used to adjust the scaling of the V1 (-10 to 0V) analog input signal. The scaling and slope of the analog signal is adjusted by setting parameters I2-I5. A filter time can also be set to reduce the affects of noise on the analog signal. This parameter is active if Frq is set to 5 or 6.

Code	Default	Setting	Code	Default	Setting
I2	0V	-10~0	I4	-10V	0~-10V
I3	0Hz	0~Max. freq	I5	60Hz	0~Max. freq



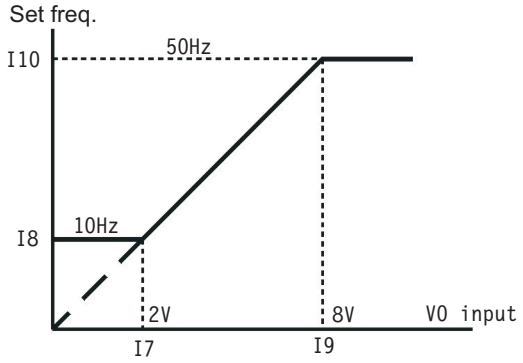
I1 is the filtering time constant for the V1 (0-10Vdc) input. Increasing this value will reduce the drive's response to noise. However, increasing this parameter will also make the drive respond slower to speed changes.

I6 - I10: Bias and Gain of the -10 to 0V Signal

Range:

Description: These parameters are used to adjust the scaling of the V1 (-10 to 0V) analog input signal. The scaling and slope of the analog signal is adjusted by setting parameters I2-I5. A filter time can also be set to reduce the affects of noise on the analog signal. This parameter is active if Frq is set to 3 or 5.

Code	Default	Setting	Code	Default	Setting
I7	0V	0-10V	I9	10V	0~10V
I8	0Hz	0~Max. freq	I10	60Hz	0~Max. freq



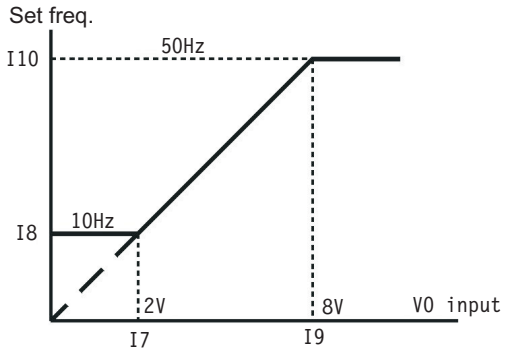
I6 is the filtering time constant for the V1 (0-10Vdc) input. Increasing this value will reduce the drive's response to noise. However, increasing this parameter will also make the drive respond slower to speed changes.

I11 - I15: Bias and Gain of the -10 to 0V Signal

Range:

Description: These parameters are used to adjust the scaling the -10 to 0V analog input signal. The scaling and slope of the analog signal is adjusted by setting parameters I2-I5. A filter time can also be set to reduce the affects of noise on the analog signal. This parameter is active if Frq is set to 3 or 5.

Code	Default	Setting	Code	Default	Setting
I12	4mA	0-20mA	I14	20mA	0~20mA
I13	0Hz	0~Max. freq	I15	60Hz	0~Max. freq



I11 is the filtering time constant for the V1 (0-10Vdc) input. Increasing this value will reduce the drive's response to noise. However, increasing this parameter will also make the drive respond slower to speed changes.

I16: Criteria for Analog Input Signal Loss

Range: 0 - 2 (Default: 0)

Description: This is to set the criteria for loss of analog input signal when DRV-15 [Frequency Mode] is set to ‘V1’, ‘V1S’ ‘I’, ‘V1+I’ or ‘Pulse’. This function is does not operate when the set to V1 +I.

Display:	Function:
0	Disabled.
1	Activated below half of set value.
2	Activated below set value.

Ex 1) The drive determines the freq reference is lost when DRV- Frq is set to 3 (Analog V1 input), I 16 to 1 and analog input signal is less than half the value set in I 7.

Ex 2) The drive determines the freq reference is lost when DRV- Frq is set to 6 (V1+I), I 16 to 2 and V1 input signal is either below the value set in I 7 or I input value is less than the I 12 value.

I17-I24: Multi-Function Input Terminals

Range: 0-24

Description: The multi-function input terminals can be defined for many different applications. The following table shows the various programmable functions.

Code	Display	Default	Setting
I17	P1 define	0	See table below
I18	P2 define	1	
I19	P3 define	2	
I20	P4 define	3	
I21	P5 define	4	
I22	P6 define	5	
I23	P7 define	6	
I24	P8 define	7	

Setting Range / Display	Description	Setting Range / Display	Description
0	Forward Run	13	-Reserved-
1	Reverse Run	14	-Reserved-
2	Stop Trip	15	Frequency (Up) Command
3	Reset [RST]	16	Frequency (Down) Command
4	Jog Operation	17	3-wire operation
5	Step freq - Low	18	External trip: A (EtA)
6	Step freq - Mid	19	External trip: B (EtB)
7	Step freq - High	20	Self-diagnostic
8	Accel/Decel - Low	21	Exchange between PID operation and V/F operation
9	Accel/Decel - Mid	22	Exchange between Option and drive
10	Accel/Decel - High	23	Analog Hold
11	DC brake	24	Accel/Decel Disable
12	2nd motor		

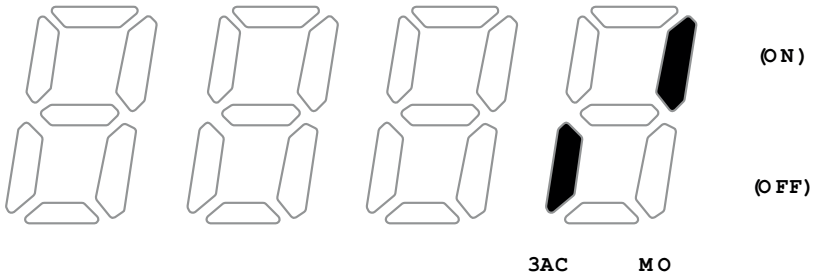
I25: Input Terminal Status Display

Range:

Description: This code displays the input status of control terminals P1-P8. Current input terminal status (ON/OFF) can be monitored in I25.

Input T/M	P8	P7	P6	P5	P4	P3	P2	P1
	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
OFF status								
ON status								

- The following is displayed when P1, P3, P4 are ON and P2, P5 are OFF.



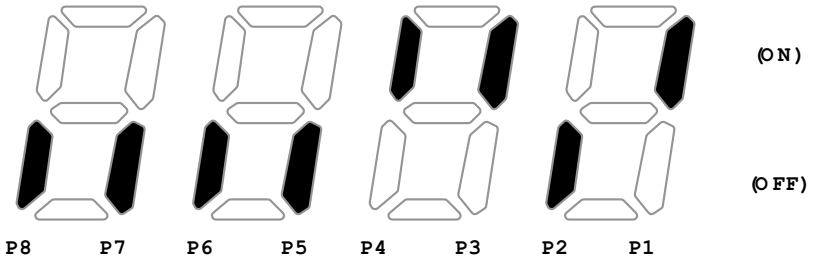
I26: Output Terminal Status Display

Range: BIT1 - BIT0
3AC - MO

Description: This parameter displays the condition of each of the outputs. This is useful in monitoring the status of the terminals. Current output terminals (MO, relays) status (ON/Off) can be monitored in I26.

Input T/M	3AC	MO
	1 Bit	0 Bit
OFF status		
ON status		

- The followings are displayed when Multi-function output terminal (MO) is ON with Multi-function relay OFF.



I27: Filtering Time Constant for Multi-function Input Terminal

Range: 1 - 7 (Default: 4)

Description: Debounces and sets the responsiveness of input terminals M1-M8. Increasing the filter time is effective when noise level is high. Increasing this parameter will make response time slower and decreasing it will make response faster.

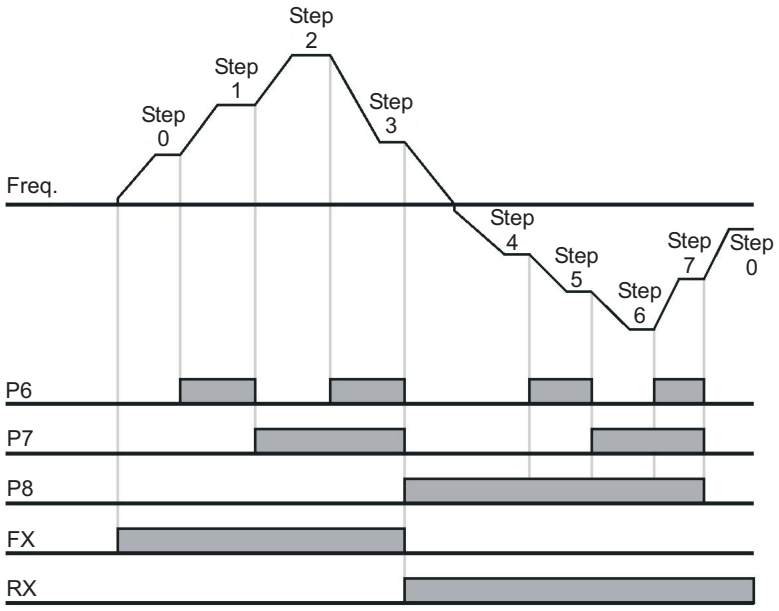
⌘ **Note:** Set the parameter higher than 100msec when attempting drive-commercial line exchange operation. This will prevent chattering during the transition.

I30-I33: Multi-Step Frequency 4 - 7

Range: 0 - 400Hz (Default: I30 - 30.00Hz, I31 - 25.00Hz, I32 - 20.00Hz, I33 - 15.00Hz)

Description: These codes set the step frequencies. These frequencies are applied when the multi-function input terminals (P1, P2, P3) select the step. See [Speed-L, Speed-M, Speed H] in DRV 5 - DRV 7. It cannot be set greater than F21 (Max frequency).

- Select a terminal to give Multi-step frequency command among P1-P8 terminals.
- If terminals P6-P8 are selected, set I22-I24 to 5-7 to give Multi-step frequency command.
- Multi-step frequency 0 is settable in Frq – [Frequency mode] and 0.00 – [Frequency command].
- Multi-step frequency 1-3 are set at St1-St3 in Drive group, while Step frequency 4-7 are set at I30-I33 in I/O group.



Step Freq.	FX or RX	P8	P7	P6
0	✓	-	-	-
1	✓	-	-	✓
2	✓	-	✓	-
3	✓	-	✓	✓
4	✓	✓	-	-
5	✓	✓	-	✓
6	✓	✓	✓	-
7	✓	✓	✓	✓

I34 - I47: 1st - 7th Accel/Decel Time

Range: 0 - 6000sec.

Description: These codes are applied when the multi-function input terminals (P1,P2,P3) select the accel/decel time.

