RSi H2 Series

Variable Frequency Drive

7.5 to 125 HP - 230V
7.5 to 800 HP - 460V
7.5 to 125 HP - 575V

Instruction Manual

890053-00-02

BENSHAW
Applied Motor Controls

Safety Information

Read and follow all safety instructions in this manual to avoid unsafe operating conditions, property damage, personal injury, or death.

Safety symbols in this manual

⚠ Danger

Indicates an imminently hazardous situation which, if not avoided, will result in severe injury or death.

⚠ Warning

Indicates a potentially hazardous situation which, if not avoided, could result in injury or death.

ⓘ Caution

Indicates a potentially hazardous situation that, if not avoided, could result in minor injury or property damage.

Safety information

⚠ Danger

- Do not open the cover of the equipment while it is on or operating. Likewise, do not operate the inverter while the cover is open. Exposure of high voltage terminals or charging area to the external environment may result in an electric shock. Do not remove any covers or touch the internal circuit boards (PCBs) or electrical contacts on the product when the power is on or during operation. Doing so may result in serious injury, death, or serious property damage.
- Do not open the cover of the equipment even when the power supply to the inverter has been turned off unless it is necessary for maintenance or regular inspection. Opening the cover may result in an electric shock even when the power supply is off.
- The equipment may hold charge long after the power supply has been turned off. Use a multi-meter to make sure that there is no voltage before working on the inverter, motor, or motor cable.

⚠ Warning

- This equipment must be grounded for safe and proper operation.
- Do not supply power to a faulty inverter. If you find that the inverter is faulty, disconnect the power supply and have the inverter professionally repaired.
- The inverter becomes hot during operation. Avoid touching the inverter until it has cooled to avoid burns.
- Do not allow foreign objects, such as screws, metal chips, debris, water, or oil to get inside the inverter. Allowing foreign objects inside the inverter may cause the inverter to malfunction or result in a fire.
- Do not operate the inverter with wet hands. Doing so may result in electric shock

Caution

- Do not modify the interior workings of the inverter. Doing so will void the warranty.
- The inverter is designed for 3-phase motor operation. Do not use the inverter to operate a single-phase motor.

Short Circuit Current Ratings

The maximum allowed short-circuit current at the input power connection is defined in UL 508C (now UL-61800-5-1) as 100 kA. Depending on the selected over current protective device (OCPD), the VFD's are suitable for use in circuits capable of delivering up to a maximum of 100 kA RMS symmetrical amperes at the inverter's maximum rated voltage. The following table shows the recommended circuit breaker frame (100F, 150F, etc.) and interrupt rating codes (EF, NF, etc.) for various SCCR ratings (RMS symmetrical amperes). Select the appropriate breaker for the SCCR requirements of the system.

Voltage	100F (EF/NF/HF)	150F (NF/HF/LF)	250F (NF/HF/LF)	400F (NF/HF/LF)	600F (NF/HF/LF)	800F (NF/HF/LF)	1200F (NF/HF/LF/PF)
240V	50/65/100kA	65/100kA	65/100kA	65/100kA	65/100kA	65/100kA	50/65/100kA
480V	25/35/65kA	35/65/100kA	35/65/100kA	35/65/100kA	35/65/100kA	35/65/100kA	35/65/100/50kA
600V	14/18/35kA	18/35/50kA	18/35/50kA	18/35/50kA	18/35/50kA	18/35/50kA	18/25/35/50kA

480V Interrupt Rating Codes
EF = Standard Fault 25kA (100F Frame Size)
NF = Normal Fault 35kA (100F - 1200F Frame Size)
HF = High Fault 65kA (100F - 1200F Frame Size)
LF = Extra High Fault 100kA (150F - 1200F Frame Size)
PF = Standard Fault 50kA (1200F Frame Size)

Table of Contents

1 Preparing the Installation

This chapter provides details on product identification, part names, installation and cable specifications. To install the inverter correctly and safely, carefully read and follow the instructions.

1.1 Product Identification

The H2 Series Inverter is manufactured within a range based on inverter capacity (HP/kW) and power source specifications (240V/480V/575V). Product name and specifications are detailed on the name plate. Check the name plate before installing the product and make sure that the product meets your requirements. For more detailed product specifications, refer to *13.1, Input and Output Specifications on page 357.*

> Note
> Check the product name, open the packaging, and then confirm that the product is free from defects. Contact your supplier if you have any issues or questions about your product.

Model RSi - 007 - H2 - 2 C

RSi
Ready Start Inverter

007
Rated Horse Power

Voltage Range			Code	HP	kW
240	480	575	**007**	7.5	5.5
240	480	575	**010**	10	7.5
240	480	575	**015**	15	11
240	480	575	**020**	20	15
240	480	575	**025**	25	18.5
240	480	575	**030**	30	22
240	480	575	**040**	40	30
240	480	575	**050**	50	37
240	480	575	**060**	60	45
240	480	575	**075**	75	55
240	480	575	**100**	100	75
240	480	575	**125**	125	90
	480		**150**	150	110
	480		**200**	200	132
	480		**250**	250	160
	480		**300**	300	185
	480		**400**	400	250
	480		**500**	500	315
	480		**650**	650	400
	480		**800**	800	500

H2
H2 Series Inverter

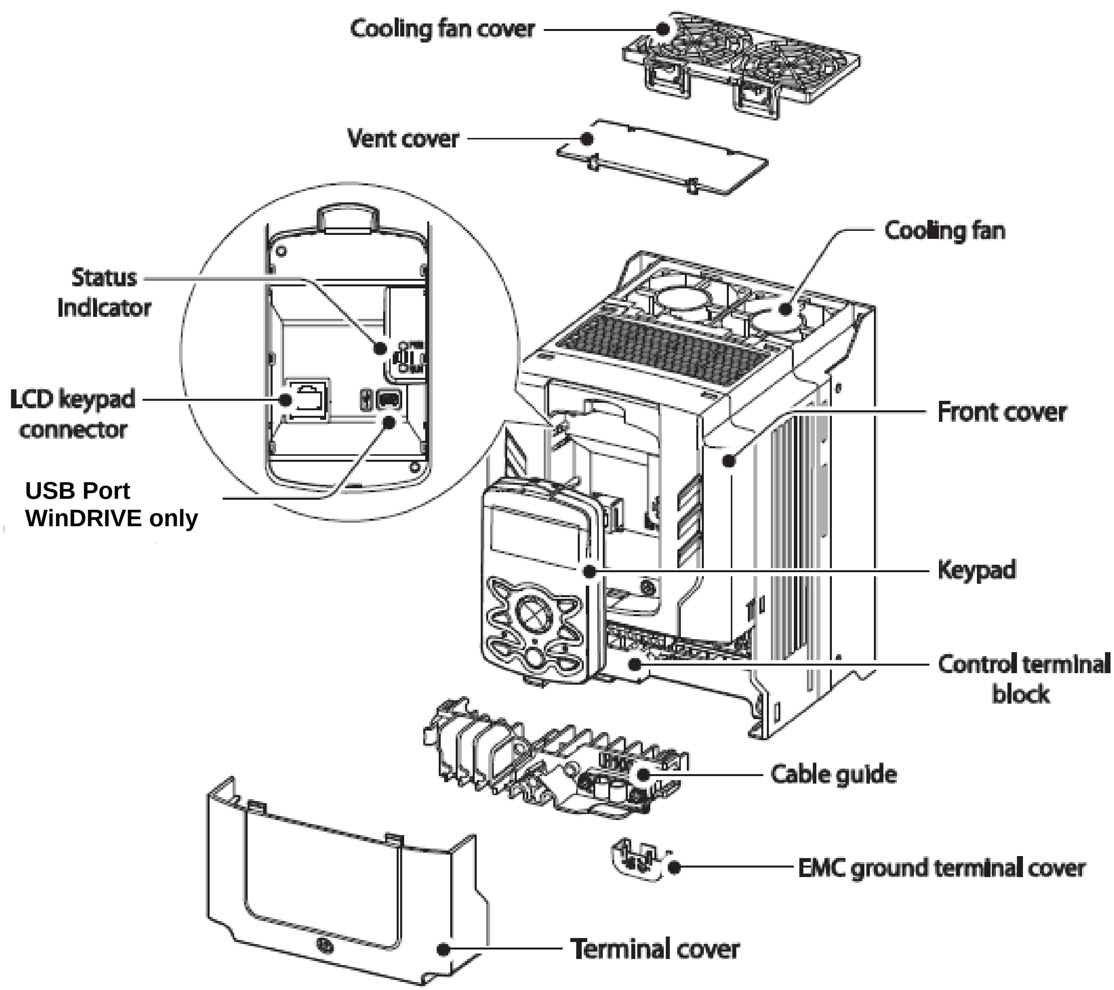
Input Voltage
2 - 240V
4 - 480V
6 - 575V

C - Chassis (UL Open)
1 - UL Type 1

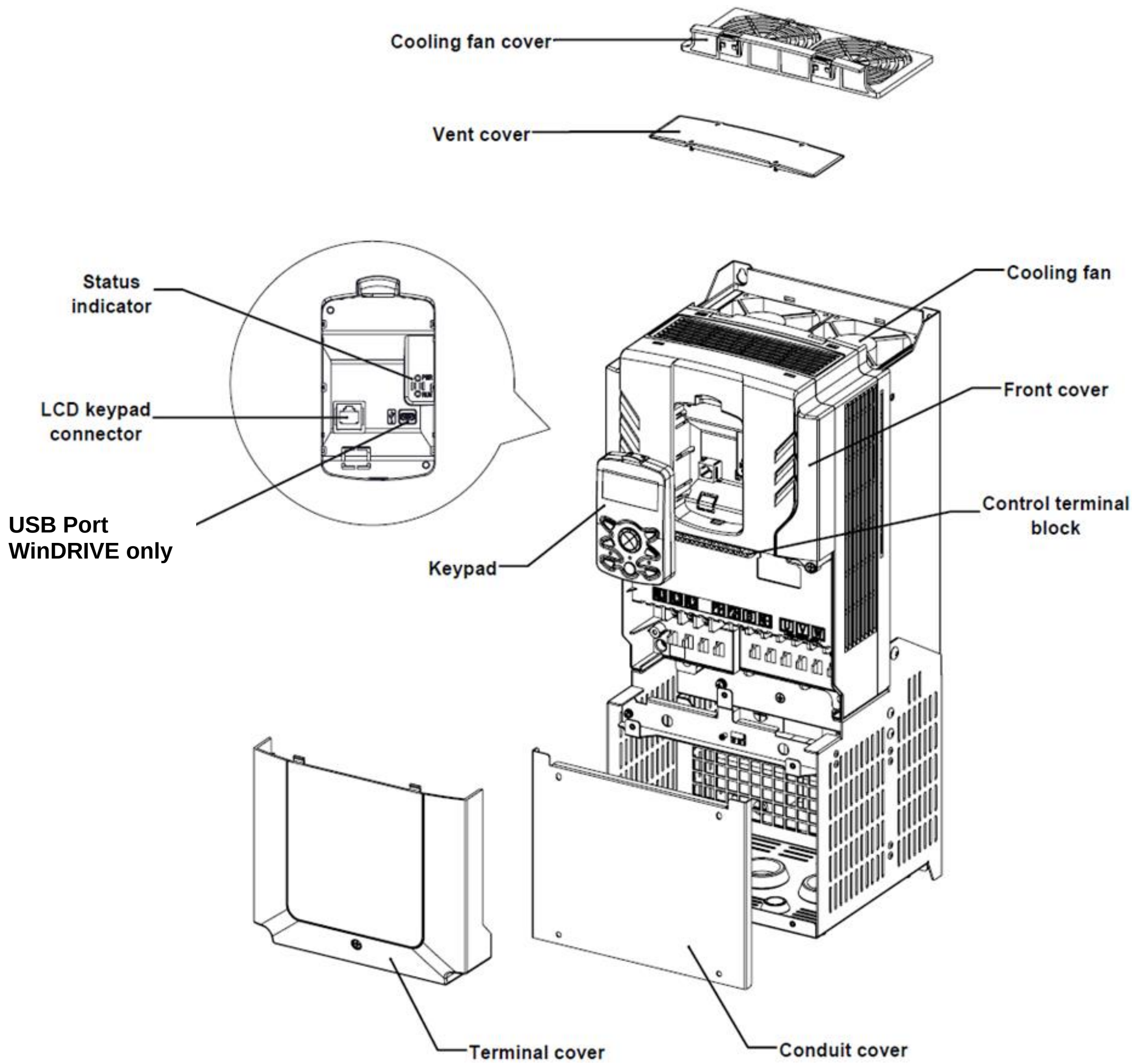
1.2 Part Identification

The illustrations below display part names. Details may vary between product ratings.

240V, 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V, 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

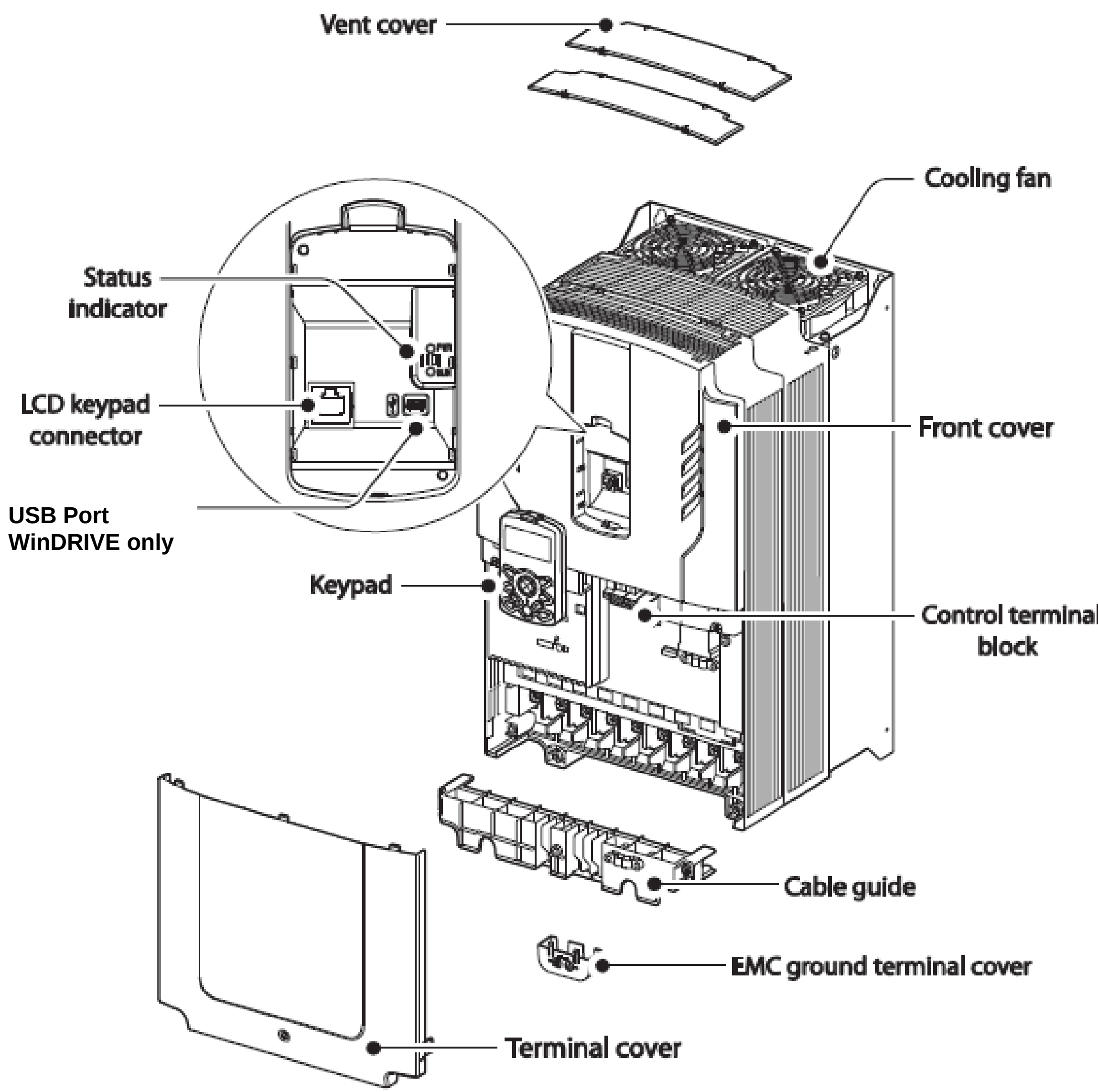


575V, 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



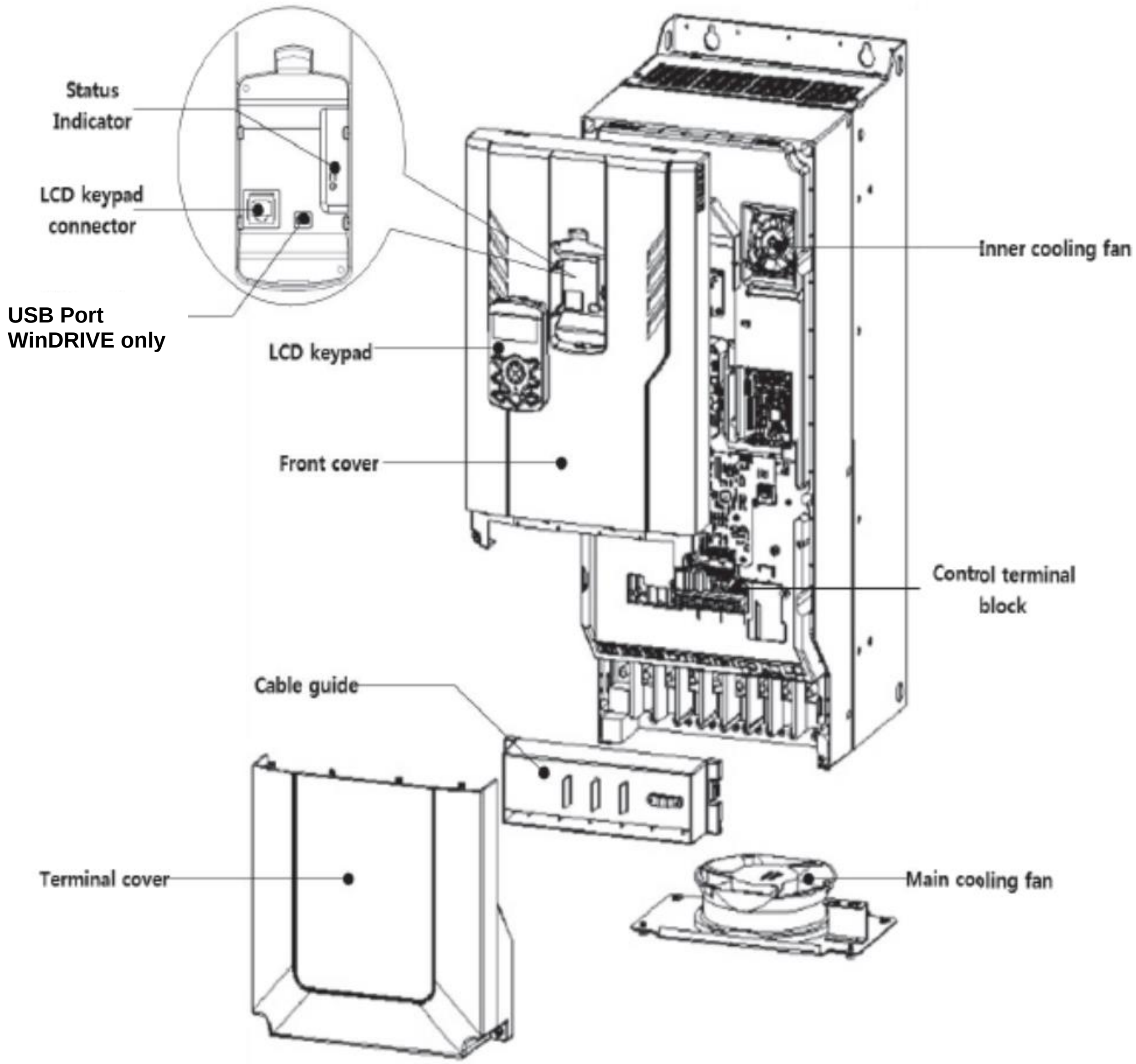
240V
30 HP ~ 60 HP (22 kW ~ 45 kW)

480V and 575V
50 HP ~ 125 HP (37 kW ~ 90 kW)



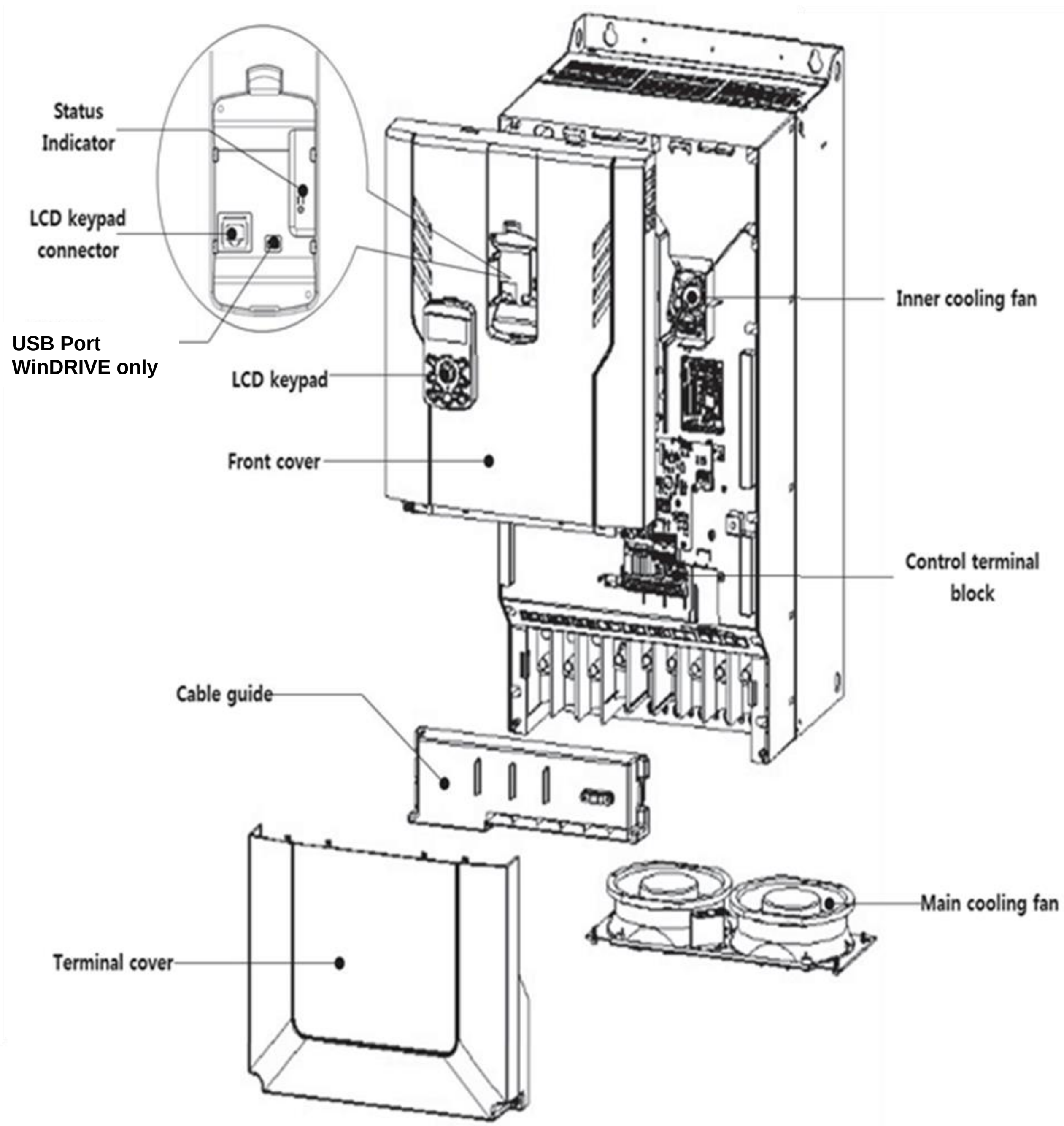
240V
75 HP ~ 100 HP (55 kW ~ 75 kW)

480V
150 HP ~ 200 HP (110 kW ~ 132 kW)

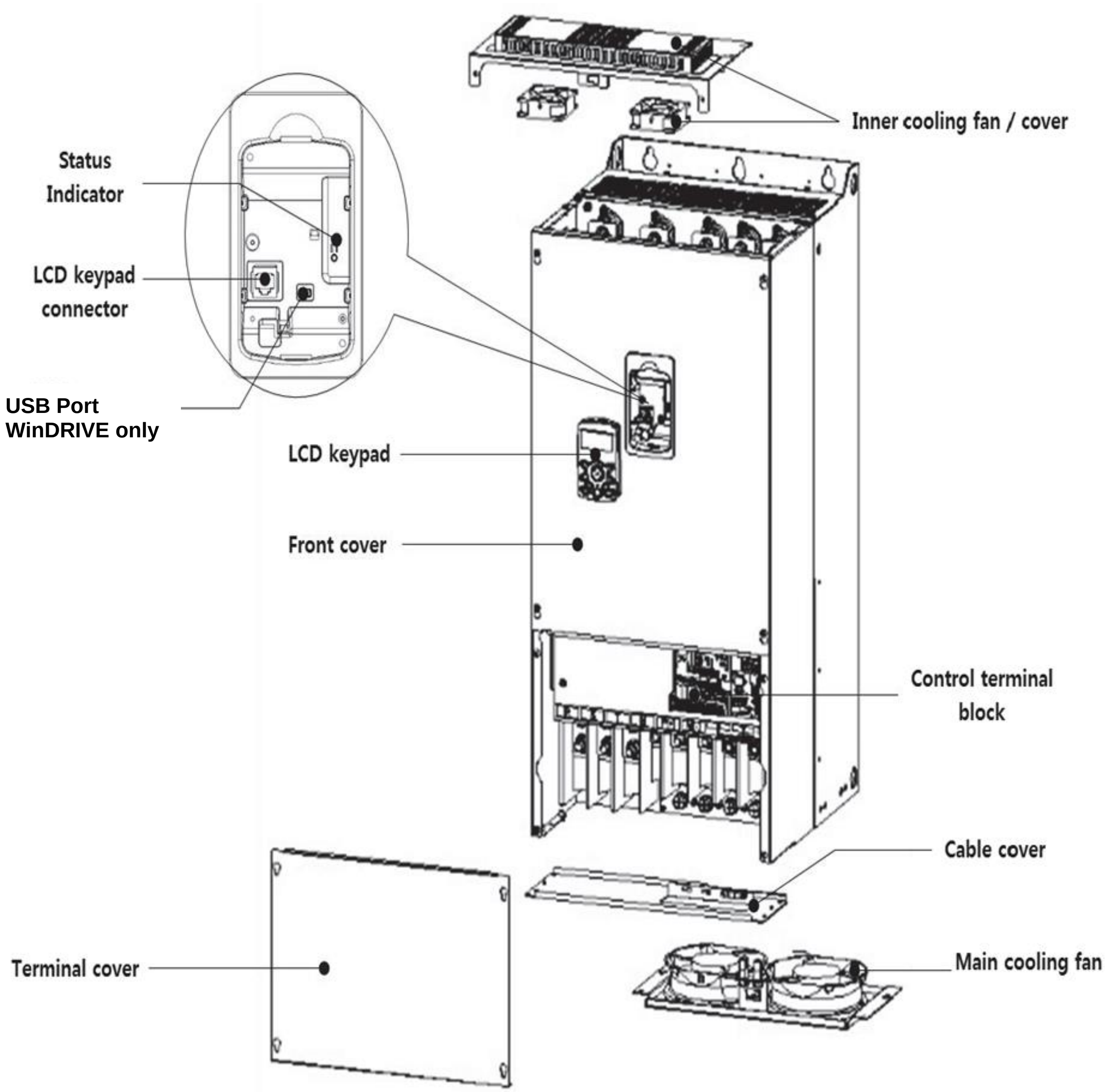


240V
125 HP (90 kW)

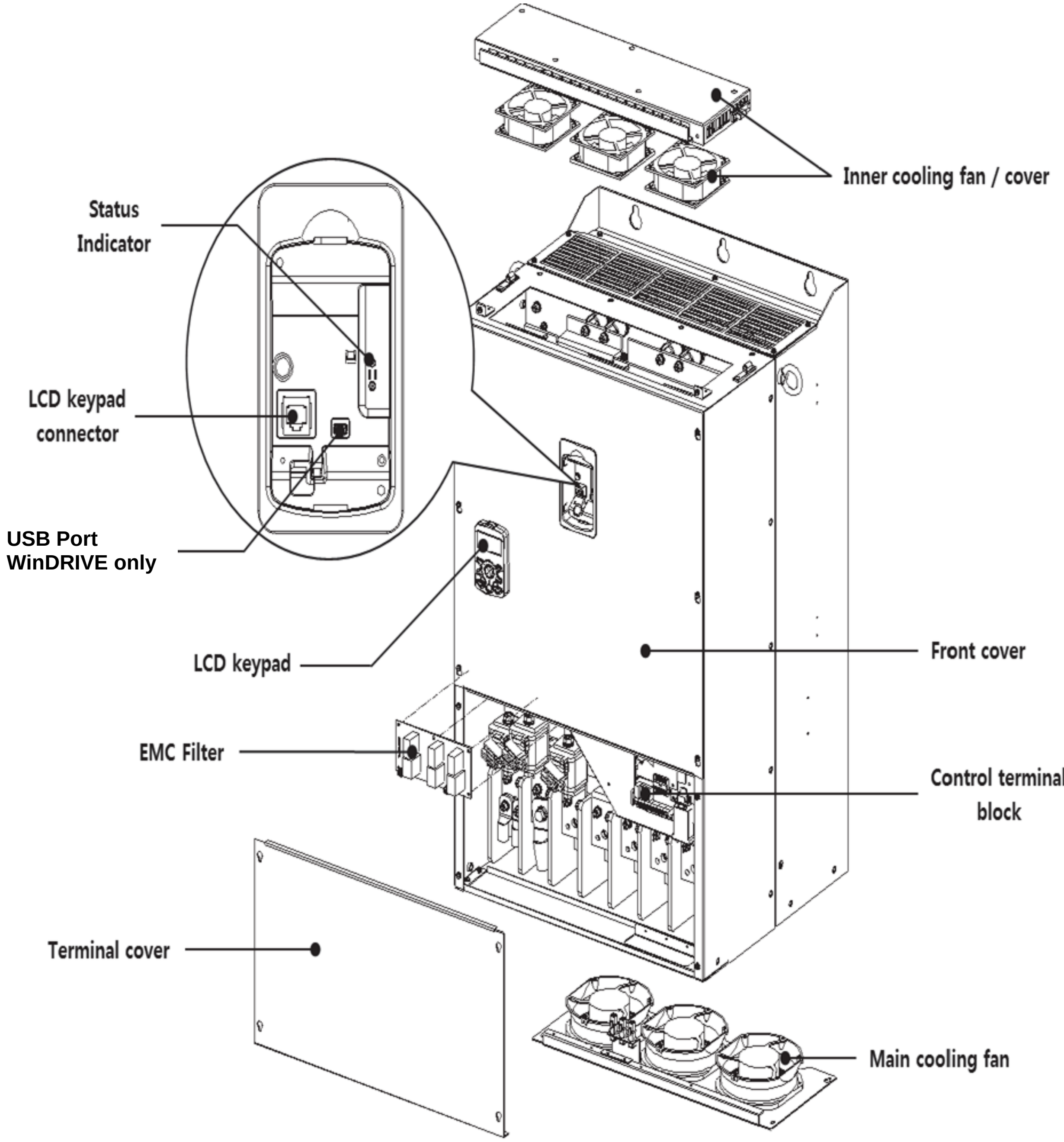
480V
250 HP ~ 300 HP (160 kW ~ 185 kW)



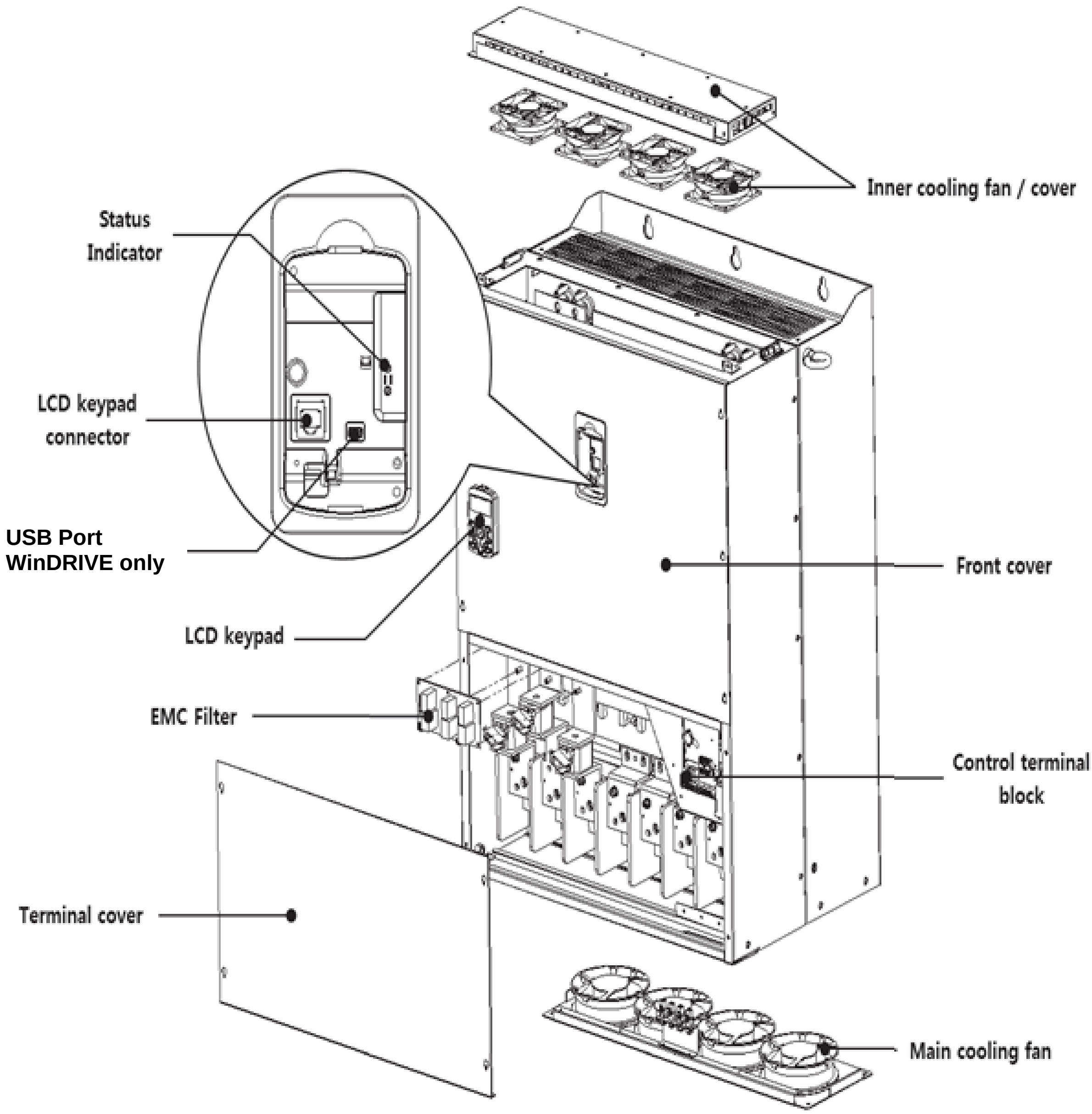
480V, 400 HP (250 kW)



480V, 500 HP ~ 650 HP (315 kW ~ 400 kW)



480V, 800 HP (500 kW)

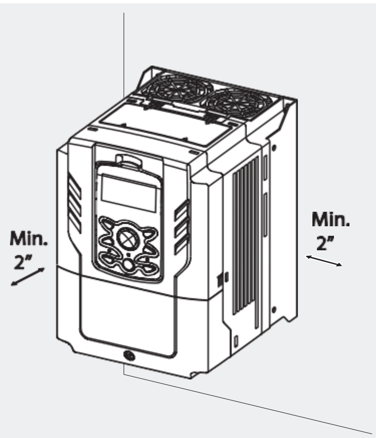


1.3 Installation Considerations

Inverters are composed of various precision, electronic devices, and therefore the installation environment can significantly impact the life span and reliability of the product. The table below details the ideal operation and installation conditions for the inverter.