I50: Analog Output Item Select

Range: 0 - 3 (Default: 0)

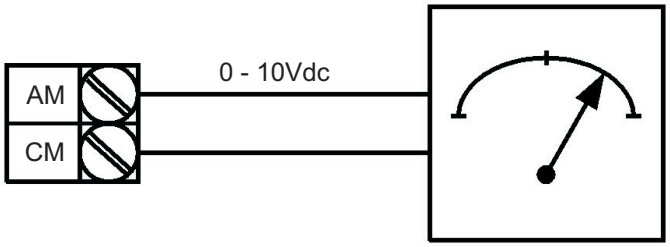
Description: This parameter selects the function of the 0-10V analog output.

	Output Item	Output to 10V	
		200V	400V
0	Output Freq.	Max frequency (F21)	
1	Output Current	150% of drive rated current	
2	Output Voltage	AC 282V	AC 564V
3	Inverter DC Link voltage	DC 400V	DC800V

I51: Analog Output Level Adjustment

Range: 10-200% (Default: 100%) Based on 10V

Description: This parameter calibrates the analog output.



I52 & I53: FDT (Frequency Detection) Level & FDT Bandwidth

Range: 0 - 400Hz (Default: I52 - 30.00Hz, I53 - 10.00Hz)

Description: I52 sets the target frequency used in parameters in I54. Cannot be set higher than F21.

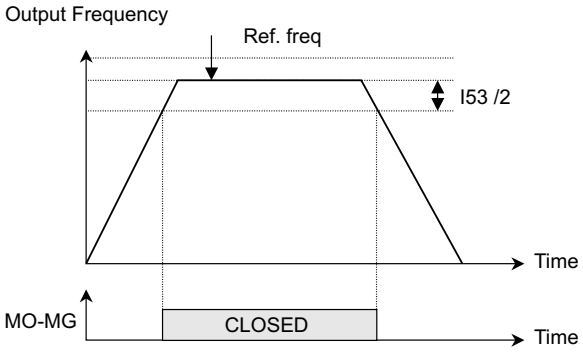
Related Functions: I54 (Multi-function Output)

I54: Multi-function Output Define (MO)

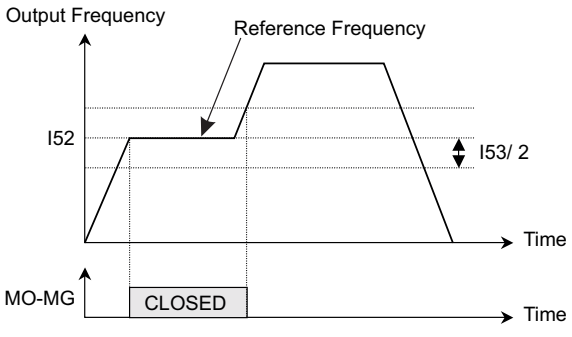
Range: 0 - 18 (Default: 12)

Description: This parameter sets the function of the MO open collector output.

Setting Range		
Select	Display	Description
FDT-1	0	Output frequency arrival detection
FDT-2	1	Specific frequency level detection.
FDT-3	2	Frequency detection with pulse.
FDT-4	3	Frequency detection 1 with contact closure.
FDT-5	4	Frequency detection 2 with contact closure.
Overload (OL)	5	Overload detection.
Inverter Overload (IOL)	6	Inverter overload detection.
Motor stall (STALL)	7	Stall prevention mode detection.
Overvoltage Trip (OV)	8	Over voltage detection.
Low voltage trip (LV)	9	Low voltage detection.
Inverter Overheat (OH)	10	Overheat detection.
Command loss	11	Lost command detection.
During Run	12	Inverter running detection.
During Stop	13	Inverter stop detection.
During constant run	14	Steady speed detection.
During speed searching	15	Speed search mode detection.
Wait time for run signal input	16	
Fault relay output select	17	
Warning for cooling fan trip	18	



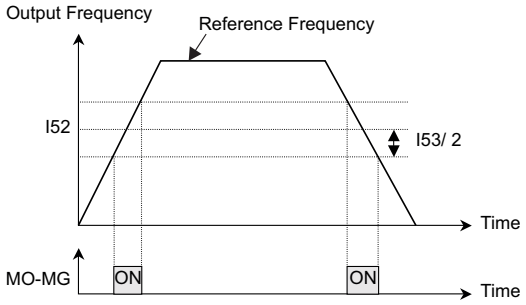
[MO configured as 'FDT-1']



[MO configured as 'FDT-2']

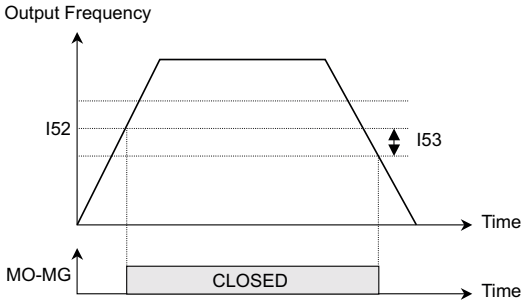
[FDT-3]
MO-MG is CLOSED when the output frequency reaches the band centered on the FDT frequency. The output is OPENED when the output frequency goes outside the I53 (FDT bandwidth) centered on the I52 (FDT frequency).

Detecting Condition: Value (Freq Detection (I52)-Output Freq)<= Freq Detection Bandwidth (I53)/2.



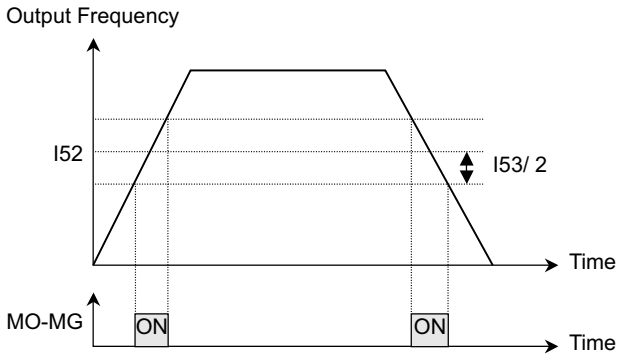
[MO configured as 'FDT-3']

[FDT-4]
MO-MG is CLOSED when the output frequency reaches the I52 (FDT frequency). The output is OPENED when the output frequency goes below the I53 (FDT bandwidth) centered on the I52 (FDT frequency).



[MO configured as 'FDT-4']

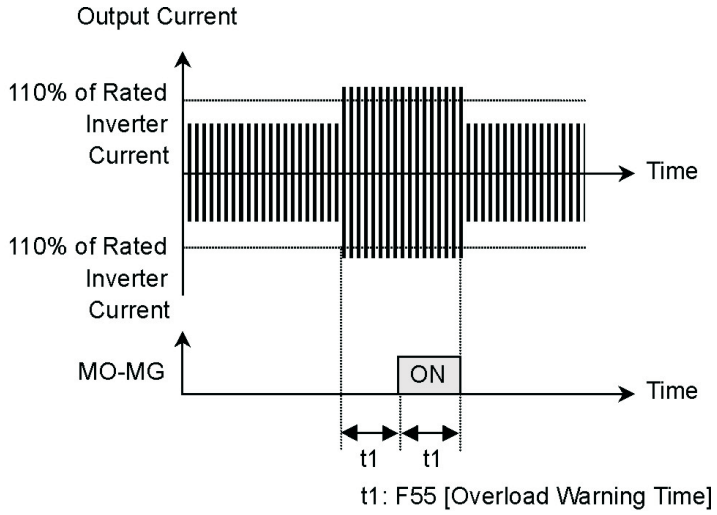
[FDT-5]
This is the inverted output of [FDT-4].



[MO configured as 'FDT-5']

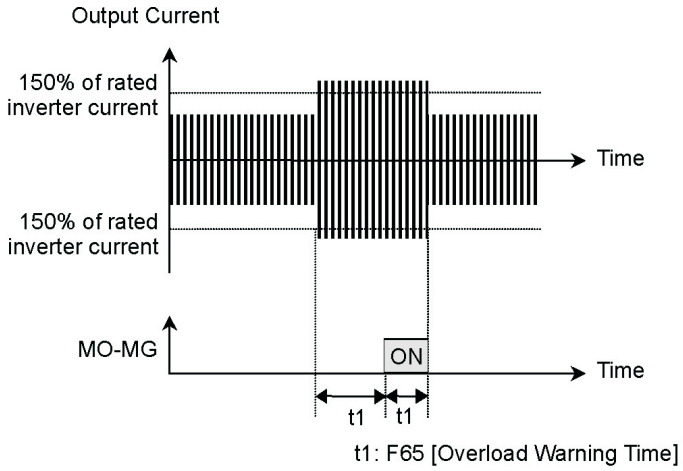
[OL]
MO-MG is CLOSED when the output current has reached the F54 [Overload Warning Level] for the F55 [Overload Warning Time].

Related Functions: F54 [Overload Warning Level]
F55 [Overload Warning Time]



[MO configured as 'OL']

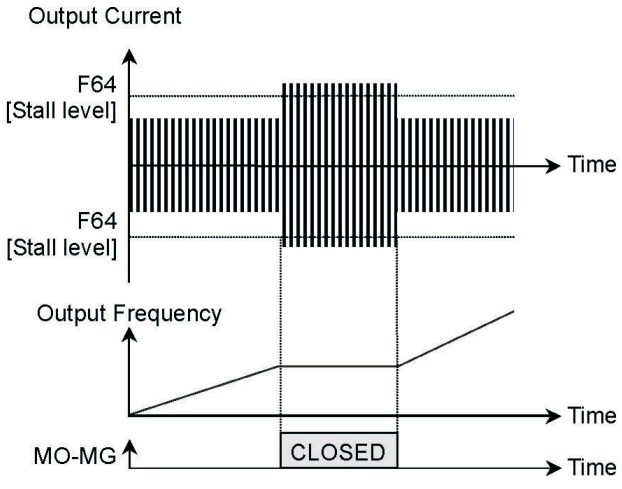
[IOL]
MO-MG is CLOSED when the output current is above the 150% of rated drive current for 36 seconds. If this situation is continued for 1 minute, drive will cut off its output and displays 'IOL' (Inverter overload) Trip. See the nameplate for the rated drive current.



[MO configured as 'IOL']

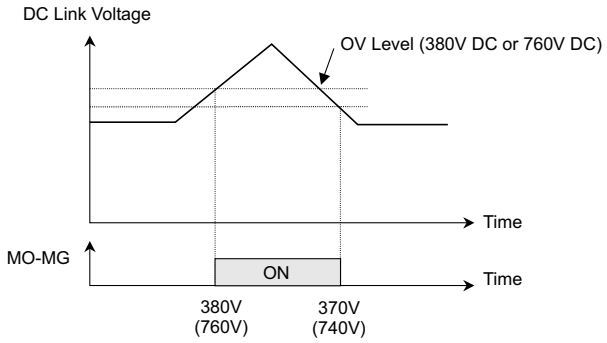
[Stall]
MO-MG is CLOSED when the drive is in the stall prevention mode.

Related Functions: F59 [Stall Prevention Mode], F60 [Stall Prevention Level]



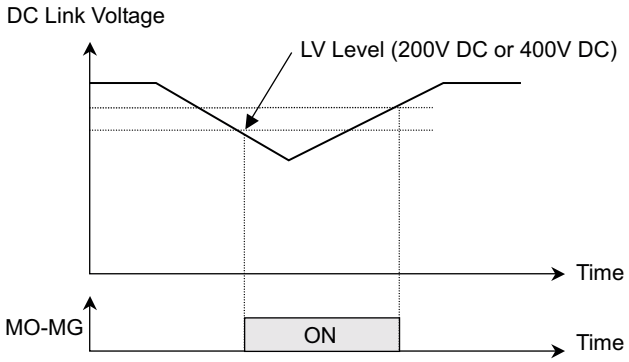
[MO configured as 'Stall']

[Ovt]
MO-MG is CLOSED when high voltage is on the DC link.



[MG configured as 'OV']

[Lvt]
MO-MG is CLOSED when low voltage trip occurs due to DC link voltage under 400V(200V).



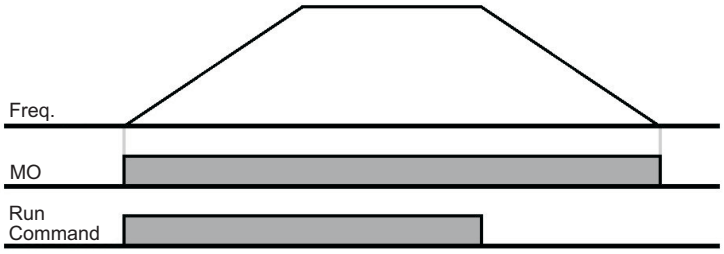
[MG configured as 'LV']

[OH]
MO-MG is CLOSED when the heat sink of the drive is above the reference level.

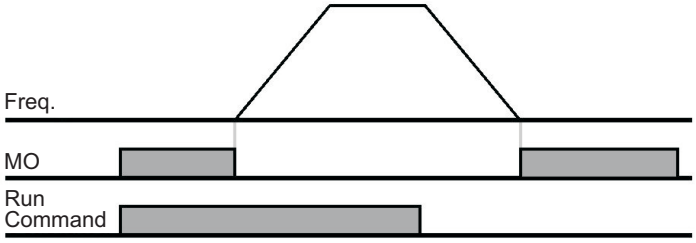
[Command Loss]
MO-MG is CLOSED when reference frequency is lost.

Related Functions: I11 [Criteria for Analog Signal Loss],
I48 [Oreating Method at Signal Loss],
I49 [Waiting Time for Time Out]

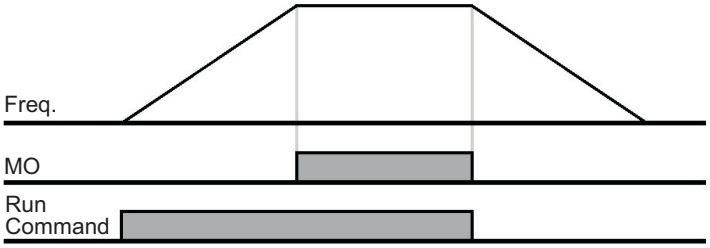
[During Run]
MO-MG is CLOSED when the drive is running.



[During Stop]
MO-MG is CLOSED when the drive is stopped.



[During Constant Run]
MO-MG is CLOSED when the drive is running at a constant speed.



[During Speed Search]
MO-MG is CLOSED during the drive is speed searching.

[Wait time for run signal input]
MO-MGis CLOSED when the drive is ready and waiting for a run command.

[Fault Relay Output Select]
The parameter set in I56 is activated. For example, if setting I55, I56 to 17 and 2, respectively, Multi-function output relay will become active when trip other than “Low voltage trip” occurred.

[Warning for cooling fan trip]
Used to output alarm signal when H78 is set to 0(constant operation at cooling fan trip).

I55: Multi-Function Relay Output

Range: 0 - 18 (Default: 17)

Description: This parameter sets the function of multi-function relay output. See parameter I54 (Multi-function Output Define).

I56: Fault Relay Output

Range: 0 - 7 (Default:2)

Description: This function is used to allow the fault output relay to operate when a fault occurs. The output relay terminal is 30A, 30B, 30C where 30A-30C is normal open contact and 30B-30C is normal close contact.

When 17 {Fault display} is selected in I54 and I55, Multi-function output terminal and relay will be activated with the value in I56.

⌘ **Note:** When several faults occurred at the same time, Bit 0 has the first priority.

I57: Output Terminal Select When Communication Error Occurs

Range: 0-3 (Default: 0)

Description: Keypad and drive CPU communication is made by serial communication, delivering information. When communication error occurs for a certain time, **"ERR"** will be displayed and error signal can be output to MO or relays.

Select relay output or open collector output when keypad-drive communication fails.

	MFI output relay	MFI output terminal	Description
	Bit 1	Bit 0	
0	0	0	Not used
1	0	1	Signal output to MO
2	1	0	Signal output to 3A, 3B, contacts.
3	1	1	Signal output to MO, 3A, 3B

I59: Communication Protocol Select

Range: 0 - Modbus RTU

Description: This parameter determines whether RTU or ASCII ModBus will be used for remote communications, or whether another fieldbus will be used.

I60: Drive Number

Range: 1 - 32 (Default: 1)

Description: Drive number sets the drives ID number for RS485 communication.

I61: Baud Rate

Range: 0 - 4 (Default: 3)

Description: This parameter sets the baud rate for serial communications. The following baud rates may be assigned:

Display:	Baud Rate Assigned:
0	1200 bps
1	2400 bps
2	4800 bps
3	9600 bps
4	19200 bps

I62: Drive Mode Select After Loss

Range: 0 - 2 (Default: 0)

Description: It is used when frequency command is given via V1 /I terminal or RS485. When no frequency command is given for the time set in I63, set the drive as the table below.

Display:	Function:
0	Continuous operation at the frequency before its command is lost.
1	Free Run stop (Coast to stop)
2	Decel to Stop

I63: Wait Time after Loss of Frequency Command

Range: 0.1 - 120 sec. (Default: 1.0 sec.)

Description: This is the time the drive determines whether there is an input frequency command or not. If there is no frequency command input during this time, the drive starts operation via the mode selected at I62.

I64: Communication Time Setting

Range: 2-100ms (Default: 5ms)

Description: Frame communication time.

7 Remote Communication

Remote Communication

7.1 Introduction

The GX drive can be controlled and monitored by the sequence program of the PLC or other master module.

Drives or other slave devices may be connected in a multi-drop fashion on the RS-485 network and may be monitored or controlled by a single PLC or PC. Parameter setting and changes are available through PC. Note that if Modbus RTU RS-485 communications are necessary an optional communication card is required. Contact Benshaw for more information regarding Modbus RTU applications.

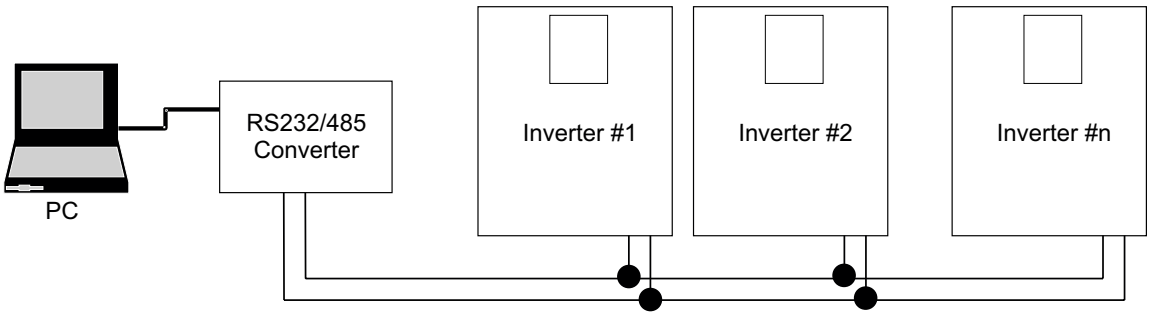
7.1.1 Features

The drive can be easily applied for Factory automation because Operation and monitoring is available by User-program.

* Parameter change and monitoring is available via computer.
  (Ex: Accel/Decel time, Freq. Command etc.)
* Interface type of RS485 reference:
  1) Allows the drive to communicate with any other computers.
  2) Allows connection of up to 31 drives with multi-drop link system.
  3) Noise-resistant interface.

Users can use any kind of RS232-485 converters. The specifications of converters depend on the manufacturers. Refer to the converter manual for detailed specifications.

7.1.2 Connection Guide for RS485 Communication with PC , PLC and RS232/485



7.1.3 Before Installation

Before installation and operation, this should be read thoroughly. If not, it can cause personal injury or damage to other equipment.

7.2 Specification

7.2.1 Performance Specification

Item	Specification
Communication Method	RS485
Transformation Form	Bus method, Multi drop Link System
Applicable Drive	RSi GX Series
Converter	RS232 converter
Connectable Drives	Max 31
Transmission Distance	Max. 1,200m (within 700m recommended)

7.2.2 Hardware Specification

Item	Specification
Installation	Use S+, S- terminals on control terminal block
Power Supply	Use Insulated power from the drive power supply

7.2.3 Communication Specification

Item	Specification
Communication Speed	19,200/9,600/4,800/2,400/1,200 bps selectable
Control Procedure	Asynchronous communication system
Communication System	Half duplex system
Character System	ASCII (8 bit)
Stop bit Length	Modbus-RTU: 2 bit
Sum Check	2 byte
Parity Check	None

7.3 Installation

7.3.1 Connecting the Communication Line

1) Connect the RS485 communication line to the drive's (S+), (S-) terminals of the control terminals.
2) Connect the CM terminal among drives for stable communication.
3) Check the connection and turn ON the drive.
4) Install a repeater to upgrade the communication speed or longer than 1200mm communication line is used. Repeater is required for upgrading communication quality in the noise-high environment.
5) If the communication line is connected correctly set the communication-related parameters as the following:
   DRV-03 [Drive mode]: 3(RS485)
   DRV-04 [Freq. mode]: 7(RS485)
   I60 [Inv. Number]: 1~32 (If more than 1 drive is connected, be sure to use different numbers for each drive)
   I61 [Baud-rate]: 3 (9,600 bps as Factory default)
   I62 [Lost Mode]: 0 - No action (Factory default)
   I63 [Time-Out]: 1.0 sec (Factory default)
   I59 [Comm. Prot]: 0 - Modbus-RTU

7.4 Operation

7.4.1 Operating Steps

1) Check whether the computer and the drive are connected correctly.
2) Turn ON the drive. But do not connect the load until stable communication between the computer and the drive is verified.
3) Start the operating program for the drive from the computer.
4) Operate the drive using the operating program for the drive.
5) Refer to “Troubleshooting” if the communication is not operating normally.