Items	Description
Ambient Temperature*	14°F~104°F (- 10°C~40°C) 2.5% per °C current derating up to 122°F (50°C) max. No ice or frost should be present.
Ambient Humidity	95% relative humidity (no condensation)
Storage Temperature	-4°F–149°F (-20ºC-65ºC)
Environmental Factors	An environment free from corrosive or flammable gases, oil residue or dust
Altitude	Maximum 3,280 ft (1,000m) above sea level for standard operation. Above that derate the inverter rated voltage and the rated output current derating by 1% for every 328 ft (100m) up to 13,123 ft (4,000m).
Vibration	Less than 1.0 G (9.8m/sec^2)
Air Pressure	10 - 15 PSIg (70 –106 kPa)

* The ambient temperature is the temperature measured at a point 2” (5 cm) from the surface of the inverter.



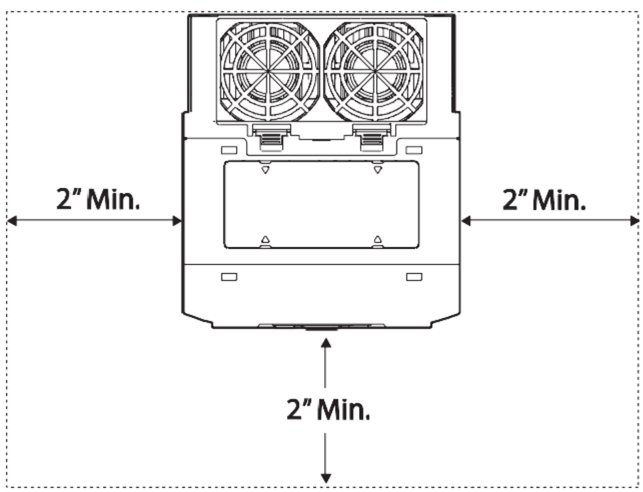
Caution

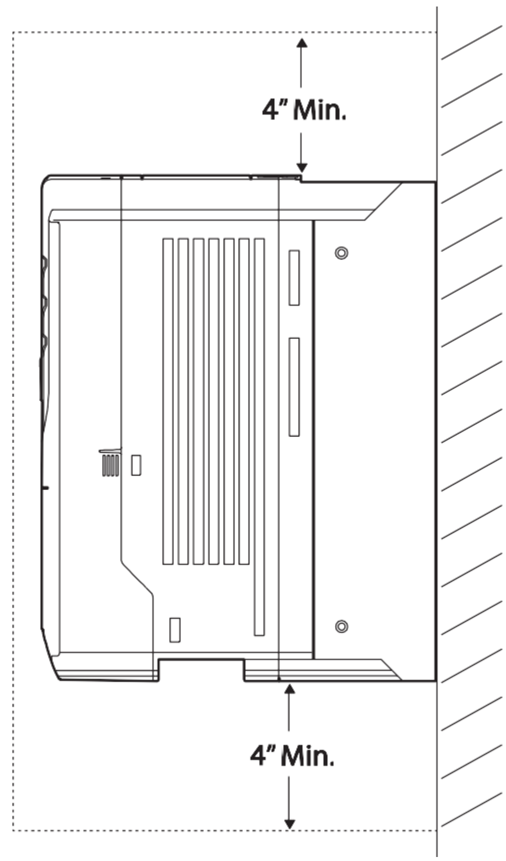
Do not allow the ambient temperature to exceed the allowable range while operating the inverter.

1.4 Selecting and Preparing a Site for Installation

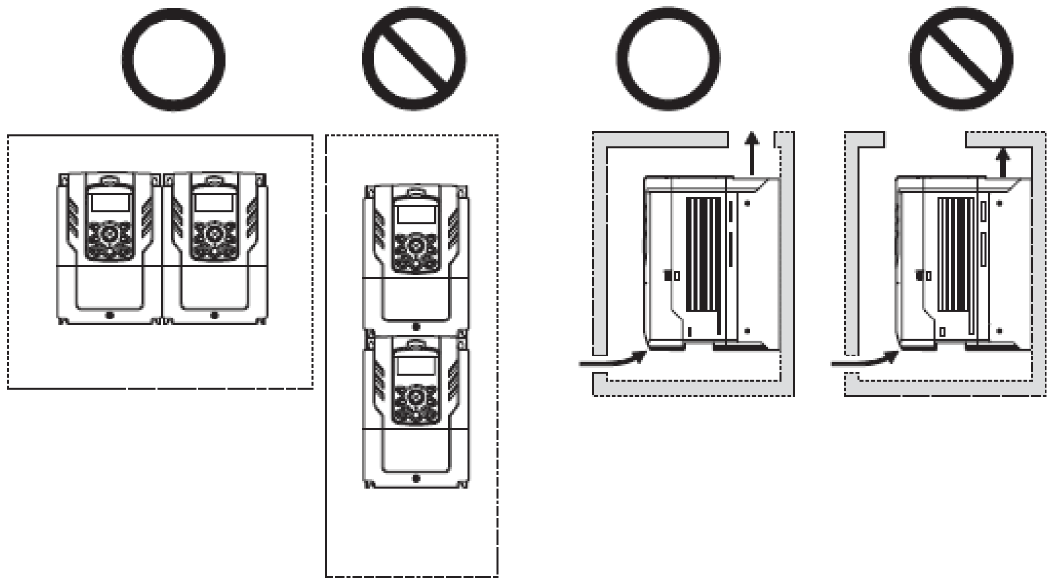
When selecting an installation location consider the following points:

The inverter must be installed on a wall that can support the inverter's weight.
The location must be free from vibration. Vibration can adversely affect the operation of the inverter.
The inverter can become very hot during operation. Install the inverter on a surface that is fire-resistant or flame-retardant and with sufficient clearance around the inverter to allow air to circulate. The illustrations below detail the required installation clearances.

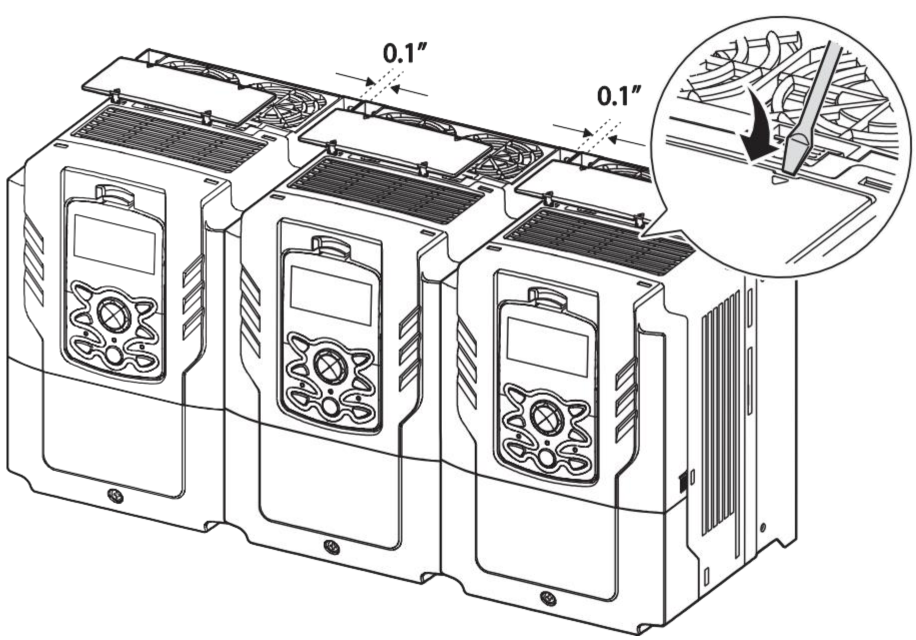




Ensure sufficient air circulation is provided around the inverter when it is installed. If the inverter is to be installed inside a panel, enclosure, or cabinet rack, carefully consider the position of the inverter's cooling fan and the ventilation louver. The cooling fan must be positioned to efficiently transfer the heat generated by the operation of the inverter.

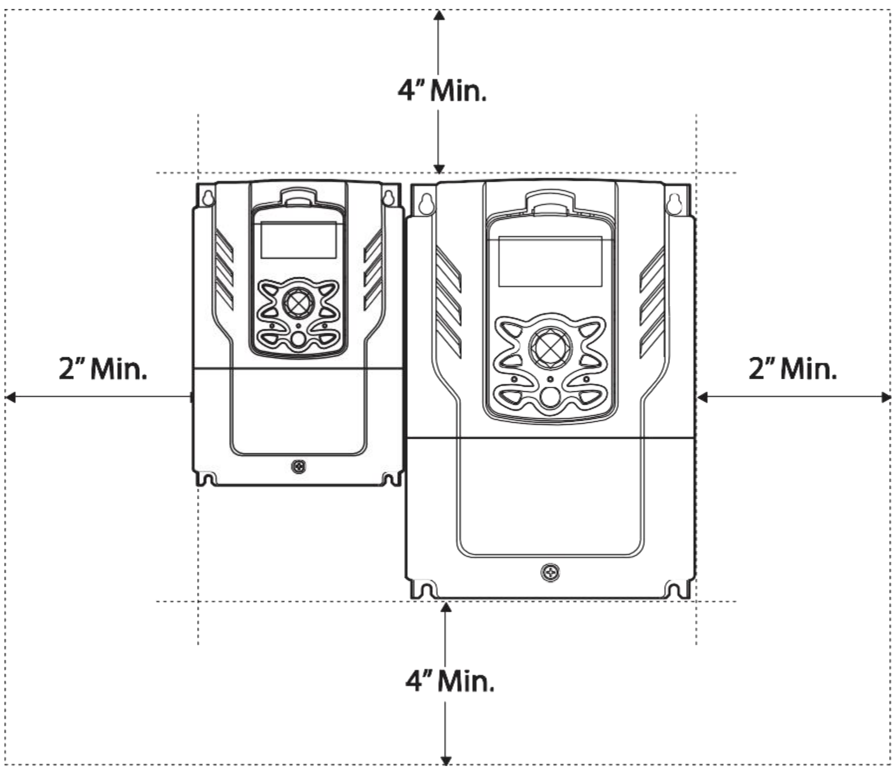


If you are installing multiple inverters in one location, arrange them side-by-side and remove the vent covers. Use a flat head screwdriver to remove the vent covers. Only the H2 inverters rated for up to 30 kW may be installed side-by-side.



> NOTE
>
> - The vent covers must be removed for side-by-side installations.
> - Side-by-side installation cannot be used for the H2 inverters rated for 37 kW and above.
> - For the H2 inverters rated for 50 HP (37 kW) and above, if the installation site satisfies the UL Open Type requirements and there is no danger of foreign objects getting inside the inverter, the vent cover may be removed to improve cooling efficiency.

If you are installing multiple inverters of different ratings, provide sufficient clearance to meet the clearance specifications of the larger inverter. The H2 inverters rated up to 30 kW may be installed side-by-side.



1.5 Cable Selection

Use cables that meet the required specification for the safe and reliable operation of the product. Refer to NEC Articles 430.2 and 430.6 along with Table 310-16 for selecting the correct wire sizing. Some local codes may take precedence over the NEC. Refer to the following information to assist you with cable selection.

Caution

- Wherever possible, use cables with the largest cross-sectional area for mains power wiring to ensure that voltage drop does not exceed 2%.
- Use copper cables rated for 600 V, 75º C for power terminal wiring.
- Use copper cables rated for 300 V, 75º C for control terminal wiring.
- The inverters must be grounded with fixed connections.
- The minimum size of the protective ground conductor shall comply with the local safety regulations for high protective grounding.

Ground Cable and Power Cable Specifications

Voltage	kW	HP	Ground Wire		Input/Output Power Wire			
			mm^2	AWG	mm^2		AWG	
					R/S/T	U/V/W	R/S/T	U/V/W
240V	5.5	7.5	10	10	4	4	12	12
	7.5	10			6	6	10	10
	11	15			10	10	8	8
	15	20	14	6	16	16	6	6
	18.5	25			25	22	4	4
	22	30	25	4		25		
	30	40			50	50	1/0	1/0
	37	50	38	2	70	70		
	45	60						
	55	75	50x2	1x2	70x2	70x2	1/0x2 300	1/0x2 300
	75	100			95x2	95x2	2/0x2 400	2/0x2 400
	90	125	50x2 70x2	1/0x2			4/0x2	4/0x2

Voltage	kW	HP	Ground Wire		Input/Output Power Wire			
			mm^2	AWG	mm^2		AWG	
					R/S/T	U/V/W	R/S/T	U/V/W
480V	5.5	7.5	4	12	2.5	2.5	14	14
	7.5	10			4	2.5	12	14
	11	15			4	4	12	12
	15	20	16	8	6	6	10	10
	18.5	25			16	10	6	8
	22	30	14	6	16	10	6	8
	30	40			25	16	4	6
	37	50	25	4	25	25	4	4
	45	60			25	25	4	4
	55	75			50	50	1/0	1/0
	75	100	38	2	70	70	1/0	1/0
	90	125			70	70	1/0	1/0

Voltage	kW	HP	Ground Wire mm2	Ground Wire AWG	Input/Output Power Wire mm2 R/S/T	Input/Output Power Wire mm2 U/V/W	Input/Output Power Wire AWG R/S/T	Input/Output Power Wire AWG U/V/W
	110	150	50x2	1x2	70x2	70x2	1/0 x2 300	1/0 x2 300
	132	200	50x2	1x2	95x2	95x2	2/0 x2 400	2/0 x2 400
	160	250	50x2 70x2	1/0 x2	95x2	95x2	4/0 x2	4/0 x2
	185	300	70x2 95x2	3/0 x2	120x2	120x2	250 x2	250 x2
	250	400	95x2	300 x2	185x2	185x2	350 x2	350 x2
	315	500	60x4 150x2	2/0 x4	185x2	185x2	350 x2	350 x2
	400	650	95x4 200x2	4/0 x4	120x4 400x2	120x4 400x2	250 x4 800 x2	250 x4 800 x2
	500	800	120x4 350x2	4/0 x4 750x2	185x4 630x2	185x4 630x2	350 x4 1500 x2	350 x4 1500 x2

Voltage	kW	HP	Ground Wire mm2	Ground Wire AWG	Input/Output Power Wire mm2 R/S/T	Input/Output Power Wire mm2 U/V/W	Input/Output Power Wire AWG R/S/T	Input/Output Power Wire AWG U/V/W
575V	5.5	7.5	2.5	14	2.5	2.5	14	14
	7.5	10		12			14	12
	11	15		10			12	10
	15	20	4	10	4	4	10	10
	18.5	25	6	8	4	6	8	8
	22	30	10	8	6	10	8	8
	30	40		6	10		8	6
	37	50	16	4	16	16	4	4
	45	60			16	25	4	4
	55	75			25	35	3	2
	75	100	25	3	50	50	1	1/0
	90	125	35	2	70	70	2/0	2/0

Signal (Control) Cable Specifications

Terminals	Wire thickness 1) mm2	Wire thickness 1) AWG
P1–P7/CM/VR/V1/I2/24/TI	0.33–1.25	16–22
AO1/AO2/CM/Q1/EG	0.33–2.0	14–22
A1/B1/C1/A2/C2/A3/C3/A4/C4/A5/C5	0.33–2.0	14–22
S+, S-, SG	0.75	18

1) Use STP (shielded twisted pair) cables for signal wiring.

2 Installing the Inverter

This chapter describes the physical and electrical installation of the H2 series inverters, including mounting and wiring of the product. Refer to the flowchart and basic configuration diagram provided below to understand the procedures and installation instructions to be followed to install the product correctly.

Installation Flowchart

The following flowchart lists the sequence to be followed during installation. The steps cover equipment installation and testing of the product. More information on each step is referenced in the steps.

Product Identification (p.1)

Select the Installation Location (*p.10*)

Mounting the Inverter (p.20)

Wiring the Ground Connection (p.27)

Power and Signal Wiring (p.27)

Post-Installation Checks (p.49)

Turn on the Inverter

Parameter Configuration (p.72)

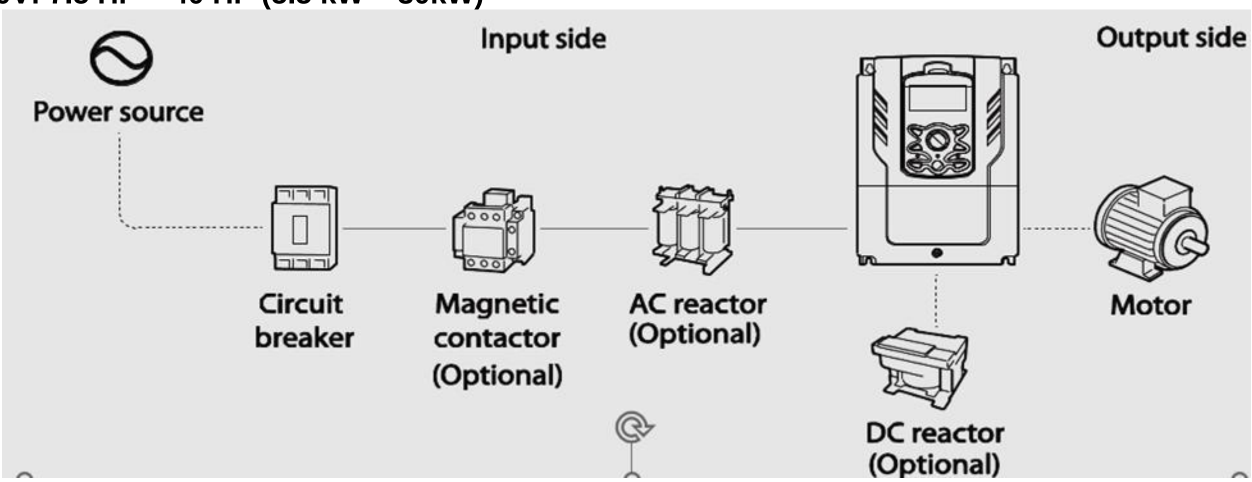
Testing (p.51)

Basic configuration diagram

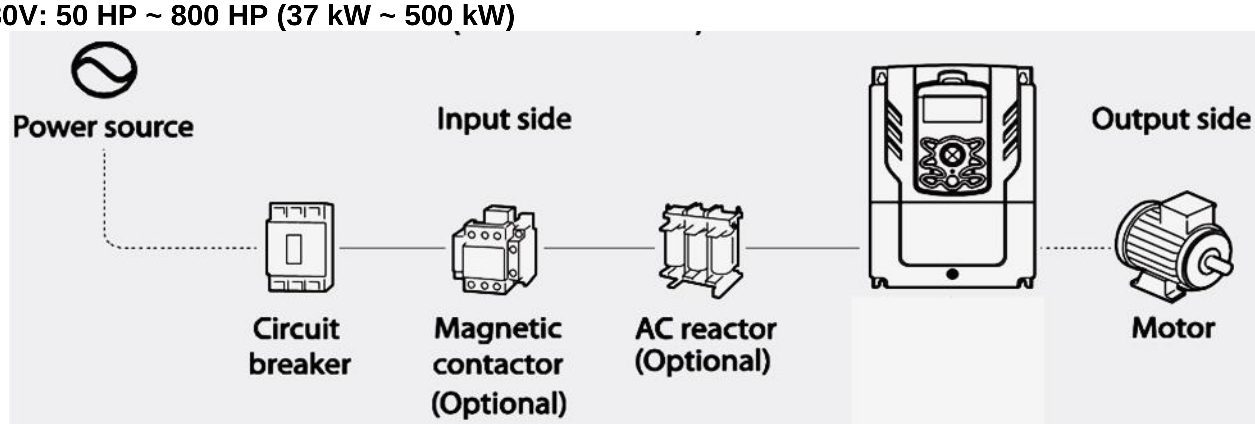
The reference diagram below shows a typical system configuration showing the inverter and peripheral devices.

Prior to installing the inverter, ensure that the product is suitable for the application (power rating, capacity, etc.). Ensure that all of the required peripherals and optional devices (contactors, reactors, noise filters, etc.) are available.

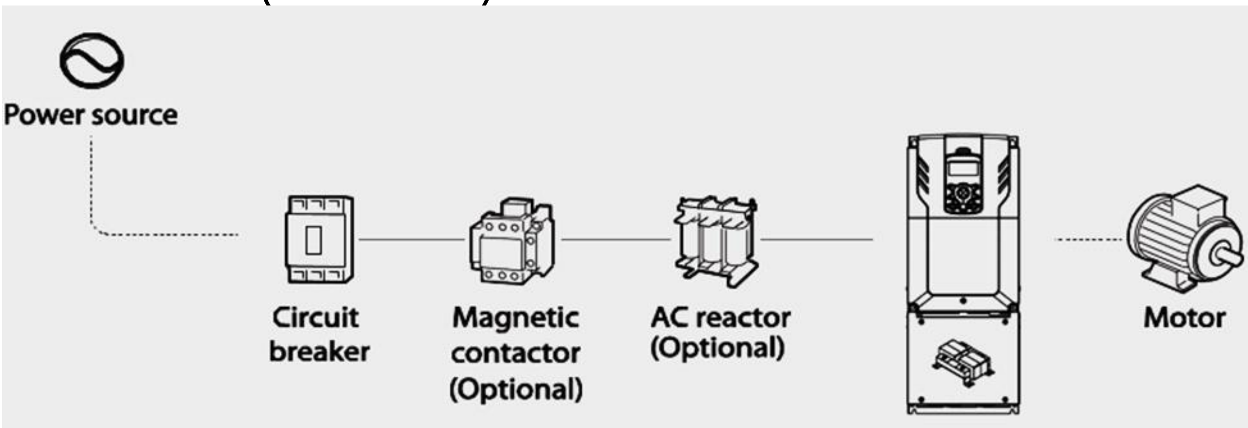
240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30kW)



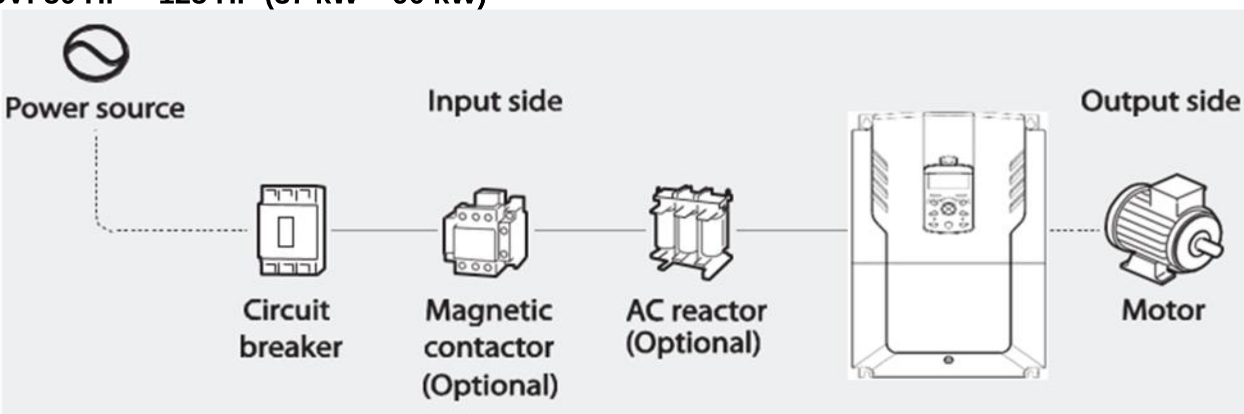
240V: 30 HP ~ 125 HP (22 kW ~ 90 kW)
480V: 50 HP ~ 800 HP (37 kW ~ 500 kW)



575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)



Caution

- Figures in this manual are shown with covers removed to show a more detailed view of the installation arrangements. Install covers before operating the inverter. Operate the product according to the instructions in this manual.
- Do not start or stop the inverter using a magnetic contactor installed on the input power supply.
- If the inverter is damaged and loses control, the machine may cause a dangerous situation. Install an additional safety device such as an emergency brake to prevent these situations.
- High levels of current draw during power-on can affect the system. Ensure that correctly rated circuit breakers are installed to operate safely during power-on situations.
- Line Reactors can be installed to improve the power factor. Note that reactors may be installed within 32.8 ft (10 m) from the power source if the input power exceeds 600 kVA.

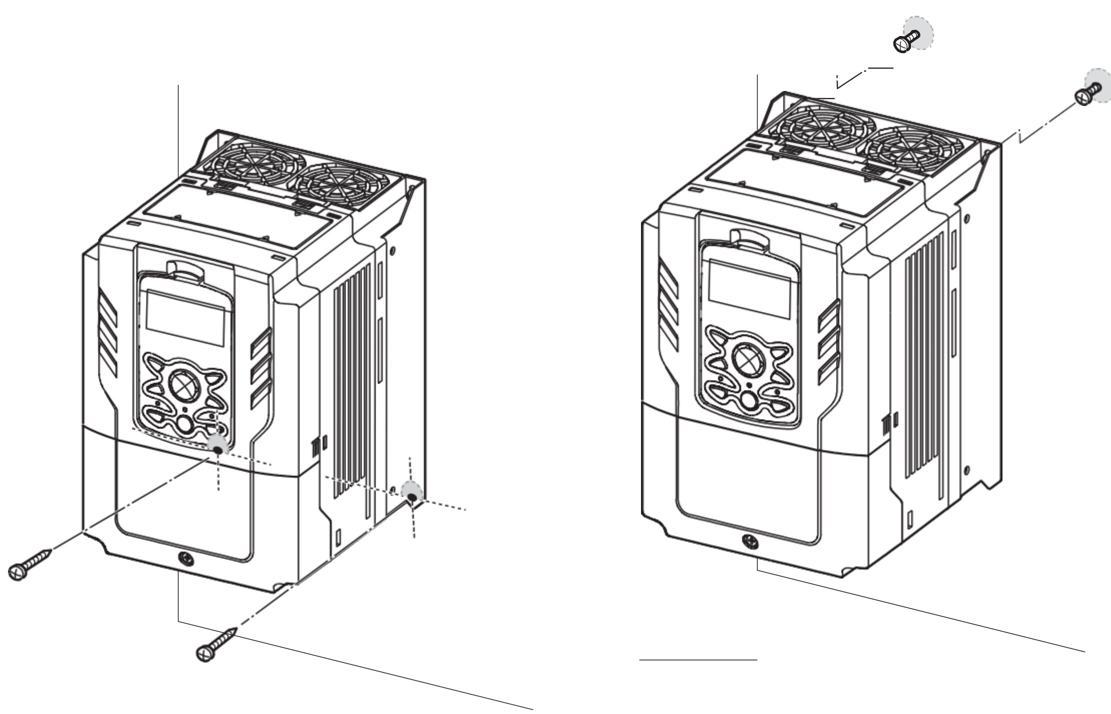
2.1 Mounting the Inverter

Mount the inverter on a wall or inside a panel following the procedures provided below. Before installation, ensure that there is sufficient space to meet the clearance specifications, and that there are no obstacles impeding the cooling fan's air flow.

Select a wall or panel suitable to support the installation. For all inverters, refer to *13.3, External Dimensions on page 367* and check the inverter's mounting dimensions.