7.5 Communication Protocol (MODBUS-RTU)

Use Modbus-RTU protocol (Open protocol).
Computer or other hosts can be Master and drives slave. The drive responds to Read/Write command from Master.

7.5.1 Supported function code

Function Code	Description
0x03	Read Hold Register
0x04	Read Input Register
0x06	Preset Single Register
0x10	Preset Multiple Register

7.5.2 Exception code

Function Code		Description
0x01		ILLEGAL FUNCTION
0x02		ILLEGAL DATA ADDRESS
0x03		ILLEGAL DATA VALUE
0x06		SLAVE DEVICE BUSY
User define	0x14	1. Write Disable (Address 0x0004 value is 0). 2. Read Only or Not Program during Running.

7.5.3 Baudrate

1200, 2400, 4800, 9600, 19200bps (Default value of 9600bps)

7.6 Parameter code list <Common area>

<Common area>: Area accessible regardless of drive models (Note 3)

Address	Parameter	Scale	Unit	R/W	Data Value
0x0000	Drive model			R	0: SV-iS35:SV-iV5 1: SV-iG7: SV-iG5 2: SV-iV8: SV-iC5 3: SV-iH9: SV-iP5 4: SV-iS5A: SV-iG5A
0x0001	Drive capacity			R	FFFF:0.4kW 0000: 0.75kW 0002:1.5kW 0003: 2.2kW 0004: 3.7kW 0005:4.0kW 0006: 5.5kW 0007: 7.5kW
0x0002	Drive Input Voltage			R	0: 220V class 1: 440V class
0x0003	S/W Version			R	(Ex) 0x0100: Version 1.0 0x0101: Version 1.1
0x0004	Parameter Lock			R/W	0: Lock (default) 1: Unlock
0x0005	Frequency Reference	0.01	Hz	R/W	Starting freq. ~ Max. freq.
0x0006	Run Command (Note 1)			R/W	Bit 0: Stop (S) Bit 1: Forward run (F) Bit 2: Reverse run (R)
				W	Bit 3: Fault reset (0->1) Bit 4: Emergency stop
				-	Bit 5: Not used
				R	Bit 6-7: Output freq. arrival 0(Terminal), 1(keypad) 2(Reserved), 3(communication) Bit 8-12: Freq. command 0-8: Multi-step speed freq. (0,2-8) 9-11: UpDown (Up, Down, UDZero) 12-16: Analog (V0,V1,I,V0I,V1I) 17: Jog, 18: PID, 19: Communication 20-31: Reserved
				-	Bit 15: Not used
0x0007	Acceleration Time	0.1	sec	R/W	
0x0008	Deceleration Time	0.1	sec	R/W	
0x0009	Output Current	0.1	A	R	
0x000A	Output Frequency	0.01	Hz	R	
0x000B	Output Voltage	0.1	V	R	
0x000C	DC Link Voltage	0.1	V	R	
0x000D	Ouput Power	0.1	kW	R	

Address	Parameter	Scale	Unit	R/W	Data Value
0x000E	Drive Status			R	Bit 0: Stop Bit 1: Forward running Bit 2: Reverse running Bit 3: Fault (Trip) Bit 4: Accelerating Bit 5: Decelerating Bit 6: Speed arrival Bit 7: DC braking Bit 8: Stopping Bit 9: Not used Bit 10: Brake open Bit 11: Forward run command Bit 12:Reverse run command Bit 13: REM. R/S Bit 14: REM. Freq.
0x000F	Trip Information			R	Bit 0: OCT Bit 1: OVT Bit 2: EXT-A Bit 3: EST (BX) Bit 4: COL Bit 5: GFT (Ground fault) Bit 6: OHT (Drive overheat)
0x000F					Bit 7: EHT (Motor overheat) Bit 8: OLT (Overload trip) Bit 9: HW-Diag Bit10: EXT-B Bit 11: EEP (Parameter Write Error) Bit 12: FAN (Lock & Open Error) Bit 13: PO (Phase Open) Bit 14: IOLT Bit 15: LVT (Low voltage)
0x0010	Input Terminal Status			R	Bit 0: P1 Bit 1: P2 Bit 2: P3 Bit 3: P4
0x0010	Input Terminal Status				Bit 4: P5 Bit 5: P6 Bit 6: P7 Bit 7: P8
0x0011	Output Terminal Status			R	Bit 0: Not used Bit 1: Not used Bit 2: Not used Bit 3: Not used Bit 4: MO (mulit-output with OC) Bit 5: Not used Bit 6: Not used Bit 7: 3AC
0x0012	V1	0-3FF		R	Value corresponding to 0V-+10V
0x0013	V2	0-3FF		R	Value corresponding to 0V - -10V input when setting FreqMode to 2
0x0014	I	0-3FF		R	Value corresponding to 0-20mA input
0x0015	RPM			R	
0x001A	Unit display			R	Not used
0x001B	Pole number			R	Not used

Address	Parameter	Scale	Unit	R/W	Data Value
0x001C	Custom Version			R	Not used
0x001D	Trip information-B			R	Bit 0: COM (I/O Board Reset) Bit 1: FLTL Bit 2: NTC Bit 3: REEP Bit 4-15: Not used

⌘ Note: 1) Detail description on Common area address 0x0006

Bit	Value	R/W	Name	Description
0 1 2 3 4 5,15	0x01 0x02 0x04 0x08 0x10	R/W R/W R/W W W -	Stop Forward run Reverse run Fault reset Emergency stop Not used	Stop command via communication (0->1) Forward run command via communication (0->1) Reverse run command via communication (0->1) Fault reset command via communication (0->1) Emergency stop command via communication (0->1) Not used
6-7		R	Operating command	0(Terminal), 1(Keypad), 2(Option), 3(Int. 485)
8-14		R	Frequency command	A. When operating command is issued via terminal, keypad or option 0: DRV-00 1:Not used 2:Multi-speed 1 3: Multi-speed 2 4: Multi-speed 3 5: Multi-speed 4 6: Multi-speed 5 7: Multi-speed 6 8: Multi-speed 7 9: Up 10:Down 11:Up/Down Zero 12:V0 13:V1 14:I 15:V0+I 16:V1+I1 17:Jog 18:PID 19:Communication 20-31: Reserved

⌘ **Note 2)** The changed value in Common area affects the current setting but returns to the previous setting when power is cycled or drive is reset. However, changing value is immediately reflected in other parameter groups even in the case of Reset or Power On/Off.

⌘ **Note 3)** S/W version of Common area is displayed in 16 bit, while that of parameter area is displayed in 10 bit.

Drive Group

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A100	41216	D00	Command Frequency	0	Max. Freq	0
A101	41217	D01	ACC	50	60000	0
A102	41218	D02	Dec	100	60000	0
A103	41219	D03	DRV	1	3	0
A104	41220	D04	FRQ	0	8	0
A105	41221	D05	ST 1	1000	Max Freq	0
A106	41222	D06	ST 2	2000	Max Freq	0
A107	41223	D07	ST 3	3000	Max Freq	0
A108	41224	D08	CUR	0	1	0
A109	41225	D09	RPM	0	1800	0
A10A	41226	D10	DCL	0	65535	0
A10B	41227	D11	USR	0	1	0
A10C	41228	D12	FLT	0	1	0
A10D	41229	D13	DRC	0	1	0
A10E	41230	D14	DRV2	1	2	0
A10F	41231	D15	FRQ2	0	6	0

Function Group 1 (F)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A201	41473	F1	Run Prohibit	0	2	0
A202	41474	F2	ACC Pattern	0	1	0
A203	41475	F3	DEC Pattern	0	1	0
A204	41476	F4	Stop Method	0	2	0
A208	41480	F8	DcBr Freq	500	6000	Start Freq
A209	41481	F9	DcBlk Time	10	6000	0
A20A	41482	F10	DcBr Value	50	200	0
A20B	41483	F11	DcBr Time	10	600	0
A20C	41484	F12	DcSt value	50	200	0
A20D	41485	F13	DcSt Time	0	600	0
A20E	41486	F14	PreEx Time	10	600	0
A214	41492	F20	Jog Freq	1000	Max Freq	0
A215	41493	F21	Max Freq	6000	Freq High Limit	4000
A216	41494	F22	Base Freq	6000	Freq High Limit	3000
A217	41495	F23	Start Freq	50	1000	0
A218	41496	F24	Freq Limit	0	1	0
A219	41497	F25	High Freq	6000	Max Freq	0
A21A	41498	F26	Low Freq	50	High Freq	Start Freq
A21B	41499	F27	Trq Boost	0	1	0

Function Group 1 (F)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A21C	41500	F28	Fwd Boost	20	150	0
A21D	41501	F29	Rev Boost	20	150	0
A21E	41502	F30	VF Pattern	0	2	0
A21F	41503	F31	User Freq 1	1500	Max Freq	0
A220	41504	F32	User Volt 1	25	100	0
A221	41505	F33	User Freq 2	3000	Max Freq	0
A222	41506	F34	User Volt 2	50	100	0
A223	41507	F35	User Freq 3	4500	MaxFreq	0
A224	41508	F36	User Volt 3	75	100	0
A225	41509	F37	User Freq 4	6000	MaxFreq	0
A226	41510	F38	User Volt 4	100	100	0
A227	41511	F39	Volt Perc	1000	1100	400
A228	41512	F40	Energy save	0	30	0
A232	41522	F50	ETH select	0	1	0
A233	41523	F51	ETH 1min	150	200	F52
A234	41524	F52	ETH cont	100	F51	50
A235	41525	F53	Motor type	0	1	0
A236	41526	F54	OL level	150	150	30
A237	41527	F55	OL time	100	300	0
A238	41528	F56	OLT select	1	1	0
A239	41529	F57	OLT level	180	200	30
A23A	41530	F58	OLT time	600	600	0
A23B	41531	F59	Stall prev.	0	7	0
A23C	41532	F60	Stall level	150	150	30

Function Group 2 (H)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A300	41728	H0	JUMP CODE	1	100	0
A301	41729	H1	Last Fault1	0	1	0
A302	41730	H2	Last Fault2	0	1	0
A303	41731	H3	Last Fault 3	0	1	0
A304	41732	H4	Last Fault 4	0	1	0
A305	41733	H5	Last Fault5	0	1	0
A306	41734	H6	Fault Clear	0	1	0
A307	41735	H7	Dwell freq	500	maxFreq	startFreq
A308	41736	H8	Dwell time	0	100	0
A30A	41738	H10	Jump freq	0	1	0
A30B	41739	H11	jump lo 1	1000	JumpHiFreq [0]	startFreq

Function Group 2 (H)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A30C	41740	H12	jump Hi 1	1500	MaxFreq	JumpLoFreq [0]
A30D	41741	H13	jump lo 2	2000	JumpHiFreq[1]	StartFreq
A30E	41742	H14	jump Hi 2	2500	MaxFreq	JumpLoFreq[1]
A30F	41743	H15	jump lo 3	3000	JumpHiFreq[2]	StartFreq
A310	41744	H16	jump Hi 3	3500	MaxFreq	JumpLoFreq[2]
A311	41745	H17	Curve Time	40	100	1
A312	41746	H18	Curve Time1	40	100	1
A313	41747	H19	Trip select	0	3	0
A314	41748	H20	Power-on run	0	1	0
A315	41749	H21	RST restart	0	1	0
A316	41750	H22	Speed Search	0	15	0
A317	41751	H23	SS Sup-Curr	100	200	80
A318	41752	H24	SS P-gain	100	9999	0
A319	41753	H25	SS I-gain	1000	9999	0
A31A	41754	H26	Retry number	0	10	0
A31B	41755	H27	Retry delay	10	600	0
A31E	41758	H30	Motor Select	7	7	0
A31F	41759	H31	Pole number	4	12	2
A320	41760	H32	Rated-Slip	233	1000	0
A321	41761	H33	Rated-Current	263	500	10
A322	41762	H34	Noload-Current	110	200	1
A324	41764	H36	Efficiency	87	100	50
A325	41765	H37	Inertia rate	0	2	0
A327	41767	H39	Carrier Frequency	30	150	10
A328	41768	H40	Control Mode	0	3	0
A329	41769	H41	Auto Tune	0	1	0
A32A	41770	H42	Rs	2500	14000	0
A32C	41772	H44	Lsigma	2600	30000	0
A32D	41773	H45	SL P-Gain	1000	32767	0
A32E	41774	H46	SL-I-Gain	100	32767	0
A332	41778	H50	PID F/B	0	1	0
A333	41779	H51	PID P-gain	3000	9999	0
A334	41780	H52	PID I-time	100	3200	10
A335	41781	H53	PID D-time	0	3000	0
A336	41782	H54	PID F-gain	0	9999	0
A337	41783	H55	PID limit	6000	MaxFreq	Startfreq
A346	41798	H70	Acc/Dec freq	0	1	0
A347	41799	H71	Xcel T Mode	1	2	0

Function Group 2 (H)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A348	41800	H72	PowerOn disp	0	13	0
A349	41801	H73	User disp	0	2	0
A34A	41802	H74	RPM factor	100	1000	1
A34B	41803	H75	DB mode	1	1	0
A34C	41804	H76	DB %ED	10	30	0
A34D	41805	H77	FAN control	0	1	0
A34E	41806	H78	FAN Trip	0	1	0
A34F	41807	H79	S/W Version		100	0
A351	41809	H81	2nd Acc Time	50	60000	0
A352	41810	H82	2nd Dec Time	100	6000	0
A353	41811	H83	2nd BaseFreq	6000	MaxFreq	3000
A354	41812	H84	2nd V/F	0	2	0
A355	41813	H85	2nd F-Boost	50	150	0
A356	41814	H86	2nd R-boost	50	150	0
A357	41815	H87	2nd Stall	150	150	30
A358	41816	H88	2nd ETH 1min	150	200	H89
A359	41817	H89	2nd ETH cont	100	H88	50
A35A	41818	H90	2nd R-Curr	263	500	10
A35B	41819	H91	Para Read	0	1	0
A35C	41820	H92	Para Write	0	1	0
A35D	41821	H93	Para Init	0	5	0
A35E	41822	H94	Password Set	0	65535	0
A35F	41823	H95	Para. Lock	0	65535	0

I/O Group (I)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A401	41985	I1	VR filter	10	9999	0
A402	41986	I2	VR volt x1	0	ViXmax[0]	0
A403	41987	I3	VR freq y1	0	MaxFreq	0
A404	41988	I4	VR volt x2	1000	1000	ViXmin[0]
A405	41989	I5	VR freq y2	6000	MaxFreq	0
A406	41990	I6	V1 filter	10	9999	0
A407	41991	I7	V1 volt x1	0	ViXmax[1]	0
A408	41992	I8	V1 freq y1	0	MaxFreq	0
A409	41993	I9	V1 volt x2	1000	1000	ViXmin[1]
A40A	41994	I10	V1 freq y2	6000	MaxFreq	0
A40B	41995	I11	I filter	10	9999	0
A40C	41996	I12	I curr x1	400	ViXmax[2]	0
A40D	41997	I13	I freq y1	0	MaxFreq	0

I/O Group (I)

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A40E	41998	I14	I curr x2	2000	2000	ViXmin[2]
A40F	41999	I15	I freq y2	6000	MaxFreq	0
A410	42000	I16	Wire broken	0	2	0
A411	42001	I17	P1 define	0	24	0
A412	42002	I18	P2 define	1	24	0
A413	42003	I19	P3 define	2	24	0
A414	42004	I20	P4 define	3	24	0
A415	42005	I21	P5 define	4	24	0
A416	42006	I22	P6 define	5	24	0
A417	42007	I23	P7 define	6	24	0
A418	42008	I24	P8 define	7	24	0
A419	42009	I25	In status	0	255	0
A41A	42010	I26	Out status	0	3	0
A41B	42011	I27	Ti Filt Num	15	50	2
A41E	42014	I30	ST 4	3000	MaxFreq	0
A41F	42015	I31	ST 5	2500	MaxFreq	0
A420	42016	I32	ST 6	2000	MaxFreq	0
A421	42017	I33	ST 7	1500	MaxFreq	0
A422	42018	I34	Acc Time-1	30	60000	0
A423	42019	I35	Dec Time-1	30	60000	0
A424	42020	I36	Acc Time-2	40	60000	0
A425	42021	I37	Dec Time-2	40	60000	0
A426	42022	I38	Acc Time-3	50	60000	0
A427	42023	I39	Dec Time-3	50	60000	0
A428	42024	I40	Acc Time-4	60	60000	0
A429	42025	I41	Dec Time-4	60	60000	0
A42A	42026	I42	Acc Time-5	70	60000	0
A42B	42027	I43	Dec Time-5	70	60000	0
A42C	42028	I44	Acc Time-6	80	60000	0
A42D	42029	I45	Dec Time-6	80	60000	0
A42E	42030	I46	Acc Time-7	90	60000	0
A42F	42031	I47	Dec Time-7	90	60000	0
A432	42034	I50	FM mode	0	3	0
A433	42035	I51	FM adjust	100	200	10
A434	42036	I52	FDT freq	3000	MaxFreq	0
A435	42037	I53	FDT band	1000	MaxFreq	0
A436	42038	I54	Aux mode 1	12	18	0
A437	42039	I55	Aux mode 2	17	18	0
A438	42040	I56	Relay mode	2	7	0
A439	42041	I57	CommErrMode	0	3	0

Address		Code	Parameter	Initial Value	Max.	Min.
16 bit	10 bit					
A43B	42043	I59	Protocol	0	1	0
A43C	42044	I60	Inv No.	1	32	1
A43D	42045	I61	Baud rate	3	4	0
A43E	42046	I62	Lost command	0	2	0
A43F	42047	I63	Time out	10	120	1

7.6.1 Troubleshooting RS485 Communications

Check points	Corrective measures
Is the power provided to the converter?	Provide electric power to the converter.
Are the connections between converter and computer correct?	Refer to converter manual.
Is Master not polling?	Verify the master is polling the drive.
Is baud rate of computer and drive correctly set?	Set the correct value in accordance with "13.3 Installation".
Is the data format of user program* right?	Revise User Program (Note 1).
Is the connection between converter and communication card right?	Check for GF the correct wiring in accordance with "13.3 Installation".

(Note 1) User program is User made S/W for PC.

ASCII Code List

7.7 ASCII Code List

Character	Hex	Character	Hex	Character	Hex	Character	Hex	Character	Hex
A	41	a	61	0	30	:	3A	DLE	10
B	42	b	62	1	31	;	3B	EM	19
C	43	c	63	2	32	<	3C	ACK	06
D	44	d	64	3	33	=	3D	ENQ	05
E	45	e	65	4	34	>	3E	EOT	04
F	46	f	66	5	35	?	3F	ESC	1B
G	47	g	67	6	36	@	40	ETB	17
H	48	h	68	7	37	[	5B	ETX	03
I	49	i	69	8	38	\	5C	FF	0C
J	4A	j	6A	9	39	]	5D	FS	1C
K	4B	k	6B	space	20		5E	GS	1D
L	4C	l	6C	!	21		5F	HT	09
M	4D	m	6D	"	22		60	LF	0A
N	4E	n	6E	#	23	{	7B	NAK	15
O	4F	o	6F	$	24		7C	NUL	0F
P	50	p	70	%	25	}	7D	RS	1E
Q	51	q	71	&	26	~	7E	S1	0F
R	52	r	72	'	27	BEL	07	SO	0E
S	53	s	73	(	28	BS	08	SOH	01
T	54	t	74	)	29	CAN	18	STX	02
U	55	u	75	*	2A	CR	0D	SUB	1A
V	56	v	76	+	2B	DC1	11	SYN	16
W	57	w	77	'	2C	DC2	12	US	1F
X	58	x	78	-	2D	DC3	13	VT	0B
Y	59	y	79	.	2E	DC4	14		
Z	5A	z	7A	/	2F	DEL	7F		

8 Troubleshooting & Maintenance

Protective Functions

8.1 Protective Functions

WARNING

When a fault occurs, the cause must be corrected before the fault can be cleared. If the protective function stays active, it could lead to a reduction in product life and damage to the equipment.

Keypad Display	Protective Function	Description
OCt	Overcurrent	The drive turns off its output when the output current of the drive flows more than 200% of the drive rated current.
GFt	Ground fault current	The drive turns off its output when a ground fault occurs and the ground fault current is more than the internal setting value of the drive.
I OL	Inverter Overload	The drive turns off its output when the output current of the drive flows more than the rated level (150% for 1 minute).
OLt	Overload trip	The drive turns off its output if the output current of the drive flows at 150% of the drive rated current for more than the current limit time (1 min.).
OHt	drive Overheat	The drive turns off its output if the heatsink overheats due to a damaged cooling fan or an alien substance in the cooling fan by detecting the temperature of the heatsink.
POt	Output Phase loss	The drive turns off its output when the one or more of the output (U, V, W) phase is open. The drive detects the output current to check the phase loss of the output.
Out	Over Voltage	The drive turns off its output if the DC voltage of the main circuit increases higher than 400 V when the motor decelerates. This fault can also occur due to a surge voltage generated at the power supply system.
Lut	Low Voltage	The drive turns off its output if the DC voltage is below 180V because insufficient torque or overheating of the motor can occur when the input voltage of the drive drops.
EtH	Electronic Thermal	The internal electronic thermal of the drive determines the overheating of the motor. If the motor is overloaded, the drive turns off the output. The drive cannot protect the motor when driving a motor having more than 4 poles or multi motors.
COL	Input Phase Loss	Drive output is blocked when one of R, S, T is open or the electrolytic capacitor needs to be replaced.
FLtL	Self-diagnostic malfunction	Displayed when IGBT damage, output phase short, output phase ground fault or output phase open occurs.