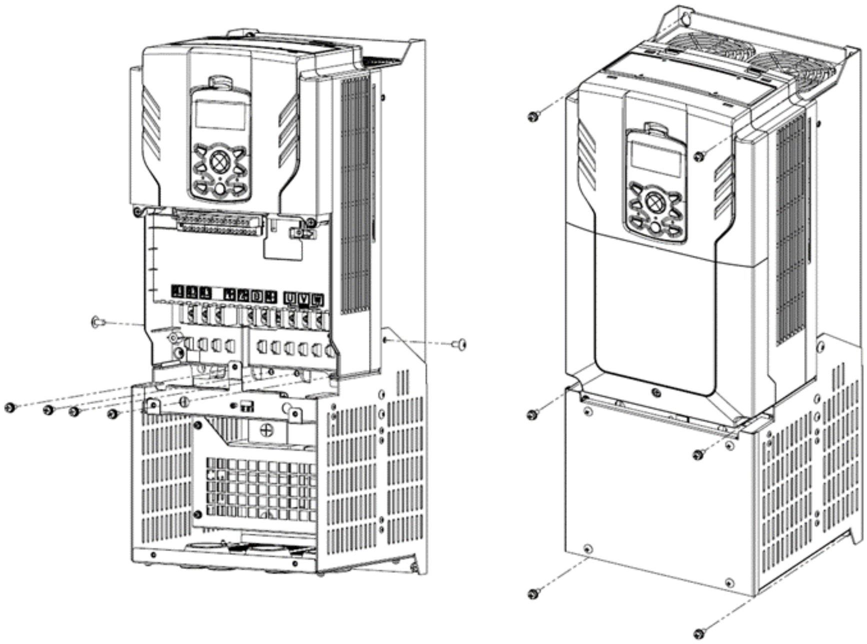
Use a level to draw a horizontal line on the mounting surface, and then carefully mark the upper mounting points. Drill the two upper mounting bolt holes and then install the mounting bolts. Do not fully tighten the bolts at this time. For smaller inverters, mount the inverter on the wall or inside a panel using the two upper bolts. Verify it is level. Mark the lower mounting points. Remove the Inverter and drill the lower bolt holes. Install the lower mounting bolts but do not fully tighten. Mount the inverter and fully tighten all mounting bolts. For larger inverters, refer to *13.3, External Dimensions on page 367.*

240V, 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V, 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

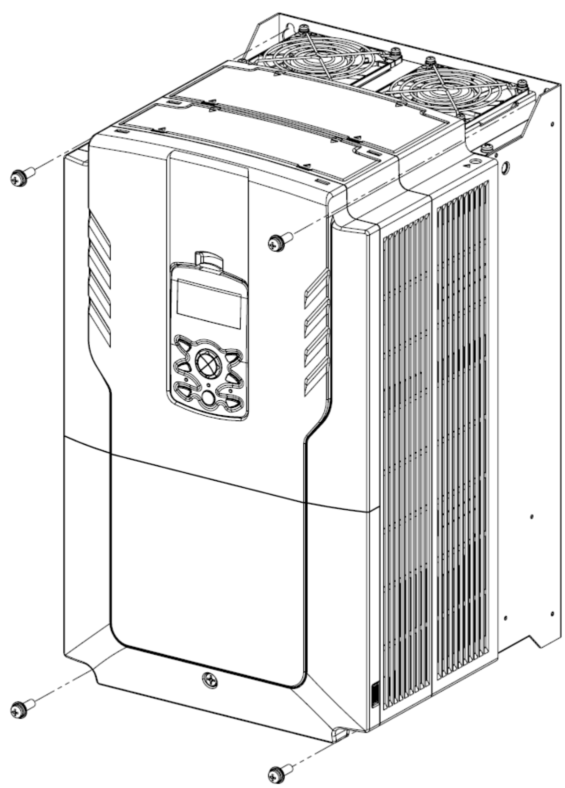


Ensure that the inverter is placed flat on the mounting surface and that the installation surface can securely support the weight of the inverter

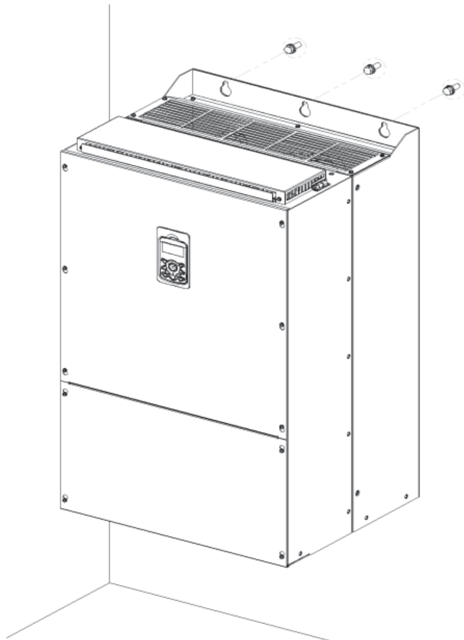
575V, 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



240V, 30 HP ~ 125 HP (22 kW ~ 90 kW)
480V, 50 HP ~ 300 HP (37 kW ~ 185 kW)
575V, 50 HP ~ 125 HP (37 kW ~ 90 kW)



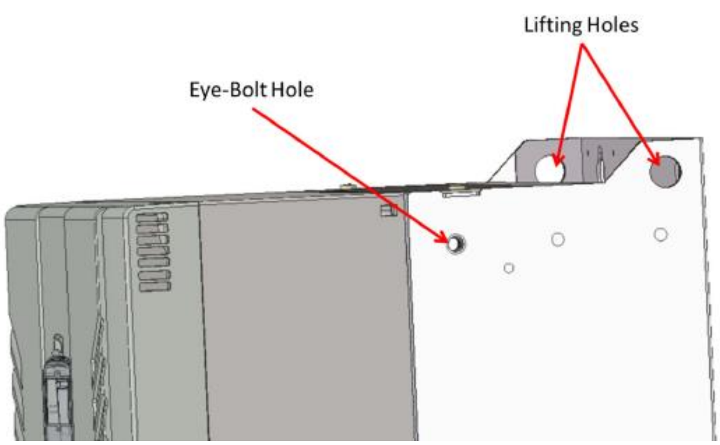
480V, 400 HP ~ 800 HP (250 kW ~ 500 kW)



Caution

- Do not transport the inverter by lifting with the inverter's covers or plastic surfaces. The cover may come loose causing the inverter to be dropped which can cause injuries or damage to the product. Always support the inverter using the metal frames when moving it.
- Hi-capacity inverters are very heavy and bulky. Use an appropriate transport and lifting methods that are suitable for the weight.

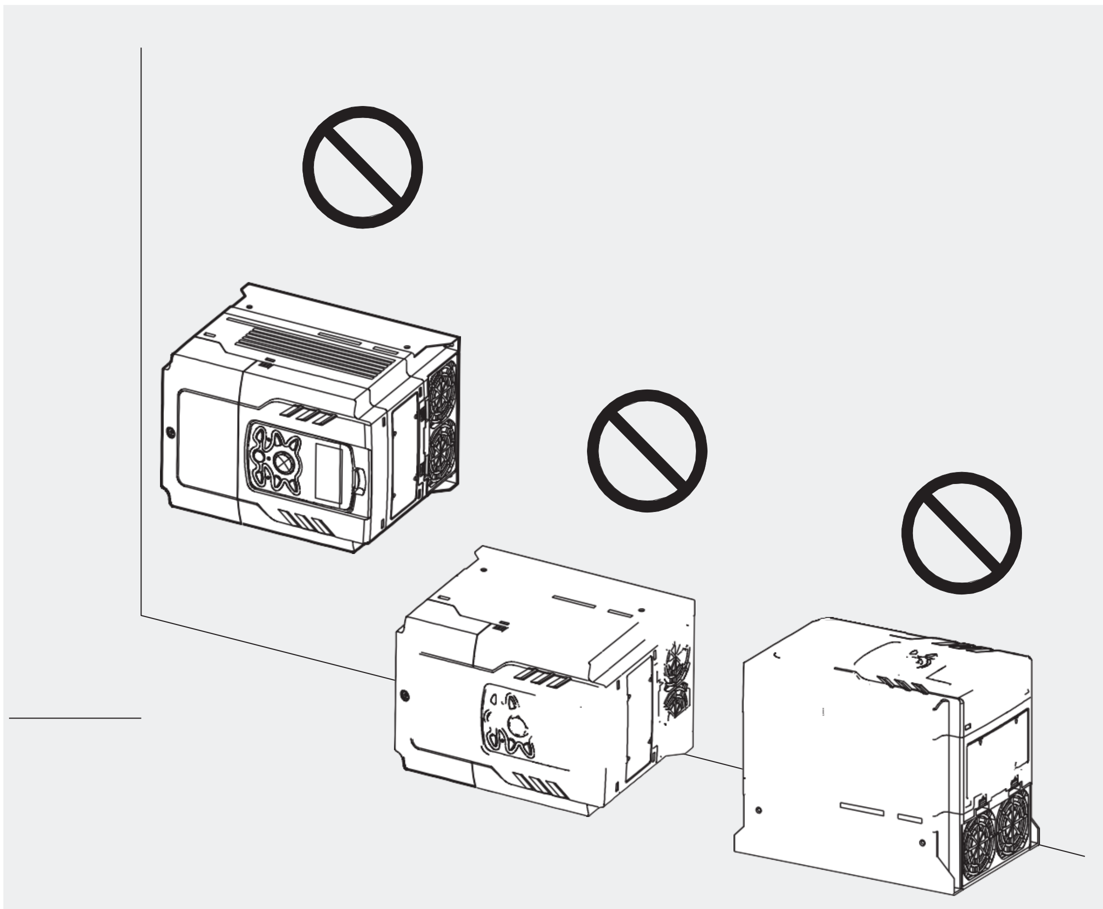
The larger H2 VFD's have provisions for Eye Bolts. See diagram and table below. Eyebolts are not included with the VFD's.



Voltage, HP	Weight (lbs)	Eye Bolt (course)
240V, 75 HP	118.2	M10
480V, 150 HP	123.0	M10
240V, 100 HP	121.9	M10
480V, 200 HP	123.0	M10
240V, 125 HP	159.2	M10
480V, 250 HP	164.7	M10
480V, 300 HP	164.7	M10
480V, 400 HP	264.6	M12
480V, 500 HP	409.0	M12
480V, 650 HP	409.0	M12
480V, 800 HP	584.0	M16

Caution

Do not install the inverter on the floor or mount it sideways against a wall. The inverter must be installed vertically on a wall or inside a panel with its rear flat on the mounting surface.



2.2 Enabling the RTC (Real-Time Clock) Battery

The H2 Series inverter comes from the factory with a CR2032 lithium-manganese battery pre-installed on the I/O CPU PCB. The battery powers the inverter's built-in RTC. The battery is installed with a protective insulation strip to prevent battery discharge. Remove this protective film before installing and using the inverter.

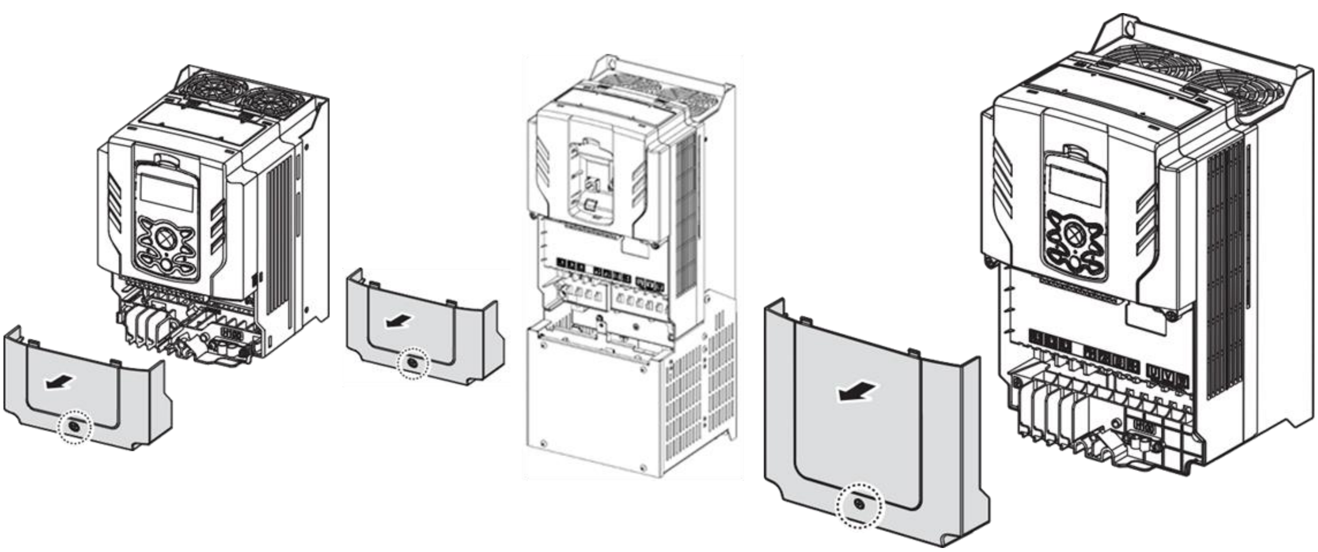
> **Caution**
>
> ESD (Electrostatic discharge) from the human body may damage sensitive electronic components on the PCB's. Therefore, be extremely careful not to touch the PCB or the components on the PCB with bare hands while you work on the I/O CPU PCB.
>
> To prevent damage to the PCB from ESD, touch a metal object with your hands to discharge any electrical charge before working on the PCB, or wear an anti-static wrist strap and ground it on a metal object.

2.2.1 Battery Access

Follow the instructions below to activate (or replace) the battery. Remove the protective insulation strip underneath the battery to enable the RTC feature on the H2 series inverters.

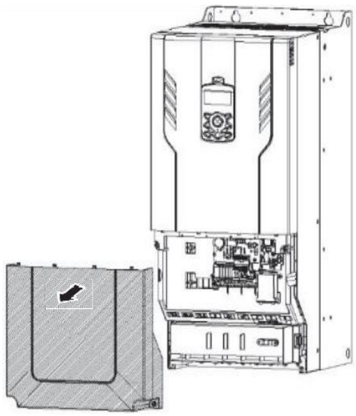
> **Caution**
>
> Ensure that the inverter is turned off and DC bus voltage has dropped to a safe level before opening the terminal cover when enabling or replacing the RTC battery.

Loosen the screw(s) on the power cover then remove the power cover.

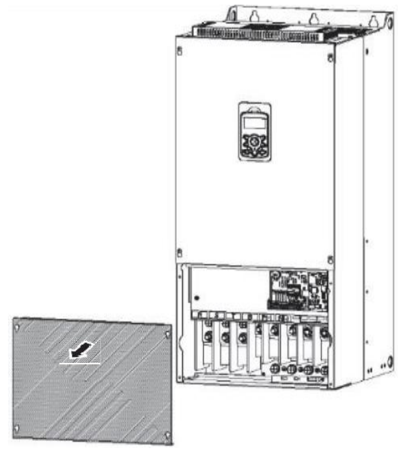


240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)

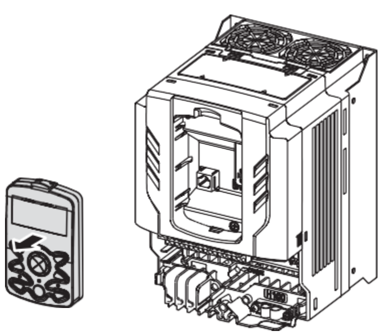


240V: 75 HP ~ 125 HP (55kW ~ 90 kW)
480V: 150 HP ~ 300 HP (110 kW ~ 185 kW)

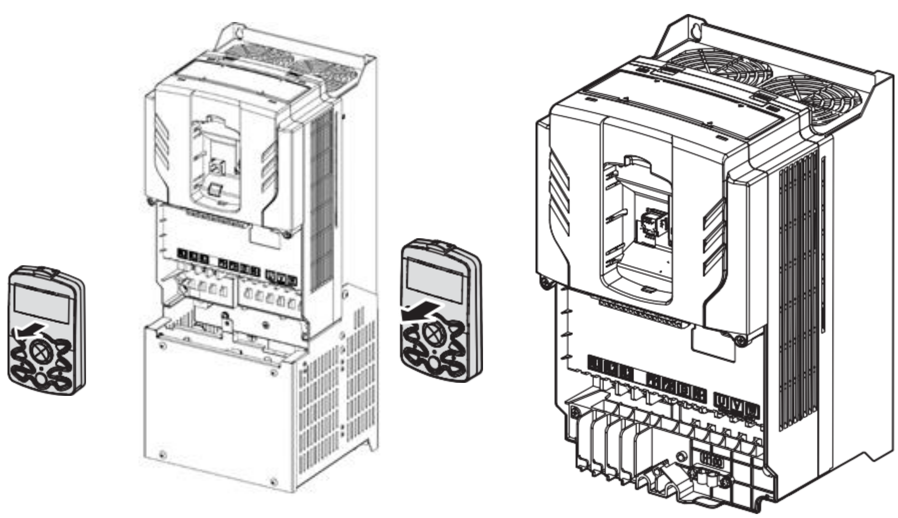


480V: 400 HP ~ 800 HP (250 kW ~ 500 kW)

For 7.5 ~ 125 HP only. Remove the keypad from the inverter body.

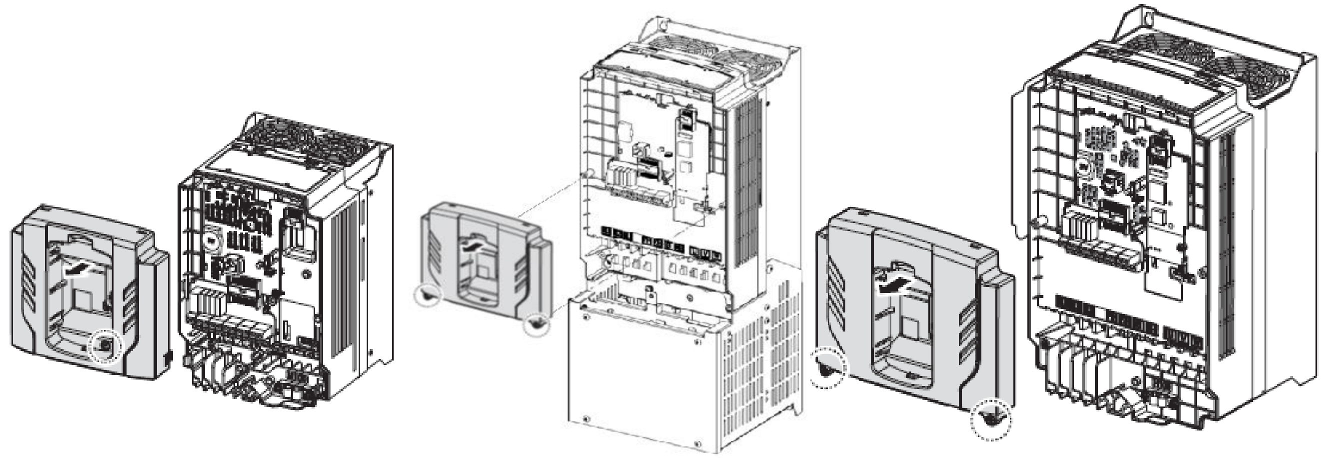


240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)

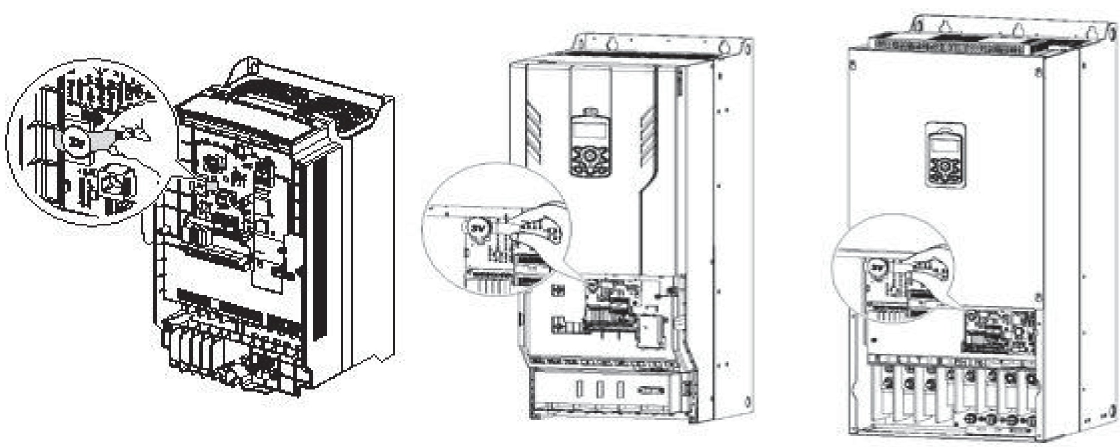
For 7.5 HP ~ 125 HP only. Loosen the screws securing the front cover and remove the front cover by lifting it. The I/O CPU PCB is exposed.



240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)

Locate the RTC battery holder on the I/O CPU PCB and remove the protective insulation strip by gently pulling it. If replacing, gently pry out the battery and replace.



Reattach the front cover, the power cover, and the keypad back onto the inverter body.

2.2.2 Battery Specifications

Model type: CR 2032 (lithium-manganese) Nominal voltage: 3 V
Nominal capacity: 220 mAh
Operating temperature range: -20–80 degrees C
Life span (approximately): 53,300 hrs (inverter on) / 25,800 hrs (inverter off)

2.3 Cable Wiring

Complete the cable connections by connecting an appropriately rated cable to the terminals on the power and control terminal blocks. Read the following information carefully and follow all warning instructions.

Do not connect power to the inverter until installation has been fully completed and the inverter is ready to be operated.

⚠ Warning

- Power supply wiring must be connected to the R, S, and T terminals. Arrangement of the input phase sequence is not necessary. Connecting power supply cables to other terminals will cause internal damage to the inverter.
- Motor cables must be connected to the U, V, and W Terminals. Arrangement of the output phase sequence will affect motor rotation direction.
- Ground cables must be connected to the designated ground terminals. Do not connect ground wires to the DC bus negative bus (N-) terminal.
- Use cables with the largest possible cross-sectional area to ensure that voltage drop is minimized over long cable runs. Lowering the carrier frequency or installing a micro surge filter will also help reduce voltage drop.
- Use copper cables rated at 600 V, 75 °C for the power terminal wiring.
- Use copper cables rated at 300 V, 75 °C for the control terminal wiring
- Voltage drop is calculated with the following formula.
  - Voltage Drop (V) = [√3 X cable resistance (mΩ/m) X cable length (m) X current (A)] / 1000

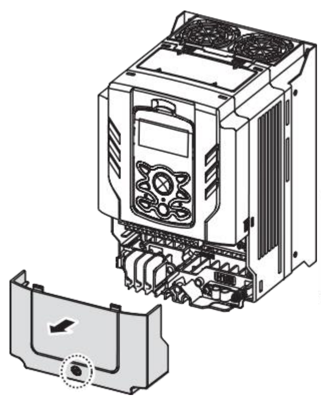
Distance	< 165 ft (50 m)	< 330 ft (100 m)	> 330 ft (100 m)
Allowable Carrier Frequency	<15 kHz	<5 kHz	<2.5 kHz

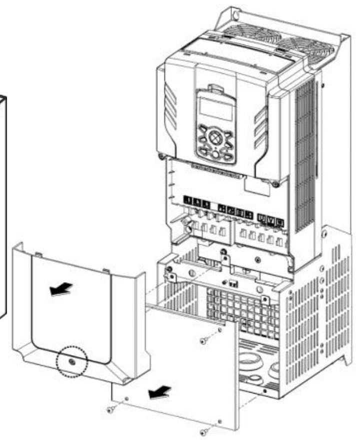
- Apply rated torques to the terminal screws. Loose screws cause heated connections and can lead to short circuits and malfunctions. Tightening the screws too much may damage the terminals.
- The inverter's power terminal connections can cause harmonics that may interfere with other communication devices located near to the inverter. To reduce interference the installation of noise filters or line filters may be required.
- Long cable runs can cause reduced motor torque in low frequency applications due to voltage drop. Long cable runs also increase the circuits susceptibility to stray capacitance and may trigger over current protection within the inverter or result in malfunction of equipment connected to the inverter.
- **Motor Cable Length**:
  - 7.5 HP → 800 HP-----492 ft. (150 m).
- To increase the service life of the motor and the inverter, Benshaw recommends adding an output reactor with motor lead lengths up to 100 ft. For motor lead lengths between 100 ft. up to 1500 ft., install a Long Lead (dV/dT) filter.
- To avoid circuit interruption or damaging connected equipment, do not install PFCC's, surge protection or EMC filters on the output side of the inverter.
- When connecting a contactor to the output of the inverter, avoid ON / OFF contactor operation while inverter is running. It may cause the inverter to trip or short circuit the output of the inverter.
- Route signal cables away from power cables to avoid interference.

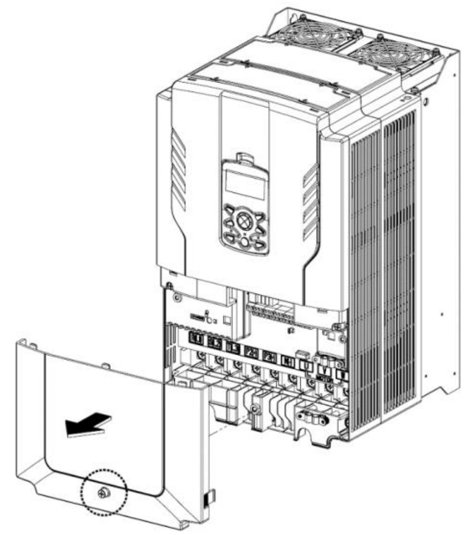
Step 1 Terminal Cover and Cable Guide

The terminal cover and cable guide must be removed to install cables. Refer to the following procedures to remove the covers and cable guide. The steps to remove these parts may vary depending on the inverter model.

Loosen the bolt(s) that secure the terminal cover. Then remove the cover by lifting it from the bottom and away from the front.

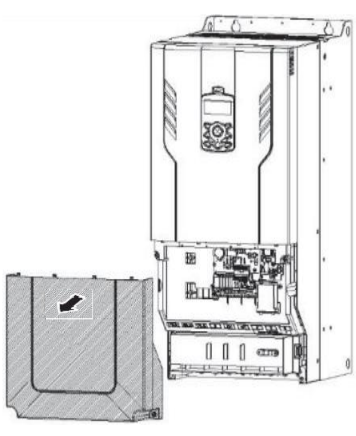




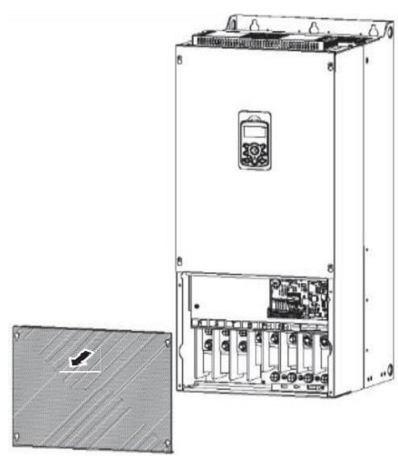


240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)



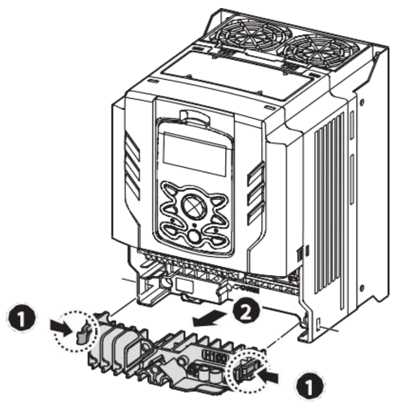
240V: 75 HP ~ 125 HP (55kW ~ 90 kW)
480V: 150 HP ~ 300 HP (110 kW ~ 185 kW)



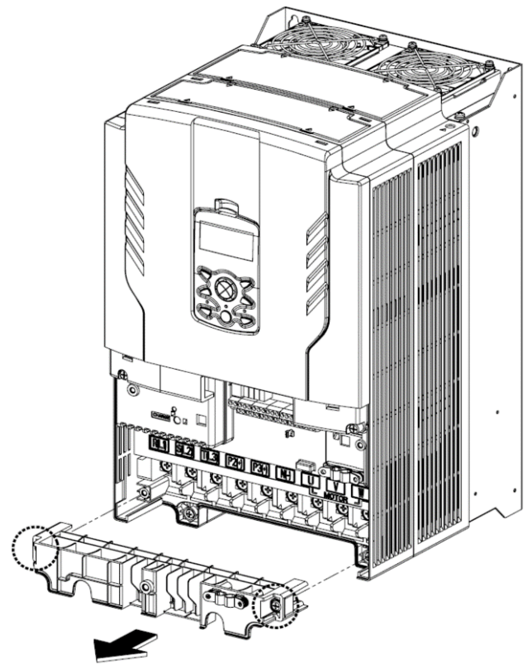
480V: 400 HP ~ 800 HP (250 kW ~ 500 kW)

Remove Cable Guide

(①) Push and hold the levers on both sides of the cable guide and then (②) removethe cable guide by pulling it directly away from the front of the inverter.
In some models (50 HP ~ 125 HP, 37 kW ~ 90kW) the cable guide is secured by a bolt. Remove the bolt first.

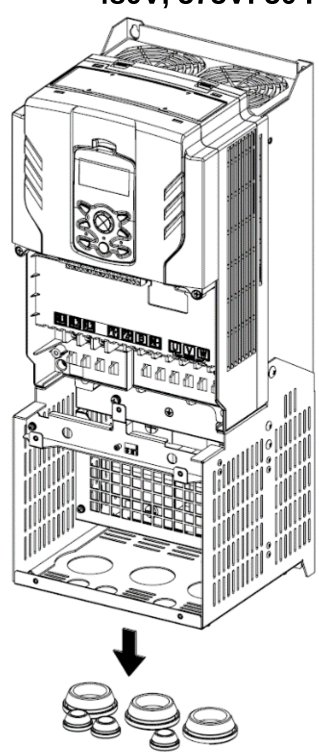


240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)

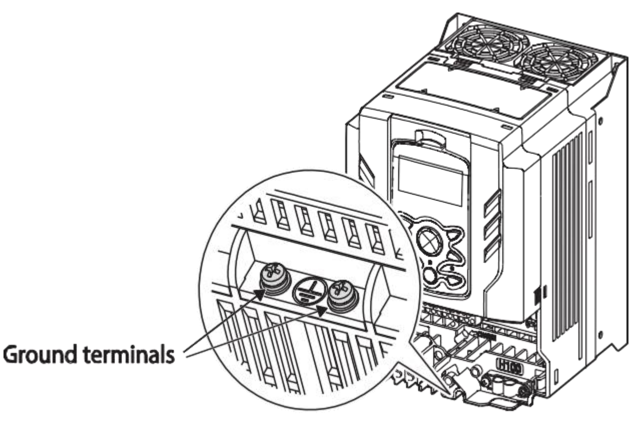
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



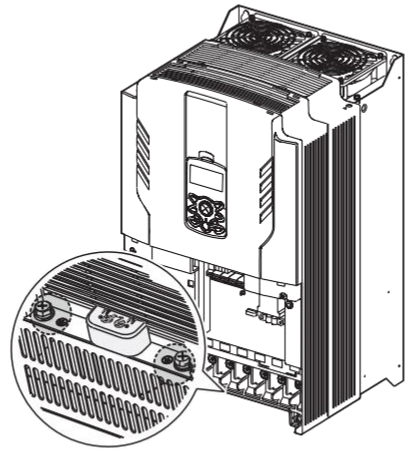
Connect the cables to the power terminals and the control terminals. For cable specifications, refer to *1.5 Cable Selection* on page *14*.