Keypad Display	Protective Function	Description
EEP	Parameter save error	Displayed when user-setting parameters fails to be entered into memory.
H'Lt	Inverter hardware fault	Displayed when an error occurs in the control circuitry of the drive.
Err	Communication Error	Displayed when the drive cannot communicate with the keypad.
rErr	Remote keypad communication error	Displayed when the drive and remote keypad do not communicate with each other. It does not stop drive operation.
CONn	Keypad error	Displayed after the drive resets the keypad when a keypad error occurs and this status is maintained for a certain time.
FAn	Cooling fan fault	Displayed when a fault condition occurs in the drive cooling fan.
EST	Instant cut off	Used for the emergency stop of the drive. The drive instantly turns off the output when the EST terminal is turned on.
		Caution: The drive starts to regular operation when turning off the EST terminal while FX or RX terminal is ON.
EtA	External fault A contact input	When multi-function input terminal (I20-I24) is set to 19 {External fault signal input: A (Normal Open Contact)}, the drive turns off the output.
Etb	External fault B contact	When multi-function input terminal (I20-I24) is set to 19 {External fault signal input:B (Normal Close Contact)}, the drive turns off the output.
__L	Operating method when the frequency command is lost	When the drive operation is set via Analog input (0-10V or 0-20mA input) or option (RS485) and no signal is applied, operation is done according to the method set in I62 (Operating method when the frequency reference is lost).

8.2 Fault Remedy

Keypad Display	Protective Function	Description
	Caution: When an overcurrent fault occurs, operation must be started after the cause is removed to avoid damage to IGBT inside the drive.	
OCt	Accel/Decel time is too short compared to the GD^2 of the load. Load is greater than the drive rating. Drive output is issued when the motor is free running. Output short circuit or ground fault has occurred. Mechanical brake of the motor is operating too fast.	• Increase the Accel/Decel time. • Replace the drive with appropriate capacity. • Resume operation after stopping the motor or use H22 (Speed search). • Check output wiring. • Check the mechanical brake.
GFt	Ground fault has occurred at the output wiring of the drive. The insulation of the motor is damaged due to heat.	• Check the wiring of the output terminal. • Replace the motor.
I OL	Load is greater than the drive rating. Torque boost scale is set too large.	• Upgrade the capacity of motor and drive or reduce the load weight. • Reduce torque boost scale.
OLt		
OHt	Cooling system has faults. An old cooling fan is not replaced with a new one. Ambient temperature is too high.	• Check for alien substances clogged in the heat sink. • Replace the old cooling fan with a new one. • Keep ambient temperature under 50°C.
POt	Faulty contact of magnetic switch at output. Faulty output wiring.	• Make connection of magnetic switch at output of the drive securely. • Check output wiring.
FAn	A foreign substance is clogged in a ventilating slot. Drive has been in use without changing cooling fan.	• Check the ventilating slot and remove the clogged substances. • Replace the cooling fan.
Out	Decel time is too short compared to the GD^2 of the load. Regenerative load is at the drive output. Line voltage is too high.	• Increase the Decel time. • Use Dynamic Brake Unit. • Check whether line voltage exceeds its rating.
Lut	Line voltage is low. Load larger than line capacity is connected to line (ex: welding machine, motor with high starting current connected to the commercial line). Faulty magnetic switch at the input side of the drive.	• Check whether line voltage is below its rating. • Check the incoming AC line. Adjust the line capacity corresponding to the load. • Change a magnetic switch.

Keypad Display	Protective Function	Description
EtH	Motor has overheated. Load is greater than drive rating. ETH level is set too low. Drive capacity is incorrectly selected. Drive has been operating at low speed for too long.	• Reduce load weight and operating duty. • Change drive with higher capacity. • Adjust ETH level to an appropriate level. • Select correct drive capacity. • Install a cooling fan with a separate power supply.
EtA EtB	The terminal set to “18 (External fault-A)” or “19 (External fault-B)” in I20-I24 in I/O group is ON.	• Eliminate the cause of fault at circuit connected to external fault terminal or cause of external fault input.
__L	No frequency command is applied to V1 and I.	• Check the wiring of V1 and I and frequency reference level.
rErr	Communication error between drive keypad and remote keypad.	• Check for connection of communication line and connector.

Keypad Display	Protective Function
EEP HWt Err COn EEP :Parameter save error HWT :Hardware fault Err :Communication Error COM :Keypad error	• Contact your local Benshaw sales representative.

- **Overload Protection**

  IOLT: IOLT (Inverter Overload Trip) protection is activated at 150% of the drive rated current for 1 minute and greater.

  OLT: OLT is selected when parameter F56 is set to 1 and activated at 200% of parameter F57 [Motor Rated Current] for 60 seconds in parameter F58. This can be programmable.

  ⌘ **Note:** The RSi GX is not provided with "Overspeed Protection".

- **Fault Reset**

  There are 3 ways to reset the drive. The auto retry number will be initialized when the user resets the drive.

  1) Reset by using the [STOP/RESET] key of the keypad.
  2) Reset by shorting the RST-CM terminals of the control terminal.
  3) Turn OFF the drive and turn the drive back ON.
  4) If the problem persists, please contact the factory or your local Benshaw distributor.

Precautions for Maintenance and Inspection

8.3 Precautions forMaintenance and Inspection

WARNING

Make sure to remove the input power while performing maintenance.
Make sure to perform maintenance after checking the DC link capacitor has discharged. The bus capacitors in the drive main circuit can still be charged even after the power is turned off. Check the voltage between terminal P or P1 and N using a tester before proceeding.
The RSi-GX series drive has ESD (Electrostatic Discharge) sensitive components. Take protective measures against ESD before touching them for inspection or installation.
Do not change any inner parts and connectors. Never modify the drive.

Check Points

8.4 Check Points

Daily inspections

- Proper installation environment
- Cooling system fault
- Unusual vibration and noise
- Unusual overheating and discoloration

Periodic Inspection

- Screws and bolts may become loose due to vibration, temperature changes, etc.
- Check that they are tightened securely and retighten as necessary.
- Alien substances are clogged in the cooling system.
- Clean it using the air.
- Check the rotating condition of the cooling fan, the condition of capacitors and the connections with the magnetic contactor.
- Replace them if there are any abnormalities.

Replacement Parts

8.5 Replacement Parts

The drive consists of many electronic parts such as semiconductor devices. The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or failure of the drive. For preventive maintenance, the parts must be changed periodically. The parts replacement guidelines are indicated in the following table. Lamps and other short-life parts must also be changed during periodic inspection.

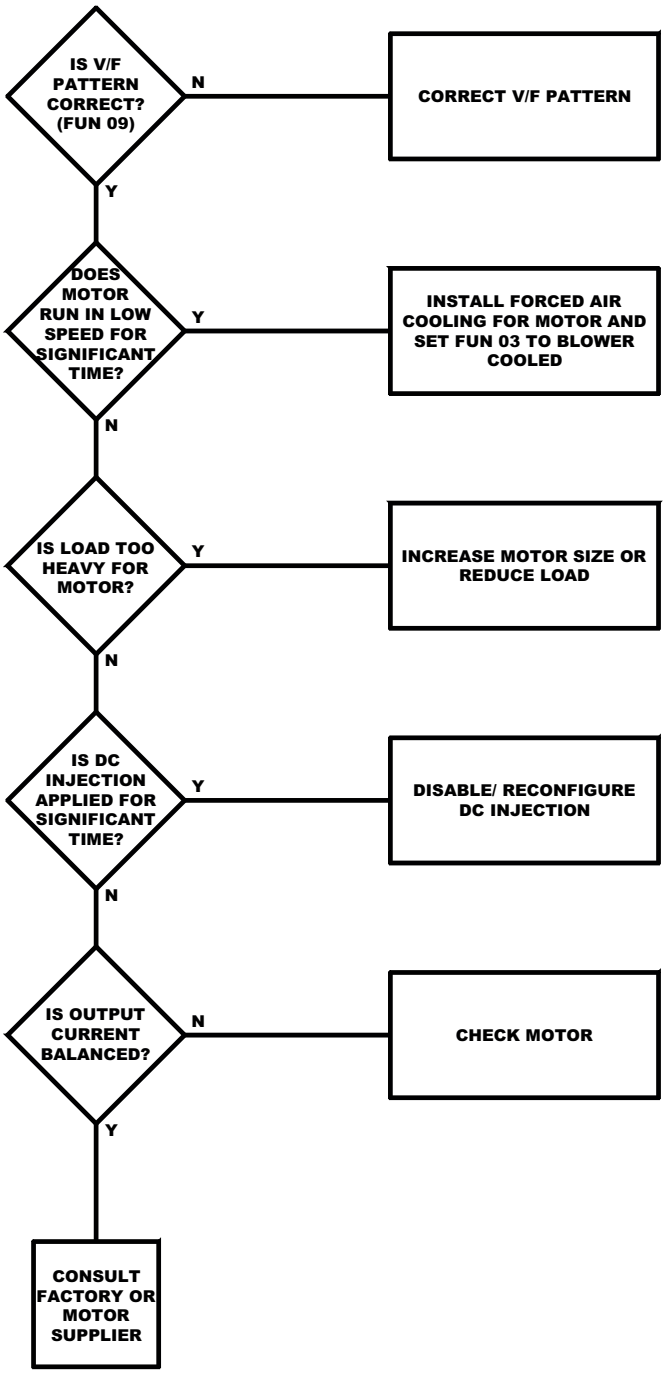
Part Name	Change Period (unit: Year)	Description
Cooling fan	3	Exchange (as required)
DC link capacitor in main circuit	4	Exchange (as required)
Electrolytic capacitor on control board	4	Exchange (as required)
Relays	-	Exchange (as required)

Troubleshooting

8.6 Troubleshooting

Condition	Check Point
The motor does not rotate	1) Main circuit inspection • Is the input(line) voltage normal.(If the LED in the drive is lit) • Is the motor connected correctly? 2) Input signal inspection • Do the operating signal input to the drive. • Do the forward and the reverse signal input simultaneously to the drive? • Do the command frequency signal input to the drive. 3) Parameter setting inspection • Is the reverse prevention (FU1-03) function set? • Is the operation mode (FU1-01) set correctly? • Is the command frequency set to 0? 4) Load inspection • Is the load too large, or is the motor restrained.(mechanical brake) 5) Other • Is the alarm displayed on the keypad, or the alarm LED (STOP LED blinks) lit.
The motor rotates at opposite directions	• Is the phase sequence of the output terminal U,V,W correct. • Is the starting signal (forward/reverse) connected correctly?
The difference between the rotating speed and the reference is too big	• Is the frequency reference signal correct.(Check the level of the input signal) • Is the following parameter setting is correct. • Lower Limit Frequency(FU1-24), Upper Limit Frequency(FU1-25), Analog Frequency Gain(I/O-1~10) • Is the input signal line is influenced by external noise.(Use a shielded wire)
The drive does not accelerate or decelerate smoothly	• Is the acceleration/deceleration time is set too short. • Is the load too large? • Is the Torque Boost (FU1-27, 28) value is too high that the current limit function and the stall prevention function do not operate.
The motor current is too high	• Is the load too large? • Is the Torque Boost Value (manual) too high?
The rotating speed does not increase	• Is the Upper Limit Frequency (FU1-25) value is correct. • Is the load too large? • Is the Torque Boost (FU1-27, 28) value is too high that the stall prevention function (FU1-59, 60) does not operate.
The rotating speed oscillates when the drive is operating.	1) Load inspection • Is the load oscillating? 2) Input signal inspection • Is the frequency reference signal oscillating? 3) Other • Is the wiring too long when the drive is using V/F control.(over 500m)

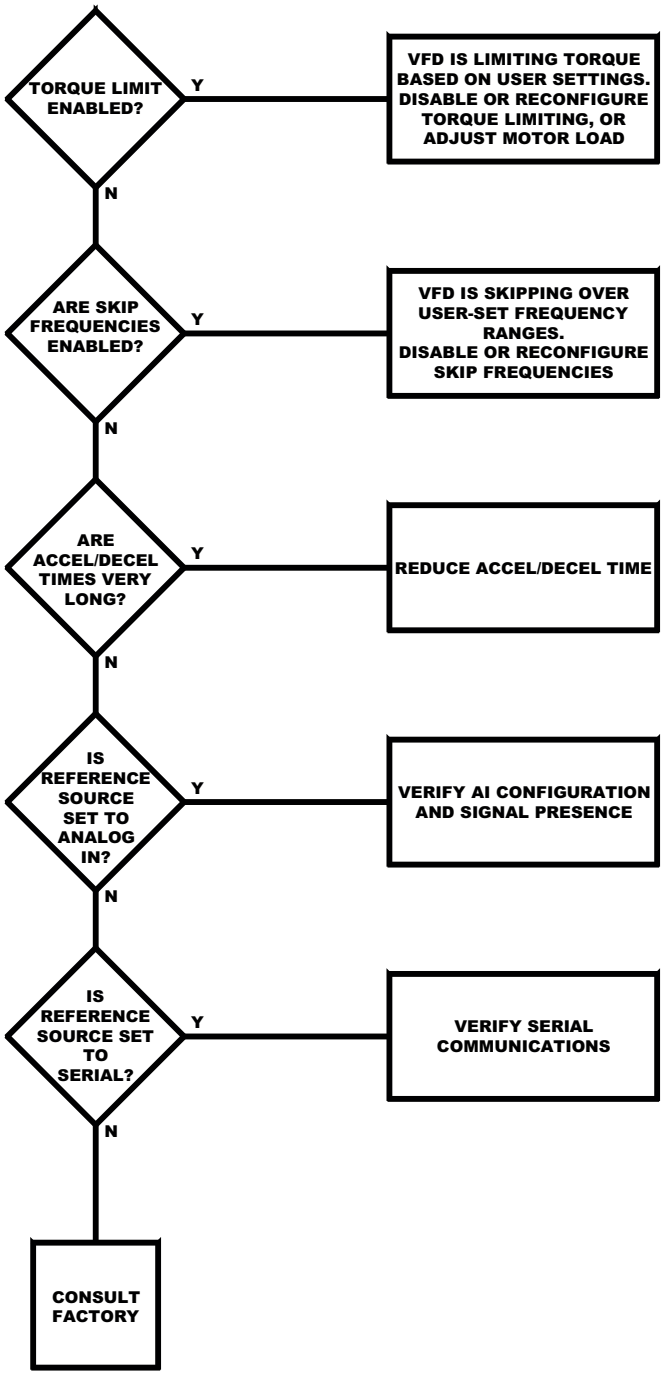
8.6.1 Motor Overheats



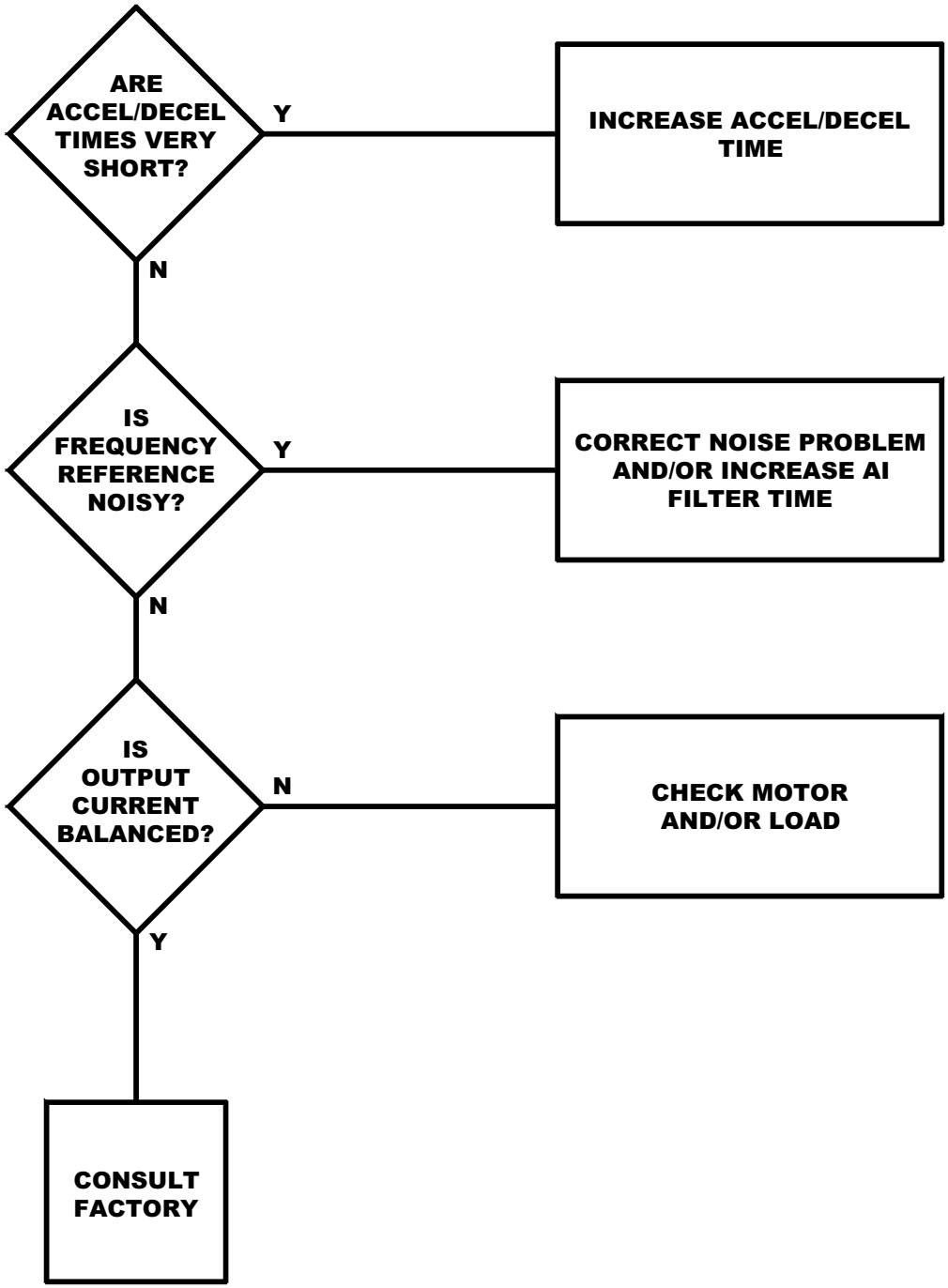
DANGER

Risk of Electric Shock - Ensure all electrical power is removed before servicing.

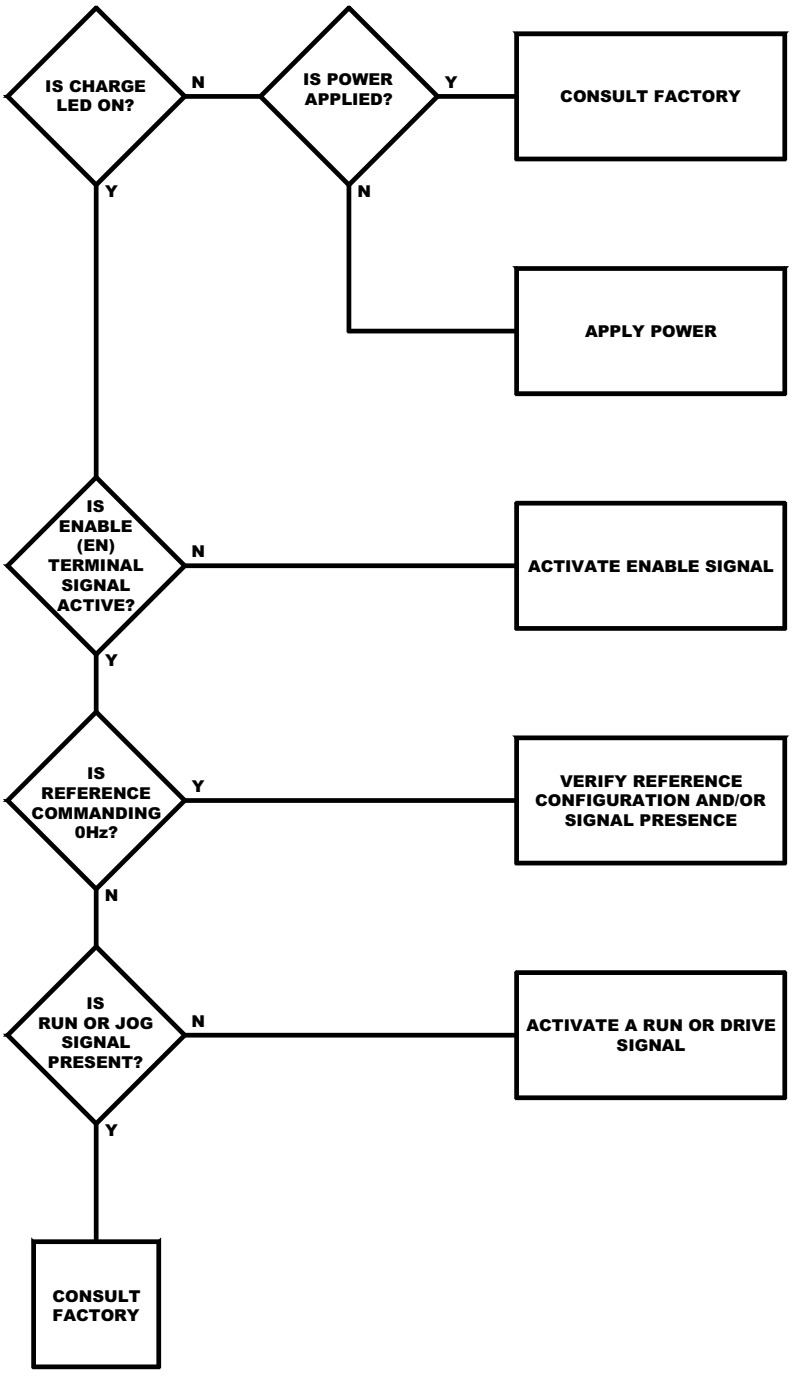
8.6.2 Motor Speed is not equal to the Command Frequency