Step 2 Ground Connection

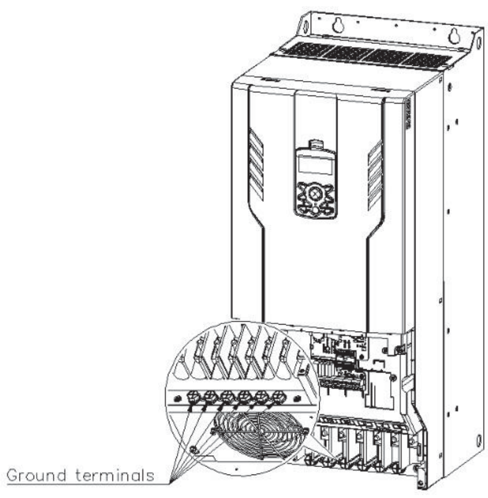
Install the ground connection for the inverter.
Locate the ground terminal and connect an appropriately rated ground cable to the terminals. Refer to *1.5 Cable Selection on page 14* to find the appropriate cable specification for your installation.



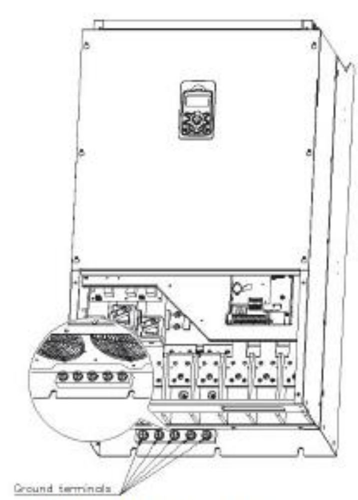
240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V, 575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)



240V: 75 HP ~ 125 HP (55kW ~ 90 kW)
480V: 150 HP ~ 300 HP (110 kW ~ 185 kW)



480V: 400 HP ~ 800 HP (250 kW ~ 500 kW)

Connect the other ends of the ground cables to the supply ground terminal.

Note
- 240 V products require Class 3 grounding. Resistance to ground must be ≤ 100 Ω.
- 480V/575V products require Special Class 3 grounding. Resistance to ground must be ≤ 10 Ω.

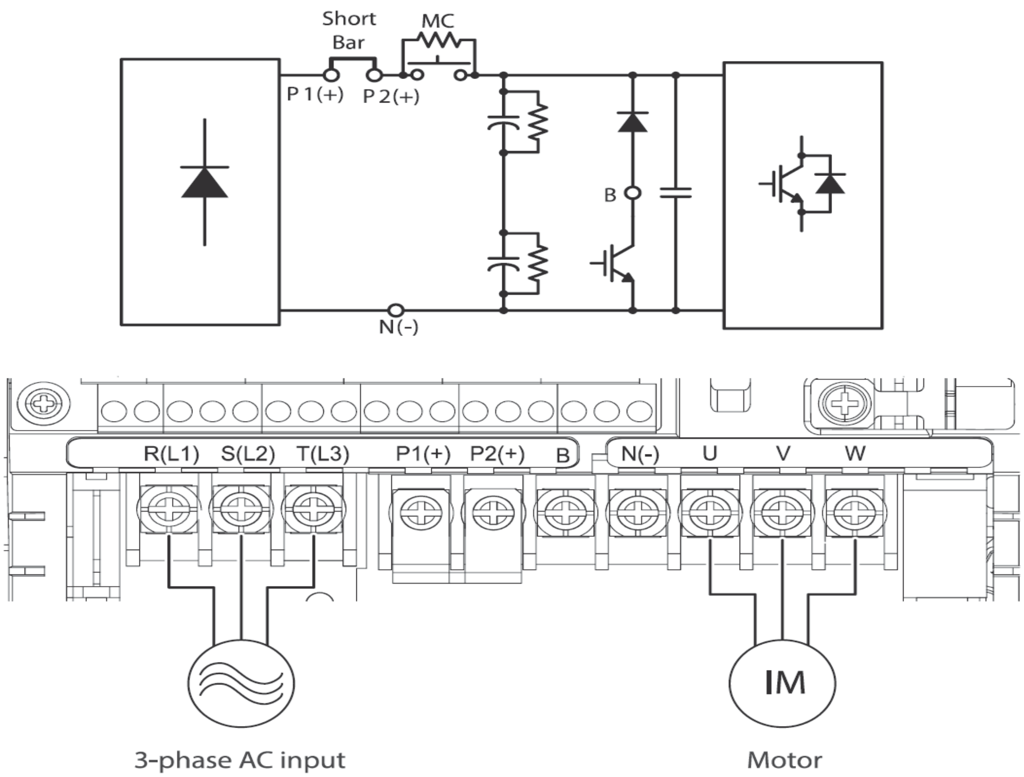
⚠ Warning
Install ground connections for the inverter and the motor by following the correct specifications to ensure safe and accurate operation. Using the inverter and the motor without the specified grounding connections may result in electric shock.

This product can cause a D.C current in the ground conductor. If a ground fault device (RCD or monitoring RCM) is used for protection, only Type B is allowed on supply side of this product.

Step 3 Power Terminal Wiring

The following illustration shows the terminal layout on the power terminal block. Refer to the power terminal descriptions to understand the function and location of each terminal before making wiring connections. Ensure that the cables selected meet or exceed the specifications in *1.5 Cable Selection on page 14* before installing them.

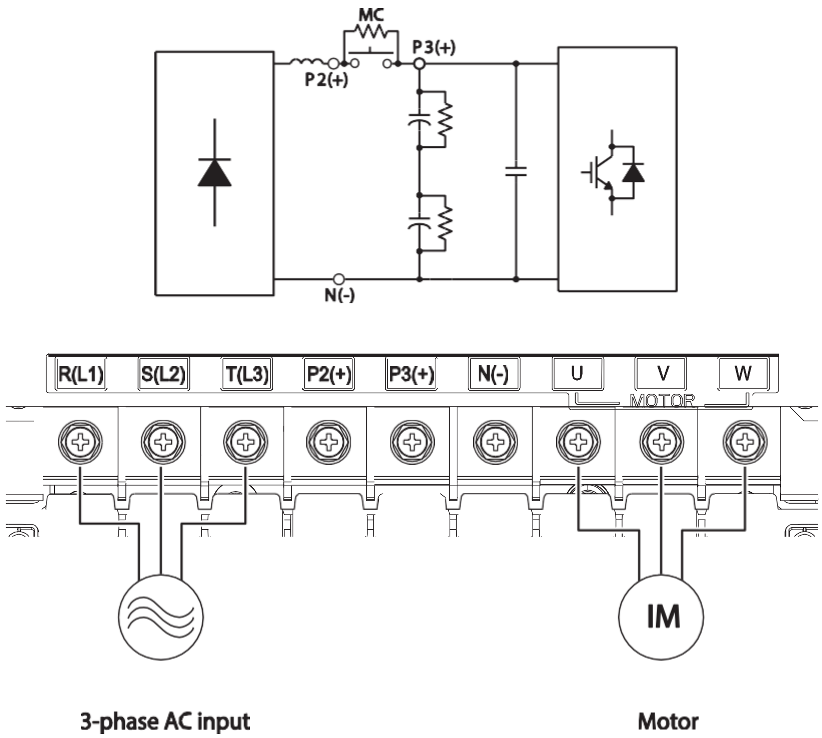
240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)



Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC bus terminal	DC voltage terminals.
P1(+) / P2(+)	DC Reactor terminal	DC Reactor connection. Remove shorting bar when you add a DC Reactor.
P2(+) / B	Brake resistor terminals	Brake resistor wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

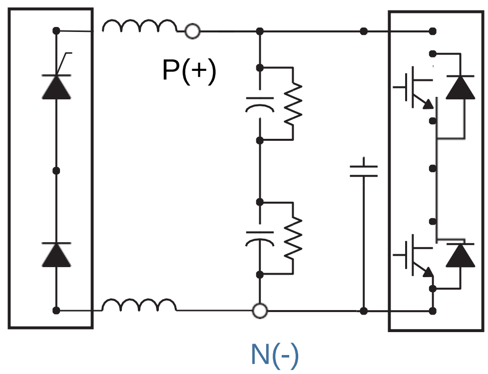
240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V: 50 HP ~ 125 HP (37 kW ~ 90 kW)

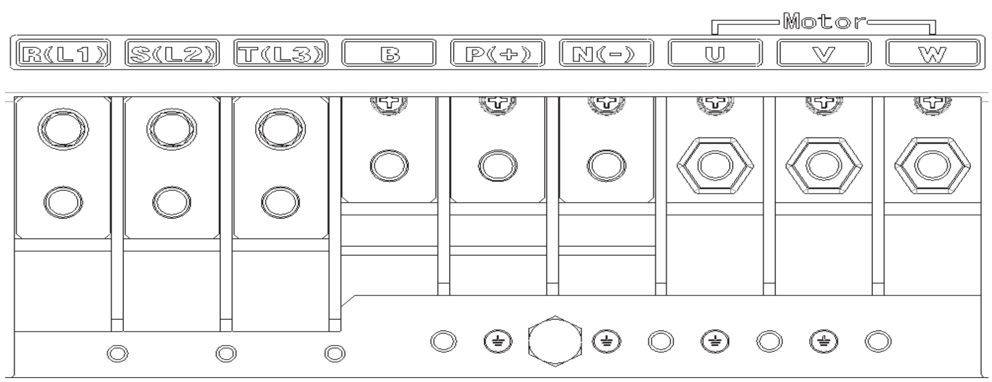


Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC bus terminals	DC voltage terminals.
P3(+) / N(-)	Brake unit (DBU) terminals	Brake unit (module) wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

240V: 75 HP ~ 125 HP (55 kW ~ 90 kW)
480V: 150 HP ~ 400 HP (110 kW ~ 250 kW)

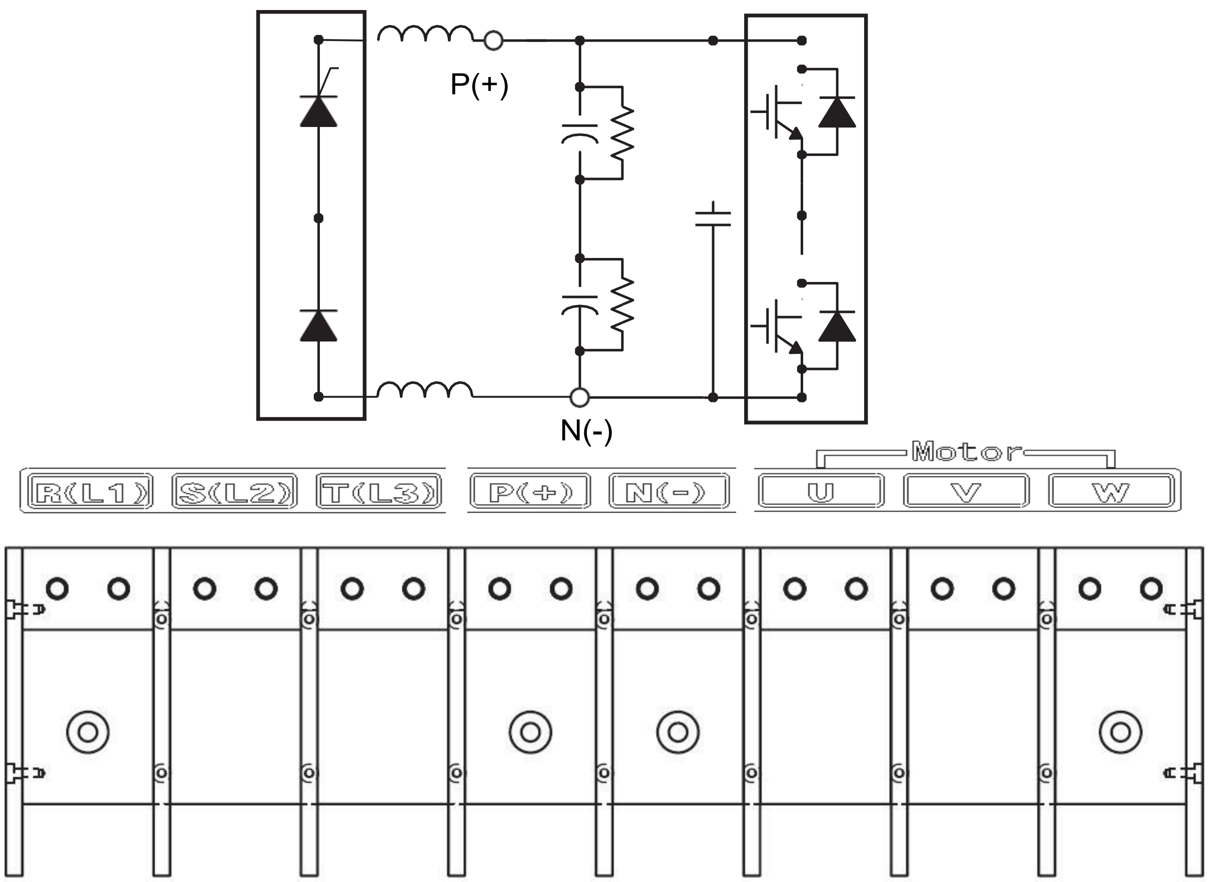




Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
B	-	Not used - does not include a braking transistor (IGBT).
P(+) / N(-)	DC bus terminal (or DBU connection terminals)	DC voltage terminals. (or Brake unit wiring connection)
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

480V: 500 HP ~ 800 HP (315 kW ~ 500 kW)

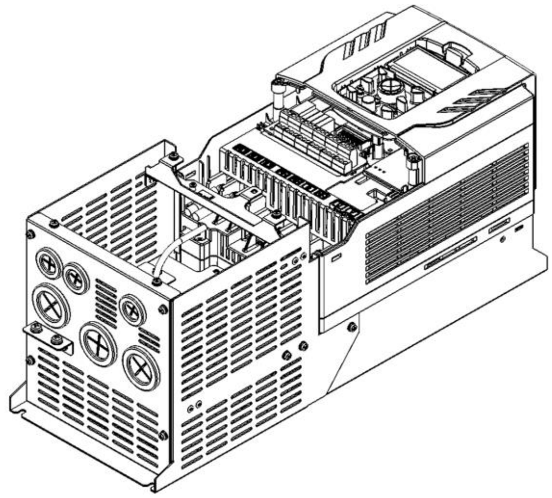


Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P(+) / N(-)	DC bus terminal (or DBU connection terminals)	DC voltage terminals. (or Brake unit wiring connection)
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

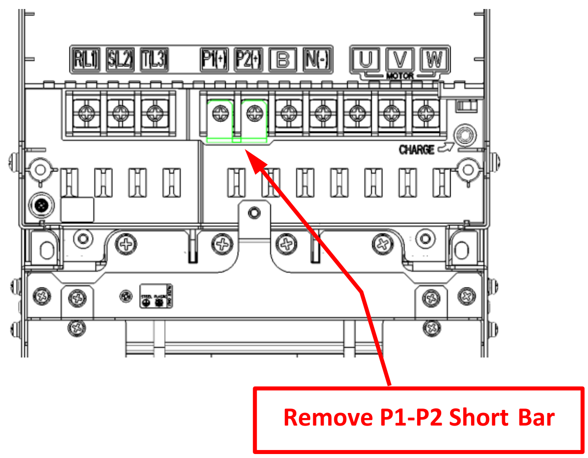
2.3.1 575V Inverter - DC Reactor Installation

For 575V inverters (7.5 HP ~ 40 HP), a DC Reactor is supplied mounted in a conduit box. It requires mounting and connection to the inverter. Follow the steps below to install and connect the DC Reactor.

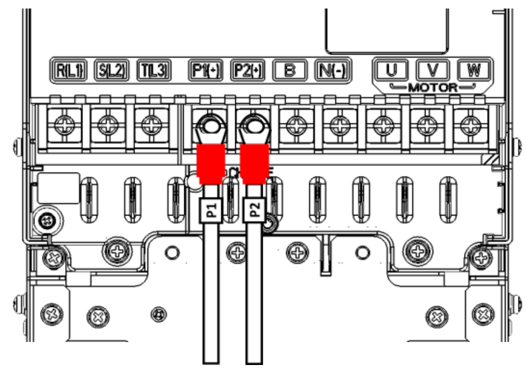
7.5 HP ~ 40 HP



a. Remove the Terminal cover from the inverter.
b. Remove the Cable Guide/Bracket from the inverter.
c. Remove the top cover of the DC Reactor/Conduit Box.
d. Mount the DC Reactor/Conduit Box to the inverter.



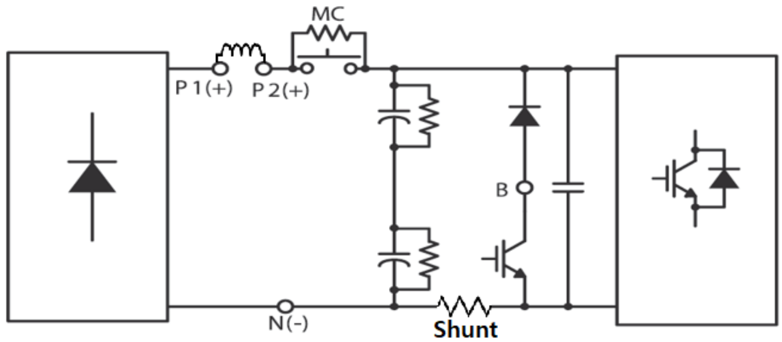
e. Remove the Jumper (Shorting Bar) from terminals P1 and P2.

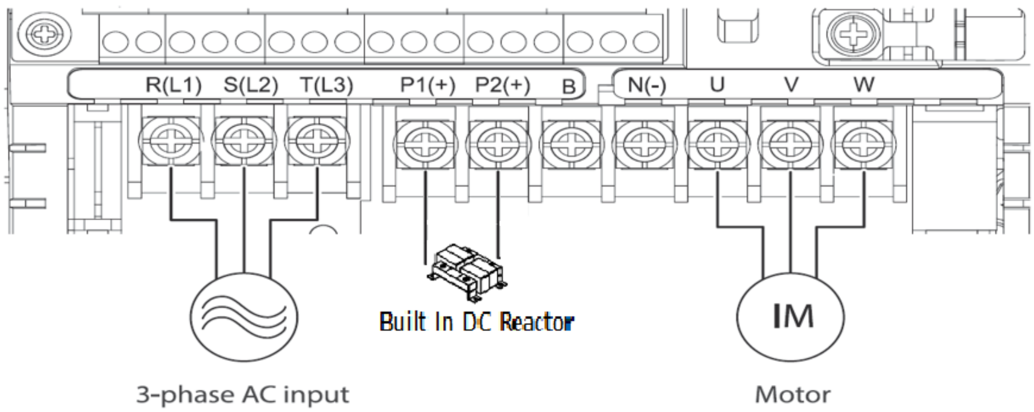


f. Connect DC Reactor wires to terminals P1 and P2.

g. Reinstall the Cable Guide/Bracket.
h. Inverter can be mounted at this time.
i. Complete the remaining Power wiring.
j. Complete the Control wiring.
k. Reinstall the Terminal cover.
l. Install the top cover of the DC Reactor/Conduit Box.

575V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW, Built-in DC Reactor)

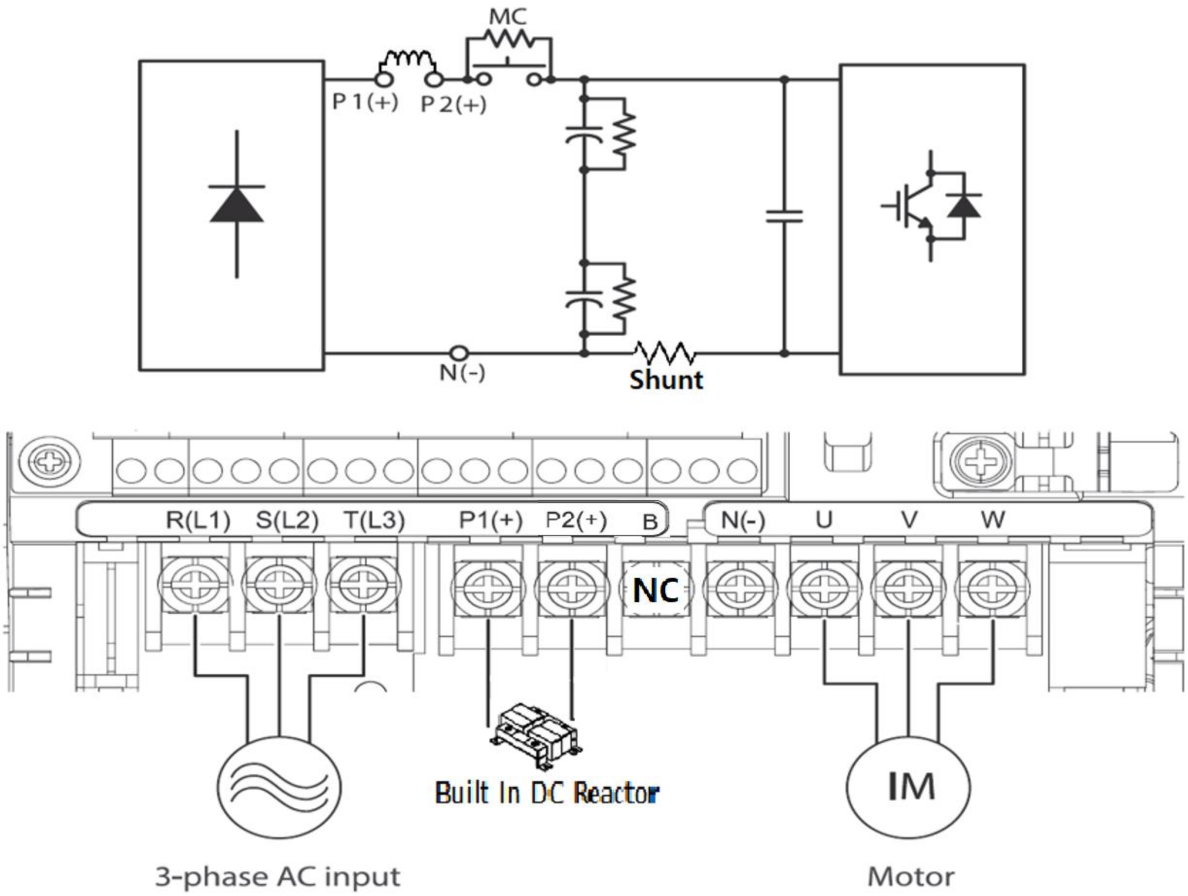




Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC bus terminal	DC voltage terminals.
P1(+) / P2(+)	DC Reactor terminal	DC Reactor wiring connection.
P2(+) / B	Brake resistor terminals	Brake resistor wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

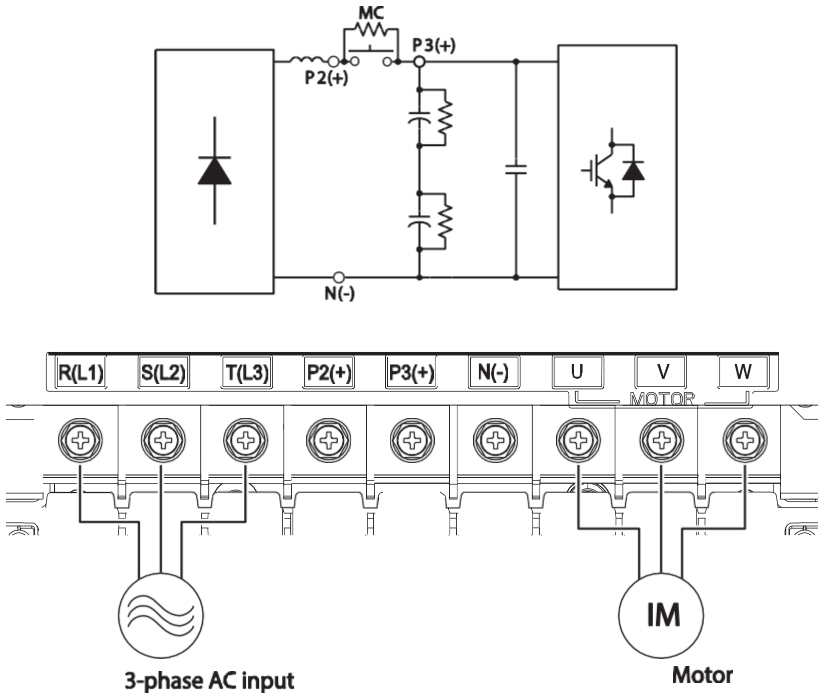
575V: 25 HP ~ 40 HP (22 kW ~ 30 kW, Built-in DC Reactor)



Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC bus terminal	DC voltage terminals.
P1(+) / P2(+)	DC Reactor terminal	DC Reactor wiring connection.
P2(+) / N(-)	Brake unit (DBU) terminals	Brake unit wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

575V: 50 HP ~ 125 HP (37 kW ~ 90 kW, Built-in DC Reactor)

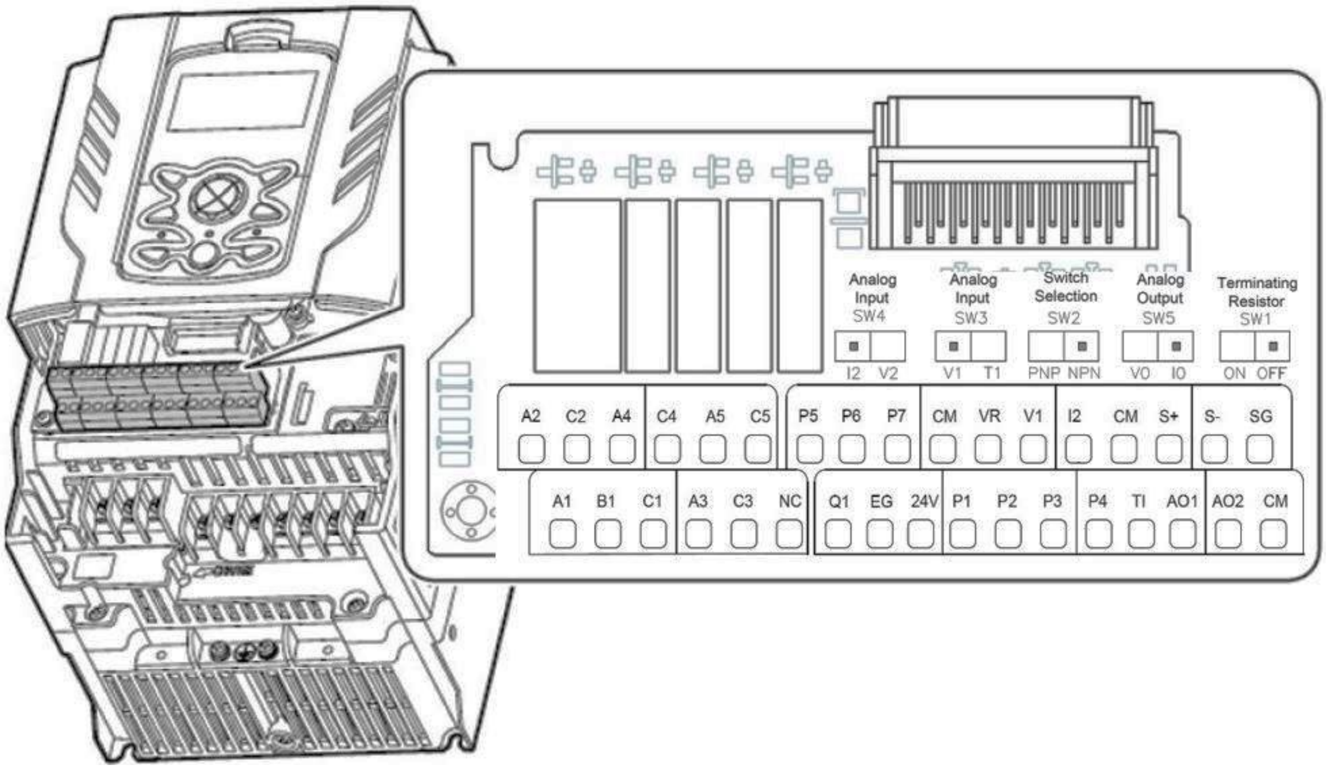


Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC bus terminal	DC voltage terminals.
P3(+) / N(-)	Brake unit (DBU) terminals	Brake unit wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

Step 4 Control Terminal Wiring

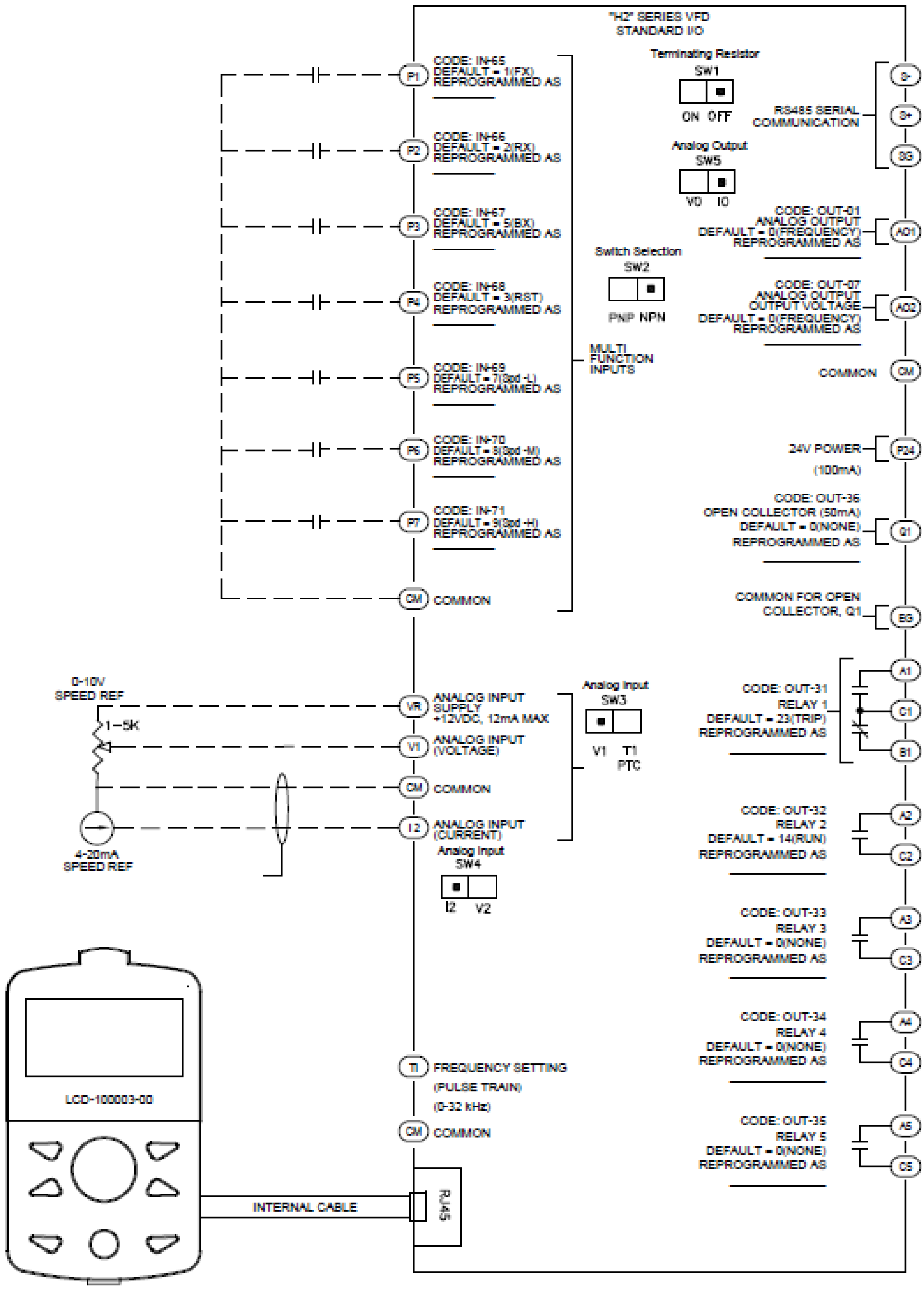
The illustrations below show the layout of control wiring terminals and control board switches located on the I/O TB PCB. Refer to the detailed information provided below and *1.5 Cable Selection on page 14* before installing control terminal wiring.



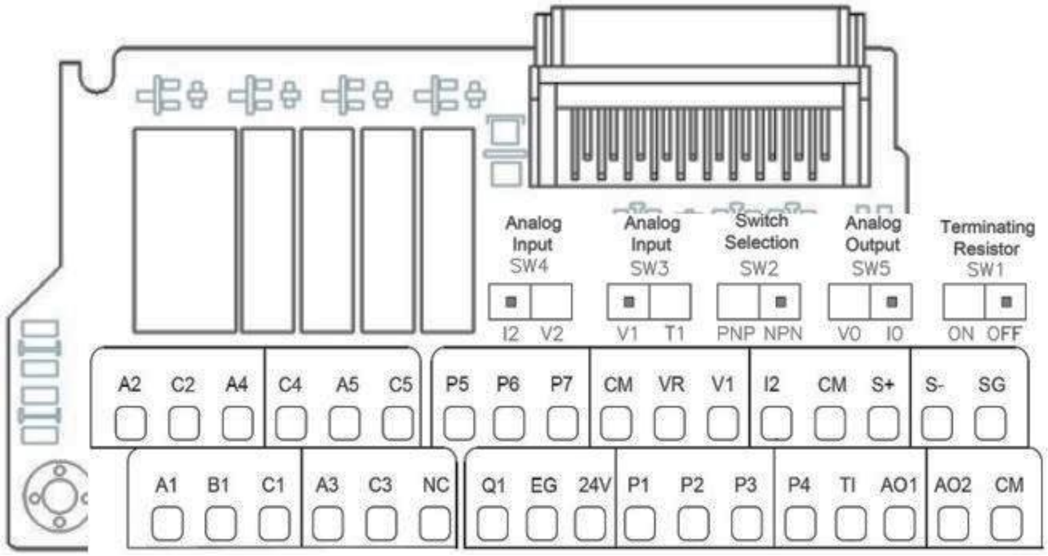
Switch Symbols and Description

Switch	Description	Factory Default
SW1	Terminating Resistor (RS-485) selection switch (Left: On, Right: Off)	Right: OFF
SW2	NPN/PNP mode selection switch (Left: PNP, Right: NPN)	Right: NPN
SW3	Analog Input Terminal V1 - V1/T1 Input mode selection switch (Left: V1, Right: T1, PTC)	Left: V1
SW4	Analog Input Terminal I2 - Current/Voltage input selection switch (Left: I2, Right: V2)	Left: I2
SW5	Analog Output Terminal AO1 - Voltage Output/Current (I) Output selection switch (Left: VO, Right: IO)	Right: IO

Input Output Control Terminal Block Wiring Diagram



Input Output Terminal Block (IO TB PCB)



Input Terminal Labels and Descriptions

Function	Label	Name	Description
Multi-function input terminal configuration	P1~P7	Multi-function Inputs 1-7	Configurable multi-function input terminals. Factory default settings are as follows: P1: Fx P2: Rx P3: BX P4: RST P5: Speed-L P6: Speed-M P7: Speed-H
	CM	Common	Common terminal for multi-function input terminals and analog input/output terminals. All three CM terminals are the same circuit.
Analog input configuration	VR	Potentiometer power supply	10 VDC Voltage Reference Source: Used as the 10 VDC source to power potentiometer. Maximum Voltage Output: 12 V Maximum Current Output: 12 mA Potentiometer: 1 ~ 5k Ω
	V1/(T1)	Voltage input for frequency reference	Switch between Voltage (V1) and PTC (T1) input modes using SW3 on the IO TB board. **V1** - Modify a frequency reference via analog voltage input. Unipolar: 0 ~ 10 V (12 V Max) Bipolar: -10 ~ 10 V (±12 V Max)
		Thermistor (PTC) input for motor temperature monitor and protection	**T1** - Analog input to monitor motor temperature via the motor thermistor (PTC).

Function	Label	Name	Description
Analog input configuration	I2/(V2)	Current/Voltage input for frequency reference input	Switch between current (I2) and voltage (V2) input modes using SW4 on the IO TB board. **I2** - Modify a frequency reference via analog current input. **V2** - Modify a frequency reference via analog voltage input. Input current: 0–20 mA Maximum Input: 24 mA Input resistance 249 Ω
Pulsed Input	TI	Frequency Reference input via Pulse Train	Modify a frequency reference via Pulse Train input from 0 to 32 kHz. Low Level: 0–0.8 V, High Level: 3.5–12 V.

Outputs/Communication Terminal Labels and Descriptions

Function	Label	Name	Description
Analog Outputs	AO1	Voltage/Current Output	Switch between current (IO) and voltage (VO) output modes using SW5 on the IO TB board. **IO** - 4-20mA output representing various inverter information. Set OUT-01 to output frequency, output current, output voltage and others. **VO** - 0-10VDC output. Output Signal Specifications: Output current: 0–20 mA Maximum output current: 24 mA Output voltage: 0–10 V Maximum output voltage/current: 12 V/12 mA Factory default 4-20mA OUT-01: Frequency
	AO2	Voltage Output (only)	0-10VDC output representing various inverter information. Set OUT-07 to output frequency, output current, output voltage and others. Output Signal Specifications: Output voltage: 0–10 V Maximum output voltage/current: 12 V/12 mA Factory default 0-10V OUT-07: Frequency

Function	Label	Name	Description
Relay Outputs	A1/C1/B1	Multi-function output relay (Form C)	Form C, configurable output terminal. Activates based on OUT-31 setting. Normal operation: B1-C1 closed. A1-C1 open Activated condition: A1-C1 closed, B1-C1 open Specifications: N.O.: AC250 V, ≤ 2 A, DC 30 V, ≤ 3 A N.C.: AC250 V, ≤ 1 A, DC 30 V, ≤ 1 A Factory default: OUT-31: Trip
Relay Outputs	A2/C2 A3/C3 A4/C4 A5/C5	Multi-function output relays (Form A)	Form A, configurable output terminals. Activate based on OUT-32 ~ OUT-36 settings. Specifications: AC 250 V, ≤ 5 A, DC 30 V, ≤ 5 A. Factory defaults: OUT-32: Run OUT-33~36: None
Digital Output	Q1/(TO)	Multi-function (Open Collector) / Pulse Output	Open collector, configurable output terminal. Activates based on OUT-36 setting. Use the “24” terminal or external power source. Can provide a pulsed output (Set OUT-36 = TO) configurable to OUT-61 settings. Specifications: DC 26 V, 50 mA or less Pulsed output frequency: 0–32 kHz., 0–12 V
	EG	Common	Ground terminal for Q1 (open collector).
	24	24 VDC power supply	Primary use is for supplying the digital input terminals in PNP mode. May be used for other purposes (EX: 2-wire transducer). Caution on the limited power rating of the “24” terminal. Specifications: 24VDC Maximum output current: 100 mA
RS-485	S+/S-/SG	RS-485 signal line	Send / receive RS-485 signals. Refer to *10, RS-485 Communication Features on page 299* for more details.

Note

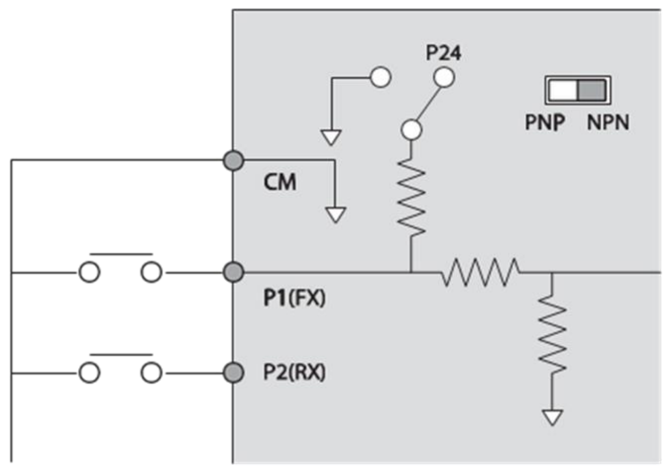
- STP (Shielded Twisted Pair) cable has a highly conductive shielded screen around twisted cable pairs. STP cables protect conductors from electromagnetic interference.
- When making wiring connections at the control terminals ensure that the total cable length does not exceed 165 ft (50 m).
- Ensure that the length of any safety related wiring does not exceed 100 ft (30 m).
- Ensure that the cable length between the keypad and the inverter does not exceed 50 ft (15.24 m). Cable connections longer than 50 ft (15.24 m) may cause signal errors.
- Use a ferrite core to protect signal cables from electro-magnetic interference.

Step 5 PNP/NPN Mode Selection

The H2 inverter supports both PNP (Source) and NPN (Sink) modes for activating the digital inputs at the terminal block. Select an appropriate mode to suit switching requirements using the PNP/NPN selection switch (SW2) on the IO TB board. The following describes each mode along with connection diagrams. Switch position (status) can be viewed at parameter IN-90.

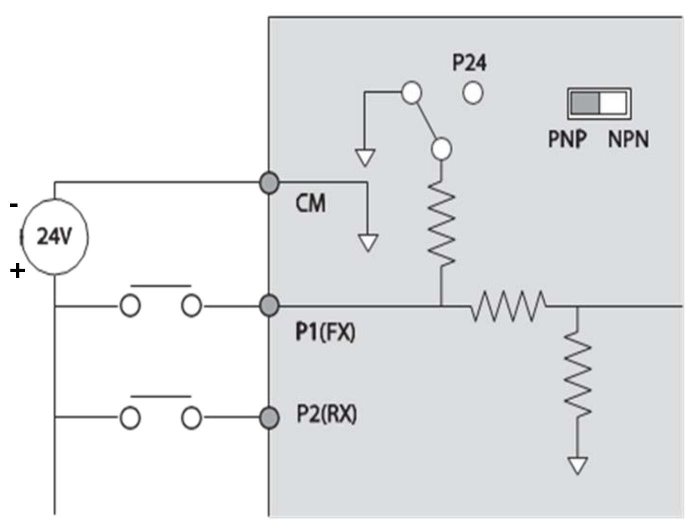
NPN Mode (Sink)

This is the factory default setting of the inverter. With SW2 (on IO TB PCB) in the NPN position, connect an external contact (switch, relay, transistor) between Px and CM. When the external contact closes, the input is activated by connecting the internal 24V source to CM (sink). CM is the common ground terminal for all digital input terminals.



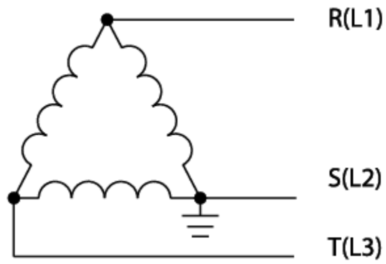
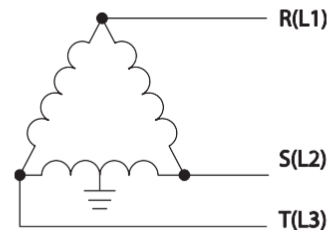
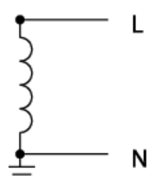
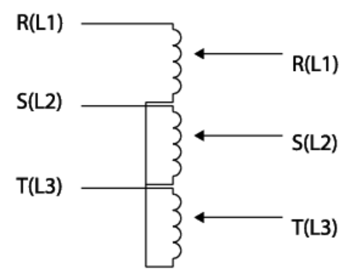
PNP Mode (Source)

With SW2 (on the IO TB PCB) in the PNP position, the input is activated by applying 24V to the digital input. Connect an external contact (switch, relay, transistor) between 24 and Px terminal. When the contact closes, the input is activated by applying 24V to the digital input. The 24V source can be from the inverter's "24" terminal or an external supply. When using an external 24V source, connect the external source (-) to the CM terminal. CM is the common ground terminal for all digital inputs.



Step 6 Disabling the EMC Filter for Power Sources with Asymmetrical Grounding

H2 inverters have built-in EMC filters (exceptions are 240V:50 HP and 60 HP, 480V and 575V:100 HP and 125 HP). An EMC filter prevents electromagnetic interference by reducing radio emissions from the inverter. Using the built in EMC filter is not always recommended as it increases leakage current. Before using the inverter, confirm the power supply's grounding system. **If the inverter is connected to a power source with an asymmetrical grounding connection, the EMC filter must be disconnected.**

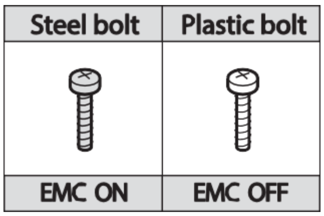
Asymmetrical Grounding Connection			
One phase of a delta connection is grounded (TN Systems)		Intermediate grounding point on one phase of a delta connection (TN Systems)	
The end of a single phase is grounded (TN Systems)		A 3-phase connection without grounding (TN Systems)	

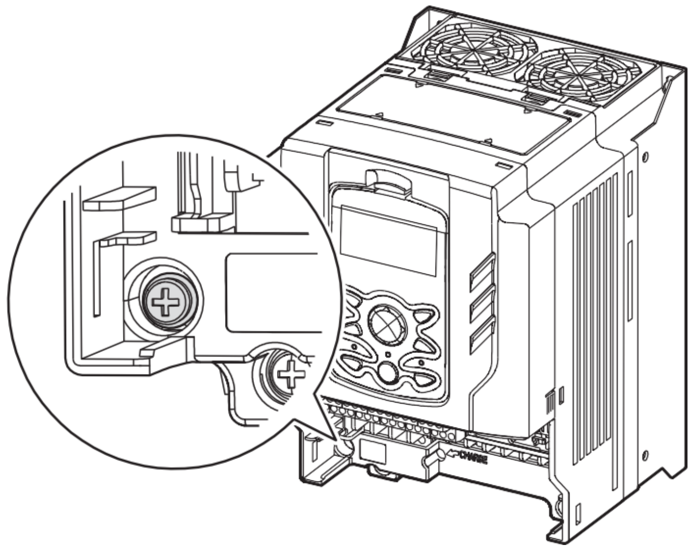
⚠ Danger

- Disconnect the EMC filter if the inverter is connected to a power source with an asymmetrical grounding structure (Examples above). Personal injury or death by electric shock may result.
- Wait at least 10 minutes before opening the covers and exposing the terminal connections. Before starting work on the inverter, test the connections to ensure all DC voltage has been fully discharged. Personal injury or death by electric shock may result.

Disabling the Built-in EMC Filter
240V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)
480V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)
575V: 7.5 HP ~ 40 HP (5.5 kW ~ 30 kW)

Refer to the figures below to locate the EMC filter on/off terminal and replace the metal bolt with the plastic bolt. If the EMC filter is required in the future, reverse the steps, and replace the plastic bolt with the metal bolt to reconnect the EMC filter.

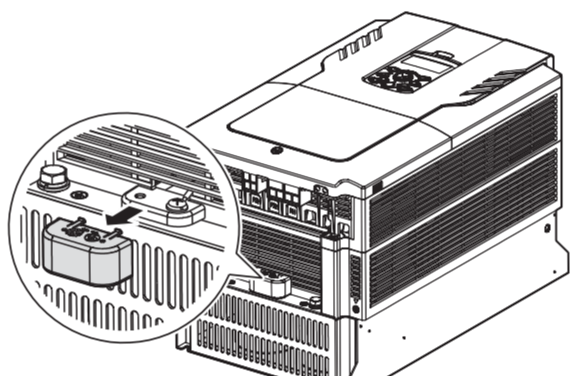




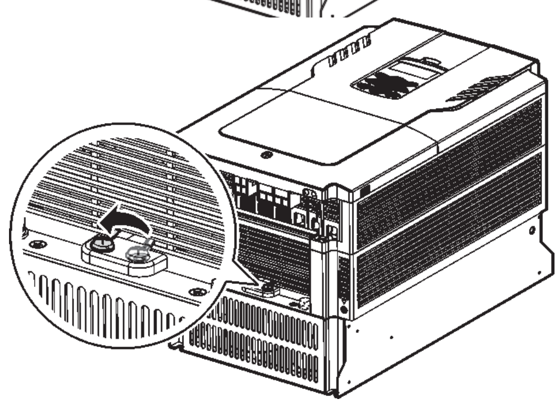
Disabling the Built-in EMC Filter
240V: 30 HP ~ 40 HP (22 kW ~ 30 kW)
480V: 50 HP ~ 75 HP (37 kW ~ 55 kW)
575V: 50 HP ~ 75 HP (37 kW ~ 55 kW)

Remove the EMC ground cover located at the bottom of the inverter.

The terminal on the right is used to ENABLE the EMC filter (factory default). The terminal on the left is used to DISABLE the EMC filter.



Remove the EMC ground cable from the right terminal (EMC filter-ON / factory default) and connect it to the left terminal (EMC filter-OFF).



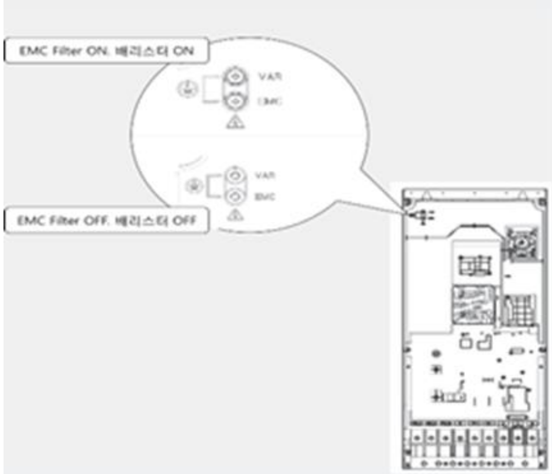
If the EMC filter is required in the future, reverse the steps and connect the EMC ground cable to the right terminal to enable the EMC filter.

Disabling the Built-in EMC Filter
240V: 75 HP ~ 125 HP (55 kW ~ 90 kW)
480V: 150 HP ~ 800 HP (110 kW ~ 500 kW)

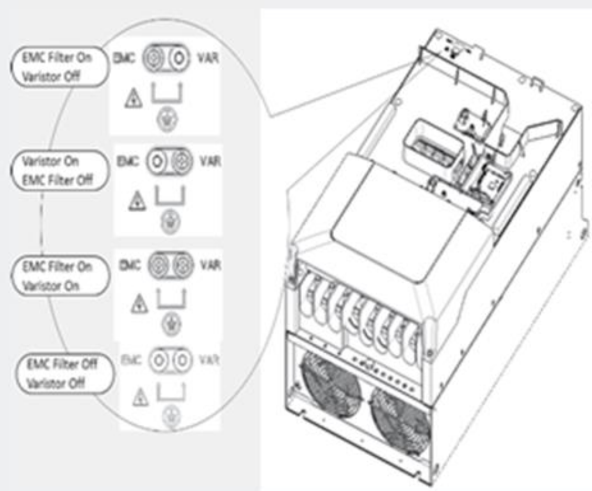
Follow the instructions listed below to disable the EMC filters for the H2 inverters with the above ratings.

Remove the front cover located at the top of the inverter. **NOTE: With 400 HP and larger inverters, the LCD cable is connected to the back of the cover and will need disconnected.**
Remove the EMC ground cable from the right terminal (EMC filter-ON / factory default) and connect it to the left terminal (EMC filter-OFF / for power sources with asymmetrical grounding).

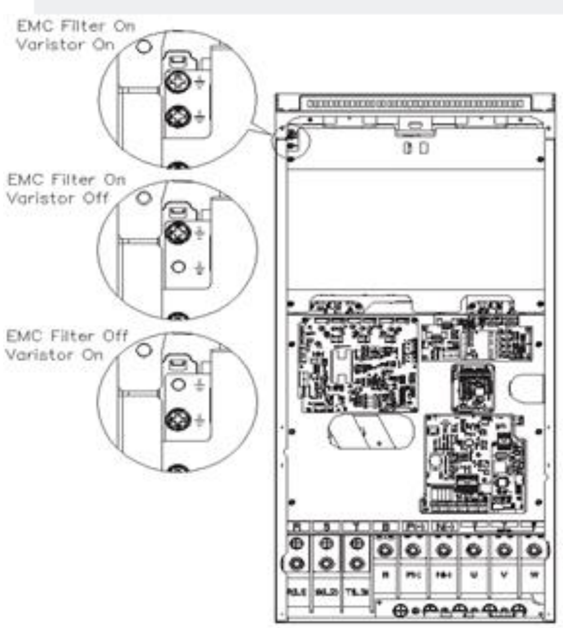
240V: 75 HP ~ 100 HP (55 kW ~ 75 kW)
480V: 150 HP ~ 200 HP (110 kW ~ 132 kW)



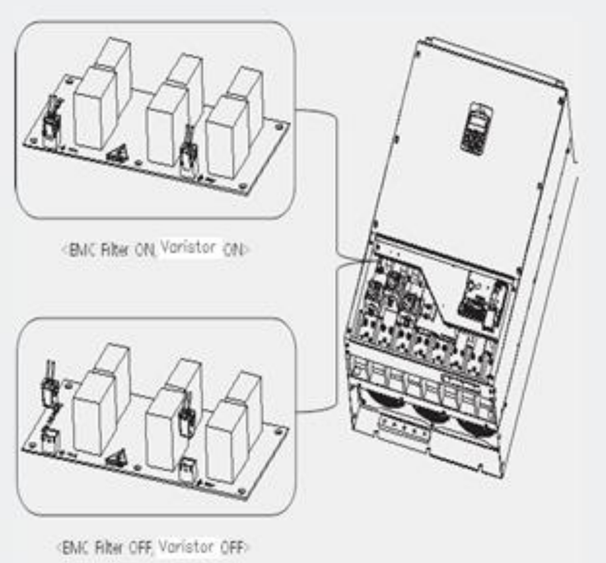
240V: 125 HP (90 kW)
480V: 250 HP ~ 300 HP (160 kW ~ 185 kW)



480V: 400 HP (250 kW)



480V: 500 HP ~ 800 HP (315 kW ~ 500 kW)



Step 7 Re-assembling the Covers and Routing Bracket

Re-assemble the cable routing bracket and the covers after completing the wiring and basic configurations. Note that the assembly procedure may vary according to the product group or frame size of the product.

2.4 Post-Installation Checklist

After completing the installation, check the items in the following table to make sure that the inverter has been safely and correctly installed.

Items	Check Point	Ref.	Result
Installation Location/Power I/O Verification	Is the installation location appropriate?	*p.11*	
	Does the environment meet the inverter's operating conditions?	*p.10*	
	Does the power source match the inverter's rated input?	*p.357*	
	Is the inverter's rated output sufficient to supply the equipment? Degraded performance will result in certain circumstances. Refer to *13.6 Continuous Rated Current Derating on page 379* for details.	*p.379*	
Power Terminal Wiring	Is a circuit breaker installed on the input side of the inverter?	-	
	Is the circuit breaker correctly rated?	-	
	Are the power source cables correctly connected to the R/S/T terminals of the inverter? (Caution: connecting the power source to the U/V/W terminals may damage the inverter.)	*p.27*	
	Are the motor output cables connected in the correct phase rotation (U/V/W)? (Caution: motors will rotate in reverse direction if three phase cables are not wired in the correct rotation.)	*p.27*	
	Are the cables used in the power terminal connections correctly rated?	*p.14*	
	Is the inverter grounded correctly?	*p.27*	
	Are the power terminal screws and the ground terminal screws tightened to their specified torques?	*p.372*	
	Are the overload protection circuits installed correctly on the motors (only if multiple motors are connected to one inverter)?	-	
	Is the inverter separated from the power source by a magnetic contactor (if a braking unit/resistor is in use)?	-	
	Are PFCC's, surge protection and electromagnetic interference filters installed correctly? (These devices MUST NOT be installed on the output side of the inverter.)	*p.27*	
	Check Motor Lead Length 7.5 HP (5.5kW) -> 800 HP (500kW) ----492 ft (150 m)	*p.27*	

Items	Check Point	Ref.	Result
Control Terminal Wiring	Are STP (shielded twisted pair) cables used for control terminal wiring?	-	
	Is the shielding of the STP wiring properly grounded?	-	
	If 3-wire operation is required, are the multi-function input terminals defined prior to the installation of the control wiring connections?	*p.169*	
	Are the control cables properly wired?	*p.27*	
	Are the control terminal screws tightened to their specified torques?	*p.372*	
	Is the total cable length of all control wiring < 165 ft (100 m)?	-	
	Is the total length of safety wiring < 100 ft (30 m)?	-	
Miscellaneous	Are optional cards connected correctly?	-	
	Is there any debris left inside the inverter?	-	
	Are any cables contacting adjacent terminals, creating a potential short circuit risk?	-	
	Are the control terminal connections separated from the power terminal connections?	-	
	Have the capacitors been replaced if they have been in use for > 2 years?	*p.352*	
	Has a fuse been installed for the power source?	-	
	Are the connections to the motor separated from other connections?	-	

Note
STP (Shielded Twisted Pair) cable has a highly conductive shielded screen around twisted cable pairs. STP cables protect conductors from electromagnetic interference.

2.5 Test Run

1. After the post-installation checklist has been completed, follow the instructions below to test the inverter.
2. Turn on the power supply to the inverter. Ensure that the keypad display light is on.
3. Choose to Run Quick Start?
4. Select the command source.
5. Set a frequency reference, and then check the following:
   - If V1 is selected as the frequency reference source, does the reference change according to the input voltage atVR?
   - If V2 is selected as the frequency reference source, is the voltage/current selector switch (SW4) set to 'voltage', and does the reference change according to the input voltage?
   - If I2 is selected as the frequency reference source, is the voltage/current selector switch (SW4) set to 'current', and does the reference change according to the input current?
6. Set the acceleration and decelerationtime.
7. Start the motor and check the following:
   - Ensure that the motor rotates in the correct direction (refer to the note below).
   - Ensure that the motor accelerates and decelerates according to the set times, and that the motor speed reaches the frequency reference.

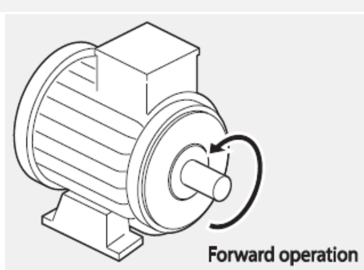
Note
If the forward command (Fx) is on, the motor should rotate counterclockwise when viewed from the load side of the motor. If the motor rotates in the reverse direction, switch the cables at the U and V terminals.

Caution

- Check the parameter settings before running the inverter. Parameter settings may have to be adjusted depending on the load.
- To avoid damaging the inverter, do not supply the inverter with an input voltage that exceeds the rated voltage for the equipment.
- Before running the motor at maximum speed, confirm the motor's rated capacity. As inverters can be used to easily increase motor speed, use caution to ensure that motor

Verifying the Motor Rotation

1 On the keypad, set DRV-07 to '1 (Keypad)'.
2 Set a frequency reference.
3 If the inverter is in OFF mode, press the [AUTO] button twice on the keypad to operate the inverter in the forward (Fx) direction.
4 If the inverter is operating in AUTO mode, press the [AUTO] button once on the keypad to operate the inverter in the forward (Fx) direction.
5 Observe the motor's rotation from the load side and ensure that the motor rotates Counterclockwise.



2.6 Run Quick Start

The inverter LCD boots up to the "Quick Start" menu on power up. The parameters in the below table will be displayed in order to quickly setup the inverter. These include the Control Source, Frequency Reference Source, Motor and Protection parameters. The Quick Start menu contains basic parameter settings for control and protection of a standard induction motor. The default settings are used for a standard induction motor controlled with a linear (fixed) V/Hz. pattern with a base frequency of 60 Hz.

- During programming, use escape (ESC) to exit the Quick Start menu.
- To access the Quick Start menu when already powered up, set DRV.31 (PopUp Q. Start) to "Yes" to return to the Run Quick Start menu.
- The inverter will display the Quick Start menu on every power up. Parameter CNF-61 (Run Quick Start?) is set to "Yes" by default. To disable the Quick Start menu at power up, set CNF-61 to "No".

DRV	31	Quick Start Pop Up menu	PopUp Q. Start	0	No	0 - 1
				1	Yes	
CNF	61	Quick Start menu setting	Run QuickStart?	0	No	0 - 1
				1	Yes	

Quick Start Setting Details

Code	Description
CNF-61 Run QuickStart?	Select "Yes" at the Run QuickStart display. Make selections for each of the parameters in the Quick Start menu. After making all selections, the display will return to the Monitor menu. Make selections of the following parameters on the LCD keypad. To escape from the Quick Start menu, press the [ESC] key. CNF-43 Select Macro AP3-01 Set Date AP3-02 Set Time DRV-06 Cmd Source: Set start command source. DRV-07 Freq Ref Src: Set Frequency Reference. MOT-01 Motor Capacity: Set motor capacity. MOT-03 Pole Number: Set # of motor poles. MOT-05 Rated Curr: Set motor rated current. MOT-06 NoLoad Curr: Set motor no load current MOT-07 Motor Volt: Set motor rated voltage. MOT-10 AC Input Volt: Set source/supply voltage. ADV-09 Run Prevent: Set run prevent direction. PRT-05 Phase Loss Chk: Set phase loss protection. PRT-20 OL Trip Select: Set OL trip response. PRT-21 OL Trip Level: Set OL trip level. PRT-22 OL Trip Time: Set OL trip time. PRT-40 ETH Trip Sel: Set ETH trip response. PRT-41 Motor Cooling: Set motor cooling mode. PRT-42 ETH 1min: Set ETH (thermal) 1 minute trip level. PRT-43 ETH Cont: Set ETH continuous running (service factor) level. If DRV-07, Freq Ref Source is set to Keypad-1, program the reference frequency at the first line of the Monitor menu or at parameter DRV-01, Cmd Frequency. If DRV-06, Cmd Source (Start/Stop) is set to Keypad, the inverter can be started with the AUTO button on the LCD Keypad. **NOTE:** The **HAND** button is used for local (keypad) operation of the inverter. Both start/stop and speed reference are from the Keypad. When the settings are completed, the minimum parameter settings for motor control and protection have been made. The LCD keypad will return to a monitoring display. Now the motor can be operated with the command source set at DRV-06 and the reference frequency set at DRV-07.

3 Performing Basic Operations

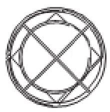
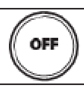
This chapter describes the keypad layout and functions. It also introduces parameter groups/codes and LCD Display Modes required to perform basic operations. The chapter also outlines the correct operation of the inverter before advancing to more complex applications. Examples are provided to demonstrate keypad operation.

3.1 LCD Display/Keypad

The keypad is composed of two main components – the LCD display and the operation buttons. Refer to the following illustration.

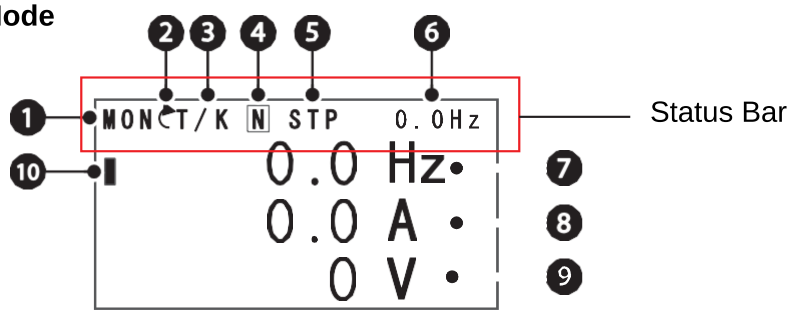
3.1.1 Operation Buttons

The following table lists the names and functions of the keypad’s operation buttons.