8.6.3 Motor Does Not Run Smoothly

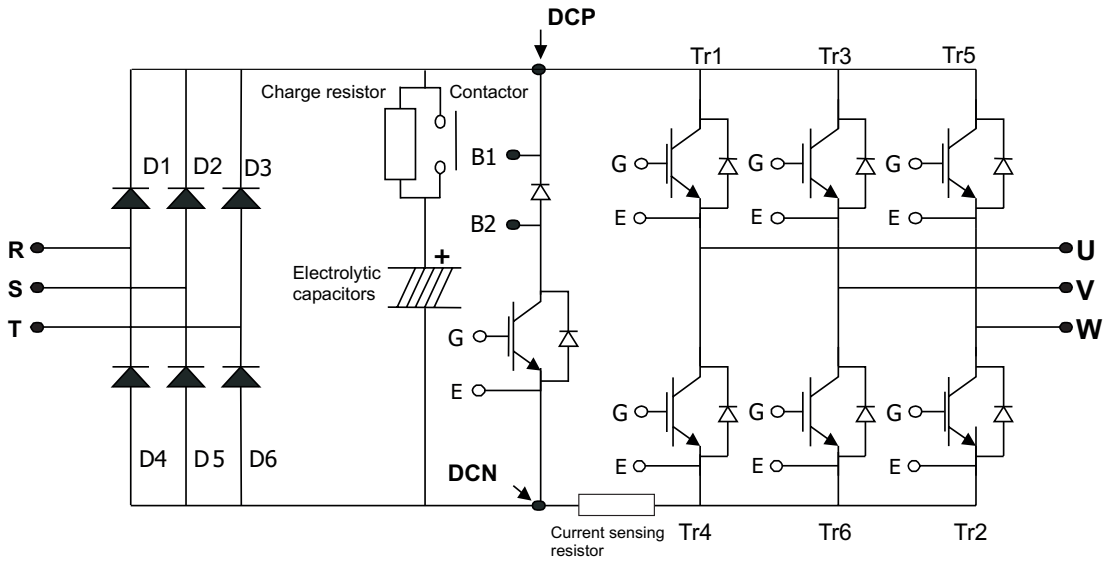


8.6.4 Motor Does Not Run



8.7 How to Check Power Components

Before checking the power components, be sure to disconnect AC Input supply and wait until the Main Electrolytic Capacitors (DCP-DCN) discharge.



1) Disconnect the power input line (R, S, T) and the drive output to the motor (U, V, W).
2) Verify whether the drive terminal R, S, T, U, V, W, B1,B2 is short or open by changing the polarity of the tester.
3) Verify that the capacitor has discharged before testing.
4) The tester should display several megaohms when open. The tester can display that the terminal is short for a short time and then display several megaohms because of the electrolytic capacitor. The tester should display several Ω ~ several tens Ω. If all measured values are almost the same the modules are without fault.
5) The number of each element of the module and the check terminal.

Elements		Test Polarity		Measured Value	Element	Test Polarity		Measured Vlaue
		+	-			+	-	
Diode Module	D1	R	B1	Open	D4	R	DCN	Short
		B1	R	Short		DCN	R	Open
	D2	S	B1	Open	D5	S	DCN	Short
		B1	S	Short		DCN	S	Open
	D3	T	B1	Open	D6	T	DCN	Short
		B1	T	Short		DCN	T	Open
IGBT Module	Tr1	U	B1	Open	Tr4	U	DCN	Short
		B1	U	Short		DCN	U	Open
	Tr3	V	B1	Open	Tr6	V	DCN	Short
		B1	V	Short		DCN	V	Open
	Tr5	W	B1	Open	Tr2	W	DCN	Short
		B1	W	Short		DCN	W	Open

Daily and Periodic Inspection Items

8.8 Daily and Periodic Inspection Items

Inspection Location	Inspection Item	Inspection	Period			Inspection Method	Criterion	Measuring Instrument
			Daily	1 year	2 year			
All	Environment	Is there any dust? 1Is the ambient temperature and humidity adequate?	O			Refer to the precautions	Temperature: -10~+40 no freezing. Humidity: Under 90% no dew	Thermometer, Hygrometer, Recorder
	Equipment	Is there any abnormal oscillation or noise?	O			Use sight and hearing	No abnormality	
	Input Voltage	Is the input voltage of the main circuit normal?	O			Measure the voltage between the terminals L1/R, L2/S, L3/T		Digital Multi-Meter/Tester
Main Circuit	All	Megger check (between the main circuit and the ground) Are any fixed parts removed? Are there any traces of overheating at each component's cleaning?		O O O		None. Consult Factory Tighten the screws. Visual check.	 No fault	
	Conductor / Wire	Is the conductor oxidized? Is the wire coating damaged?		O O		Visual check	No fault	
	Terminal	Is there any damage?		O		Visual check	No fault	
	IGBT Module/ Diode Module	Check the resistance between each of the terminals.			O	Undo the VFD connection and measure the resistance between R,S,T and U,V,W with a tester.	(Refer 'How to Check Power Components")	Digital Multi-Meter / Analog Tester
	Smoothing Capacitor	Is there any liquid coming out? Is the safety pin out, and is there any swelling? Measure the capacitance.	O O	O		Visual check. Measure with a capacitance-measuring device.	No fault Over 85% of the rated capacity	Capacitance Measuring Device
	Relay	Is there any chattering noise during operation? Is there any damage to the contact		O O		Auditory check. Visual check	No fault	
	Resistor	Is there any damage to the resistor insulation? Is the wiring in the resistor damaged (open)?		O O		Visual check. Disconnect one of the connections and measure with a tester.	No fault Error must be within 10% the displayed resistance	Digital MultiMeter / Analog Tester
Control Circuit Protective Circuit	Operation Check	Is there any unbalance between each phases of the output voltage? Nothing must be wrong with display circuit after executing the sequence protective operation		O O		Measure the voltage between the output terminals U, V and W. Short and open the VFD protective circuit output.	The voltage balance between the phases for 200V (800V) class is under 4V (8V).The fault circuit operates according to the sequence.	Digital Multi-Meter/ Rectifying Voltmeter
Cooling System	Cooling Fan	Is there any abnormal oscillation or noise? Is the connection area loose?	O	O		Turn OFF the power and turn the fan by hand. Tighten the connections.	Must rotate smoothly. No fault	
Display	Meter	Is the displayed value correct?	O	O		Check the meter reading at the exterior of the panel	Check the specified and management values.	Voltmeter / Ammeter etc.
Motor	All	Are there any abnormal vibrations or noise? Is there any unusual odor?	O O			Auditory, sensory, visual check. Check for overheat and damage.	No fault	
	Insulation Resistor	Megger check (between the output terminals and the ground terminal)			O	Disconnect motor from VFD and short motor leads together.	Over 5MO	500V class Megger

Notes:

9 Options

Braking Resistor

9.1 Short Circuit Fuse / Braking Resistor

Use class H or K5 UL Listed Input Fuse or a UL listed breaker only. See the table below for the required voltage and current rating of fuses and breakers. Recommended suppliers for input fuses are Bussman or Ferraz Shawmut.

Input Voltage	Motor [HP]	100% Braking		150% Braking	
		[Ω]	[W]*	[Ω]	[W]*
200V Class	1.0	200	100	150	150
	2.0	100	200	60	300
	3.0	60	300	50	400
	5.0	40	500	33	600
400V Class	1.0	900	100	600	150
	2.0	450	200	300	300
	3.0	300	300	200	400
	5.0	200	500	130	600

* The wattage is based on Enable duty (%ED) 5% with continuous braking time 15 sec.

10 Appendices

EU DECLARATION OF CONFORMITY

Council Directive(s) to which conformity is declared:

CD 73/23/EEC and CD 89/336/EEC

Units are certified for compliance with:

EN 61800-3/A11 (2000), EN61000-4-2/A2 (2001), EN 61000-4-3/A2 (2001), EN 61000-4-4/A2 (2001), EN 61000-4-5/A1 2001), EN 61000-4-6/A1 (2001), EN 55011/A2 (2002), EN 50178 (1997), IEC/TR 61000-2-1 (1990), EN 61000-2-4 (1994), EN 60146-1-1/A1 (1997)

Product Category:	**Motor Controller**
Type of Equipment:	**Adjustable Speed Drive**
Model Name:	**RSi GX Series**
Manufacturer Name:	**Benshaw Inc.**
Manufacturers Address:	**1659 East Sutter Road Glenshaw, PA USA 15116-1745**

The products referenced above are for the use of control of the speed of AC motors. For application information, consult the following documentation from Benshaw: Publication number 890030-01-01.

The use in residential and commercial premises (Class B) requires an optional RSi series filter. Via internal mechanisms and Quality Control, it is verified that these products conform to the requirements of the Directive and applicable standards.

We, the undersigned, hereby declare that equipment specified above conforms to the Directives and Standards mentioned.

Glenshaw, PA USA - 29 January 2005

Neil Abrams Quality Control Manager	Harry Hagerty VP General Manager

Revision History;

Revision	Date [d/m/y]	ECO#	Description
00	08/01/05	#890030-01-00	Initial Release.
01	22/04/05	E0996	Adjusted model numbers to represent box.

BENSHAW PRODUCTS

Low Voltage Solid State Reduced Voltage Starters

- RSD/RSM6 - SSRV Non or Separate Bypass
- RDB/RMB6 - SSRV Integral Bypass
- RSM7 - SSRV + DC Injection Braking
- RSM10 - SSRV + Reversing
- RSM11 - SSRV + DC Injection Braking + Reversing
- RSM10/12TS - SSRV Two Speed
- WRSM6 - SSRV Wound Rotor
- SMRSM6 - SSRV Synchronous
- DCB3 - Solid State DC Injection Braking

Medium Voltage Solid State Reduced Voltage Starters

- 5kV - Induction or Synchronous to 10,000HP
- 7.2kV - Induction or Synchronous to 10,000HP
- 15kV - Induction or Synchronous to 60,000HP

Low Voltage - AC Drives

- Standard Drives to 1000HP
- Custom Industrial Packaged Drives
- HVAC Packaged Drives
- 18 Pulse/IEEE 519 Compliant Drives

RSC Series Contactors

- SPO/SPE/SPD Motor Protection Relays
- Enclosed Full Voltage, Wye Delta, Two Speed Part Winding and Reversing Starters

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