Button	Name	Description
	[MODE]	Used to switch between modes (MON, PAR, CNF).
	[PROG / ENT]	Used to select, confirm, and save a parameter value.
	[Up] [Down]	Move between parameters and increase/decrease parameter values when in PROG mode.
	[Left] [Right]	Move between PAR groups and move the cursor when in PROG mode.
	[MULTI]	Can be assigned to perform special functions with parameter CNF-42, such as User Group parameter registration or to display the date and time when pressed.
	[ESC]	Used to cancel an input during parameter setup (PROG mode). Pressing the [ESC] key before pressing [PROG / ENT] reverts back to the previously set parameter value. Pressing the [ESC] key while editing the parameters in any group moves the display to the first parameter of the group. Pressing the [ESC] key while moving through the modes moves the display to the Monitor (MON) mode.
	[HAND]	Used to operate in HAND (local/manual) operation mode.
	[OFF]	Used to switch to OFF (standby) mode (RED LED on) or to reset a fault (RED LED blinking).
	[AUTO]	Used to switch to AUTO (remote) operation mode.

3.1.2 About the Display

3.1.2.1 Monitor Mode

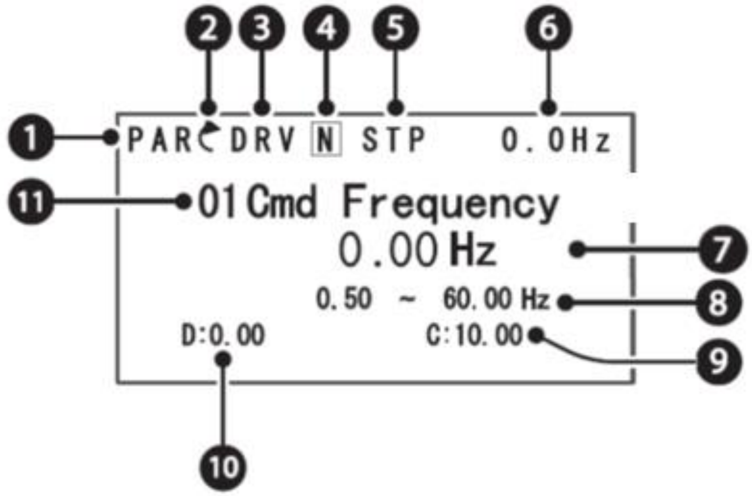


The following table lists display icons and their names/functions.

No.	Name	Description
1	Operation mode	Displays one of the following inverter modes: Use MODE button to move through modes. **MON**: Monitor mode **PAR**: Parameter mode **U&M**: User Group and Macro mode **TRP**: Trip mode **CNF**: Configure mode
2	Rotational direction	Displays the motor's rotational direction: : Forward : Reverse
3	Command Source / Frequency reference (EX: **T / K**)	Displays a combination of a command source and a frequency reference source. **Command source** **K**: Keypad **T**: Terminal block (digital input) **O**: Optional Fieldbus module **A**: Application option **E**: Time event **R**: Built-in RS-485 communication **Frequency reference source** **K**: Keypad **V**: V1 terminal **X**: I2 terminal **P**: Pulse terminal **U**: Up operation frequency (Up-down operation) **D**:Down operation frequency (Up-down operation) **S**: Stop operation frequency (Up-down operation) **O**: Optional Fieldbus module **J**: Jog frequency **R**: Built-in RS-485 communication **1~7:** Multi-step frequency (Fixed Speeds)

No.	Name	Description
4	Multi-function button configuration	The function of the “MULTI” button is selected with parameter CNF-42. It can be used to register or delete parameters in the User group or can also be used for Time/Date display. N = None U = User Group - Used to select parameters to put in User Group (U&M). T = Time - Displays Date, Time and Day of week when pressed.
5	Operating status	Displays one of the following operating states: **STP**: Stop **FWD**: Forward operation **REV**: Reverse operation **DC**: DC output **WAN**: Warning **STL**: Stall **SPS**: Speed search **OSS**: S/W over current protection is on **OSH**: H/W overcurrent protection **TUN**: Auto tuning **PHT**: Pre-heat **FIR**: Fire mode operation **SLP**: Sleep mode operation **LTS**: Load tuning **PCL**: Pump clean
6	Status Bar Display item	Displays data selected with parameter CNF-20 (Anytime Para). Default: Frequency
7	Monitor mode item 1	Displays data selected with parameter CNF-21 (Monitor Line-1). Default: Frequency
8	Monitor mode item 2	Displays data selected with parameter CNF-22 (Monitor Line-2). Default: Output Current
9	Monitor mode item 3	Displays data selected with parameter CNF-23 (Monitor Line-3). Default: Output Voltage
10	Monitor mode cursor	Used to highlight currently selected items.

3.1.2.2 Parameter Program Mode



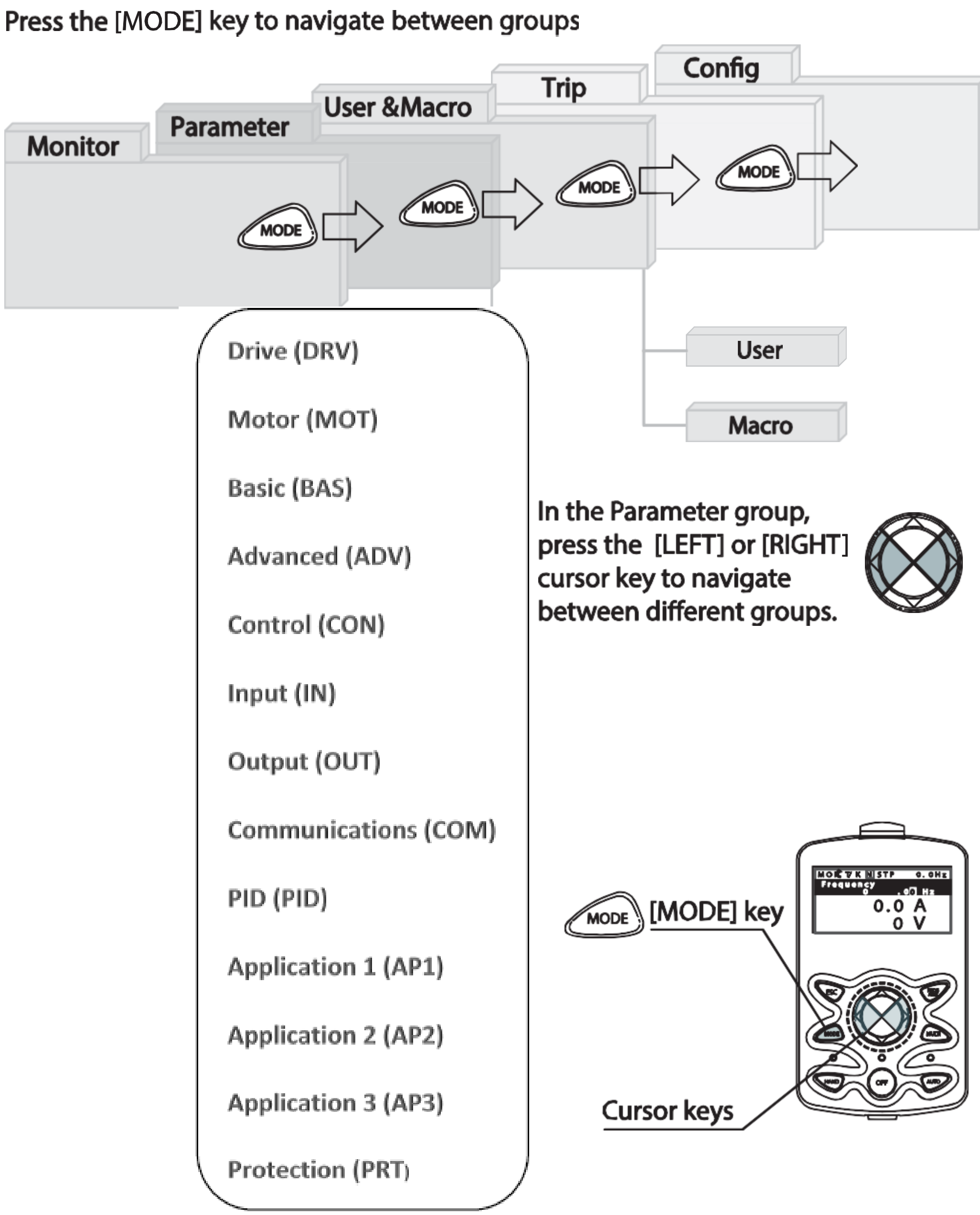
The following table lists display icons and their names/functions.

No.	Name	Description
1	Operation mode	Displays one of the following inverter modes: Use MODE button to move through modes. **MON**: Monitor mode **PAR**: Parameter mode **U&M**: User defined and Macro mode **TRP**: Trip mode **CNF**: Config mode
2	Rotational direction	Displays the motor's rotational direction: ↻: Forward ↺: Reverse
3	Parameter group	Displays one of the following parameter group names: **DRV**: Drive group **MOT**: Motor group **BAS**: Basic group **ADV**: Advanced group **CON**: Control group **IN**: Input group **OUT**: Output group **COM**: Communication group **PID**: PID group **AP1, AP2, AP3**: Application groups **PRT**: Protection function group

No.	Name	Description
4	Multi-function button configuration	The function of the "MULTI" button is selected with parameter CNF-42. It can be used to register or delete parameters in the User group or can also be used for Time/Date display. N = None U = User Group - Used to select parameters to put in User Group (U&M). T = Time - Displays Date, Time and Day of week when pressed.
5	Operating status	Displays one of the following operation states: **STP**: Stop **FWD**: Forward operation **REV**: Reverse operation **DC**: DC output **WAN**: Warning **STL**: Stall **SPS**: Speed search **OSS**: S/W over current protection is on **OSH**: H/W overcurrent protection **TUN**: Auto tuning **PHT**: Pre-heat **FIR**: Fire mode operation **SLP**: Sleep mode operation **LTS**: Load tuning **PCL**: Pump clean
6	Status Bar Display item	Displays data selected with parameter CNF-20 (Anytime Para). Default: Frequency
7	Parameter value	Displays the value of currently selected parameter. Can be changed at this screen (Arrow buttons).
8	Setting range	Displays the range of values for the selected parameter.
9	Set value	Displays the currently set value for the parameter.
10	Default	Displays the factory default value for the parameter.
11	Parameter # and name	Displays the number and name of the currently selected code/number.

3.1.3 LCD Display Modes

The H2 inverter uses 5 modes to monitor or configure various inverter functions. The majority of parameters are in the Parameter Mode (PAR Mode). The inverter boots up in the Monitor Mode (MON). The MON Mode can be configured to display data most important to the user. Refer to table *3.1.3.1* for descriptions of each mode.



3.1.3.1 Table of LCD Display Modes

The following table describes the 5 display modes used to monitor and program the inverter functions. Refer to section *9 LCD Display Modes on page 279* for more detail on the LCD Display Modes.

Mode Name	Keypad Display	Description
Monitor mode	MON	Displays the inverter's operation status information. In this mode, information including the inverter's frequency reference, operation frequency, output current, and voltage may be monitored.
Parameter mode	PAR	Used to configure the parameters and functions required to operate the inverter. The parameters are divided into 14 groups based on purpose and complexity.
User & Macro mode	U&M	This mode will be displayed when a User Group has been created or a macro has been selected. The User-selected parameters allow specific parameters to be grouped and managed in a separate User group. A macro group is a predefined group of parameters related to an application. These modes are not displayed when you navigate through the modes if a User group or Macro group has not been defined or selected.
Trip mode	TRP	Used to monitor the inverter's fault information including the fault history. When a fault occurs during inverter operation, the inverter stores nine (9) pieces of data about the fault. Including operation frequency, output current, output voltage and date/time. This mode is not displayed if the inverter does not have a fault or a fault history.
Config mode	CNF	Used to configure the inverter features that are not directly related to the operation of the inverter. The settings you can configure in the Config mode include Monitor (MON) mode displayed items, parameter initialization, parameter Read/Write and Save, Password setting and inverter Run Time and On Time.

3.1.3.2 Parameter Mode (PAR)

The following table lists the groups of parameters in Parameter (PAR) mode. When in PAR mode, use the right and left arrow buttons to move through the groups of parameters. At the parameter level, you can set parameter values to turn specific functions on or off or decide how the functions will be used. For detailed information on the parameters in each parameter group, refer to section *4.2 Parameter Lists on page 82.*

Function Group Name	Keypad Display	Description
Drive	DRV	Configures basic operation parameters. These include Accel/Decel times, Start/Stop sources, Speed Reference Source, jog operation and torque boost.
Motor	MOT	Configures all Motor parameters along with Sensorless selection and Auto tuning..
Basic	BAS	Configures basic operation parameters. These parameters include 2nd Source selections, V/Hz. pattern, and multi-step frequency parameters.
Advanced	ADV	Configures acceleration or deceleration patterns, start/stop modes, frequency limits, energy saving features and regeneration prevention features.
Control	CON	Configures the features related to carrier frequency, speed search and KEB (kinetic energy buffering).
Input Terminals	IN	Configures input terminal functions including assigning digital and analog inputs, pulsed input.
Output Terminals	OUT	Configures output terminal functions including assigning relay outputs, analog outputs, pulsed output (Q1 terminal).
Communication	COM	Configures the communication related features for RS-485, Modbus-RTU, Metasys N2, and BACnet. Optional communication module related features may be configured as well, if one is installed.
PID process	PID	Configures the PID control-related features.
Application 1	AP1	Configures the Sleep/Wake Up, Boost, and Soft Fill features related to the PID control.
Application 2	AP2	Configures pump related features including load tuning, pump cleaning, Damper control, Oil Pump control and motor Pre-Heat functions.
Application 3	AP3	Configures the Event Timer functions including scheduling for 24/7 operation.
Protection	PRT	Configures motor and inverter protection features.

3.2 Learning to Use the Keypad

The keypad includes HAND, OFF and AUTO buttons that are described further.

3.2.1 HAND - OFF - AUTO Buttons Operation

The inverter is operable only when it is in HAND or AUTO mode. HAND mode is for local control using the keypad, while AUTO mode is primarily for remote control via terminal strip or communications. The inverter stops operating when it is in OFF mode. Select one of the modes (HAND or AUTO) to operate the inverter or OFF to stop the operation.

3.2.1.1 HAND Button

The **HAND** button is used for local (keypad) operation of the drive. Both start/stop and speed reference are from the Keypad. The inverter will ignore all digital inputs except for BX, External Trip, Fire Mode and Fixed Speed inputs (Speed-L, Speed-M and Speed-H).

Caution

- **Pressing the HAND button will start the inverter. The HAND button acts as a start button.**
- The default speed is zero (0) Hz.
- To set speed, at the Monitor display (MON), Frequency is on Line-1. The speed can be changed at this screen using Up, Down, Left and Right arrow buttons only. **The PROG/ENT button is not required.**
- The speed can be changed while running in Hand mode or while stopped (OFF button).
- Hand mode disregards the settings of DRV-06 (Cmd Source) and DRV-07 (Freq Ref Src).
- IN HAND MODE, the frequency (speed) displayed at the Monitor display (MON) is duplicating parameter DRV-25, “HAND Cmd Freq”. The default speed is 0 Hz.

3.2.1.2 AUTO Button

The **AUTO** button on the keypad is primarily used to put the inverter in the ready mode for remote start/stop operation. The AUTO button may be used to start and stop the inverter locally depending on DRV-06 settings described below.

DRV-06 (Cmd Source) default setting is **Fx/Rx-1** for remote start command.
DRV-07 (Freq Ref Src) default setting is **Keypad-1** for changing speed (frequency).

- With these default settings, the AUTO button will not start the inverter.
- The inverter is looking for a remote start command at terminal P1 (IN-65 default is Fx, Forward).
- The AUTO button must be pressed once to put the inverter in the Ready mode (Green LED blinking).
- When the remote start command is made, the inverter will start and the AUTO LED will remain on (solid). This is the normal running mode of the inverter.
- If a remote start command is already made (at P1) during power up, the inverter will not start. The start command has to be deactivated (opened) and re-activated (closed) to start the inverter.
- The speed (frequency) can be set at the Monitor display (MON). Frequency is on Line-1.
- Press the PROG/ENT button.
- Use the Up, Down, Left and Right arrow buttons.
- Press the PROG/ENT button again to save the change.
- Other remote Frequency References (DRV-07) may be used.

Changing DRV-06 (Cmd Source) to Keypad

Caution

The **AUTO** button is now the start and stop command for the inverter.
Pressing the AUTO button once puts the inverter in Ready mode (AUTO LED blinking).
Pressing the AUTO button a second time, will start the inverter.

- From the OFF state, pressing the AUTO button once (Green LED blinking) puts inverter in Ready mode.
- Pressing the AUTO button a second time, starts the inverter.
- Pressing the AUTO button **while running**, stops the inverter.
- Pressing the OFF button also stops the inverter.
- The speed (frequency) is still Keypad-1 and can be set at the Monitor display (MON). Frequency is on Line-1.
  - Pressing the PROG/ENT button
  - Use the Up, Down, Left and Right arrow buttons.
  - Press the PROG/ENT button again to save the change.
  - The inverter will go to the newly programmed speed.
- Other remote Frequency References (DRV-07) may be used.
- In Auto mode, the frequency (speed) displayed at the Monitor display (MON) is duplicating parameter DRV-01 (Cmd Frequency). The default speed is 0 Hz.

Changing DRV-07 (Freq Ref Src)

DRV-07 - Keypad-1 vs Keypad-2

When changing speed (frequency) at the Keypad in AUTO mode, the difference between Keypad-1 and Keyypad-2 settings is:

- Both - Still have to press the PROG/ENT button to change the speed.
- Use the Up, Down, Left and Right arrow buttons to change the speed.
- Keypad-1 - Press the PROG/ENT button again to save the newly set speed. The inverter will go to the newly programmed speed.
- Keypad-2 - The speed is changing while setting the new speed.

DRV-07 - Other Frequency Reference Sources

When setting DRV-07 to the other frequency refernce sources listed below, the inverter simply looks at the designated terminal for the frequency reference signal.
Choices are:

- Analog: V1, V2, I2 and with Ext IO Bd. V3, I3
- Communications: Int 485 (Modbus)
- Field bus: Other Communication Option Cards
- Pulse: High Frequency signal

OFF Button

The **OFF** button puts the inverter in the OFF Mode, Red LED on solid. It will not start until put in HAND mode or AUTO mode with a remote start command. Note: A Fire mode input can be applied and is active in the OFF mode.

3.2.2 Switching Operation Modes (HAND / OFF / AUTO)

The H2 Series inverters have two operating modes–the HAND and AUTO modes. HAND mode is used for local control using the keypad. AUTO mode is used for remote operation using the terminal inputs or network commands.

3.2.2.1 HAND Mode Operation

Follow the instructions listed below to operate the inverter in HAND mode.

> ⓘ Caution
> - Pressing the HAND button starts the inverter.

- Press the [HAND] button. The inverter starts operating in HAND mode. The display is now in the Monitor mode. The HAND LED turns on.
- At the Monitor menu (Line 1 of the MON display) set the running frequency using the [Up], [Down], [Left], and [Right] buttons.
- Press the [OFF] button. The OFF LED turns on and the inverter stops operating.

3.2.2.2 AUTO Mode Operation

Follow the instructions listed below to operate the inverter in AUTO mode.

- Press the [AUTO] button to switch to AUTO mode. AUTO LED is blinking.
- Operate the inverter based on the settings of DRV-06, Cmd Source and DRV-07, Freq Ref Src. The MON display will show these in the upper left corner (EX: T/V).
- Press the [OFF] button. The OFF LED turns on and the inverter stops operating.

> ⓘ Caution
> - In AUTO mode, if DRV-06. Cmd Source is set as ‘keypad’, the Auto button will start the inverter. If DRV-07, Freq Ref Src is set to Keypad (-1 or -2), the inverter will go to the speed set in DRV-01, Cmd Frequency.

3.2.2.3 Mode Buttons and LED Status

Buttons / LED	Description
	Used to enter the HAND operating mode and start the inverter.
	Used to enter the OFF mode (standby mode) or to reset faults.
	Used to enter the AUTO operating mode or to start and stop inverter operation in AUTO mode.
HAND LED	Turns on green (steady) during HAND mode operation.
OFF LED	Turns on red (steady) while the inverter is in OFF mode (standby) and flashes when a fault occurs. When the OFF LED is flashing, a fault is present. Press the OFF button. The LED turns on red (steady) when the fault is reset.
AUTO LED	Turns on green (flashing) when the inverter is in AUTO (Ready) mode but is not operating. Turns on (steady) when the inverter operates (runs) in Auto mode.

3.2.2.4 Basic HAND / OFF / AUTO Mode Operations

<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>HAND Mode (Locally controlled operation mode)</td><td>In HAND mode, Start/Stop operation is available only by the keypad HAND and OFF buttons. The frequency reference is set at the Monitor mode, Line-1 and is displayed at all times. The same frequency reference is also reflected in parameter DRV-25, HAND Cmd Freq.

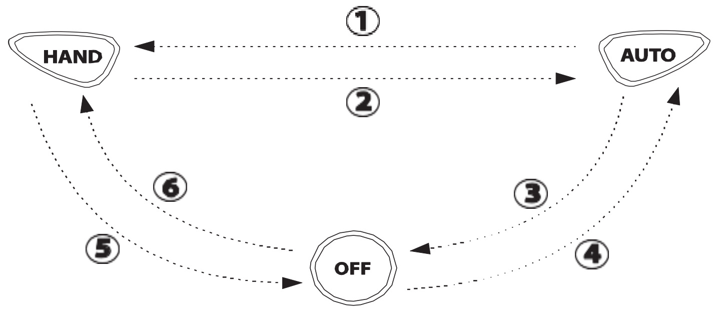
Also, in HAND mode:
The first monitoring item is used to adjust the frequency with the up/down and left/right buttons.
The motor’s rotation direction can be set at DRV-02 (Keypad Run Dir).
Terminal block functions do not operate (with the exception of BX, External Trip, Fire Mode and Fixed Speed inputs (Speed-L, Speed-M and Speed-H).
Fire mode commands take the highest priority (if any are given).
The following advanced features are not available:
- PID
- Flow compensation
- Pump clean
- Load tuning
- Motor preheating
- Time scheduling
- PowerOn resume
- Multiple motor control
Inverter monitoring and protection features are available in HAND mode.</td></tr>
<tr><td>OFF Mode (Standby)</td><td>In OFF mode, the inverter operation stops. Pressing the OFF button during HAND/AUTO mode operations will cause the OFF LED to turn on. The inverter stops operating and stops according to the deceleration options set at ADV-08, Stop Mode.

Also, in OFF mode:
Terminal block functions do not operate (with the exception of BX, External Trip, Fire Mode and Fixed Speed inputs (Speed-L, Speed-M and Speed-H).
Fire mode commands take the highest priority (if any are given).</td></tr>
<tr><td>AUTO Mode (Remotely controlled operation mode)</td><td>In AUTO mode, the inverter operates based on the command from the command source set at DRV-06 (Cmd Source) and the frequency reference from the source set at DRV-07 (Freq Ref Src).
If the frequency reference is set to Keypad, program the speed at the Monitor display (MON), Frequency is on Line-1. Alternately, set the speed at DRV-01, Cmd Frequency.</td></tr>
</table>

3.2.2.5 Parameters related to HAND/OFF/AUTO Operation Modes

<table>
<tr><th>Codes / Functions</th><th>Description</th></tr>
<tr><td>DRV-01
Cmd Frequency</td><td>Frequency reference in AUTO mode when DRV-07 is set to’ KeyPad’.</td></tr>
<tr><td>DRV-02
KeyPad Run Dir</td><td>Rotation direction of the keypad start/run command in the HAND or AUTO mode.
<table>
<tr><th colspan="2">Settings</th></tr>
<tr><td>0</td><td>Forward</td></tr>
<tr><td>1</td><td>Reverse</td></tr>
</table></td></tr>
<tr><td>DRV-05
KPD H.O.A Lock</td><td>To make HAND-OFF-AUTO buttons enabled/disabled.
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>Locked</td><td>HAND-OFF-AUTO buttons are disabled. If pressed, Message displayed as:
KPD H.O.A Lock
All other keypad buttons remain functional for programming and viewing. When Locked, the AUTO button flashes indicating the inverter is in ready mode waiting for a start command from the DRV-06 setting.</td></tr>
<tr><td>1</td><td>During Run</td><td>If DRV-06, Cmd Source is Fx/Rx-1, Fx/Rx-2, Int485 or fieldbus, HAND-OFF-AUTO buttons are disabled during running.</td></tr>
<tr><td>3</td><td>Unlocked</td><td>HAND-OFF-AUTO buttons are enabled all the time.</td></tr>
</table></td></tr>
<tr><td>DRV-25
HAND Cmd Freq</td><td>Frequency displayed at the monitor display item (Monitor Line-1) when the HAND button is pressed in other modes (default frequency reference for HAND mode).</td></tr>
<tr><td>DRV-26
HAND Ref Mode</td><td>
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>Hand Parameter</td><td>The inverter operates based on the rotation direction set at DRV-02 (Keypad Run Dir) and the frequency reference set at DRV-25 (HAND Cmd Freq).</td></tr>
<tr><td>1</td><td>Follow Auto</td><td>The inverter takes over the rotation direction and the frequency reference from the settings for AUTO mode and keeps performing the same operation. If the inverter was stopped in AUTO mode, the operation direction is set as Fx and the frequency reference is set as 0 (no inverter output).</td></tr>
</table></td></tr>
<tr><td>OUT-31–36
Relay 1–5, Q1</td><td>Set AUTO State (36) to ensure that the inverter is in AUTO mode.</td></tr>
<tr><td>OUT-31–36
Relay 1–5, Q1</td><td>Set HAND State (37) to ensure that the inverter is in HAND mode.</td></tr>
</table>

3.2.2.6 Switching between the HAND/OFF/AUTO Modes



<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>①AUTO➔HAND</td><td>Press the HAND button in AUTO mode to switch to HAND mode. The inverter operates as follows based on the setting at DRV-26 (Hand Ref Mode).
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>Hand Parameter</td><td>The inverter operates based on the rotation direction set at DRV-02 (Kepad Run Dir) and the frequency reference set at DRV-25 (HAND Cmd Freq).</td></tr>
<tr><td>1</td><td>Follow Auto</td><td>The inverter takes over the rotation direction and the frequency reference from the settings for AUTO mode and keeps performing the same operation. If the inverter was stopped in AUTO mode, the operation direction is set as Fx and the frequency reference is set as 0 (no inverter output).</td></tr>
</table></td></tr>
<tr><td>②HAND➔AUTO</td><td>Press the AUTO button in HAND mode to switch to AUTO mode. The inverter operates based on the command source and frequency reference settings set at DRV-06 and DRV-07. If DRV-06 (Cmd Source) is set to ‘keypad’ press the AUTO button once again to start inverter operation.</td></tr>
<tr><td>③AUTO➔OFF</td><td>Press the OFF button in AUTO mode to stop the inverter operation (the inverter enters OFF mode).</td></tr>
<tr><td>④ OFF➔AUTO</td><td>Press the AUTO button in OFF mode to switch to AUTO mode. The inverter operates based on the command source and frequency reference settings set at DRV-06 and DRV-07. If DRV-06 (Cmd Source) is set to ‘keypad’ press the AUTO button once again to start inverter operation.</td></tr>
<tr><td>⑤ HAND➔OFF</td><td>Press the OFF button in HAND mode to stop the inverter operation (the inverter enters OFF mode).</td></tr>
<tr><td>⑥ OFF➔HAND</td><td>Press the HAND button in OFF mode to switch to HAND mode. The inverter operates (Starts) based on the operation direction set at DRV-02 (Keypad Run Dir) and the frequency reference set at DRV-25 (HAND Cmd Freq).</td></tr>
</table>

Operation Mode at Power Recovery

If a power interruption occurs during inverter operation in the OFF or HAND mode, the inverter stops the operation with low voltage fault. When the power is recovered, the inverter powers up in the OFF mode.
If the inverter was operating in AUTO mode at the time of the power interruption, the inverter powers up in AUTO mode and the operation may vary depending on the inverter's 'Power-on Run' and 'PowerOn Resume' settings. Refer to *5.4.5 ADV-10 Power-on Run on page 144.*

Note

- To operate the inverter using the keypad in AUTO mode, set DRV-06 (CMD Source) to 'KeyPad' and press the AUTO button to enter AUTO mode (LED blinking). Then, press the AUTO button on the keypad once again to start the inverter operation.
- If a fault occurs during an operation in the AUTO or HAND mode, the inverter can be reset by pressing the OFF button (flashing during fault). After the reset and the fault is cleared, the inverter enters OFF mode.
- If a fault occurs during an operation in the AUTO mode, the inverter can be reset using the reset signal from the digital input terminal. In this case, the inverter returns to the AUTO mode after the fault is reset.

Caution

Use caution when the inverter is set to operate in AUTO mode by commands over communication. If COM-96 (PowerOn Resume) is set to 'yes', the motor will begin rotating when the inverter starts up, without additional run commands.

3.2.3 Moving among LCD Display Modes

Pressing the **MODE button** will move through the various LCD display modes.

MON T/K U STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •Press the **MODE button** once to move to the parameter (PAR) mode.
PAR DRV U STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Parameter (PAR) mode is displayed. •Press the **MODE button** once again to move to the User & Macro (U&M) mode.
U&M USR U STP 0.0Hz 00 Jump Code 1 CODE 01 Acc Time 20.0 sec 02 Cmd Source Fx-Rx-1	•The User & Macro (U&M) mode is displayed showing the USR group of parameters. **Note:** If a User or Macro has not been selected, the menu will skip the U&M Mode. •Press the **MODE button** once again.
TRP Last-1 00 Trip Name Fuse Open 01 Output Freq 29.00 Hz 02 Output Current 74.6 A	•The Trip (TRP) mode is displayed showing the most recent fault. **Note:** If the inverter does not have any fault history, the menu will skip the TRP Mode. •Press the **MODE button** once again.
CNF U STP 0.0Hz 00 Jump Code 42 CODE 01 Language Sel English 02 LCD Contrast	•The Configure (CNF) mode is displayed. This is the last mode. •Press the **MODE button** once again.
MON T/K U STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	After the last mode (CNF), the menu returns to the first mode. The Monitor (MON) mode is displayed.

3.2.4 Switching Parameter Groups in Parameter Mode (PAR)

After entering Parameter mode from Monitor mode, press the **Right arrow button** to move to the next parameter group. Press the **Left arrow button** to go back to the previous group.

MON K/K N STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •Press the **MODE button** once to move to the parameter (PAR) mode.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Parameter (PAR) mode is displayed. •The Drive (DRV) group of parameters is the first parameter group to be displayed. •Press the **right arrow button**.
PAR MOT N STP 0.0Hz 00 Jump Code 10 CODE 01 Motor Capacity 7.5 HP 02 Base Freq 60.00 Hz	•The Motor (MOT) group of parameters is the second parameter group to be displayed. •Press the **right arrow button**.
PAR BAS N STP 0.0Hz 00 Jump Code 20 CODE 01 Cmd 2nd Src Fx/Rx-1 02 Freq 2nd Src Keypad-1	•The Basic (BAS) group of parameters is the third parameter group to be displayed. •Press the **right arrow button 10 times to move through the remaining parameter groups**. **ADV -> CON -> IN -> OUT -> COM -> PID -> AP1 -> AP2 -> AP3 -> PRT**
PAR PRT N STP 0.0Hz 00 Jump Code 40 CODE 01 Backspin Time 0.0 sec 04 Load Duty Normal Duty	•The Protection (PRT) group of parameters is the last parameter group to be displayed. •Press the **right arrow button**.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	After the last group (PRT), the menu returns to the first group, the Drive (DRV) group of parameters is displayed.

3.2.5 Viewing and Changing Parameter Values and Settings

3.2.5.1 Changing Parameters with Numerical Values

The following example shows how to view and change Accel Time (DRV-03).

MON K/K N STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •Press the **MODE button** once to move to the parameter (PAR) mode.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Parameter (PAR) mode is displayed. •The Drive (DRV) group of parameters is the first parameter group to be displayed. •Press the **down arrow button** 3 times to get to parameter DRV-03.
PAR DRV N STP 0.0Hz 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward 03 Acc Time 20.0 sec	•With parameter DRV-03 highlighted, press the **PROG/ENT button**.
PAR DRV N STP 0.0Hz 03 Acc Time 20.0 sec 0.0 ~ 600.0 sec D:20.0 C:20.0	•The cursor is highlighting the tenths digit.
PAR DRV N STP 0.0Hz 03 Acc Time 20.0 sec 0.0 ~ 600.0 sec D:20.0 C:20.0	Using **left arrow button**, move the cursor to the tens digit with the "2" highlighted.
PAR DRV N STP 0.0Hz 03 Acc Time 10.0 sec 0.0 ~ 600.0 sec D:20.0 C:20.0	Press the **down arrow button** once, changing the "2" to a "1".
PAR DRV N STP 0.0Hz 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward 03 Acc Time 10.0 sec	Press the **PROG/ENT button**, the Accel Time has been changed to 10.0 seconds.

3.2.5.2 Changing Parameters with Lists

The following example shows how to view and change the command source (DRV-06).

MON K/K N STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •Press the **MODE button** once to move to the parameter (PAR) mode.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Parameter (PAR) mode is displayed. •The Drive (DRV) group of parameters is the first parameter group to be displayed. •Press the **down arrow button 6** times to get to parameter DRV-06.
PAR DRV N STP 0.0Hz 04 Decel Time 30.0 sec 05 KPD H.O.A Lock During Run 06 Cmd Source Fx-Rx-1	•With parameter DRV-06 highlighted, press the **PROG/ENT button**.
PAR DRV N STP 0.0Hz 06 Cmd Source 0 Keypad 1 Fx/Rx-1 DC 2 Fx/Rx-2	•A list of settings for parameter DRV-06 appears (0, 1, 2) showing the default and the current setting (DC).
PAR DRV N STP 0.0Hz 06 Cmd Source 0 Keypad 1 Fx/Rx-1 2 Fx/Rx-2	Using the **up arrow button**, move the cursor to highlight the (0) Keypad selection.
PAR DRV N STP 0.0Hz 04 Decel Time 30.0 sec 05 KPD H.O.A Lock During Run 06 Cmd Source Keypad	Press the **PROG/ENT button**, the Command Source parameter, DRV-06 has been changed to Keypad.

3.2.6 Navigating Parameters using "Jump Codes"

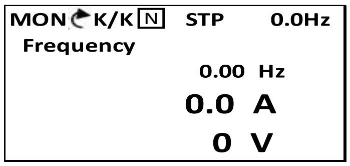
The Jump Code feature allows moving directly to a specific parameter. The Jump Code is the first code/number of each mode. The Jump Code feature is convenient when navigating for a specific code/number in a function group that has many parameters.

The following example shows how to navigate directly to parameter DRV- 16 from the initial parameter (DRV-00, Jump Code) in the Drive group.

MON K/K N STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •Press the **MODE button** once to move to the parameter (PAR) mode.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Parameter (PAR) mode is displayed. •The Drive (DRV) group of parameters is the first parameter group to be displayed. •At parameter DRV-00, Jump Code press the **PROG/ENT button**.
PAR DRV N STP 0.0Hz 00 Jump Code 9 CODE 1 ~ 99 Code D:9 C:9	•The parameter code "9" is highlighted.
PAR DRV N STP 0.0Hz 00 Jump Code 16 CODE 1 ~ 99 Code D:9 C:9	•Using the **up arrow button**, scroll up to 16. Press the **PROG/ENT button**.
PAR DRV N STP 0.0Hz 16 Fwd Boost 2.0 % 17 Rev Boost 2.0 % 19 Start Freq 0.50 Hz	The menu "Jumps" to parameter DRV-16. It can be changed here using the **PROG/ENT button**.
PAR DRV N STP 0.0Hz 00 Jump Code 16 CODE 01 Cmd Frequency 0.00 Hz 02 Keypad Run Dir Forward	Pressing the **ESC button** returns menu to DRV-00.

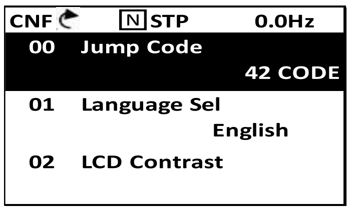
3.2.7 Setting the Monitor Mode Display Line Items

In Monitor (MON) mode, 3 different line items are displayed. The items displayed on the LCD can be changed by the user. In HAND mode and in OFF mode, the first line item is permanently fixed as the frequency reference.
The following example shows how to configure the Line-3 to display Output Power (kW).

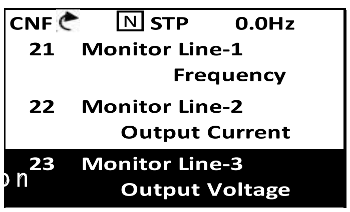


On power up, the LCD boots up in the monitor (MON) mode.

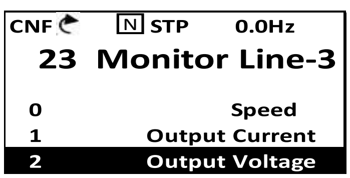
•The default settings of the monitored items are Line-1: Output Frequency, Line-2: Output Amps and Linie-3: Output Voltage.



Press the **MODE button** to move to the Configure (CNF) mode.

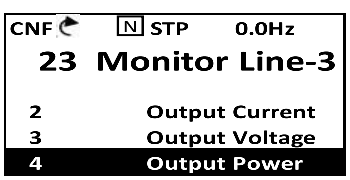


•Press the **down arrow button** to get to parammeters CNF-21, CNF-22 and CNF-23. Press the **PROG/ENT button** on CNF-23

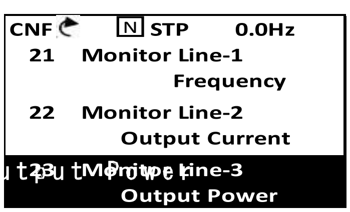


•Highlights the present setting of CNF-23.

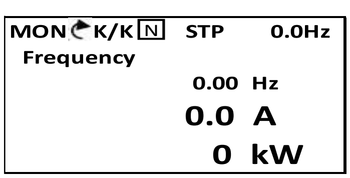
To see the available display items for Line-3, use the **up/down arrow buttons**.



At "4 Output Power", press the **PROG/ENT button** to select Output Power as Line-3.



Display returns to the CNF parameter list.



Press the **MODE button** to return to the monitor (MON) mode.

3.2.8 Selecting the Status Bar Display Item

At the top-right corner of the LCD display's status bar is another frequency item. This item refers to the frequency reference when the inverter stopped and the output frequency when the inverter is operating. In HAND or OFF modes, this monitoring item always displays frequency reference. This monitoring item can be changed to show the type of information that suits your needs. If changed, the new item will show when in AUTO mode.
The following example shows how to change this monitoring item to Output Amps.

MON K/K N STP 0.0Hz Frequency 0.00 Hz 0.0 A 0 V	On power up, the LCD boots up in the monitor (MON) mode. •In the status bar, at the top-right corner of the display is the frequency reference/output frequency (default). This displayed setting can be changed with parameter CNF-20.
CNF N STP 0.0Hz 00 Jump Code 42 CODE 01 Language Sel English 02 LCD Contrast	Press the **MODE button** to move to the Configure (CNF) mode.
CNF N STP 0.0Hz 20 AnyTime Para Frequency 21 Monitor Line-1 Frequency 22 Monitor Line-2 Output Current	•Press the **down arrow button** to get to parameter CNF-20, AnyTime Parameter.
CNF N STP 0.0Hz 20 AnyTime Para 0 Frequency DC 1 Speed 2 Output Current	•Press the **PROG/ENT button**. The default and current (present) setting is Frequency DC. Use the **up/down arrow** buttons.to see the available display items for CNF-20.
CNF N STP 0.0Hz 20 AnyTime Para 0 Frequency DC 1 Speed 2 Output Current	At "2" Output Current, press the **PROG/ENT button** to select Output Current as the displayed item for CNF-20.
CNF N STP 0.0Hz 20 AnyTime Para Output Current 21 Monitor Line-1 Frequency 22 Monitor Line-2 Output Current	Display returns to the CNF parameter list.
MON K/K N STP 0.0A Frequency 0.00 Hz 0.0 A 0 kW	Press the **MODE button** to return to the monitor (MON) mode.

3.3 Fault Monitoring

3.3.1 Monitoring Faults during Inverter Operation

The following example shows how to view fault information that occurred during inverter operation.

TRP Current **Over Voltage (01)** **01 Output Frequency** **36.00 Hz** **02 Output Current** **77.3 A**	When a fault occurs, the inverter enters the trip (TRP) mode and displays the active fault (flashing).
TRP Current **03 Inverter State** **Steady** **04 DCLink Voltage** **820 V** **05 Temperature** **22 °C**	Press the **down arrow button** to view additional information at the time of the fault.
MON T/K N STP 0.0A **Frequency** **0.00 Hz** **0.0 A** **0 kW**	•When the fault is cleared and the inverter is reset, the display returns to the previous screen, prior to the fault.

3.3.2 Monitoring Multiple Faults

The following example shows how to monitor multiple faults that occur at the same time.

Display	Description
TRP Current **Over Voltage (02)** 01 Output Frequency 36.00 Hz 02 Output Current 77.3 A	When more than one fault occurs at the same time, the number of faults is displayed to the right of the present fault. Press the **PROG/ENT button** to display all faults.
TRP Current Over Voltage (02) 01 Over Voltage **02 External Trip**	Press the **down arrow button** to view all faults. Press the **PROG/ENT button** to display information about the highlighted fault.

3.3.3 Viewing Fault History

The fault history information can be viewed in the trip (TRP) mode. The inverter stores five (5) of the most recent faults.

Display	Description
TRP Last-1 **00 Trip Name (1)** **Over Voltage** 01 Output Frequency 36.00 Hz 02 Output Current 77.3 A	•Press the **MODE button** to move to the trip (TRP) mode**.** The most recent fault (Last-1) is displayed. Use the **down arrow button** to view this fault information.
TRP Last-2 **00 Trip Name (2)** **External Trip** 01 Output Frequency 57.00 Hz 02 Output Current 96.7 A	Press the **right arrow button** to move to the next fault (Last-2) in the fault history.

3.4 Parameter Initialization

The following example demonstrates how to reset all the parameter settings back to the factory default settings. Parameter initialization may be performed on individual parameter groups as well.
NOTE: The MOT Group is not initialized.

CNF N STP 0.0Hz 00 Jump Code 42 CODE 01 Language Sel English 02 LCD Contrast	Press the **MODE button** to move to the Configure (CNF) mode.
CNF N STP 0.0Hz 40 Parameter Init ------------- No ------------ 41 Changed Para View All 42 Multi-Key Sel None	•Press the **down arrow button** to get to parammeter CNF-40. Press the **PROG/ENT button** at CNF-40.
CNF N STP 0.0Hz 40 Parameter Init 0 ------------ No ---------- DC 1 All Grp 2 DRV Grp	•Displays the list of options. Press the **down arrow button** to highlight "1 All Grp". Press the **PROG/ENT button** to initialize All Groups.
CNF N STP 0.0Hz 40 Parameter Init ------------- No ------------ 41 Changed Para View All 42 Multi-Key Sel None	The display will return to parameter CNF-40 after parameter initialization.

4 Parameter Lists and Quick Reference

4.1 Quick Reference Table

Refer to the below table for a list of functions and a link to the parameter description pages.

Groups	Description	Ref.
DRV Group	Move to DRV Group	p.101
MOT Group	Move to MOT Group	p.122
BAS Group	Move to BAS Group	p.127
ADV Group	Move to ADV Group	p.138
CON Group	Move to CON Group	p.154
IN Group	Move to IN Group	p.161
OUT Group	Move to OUT Group	p.179
COM Group	Move to COM Group	p.299
PID Group	Move to PID Group	p.220
AP1 Group	Move to AP1 Group	p.233
AP2 Group	Move to AP2 Group	p.256
AP3 Group	Move to AP3 Group	p.269
PRT Group	Move to PRT Group	p.191
CNF Mode	Move to CNF Mode	p.279
Quick Start menu	Quick Set Up of basic parameters.	p.52
Basic Tasks	**Description**	**Ref.**
HAND / OFF / AUTO buttons	Select the operation mode.	p.62
Acc/Dec times	Set acceleration and deceleration times.	p.102
Start Stop control sources	Set Start Stop sources.	p.104
Frequency Reference sources (Keypad, Analog Inputs)	Configure Frequency Reference sources.	p.107
Digital Inputs	Configure Digital Input Terminals	p.163
Set Digital Input to NC	Configure a Normally Closed Digital input	p.177
Analog Outputs	Configure Analog Output Terminals	p.179
Relay Outputs	Configure Digital Output Relays	p.183
Set Relay Output to NC	Configure a Normally Closed Relay Output	p.189
Motor Data	Set Motor Parameters	p.122
PID Control	Set PID Control settings	p.220
Control Mode (V/Hz., Slip Comp)	Set Motor control settings	p.117
Set Volts/Hz. pattern	Configure Linear, Squared, User V/Hz. Curve	p.131
Control Mode (SVC)	Set Sensorless Vector Control settings	p.239
Auto Tuning	Run Motor Auto Tuning	p.124
Start Modes	Set Accel or DC Injection Starting	p.140
Dual Ramps	Set a Switch Frequency for Dual Ramps	p.135
Stop Modes	Set Coast, Decel, Braking Stop Methods	p.141
Jogging	Set Jog speed and jog accel/decel times.	p.165
Torque Boost	Set boost levels. Set manual or automatic boost.	p.118
Frequency Limits	Set Frequency Limits on inverter output.	p.147
Speed Search	Start into a spinning load.	p.156
Regen Avoidance	Handle energy in operating in Regen Mode.	p.153

4.2 Parameter Lists

Press the MODE button on the Keypad to move to the PAR Mode (upper left corner of LCD). Press the right and left arrow buttons to move through the parameter groups.

The following tables list the parameter groups and all the parameters within each group. Set the parameters according to your operating requirements.

Parameters shaded in gray will be displayed when a related parameter has been selected. The column labeled **"Property"** shows whether the parameter can be changed while the inverter is running according to the following:

O: Write enabled during run, **Δ:** Write Disabled during run**, X** : Read/View only.

Additionally, an **"I"** or a **"P"** (or both) in the Property column relate to parameter DRV-09, Control Mode settings for Sensorless Vector Control and indicate which Sensorless Control Mode they apply to according to the following: **I:** Induction Motor, **P:** Permanent Magnet Motor.

4.2.1 Drive Group (DRV)

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
00	Jump Code	Jump Code	1–99		9		O	p.74
01	Target frequency	Cmd Frequency	0.00, Low Freq– High Freq		0.00		O	p.67
02	Keypad run direction	Keypad Run Dir	0	Reverse	1	Forward	O	p.67
			1	Forward				
03	Acceleration time	Acc Time	0.0–600.0 (sec)		20.0	240V: 7.5~60HP	O	p.102
						480V,575V: 7.5~125HP		
					60.0	240V: 75~125HP		
						480V: 150~400HP		
					100.0	480V: 500~800HP		
04	Deceleration time	Dec Time	0.0–600.0 (sec)		30.0	240V: 7.5~60HP	O	p.102
						480V,575V: 7.5~125HP		
					90.0	240V: 75~125HP		
						480V: 150~400HP		
					150.0	480V: 500~800HP		
05	HAND-OFF- AUTO Key Lock	KPD H.O.A Lock	0	Locked	1	During Run	Δ	p.67
			1	During Run				
			2	Unlocked				
06	Command source	Cmd Source	0	Keypad	1	Fx/Rx-1	Δ	p.104
			1	Fx/Rx-1				p.105
			2	Fx/Rx-2				p.105
			3	Int 485				p.116
			4	Field Bus				
			5	Time Event				p.176
07	Frequency reference source	Freq Ref Src	0	Keypad-1	0	Keypad-1	Δ	p.107
			1	Keypad-2				
			2	V1				
			4	V2				
			5	I2				
			6	Int 485				
			7	FieldBus				
			9	Pulse				
			10[1]	V3				
			11[1]	I3				
09	Control mode	Control Mode	0	V/F	0	V/F	Δ	p.131
			1	Slip Compen				p.117
			3	IM Sensorless				p.239
			4	PM Sensorless[2]				p.246

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
11	Jog frequency	Jog Frequency	0.00, Low Freq–High Freq		10.00		O	p.165
12	Jog acceleration time	Jog Acc Time	0.0–600.0 (sec)		20.0		O	
13	Jog deceleration time	Jog Dec Time	0.0–600.0 (sec)		30.0		O	
15	Torque boost options	Torque Boost	0	Manual	0	Manual	Δ	p.117
			1	Auto 1				
			2	Auto 2				
16[3]	Forward Torque boost	Fwd Boost	0.0–15.0 (%)		2.0	240V, 480V 7.5~125HP	Δ	p.117
					1.2	575V 7.5~150HP		
					1.0	480V 150~800HP		
17	Reverse Torque boost	Rev Boost	0.0–15.0 (%)		2.0	240V, 480V 7.5~125HP	Δ	p.117
					1.2	575V 7.5~150HP		
					1.0	480V 150~800HP		
19	Start frequency	Start Freq	0.01–10.00 (Hz)		0.50		Δ	p.120
20	Maximum frequency	Max Freq	40.00-400.00 (Hz) 240V, 480V		60.00		Δ	p.120
			40.00-120.00 (Hz) 575V					
			40.00-120.00 (Hz) IM Sensorless[2]					p.120
			40.00-180.00 (Hz) PM Sensorless[2]					p.120
21	Select speed unit	Hz/Rpm Sel	0	Hz Display	0	Hz Display	O	p.120
			1	RPM Display				
22[4]	Auto torque boost filter gain	ATB Filt Gain	1 – 9999 (msec)		10		O	p.117
23	Auto torque boost voltage	ATB Volt Gain	0.0-300.0%		100.0		O	p.117
25	Hand mode operation frequency	HAND Cmd Freq	0.00, Low Freq- High Freq		0.00		O	p.64
26	Hand mode operation Frequency reference source	HAND Ref Mode	0	HAND Parameter	0	HAND Parameter	Δ	p.64
			1	Follow AUTO				
30	kW/HP unit selection	kW/HP Unit Sel	0	kW	1	HP	O	p.120
			1	HP				
31	Quick Start	PopUp Q.Start	0	No	0	No	X	p.52
			1	Yes				
95	Inverter Temperature	Temperature	XXX °C				X	-
96	Inverter Software Version	Inv S/W Ver			201.00		X	-
97	Inverter Software Version	Inv Debug Ver			0.02			
98	I/O Software Version	I/O S/W Ver 1			201.00			
99	I/O Software Version	I/O S/W Ver 2			0.00			

[1] '10(V3) and 11(I3)' of DRV-07 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.
[2] IM Sensorless: Does not apply to 230V, 30~125 HP inverters.
PM Sensorless: Does not apply to 230V, 30~125 HP, 460V, 150~800 HP and all 575V Inverters.
[3] DRV-16,17 are displayed when DRV-15 is set to '0 (Manual)'.
[4] DRV-22, 23 are displayed when DRV-15 is set to 'Auto-2'.

4.2.2 Motor Group (MOT)

Code	Name	LCD Display	Setting Range	Initial value	Property*	Ref.
00	Jump Code	Jump Code	1–99	10	O	p.74
01	Motor capacity	Motor Capacity	0: 0.3HP (0.2 kW) 1: 0.5HP (0.4 kW) 2: 1.0HP (0.75 kW) 3: 1.5HP (1.1 kW) 4: 2.0HP (1.5 kW) 5: 3.0HP (2.2 kW) 6: 4.0HP (3.0 kW) 7: 5.0HP (3.7 kW) 8: 5.5HP (4.0 kW) 9: 7.5HP (5.5 kW) 10: 10.0HP (7.5 kW) 11: 15.0HP (11.0 kW) 12: 20.0HP (15.0 kW) 13: 25.0HP (18.5 kW) 14: 30.0HP22.0 kW () 15: 40.0HP (30.0 kW) 16: 50.0HP (37.0 kW) 17: 60.0HP (45.0 kW) 18: 75.0HP (55.0 kW) 19: 100.0HP (75.0kW) 20: 125.0HP (90.0kW) [1] 21: 150.0HP (110.0kW) 22: 200.0HP (132.0kW) 23: 250.0HP (160.0kW) 24: 300.0HP (185.0kW) 26: 400.0HP (250.0kW) 27: 500.0HP (315.0kW) 29: 650.0HP (400.0kW) 30: 800.0HP (500.0kW)	Dependent on motor setting	Δ	p.122
02	Base frequency	Base Freq	30.00–400.00 (Hz) 40.00-120.00(Hz) IM S/L 30.00–180.00 (Hz) PM S/L[2]	60.00	Δ	p.122
03	Number of motor poles	Pole Number	2-48	Dependent on motor capacity setting, MOT-01	Δ	p.122
04	Rated slip speed	Rated Slip	0-3000 (RPM)		Δ	
05	Motor rated current	Rated Curr	0.0-1000.0 (A)		Δ	
06	Motor no- load current	Noload Curr	0.0-1000.0 (A)		Δ	
07	Motor rated voltage	Motor Volt	0, 170-480 (V), 525-600 (V)	230V/460V/575V	Δ	
08	Motor efficiency	Efficiency	70-100 (%)	Dependent on MOT-01	Δ	
09	Trim power display	Trim Power %	70-130 (%)	100	O	p.122
10	Input power voltage	AC Input Volt	170~264V (7.5HP~125HP) 320~528V (7.5HP~125HP) 320~550V (150HP~800HP) 446-660V (7.5HP~125HP)	240 V 480 V 600 V	O	p.123
11	Auto Tuning	Auto Tuning	0: None 1: All (Rotation type) 2: All (Stdstl) Static type 3: Rs+ Lsigma (Rotation type) 4: Tr (Stdstl) Static type[2] 5: DeadT-volt 6: All (PM)[2]	0 None	Δ	p.124
12	Stator resistance	Rs	0.000-9.999 (Ω)	Dependent on motor setting MOT-01	I	p.124
13	Leakage inductance	Lsigma	0.00-99.99 (mH)		I	
14[3]	Stator inductance	Ls	0.00-999.9 (mH)		I	
15	Rotor Time Constant	Tr	25-5000 (ms)		I	
16[4]	PM Stator resistance	Rs (PM)	0.000-9.999 (Ω)	Dependent on motor setting	P	p.124
17	D-axis inductance	Ld (PM)	0.000~1000.0 (mH)	0	P	
18	Q-axis inductance	Lq (PM)	0.000~1000.0 (mH)	0	P	
19	Flux reference	PM Flux Ref	0.000~1.000 (Wb)	0.147	P	
20	Q-axis inductance scale	Lq(PM) Scale	50~150%	100	P	
21	PM auto tuning level	Ld,Lq Tune Lev	20.0~50.0%	33.3	P	
22	PM auto tuning frequency	Ld,Lq Tune Hz	80.0~150.0%	150.0/100.0	P	

[1] Maximum setting of (20) 125 HP when DRV-09 is set to (4) PM Sensorless
[2] IM Sensorless: Does not apply to 230V, 30~125 HP inverters.
PM Sensorless: Does not apply to 230V, 30~125 HP, 460V, 150~800 HP and all 575V Inverters.
[3] MOT-14 and MOT-15 displayed when DRV-09 is set to '3' IM Sensorless.
[4] MOT-16 ~ MOT-22 displayed when DRV-09 is set to '4' PM Sensorless.

4.2.3 Basic Group (BAS)

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
00	Jump Code	Jump Code	1-99		20		O	p.74
01	Second command source	Cmd 2nd Src	0	Keypad	1	Fx/Rx-1	Δ	p.127
			1	Fx/Rx-1				
			2	Fx/Rx-2				
			3	Int 485				
			4	FieldBus				
			5	Time Event				p.176
02	Second frequency source	Freq 2nd Src	0	Keypad-1	0	Keypad-1	O	p.127
			1	Keypad-2				
			2	V1				
			4	V2				
			5	I2				
			6	Int 485				
			7	FieldBus				
			9	Pulse				
			10[1]	V3				
			11	I3				
03	Auxiliary reference source	Aux Ref Src	0	None	0	None	Δ	p.128
			1	V1				
			3	V2				
			4	I2				
			6	Pulse				
			7	Int 485				
			8	FieldBus				
			10[2]	V3				
			11	I3				
04[3]	Auxiliary command calculation type	Aux Calc Type	0	M + (G * A)	0	M+(G*A)	Δ	p.128
			1	M * (G * A)				
			2	M / (G * A)				
			3	M + (M * (G * A))				
			4	M + G * 2 * (A- 50)				
			5	M * (G * 2 * (A- 50))				
			6	M / (G * 2 * (A- 50))				
			7	M + M * G * 2 * (A-50)				
05	Auxiliary command gain	Aux Ref Gain	-200.0-200.0 (%)		100.0		O	p.128
07	V/F pattern options	V/F Pattern	0	Linear	0	Linear	Δ	p.131
			1	Square				p.132
			2	User V/F				p.133
			3	Square 2				p.133
08	Acc/Dec standard frequency	Ramp T Mode	0	Max Freq	0	Max Freq	Δ	p.102
			1	Delta Freq				
09	Time scale settings	Time Scale	0	0.01 sec	1	0.1 sec	Δ	p.102
			1	0.1 sec				
			2	1 sec				
10	Input power frequency	60/50 Hz Src	0	60 Hz	0	60 Hz	Δ	p.123
			1	50 Hz				
41[4]	User frequency 1	User Freq 1	0.00-Maximum frequency (Hz)		15.00		Δ	p.133
42	User voltage1	User Volt 1	0–100 (%)		25		Δ	
43	User frequency 2	User Freq 2	0.00-Maximum frequency (Hz)		30.00		Δ	
44	User voltage2	User Volt 2	0-100 (%)		50		Δ	
45	User frequency 3	User Freq 3	0.00-Maximum frequency (Hz)		45.00		Δ	
46	User voltage3	User Volt 3	0-100 (%)		75		Δ	
47	User frequency 4	User Freq 4	0.00-Maximum frequency (Hz)		60.00		Δ	
48	User voltage4	User Volt 4	0-100 (%)		100		Δ	
50[5]	Multi-step speed frequency 1	Step Freq-1	Low Freq- High Freq		10.00		O	p.134
51	Multi-step speed frequency 2	Step Freq-2	Low Freq- High Freq		20.00		O	
52	Multi-step speed frequency 3	Step Freq-3	Low Freq- High Freq		30.00		O	
53	Multi-step speed frequency 4	Step Freq-4	Low Freq- High Freq		40.00		O	
54	Multi-step speed frequency 5	Step Freq-5	Low Freq- High Freq		50.00		O	
55	Multi-step speed frequency 6	Step Freq-6	Low Freq- High Freq		60.00		O	
56	Multi-step speed frequency 7	Step Freq-7	Low Freq-High Freq		60.00		O	

Code	Name	LCD Display	Setting Range	Initial value	Property*	Ref.
69	Acc/Dec time transition frequency	Xcel Change Fr	0.00-Maximum frequency (Hz)	0.00	Δ	p.135
70	Multi-step acceleration time1	Acc Time-1	0.0-600.0 (sec)	20.0	O	p.136
71	Multi-step deceleration time1	Dec Time-1	0.0-600.0 (sec)	20.0	O	
72[6]	Multi-step acceleration time2	Acc Time-2	0.0-600.0 (sec)	30.0	O	
73	Multi-step deceleration time2	Dec Time-2	0.0-600.0 (sec)	30.0	O	
74	Multi-step acceleration time3	Acc Time-3	0.0-600.0 (sec)	40.0	O	
75	Multi-step deceleration time3	Dec Time-3	0.0-600.0 (sec)	40.0	O	
76	Multi-step acceleration time4	Acc Time- 4	0.0-600.0 (sec)	50.0	O	
77	Multi-step deceleration time4	Dec Time-4	0.0-600.0 (sec)	50.0	O	
78	Multi-step acceleration time5	Acc Time- 5	0.0-600.0 (sec)	40.0	O	
79	Multi-step deceleration time5	Dec Time-5	0.0-600.0 (sec)	40.0	O	
80	Multi-step acceleration time6	Acc Time- 6	0.0-600.0 (sec)	30.0	O	
81	Multi-step deceleration time6	Dec Time-6	0.0-600.0 (sec)	30.0	O	
82	Multi-step acceleration time7	Acc Time- 7	0.0-600.0 (sec)	20.0	O	
83	Multi-step deceleration time7	Dec Time-7	0.0-600.0 (sec)	20.0	O	
94[7]	Initial pole position estimation type	Init Angle Sel	0 None 1 Angle Detect 2 Alignment	1 Angle Detect	P	p.251
95	Initial pole position estimateion retry	PD Repeat Num	0~10	2	P	p.251
96	Initial pole position estimation interval	Pulse Interval	1~100msec	20msec		p.251
97	Initial pole position estimation pulse current (%)	Pulse Curr %	10~100%	25%		p.251
98	Initial pole position estimation pulse voltage (%)	Pulse Volt %	100~4000	500	P	p.251

[1] ‘10(V3) and 11(I3)’ of BAS-02 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.

[2] ‘12(V3) and 13(I3)’ of BAS-03 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.

[3] BAS-04–05 are displayed when BAS-03 is not ‘0 (None)’.

[4] BAS-41–48 are displayed when BAS-07 or M2-25 is set to ‘2 (User V/F)’.

[5] BAS-50–56 are displayed when IN-65-71 is set to ‘Speed-L/M/H’.

[6] BAS-72–83 are displayed when IN-65–71 is set to ‘Xcel-L/M/H’

[7] BAS-94-98 are displayed when DRV-09 is set to '4' (PM Sensorless)

4.2.4 Advanced Group (ADV)

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
00	Jump Code	Jump Code	1-99				O	p.74
01	Acceleration pattern	Acc Pattern	0	Linear	0	Linear	Δ	p.138
			1	S-curve				
02	Deceleration pattern	Dec Pattern	0	Linear	0	Linear	Δ	
			1	S-curve				
03[1]	S-curve acceleration start point gradient	Acc S Start	1–100 (%)		40		Δ	p.138
04	S-curve acceleration end point gradient	Acc S End	1–100 (%)		40		Δ	
05[2]	S-curve deceleration start point gradient	Dec S Start	1–100 (%)		40		Δ	
06	S-curve deceleration end point gradient	Dec S End	1–100 (%)		40		Δ	
07	Start Mode	Start Mode	0	Acc	0	Acc	Δ	p.140
			1	DC-Start				
08	Stop Mode	Stop Mode	0	Dec	0	Dec	Δ	p.141
			1	DC-Brake				
			2	Free-Run				
			4	Power Braking				
09	Selection of rotation prevention	Run Prevent	0	None	0	None	Δ	p.143
			1	Forward Prev				
			2	Reverse Prev				
10	Starting with power on	Power- on Run	0	No	0	No	O	p.144
			1	Yes				
11[3]	Power-on run delay time	Power- On Delay	0.0 -6000.0 (sec)		0.0		O	p.108
12[4]	DC braking time at startup	DC-Start Time	0.00-60.00 (sec)		0.00		Δ	p.140
13	Amount of applied DC	DC Inj Level	0–200 (%)		50		Δ	
14[5]	Output blocking time before DC braking	DC-Block Time	0.00- 60.00 (sec)		0.00	240V:7.5~60HP	Δ	p.141
						480V,575V: 7.5~125HP		
					2.00	240V:75~125HP		
						480V:150~800HP		
15	DC braking time	DC-Brake Time	0.00- 60.00 (sec)		1.00		Δ	
16	DC braking rate	DC-Brake Level	0–200 (%)		50		Δ	
17	DC braking frequency	DC-Brake Freq	Startfrequency- 60 Hz		5.00		Δ	
20	Dwell frequency on acceleration	Acc Dwell Freq	Start frequency- Maximum frequency (Hz)		5.00		Δ	p.146
21	Dwell operation time on acceleration	Acc Dwell Time	0.0-60.0 (sec)		0.0		Δ	
22	Dwell frequency on deceleration	Dec Dwell Freq	Start frequency- Maximum frequency (Hz)		5.00		Δ	
23	Dwell operation time on deceleration	Dec Dwell Time	0.0-60.0 (sec)		0.0		Δ	
24	Frequency limit	Freq Limit	0	No	0	No	Δ	p.120
			1	Yes				
25[6]	Frequency lower limit value	Freq Limit Lo	0.00-Upper limit frequency (Hz)		0.50		Δ	p.120
26	Frequency upper limit value	Freq Limit Hi	Lower limit frequency- Maximum frequency (Hz)		Max freq		Δ	
27	Frequency jump	Jump Freq	0	No	0	No	Δ	p.148
			1	Yes				
28[7]	Jump frequency lower limit1	Jump Lo 1	0.00-Jump frequency upper limit1 (Hz)		10.00		O	p.148
29	Jump frequency upper limit1	Jump Hi 1	Jump frequency lower limit1- Maximum frequency (Hz)		15.00		O	
30	Jump frequency lower limit2	Jump Lo 2	0.00-Jump frequency upper limit2 (Hz)		20.00		O	
31	Jump frequency upper limit2	Jump Hi 2	Jump frequency lower limit2- Maximum frequency (Hz)		25.00		O	
32	Jump frequency lower limit3	Jump Lo 3	0.00-Jump frequency upper limit3 (Hz)		30.00		O	

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
33	Jump frequency upper limit3	Jump Hi 3	Jump frequency lower limit3- Maximum frequency (Hz)		35.00		O	
41[8]	Brake Open Current	BR Rls Curr	0.0 - 180.0%		50.00			p.147
42	Brake Open Delay Time	BR Rls Dly	0.0 - 10.0 (sec)		1.00			
44	Brake Open Forward Frequency	BR Rls Fwd Fr	0 - Maximum Frequency		1.00			
45	Brake Open Reverse Frequency	BR Rls Rev Fr	0 - Maximum Frequency		1.00			p.147
46	Brake Close Delay Time	BR Eng Dly	0.0 - 10.0 (sec)		1.00			
47	Brake Close Frequency	BR Eng Fr	0 - Maximum Frequency		2.00			
50	Energy saving operation	E-Save Mode	0	None	0	None	Δ	p.151
			1	Manual				
			2	Auto				
51[9]	Energy saving level	Energy Save	0–30 (%)		0		O	p.151
52	Energy saving point search time	E-Save Det T	0.0-100.0 (sec)		20.0		Δ	
64	Cooling fan control	Fan Control	0	During Run	0	During Run	O	p.152
			1	Always ON				
			2	Temp Control				
74	Selection of regeneration evasion function for press	RegenAvd Sel	0	No	0	No	Δ	p.153
			1	Yes				
75	Voltage level of regeneration evasion motion for press	RegenAvd Level	240V: 300-400 V		350		Δ	
			480V: 600-800 V		700			
			575V: 800-980V		870			
76[10]	Compensation frequency limit of regeneration evasion for press	CompFreq Limit	0.00-60.00 Hz		1.00		Δ	p.153
77	Regeneration evasion for press, P- Gain	RegenAvd Pgain	240V, 480V	0.0-100.0%	50.0		O	
			575V	0.0-200.0%	100.0			
78	Regeneration evasion for press, I gain	RegenAvd Igain	20–30000 (msec)		500		O	

[1] ADV-03–04 are displayed when ADV-01 is set to ‘1 (S-curve)’.

[2] ADV-05–06 are displayed when ADV-02 is set to ‘1 (S-curve)’.

[3] ADV-11 is displayed when ADV-10 is set to ‘1 (Yes)’.

[4] ADV-12 and 13 are displayed when ADV-07 is set to ‘1 (DC-Start)'.

[5] ADV-14 - 17 are displayed when ADV-08 is set to ‘1 (DC-Brake)’.

[6] ADV-25 and 26 are displayed when ADV-24 is set to '1' (Yes)

[7] ADV-28–33 are displayed when ADV-27 is set to ‘1 (Yes)’.

[8] ADV-41 - 47 are displayed if either OUT-31 ~ 36 are set to 42 (BR Control).

[9] ADV-51 is displayed when ADV-50 is set to ‘1 (Manual)’. ADV-52 is displayed when ADV-50 is set to ‘2 (Auto)’.

[10] ADV-76–78 are displayed when ADV-74 is set to ‘1 (Yes)’.

4.2.5 Control Group (CON)

Code	Name	LCD Display	Setting Range		Initial value		Prop *	Ref.
00	Jump Code	Jump Code	1-99		4		O	p.74
04	Carrier frequency	Carrier Freq	1.0~15.0 (kHz)	240V: 7.5~25HP	3.0		O	p.154
				480V: 7.5~40HP				
				575V: 7.5~30HP	2.3			
			1.0~10.0 (kHz)	240V: 30~40HP	3.0			
				480V: 50~75HP				
				575V: 40~75HP	2.3			
			1.0~7.0 (kHz)	240V: 50-60HP	3.0			
				480V: 100~125HP				
				575V: 100~125HP	2.3			
			1.0~5.0 (kHz)	240V: 75~125HP	2.0			
				480V: 150~500HP				
			1.0~4.0 (kHz)	480V: 650~800HP	1.5			
05	Switching mode	PWM Mode	0	Normal PWM	0	Normal PWM	Δ	p.154
			1	Low leakage PWM				
9[1]	Initial Excitation Time	PreExTime	0.00 - 60.00 (sec)		1.00		I	p.239
11[1]	Continued Operation Duration	Hold Time	0.00 - 60.00 (sec)		0.00		IP	p.246
13	Anti-hunting regulator mode	AHR Sel	0	No	1	Yes	Δ	p.155
			1	Yes				
14	Anti-hunting regulator P- Gain	AHR P-Gain	0-32767		1000		O	
15	Anti-hunting regulator start frequency	AHR Low Freq	0.00-AHR High Freq		0.50		O	
16	Anti-hunting regulator end frequency	AHR High Freq	AHR Low Freq-400.00		400.00		O	
17	Anti-hunting regulator compensation voltage limit rate	AHR limit	0-20		2		O	
24[3]	SL Speed Controller P Gain1	ASR-SL P Gain1	0 - 5000 %		Depends on Motor Capacity		I	p.239
25	SL Speed Controller I Gain1	ASR-SL I Gain1	10 - 9999 (ms)				I	
26	SL Speed Controller P Gain2	ASR-SL P Gain2	1 - 1000 %				I	
27	SL Speed Controller I Gain2	ASR-SL I Gain2	1 - 1000 %				I	
28	SL Speed Controller I Gain0	ASR-SL I Gain0	1 - 1000 %				I	
29	Flux Estimator P Gain	Flux P Gain	10 - 200 %				I	
30	Flux Estimator I Gain	Flux I Gain	10 - 200 %				I	
31	Speed Estimator P Gain 1	S-Est P Gain 1	0 - 32767				I	
32	Speed Estimator I Gain 1	S-Est I Gain 1	100 - 1000				I	
33	Speed Estimator I Gain 2	S-Est I Gain 2	100 - 10000				I	
34[5]	PM speed controller P gain 1	ASR P Gain 1	0~5000		100		P	p.246
35	PM speed controller I gain 1	ASR I Gain 1	0~5000		150		P	
36	PM speed controller P gain 2	ASR P Gain 2	0~5000		100		P	
37	PM speed controller I gain 2	ASR I Gain 2	0~9999		150		P	
38	Speed estimator feedforward high speed range (%)	PM Flux FF %	0~1000%		300%		P	p.246
39	PM speed estimator proportional gain 0	PM SpdEst Kp 0	0~200%		30%		P	
40	PM speed estimator integral gain 0	PM SpdEst Ki 0	0~200%		30%		P	
41	PM speed estimator proportional gain 1	PM SpdEst Kp 1	0~300%		70%		P	
42	PM speed estimator integral gain 1	PM SpdEst Ki 1	0~300%		70%		P	
43	PM speed estimator proportional gain 2	PM SpdEst Kp 2	0~300%		100%		P	

Code	Name	LCD Display	Setting Range	Initial value	Prop *	Ref.
44	PM speed estimator integral gain 2	PM SpdEst Ki 2	0~300%	100%	P	
45	PM D-axis back-EMF estimated gain (%)	PM EdGain Perc	0~300%	100%	P	
46	PM Q-axis back-EMF estimated gain (%)	PM EqGain Perc	0~300%	100%	P	
47	PM dead-time voltage (%)	PMdeadVolt Per	50~200%	100%	P	
48	Current controller proportional gain	ACR P-Gain	0~10000	1200	IP	p.239 p.246
49	Current controller integral gain	ACR I-Gain	10~1000	120	IP	
50	Voltage controller limit	V Con HR	0~100.0%	10.00%	P	p.246
51	Voltage controller I Gain	V Con Ki	0~1000.0%	10.00%	P	
52[3]	Torque Controller Output Filter	Torque Out LPF	0~2000 msec	0 msec	IP	p.239
53	Torque Limit setting options	Torque Lmt Src	0: Keypad-1 1: Keypad-2 2: V1 4: V2 5: I2 6: Int 485 7: FieldBus 9: Pulse 10: V3 11: I3	0: Keypad-1	I	p.239
54[3]	Forward direction retrograde torque limit	FWD +Trq Lmt	0-200%	180.00% [4]	IP	p.239 p.246
55	Forward direction regenerative torque limit	FWD -Trq Lmt	0-200%	180.00%	IP	
56	Reverse direction regenerative torque limit	REV +Trq Lmt	0-200%	180.00%	IP	
57	Reverse direction retrograde torque limit	REV -Trq Lmt	0-200%	180.00%	IP	
69[5]	PM Speed Search Pulse Current	SS Pulse Curr	10~100%	15.00%	P	p.246
70	Speed search mode selection	SS Mode	0: Flying Start-1 1: Flying Start-2 2: Flying Start-3 (PM)[10]	0: Flying Start-1	IP	p.156
71	Speed search operation selection	Speed Search	Bit: 0000-1111 Bit 0: Speed search on acceleration Bit 1: Restart after trips (other than LV trip) Bit 2: Restart after instantaneous interruption Bit 3: Power- on run	0000 bit 3 / bit 2 / bit 1 / bit 0 1 / 1 / 1 / 1 0 / 0 / 0 / 0	Δ	p.156
72[6]	Speed search reference current	SS Sup- Current	50–120 (%)	90: 7.5~400HP 80: 500~800HP	O	p.156
73[7]	Speed search proportional gain	SS P-Gain	0-9999	100: Flying Start-1 Dep. on MOT-01: Flying Start-2	O	
74	Speed search integral gain	SS I-Gain	0-9999	200: Flying Start-1 Dep. on MOT-01: Flying Start-2	O	
75	Output block time before speed search	SS Block Time	0.0-60.0 (sec)	1.0	Δ	
77	Energy buffering selection	KEB Select	0: No 1: Yes	0: No	Δ	p.159
78[8]	Energy buffering start level	KEB Start Lev	110.0-140.0 (%)	125.0: 240V, 480V: 7.5~125HP 115.0: 480V:	Δ	p.159

Code	Name	LCD Display	Setting Range	Initial value		Prop *	Ref.
					150~800HP		
				130.0	575V only		
79	Energy buffering stop level	KEB Stop Lev	CON-78 ~ 145.0 (%)	130.0	240V, 480V: 7.5~125HP	Δ	
				125.0	480V: 150~800HP		
				135.0	575V only		
80	Energy buffering slip gain	KEB Slip Gain	0-20000	300	240V:7.5~40HP	O	
					480V: 7.5~800HP		
				100	240V: 50~125HP		
				25	575V		
81	Energy buffering P-Gain	KEB P-Gain	0-20000	1000	240V:7.5~40HP	O	
					480V: 7.5~800HP		
				1800	240V: 50~125HP		
				3000	575V: 7.5~50HP		
				1500	575V: 60~125HP		
82	Energy buffering I-Gain	KEB I-Gain	1-20000	500	240V:7.5~40HP	O	
					480V: 7.5~800HP		
				200	240V: 50~125HP		
					575V		
83	Energy buffering acceleration time	KEB Acc Time	0.0-600.0 sec	10.0	240V, 480V: 7.5~125HP	O	
				30.0	480V: 150~800HP		
				5.0	575V		
85[9]	Flux estimator proportional gain 1	Flux P Gain 1	100 - 700	370	230V, 460V	I	*p.239*
			0-500	170	575V		
86	Flux estimator proportional gain 2	Flux P Gain 2	0 - 100	0	230V, 460V	I	*p.239*
			70-120	90	575V		
87	Flux estimator proportional gain 3	Flux P Gain 3	0 - 500	100		I	
88	Flux estimator integral gain 1	Flux I Gain 1	0 - 200	50	230V, 460V	I	
				80	575V		
89	Flux estimator integral gain 2	Flux I Gain 2	0 - 200	50		I	
90	Flux estimator integral gain 3	Flux I Gain 3	0 - 200	50		I	
91	Sensorless voltage compensation 1	SL Volt Comp 1	0 - 60	35	230V, 460V	I	*p.239*
			60-400	110	575V		
92	Sensorless voltage compensation 2	SL Volt Comp 2	0 - 60	20	230V, 460V	I	
			0-400	110	575V		
93	Sensorless voltage compensation 3	SL Volt Comp 3	0 - 60	20		I	
94	Sensorless field weakening start frequency	SL FW Freq	0 - 110%	100		I	*p.239*
95	Sensorless gain switching frequency	SL Fc Freq	0.00 - 8.00 Hz	2.00		I	
97	Sensorless Slip Compensation1	SL Slip Comp1	0-200	100 (575V only)		I	*p.239*
98	Sensorless Slip Compensation2	SL Slip Comp2	0-200	50 (575V only)		I	

[1] CON-09 is displayed when DRV-09 is set to '3' (IM Sensorless). Does not apply to 240V, 30~125 HP Inverters.
[3] CON-24 - 33 and CON-52 - 57 are displayed when DRV-09 is set to '3' (IM Sensorless). Does not apply to 240V, 30~125 HP Inverters. CON-52 - 57 are displayed when DRV-09 is set to '4' (PM Sensorless). Does not apply to 240V, 30~125 HP, 480V, 150~800 HP and all 575V Inverters.
[4] When ADV.74 is set to Yes, defaults change to 150%.
[5] CON-34 - 47 and CON-69 are displayed when DRV-09 is set to '4' (PM Sensorless). Does not apply to 240V, 30~125 HP, 480V, 150~800 HP and all 575V Inverters.
[6] CON-72 is displayed after Flying Start-1 and when any CON-71 bit is set to ‘1’.
[7] CON-73–75 are displayed when any CON-71 bit is set to ‘1’.
[8] CON-78–83 are displayed when CON-77 is set to ‘1 (Yes)’.
[9] CON-85 ~ 95 are displayed when DRV-09 is set to '3' IM Sensorless. Does not apply to 240V, 30~125 HP Inverters.
[10] PM Sensorless: Does not apply to 240V, 30~125 HP, 480V, 150~800 HP and all 575V Inverters.

4.2.6 Input Group (IN)

Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
00	Jump Code	Jump Code	1-99		65		O	p.74
01	Frequency at maximum analog input	Freq at 100%	Start Frequency - Maximum Freqency (Hz)		Maximum Frequency		O	p.108 p.111 p.113 p.115
05[1]	V1 input voltage display	V1 Monitor (V)	0-12.00(V) or -12.00~12.00 (V)		0.00		X	p.108
06	V1 input polarity selection	V1 Polarity	0	Unipolar	0	Unipolar	Δ	
			1	Bipolar				
07	V1 input filter time	V1 Filter	0–10000 (ms)		10		O	
08	V1 minimum input voltage	V1 Volt x1	0.00-10.00 (V)		0.00		O	
09	Output at V1 minimum voltage (%)	V1 Perc y1	0.00-100.00 (%)		0.00		O	
10	V1 maximum input voltage (%)	V1 Volt x2	0.00-12.00 (V)		10.00		O	
11	Output at V1 maximum voltage (%)	V1 Perc y2	0.00-100.00 (%)		100.00		O	
12[2]	V1 input at minimum voltage (%)	V1 –Volt x1’	-10.00- 0.00 (V)		0.00		O	p.111
13	Output at V1 minimum voltage (%)	V1 –Perc y1’	-100.00-0.00 (%)		0.00		O	
14	V1 maximum input voltage (%)	V1 –Volt x2’	-12.00- 0.00 (V)		-10.00		O	
15	Output at V1 maximum voltage (%)	V1 –Perc y2’	-100.00-0.00 (%)		-100.00		O	
16	V1 rotation direction change	V1 Inverting	0	No	0	No	O	p.108
			1	Yes				
17	V1 quantization change	V1 Quantizing	0.00[3], 0.04-10.00 (%)		0.04		O	
20[4]	Temperature monitor	T1 Monitor	0.00 - 100.00 (%)		-		X	p.201
35[5]	V2 input rate monitor	V2 Monitor (V)	0.00-12.00 (V)		0.00		O	p.114
37	V2 input filter time	V2 Filter	0-10000 (msec)		10		O	
38	V2 minimum input voltage	V2 Volt x1	0.00-10.00 (V)		0.00		O	
39	Output at V2 minimum voltage (%)	V2 Perc y1	0.00-100.00 (%)		0.00		O	
40	V2 maximum input voltage	V2 Volt x2	0.00-10.00 (V)		10.00		O	
41	Output at V2 maximum voltage (%)	V2 Perc y2	0.00-100.00 (%)		100.00		O	
46	V2 Rotation direction options	V2 Inverting	0	No	0	No	O	
			1	Yes				
47	V2 Quantizing level	V2 Quantizing	0.00[4], 0.04- 10.00 (%)		0.04		O	
50[6]	I2 input monitor	I2 Monitor (mA)	0–24 (mA)		0.00		O	p.113
52	I2 input filter time	I2 Filter	0–10000 (msec)		10		O	
53	I2 minimum input current	I2 Curr x1	0.00-20.00 (mA)		4.00		O	
54	Output at I2 minimum current (%)	I2 Perc y1	0.00-100.00 (%)		0.00		O	
55	I2 maximum input current	I2 Curr x2	I2 Curr x1 - 24.00 (mA)		20.00		O	
56	Output at I2 maximum current (%)	I2 Perc y2	0.00-100.00 (%)		100.00		O	
57	I2 rotation direction options	I2 Inverting	0	No	0	No	O	
			1	Yes				
58	I2 Quantizing level	I2 Quantizing	0.00[4], 0.04- 10.00 (%)		0.04		O	
59	Up/Down operation frequency save	U/D Save Mode	0	No	0	No	O	p.171
			1	Yes				
60	Safe operation selection	Run En Mode	0	Always Enable	0	Always Enable	Δ	p.161
			1	DI Dependent				
61[7]	Safe operation stop options	Run Dis Stop	0	Free-Run	0	Free-Run	Δ	
			1	Q-Stop				
			2	Q-Stop Resume				
62	Safe operation deceleration time	Q-Stop Time	0.0-600.0 (sec)		5.0		O	
65	P1 terminal configuration	P1 Define	0	None	1	Fx	Δ	p.164
			1	Fx				
66	P2 terminal configuration	P2 Define	2	Rx	2	Rx	Δ	p.164
67	P3 terminal configuration	P3 Define	3	RST	5	BX	Δ	p.164
68	P4 terminal configuration	P4 Define	4	External Trip	3	RST	Δ	p.164
69	P5 terminal configuration	P5 Define	5	BX	7	Speed-L	Δ	p.165
70	P6 terminal configuration	P6 Define	6	JOG	8	Speed-M	Δ	p.165
71	P7 terminal configuration	P7 Define	7	Speed-L	9	Speed-H	Δ	p.168
			8	Speed-M				
			9	Speed-H				
			11	XCEL-L				p.168
			12	XCEL-M				
			13	XCEL-H				
			14	XCEL Stop				
			15	RUN Enable				p.168
			16	3-Wire				p.169
			17	2nd Source				p.169

Code	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
			18	Exchange			p.170
			19	Up			p.171
			20	Down			
			22	U/D Clear			
			23	Analog Hold			p.173
			24	I-Term Clear			p.220
			25	PID Openloop			p.237
			26	PID Gain2			p.220
			27	PID Ref Change			p.220
			28	Pre Excite			p.174
			29	Timer In			p.174
			31	dis Aux Ref			p.128
			32	FWD JOG			p.167
			33	REV JOG			p.167
			34	Fire Mode			p.175
			35	Time Event En			p.176
			36	Pre Heat			p.267
			37	Damper Open			p.176
			38	Pump Clean			p.176
			39	Sleep Wake Chg			p.233
			40	PID Step Ref L			p.177
			41	PID Step Ref M			
			42	PID Step Ref H			
72[8]	P8 terminal configuration	P8 Define	Same as P1 - P7				
73[9]	P9 terminal configuration	P9 Define	Same as P1 - P7				
83	DI On Delay Selection	DI On DelayEn	0 0000 0000-1 1111 1111		P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	Δ	p.177
84	DI Off Delay Selection	DI Off DelayEn	0 0000 0000-1 1111 1111		P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	Δ	p.177
85	Multi-function input terminal On filter	DI On Delay	0–10000 (msec)		10	O	p.177
86	Multi-function input terminal Off filter	DI Off Delay	0–10000 (msec)		3	O	p.177
87	Multi-function input terminal selection	DI NC/NO Sel 1 NC (B Type) 0 NO (A Type)	0 0000 0000-1 1111 1111		P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	Δ	p.177
89	Multi-step command delay time	In Check Time	1–5000 (msec)		1	Δ	p.136
90	Multi-function input terminal status	DI Status 1 ON 0 OFF	0 0000 0000-1 1111 1111		P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	O	p.177
91	Pulse input amount display	TI Monitor	0.00-50.00 (kHz)		0.00	X	p.115
92	TI input filter time	TI Filter	0–9999 (msec)		10	O	
93	TI minimum input pulse	TI Pls x1	0 - TI Pls x2		0.00	O	
94	Output at TI minimum pulse (%)	TI Perc y1	0.00-100.00 (%)		0.00	O	
95	TI maximum input pulse	TI Pls x2	TI Pls x1-32.00		32.00	O	
96	Output at TI maximum pulse (%)	TI Perc y2	0.00-100.00 (%)		100.00	O	
97	TI rotation direction change	TI Inverting	0	No	0 No	O	
			1	Yes			
98	TI quantization level	TI Quantizing	0.00[4], 0.04-10.00 (%)		0.04	O	

[1] 'IN-05' setting range can be changed accordinig to 'IN-06' settings.

[2] IN-12–17 are displayed when IN-06 is set to ‘1 (Bipolar)’.

[3] Quantizing is disabled if ‘0’ is selected.

[4] IN-20 is displayed when the V1/T1 terminal selection switch (SW3) is selected for T1 (PTC Input).

[5] IN-35–47 are displayed when the analog current/voltage input circuit selection switch (SW4) is selected on V2.

[6] IN-50–62 are displayed when the analog current/voltage input circuit selection switch (SW5) is selected on I2.

[7] IN-61 and IN-62 are displayed when IN-60 is set to ‘1 (DI Dependent)’.

[8] IN-72 and IN-73 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.

4.2.7 Output Group (OUT)

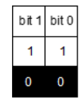
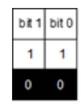
Code	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
00	Jump Code	Jump Code	1-99		30		O	p.74
01	Analog output1	AO1 Mode	0	Frequency	0	Frequency	O	p.179
			1	Output Current				
			2	Output Voltage				
			3	DCLink Voltage				
			4	Output Power				
			7	Target Freq				
			8	Ramp Freq				
			9	PID Ref Value				
			10	PID Fdb Value				
			11	PID Output				
			12	Constant				
02	Analog output1 gain	AO1 Gain	-1000.0-1000.0 (%)		100.0		O	p.179
03	Analog output1 bias	AO1 Bias	-100.0-100.0 (%)		0.0		O	p.179
04	Analog output1 filter	AO1 Filter	0–10000 (msec)		5		O	p.179
05	Analog constant output1	AO1 Const	0.0-100.0 (%)		0.0		O	p.179
06	Analog output1 monitor	AO1 Monitor	0.0-1000.0 (%)		0.0		X	p.179
07	Analog output2	AO2 Mode	Identical to the OUT-01 (AO1 Mode) selectoin range		0	Frequency		p.179
08	Analog output2 gain	AO2 Gain	-1000.0-1000.0 (%)		100.0		O	p.179
09	Analog output2 bias	AO2 Bias	-100.0-100.0 (%)		0.0		O	p.179
10	Analog output2 filter	AO2 Filter	0–10000 (msec)		5		O	p.179
11	Analog constant output2	AO2 Const	0.0-100.0 (%)		0.0		O	p.179
12	Analog output2 monitor	AO2 Monitor	0.0-1000.0 (%)		0.0		X	p.179
30	Fault output item	Trip OutMode	bit	000-111	010	bit 2 / bit 1 / bit 0 1 / 1 / 1 0 / 0 / 0	O	p.187
			Bit 0	Low voltage				
			Bit 1	Any faults other than low voltage				
			Bit 2	Automatic restart final failure				
31	Multi-function relay1	Relay 1	0	None	23	Trip	O	p.183
32	Multi-function relay2	Relay 2	1	FDT-1	14	RUN		
33	Multi-function relay3	Relay 3	2	FDT-2	0	None		
34	Multi-function relay4	Relay 4	3	FDT-3	0	None		
35	Multi-function relay5	Relay 5	4	FDT-4	0	None		
36	Multi-function 1 item	Q1 Define	5	Over Load	0	None		

Code	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
			6	IOL			
			7	Under Load			
			8	Fan Warning			
			9	Stall			
			10	Over Voltage			
			11	Low Voltage			
			12	Over Heat			
			13	Lost Command			
			14	Run			
			15	Stop			
			16	Steady			
			17	Inverter Line			
			18	Comm Line			
			19	Speed Search			
			20	Ready			
			21	Reserved			
			22	Timer Out			
			23	Trip			p.183
			24	Lost Keypad			
			25	DB Warn%ED			
			26	On/Off Control			
			27	Fire Mode			
			28	Pipe Broken			
			29	Damper Err			
			30	Lubrication			
			31	Pump Clean			
			32	Level Detect			
			33	Damper Control			
			36	AUTO State			
			37	Hand State			
			38	TO			
			39	Except Date			
			40	KEB Operating			
			41	BrokenBelt			
			42	BR Control			
			43	2nd Source			
37[1]	Multi-function relay6	Relay 6		Note 1			
38	Multi-function relay7	Relay 7		Note 1			
39	Multi-function relay8	Relay 8		Note 1			
41	Multi-function output monitor	DO Status 1 Closed 0 Open	R8 | R7 R6 Q1 R5 | R4 R3 R2 R1 1 | 1 1 1 1 | 1 1 1 1 0 | 0 0 0 0 | 0 0 0 0		0 0000 0000	X	p.187
50	Multi-function output On delay	DO On Delay	0.00-100.00 (sec)		0.00	O	p.189
51	Multi-function output Off delay	DO Off Delay	0.00-100.00 (sec)		0.00	O	p.189
52	Multi-function output contact selection	DO NC/NO Sel 1 NC (B type) 0 NO (A Type)	R8 | R7 R6 Q1 R5 | R4 R3 R2 R1 1 | 1 1 1 1 | 1 1 1 1 0 | 0 0 0 0 | 0 0 0 0		0 0000 0000	Δ	p.189
53	Fault output On delay	Trip Out On Dly	0.00-100.00 (sec)		0.00	O	p.187
54	Fault output Off delay	Trip Out Off Dly	0.00-100.00 (sec)		0.00	O	p.187
55	Timer On delay	Timer On Delay	0.00-100.00 (sec)		0.00	O	p.174

Code	Name	LCD Display	Setting Range	Initial value	Property*	Ref.
56	Timer Off delay	Timer Off Delay	0.00-100.00 (sec)	0.00	O	p.174
57	Detected frequency	FDT Frequency	0.00-Maximum frequency (Hz)	30.00	O	p.183
58	Detected frequency band	FDT Band	0.00-Maximum frequency (Hz)	10.00	O	p.183
61	Pulse output item	TO Mode	0 Frequency 1 Output Current 2 Output Voltage 3 DCLink Voltage 4 Output Power 7 Target Freq 8 Ramp Freq 9 PID Ref Value 10 PID Fdb Value 11 PID Output 12 Constant	0 Frequency	O	p.181
62	Pulse output gain	TO Gain	-1000.0-1000.0 (%)	100.0	O	p.181
63	Pulse output bias	TO Bias	-100.0-100.0 (%)	0.0	O	p.181
64	Pulse output filter	TO Filter	0–10000 (msec)	5	O	p.181
65	Pulse output constant outpuut 2	TO Const %	0.0-100.0 (%)	0.0	O	p.181
66	Pulse output monitor	TO Monitor	0.0-1000.0 (%)	0.0	X	p.181
67	Output contact On/Off control options	OnOff Ctrl Src	0 None 1 V1 3 V2 4 I2 6 Pulse 7[2] V3 8 I3	0 None	O	p.190
68	Output contact On level	On Ctrl Level	Output contact off level to 100.00%	90.00	Δ	p.190
69	Output contact Off level	Off Ctrl Level	-100.00 to output contact on level (%)	10.00	Δ	p.190

[1] OUT-37, 38, 39 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.
[2] ‘7 (V3) and 8 (I3)’ of OUT-67 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.

4.2.8 Protection Group (PRT)

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
00	Jump Code	Jump Code	1–99		40		O	p.74
01	Back Spin Timer	Backspin Time	0.0 - 6000.0 (sec)		0		O	p.191
04	Load Duty	Load Duty	0	Normal Duty	0	Normal Duty	Δ	p.197
			1	Heavy Duty				
05	Input/output open-phase protection	Phase Loss Chk	Bit	00–11	00		Δ	p.192
			Bit 0	Output open phase				
			Bit 1	Input open phase				
06	Input voltage range during open-phase	IPO V Band	1–100 (V)		15	240V, 480V	O	p.192
					40	575V		
07	Deceleration time at fault	Trip Dec Time	0.0–600.0 (sec)		3.0	240V: 7.5~60HP	O	p.195
						480V: 7.5~125HP		
						575V		
					90.0	240V: 75~125HP		
						480V:150~800HP		
08	Selection of startup on trip reset	RST Restart	Bit	00–11	00		O	p.192
			Bit 0	Faults other than LV trip				
			Bit 1	LV Trip				
09	Number of automatic restarts	Retry Number	0–10		0		O	p.192
10	Automatic restart delay time	Retry Delay	0.1–600.0 (sec)		5.0		O	p.192
11	Keypad command loss operation mode	Lost KPD Mode	0	None	0	None	O	p.195
			1	Warning				
			2	Free-Run				
			3	Dec				
12	Speed command loss operation mode	Lost Cmd Mode	0	None	0	None	O	p.195
			1	Free-Run				
			2	Dec				
			3	Hold Input				
			4	Hold Output				
			5	Lost Preset				
13[1]	Time to determine speed command loss	Lost Cmd Time	0.1–120.0 (sec)		1.0		O	p.195
14	Operation frequency at speed command loss	Lost Preset F	0.00, Low Freq–High Freq		0.00		O	p.195
15	Analog input loss decision level	AI Lost Level	0	Half of x1	0	Half of x1	O	p.195
			1	Below x1				
17	Overload warning selection	OL Warn Select	0	No	0	No	O	p.197
			1	Yes				
18	Overload warning level	OL Warn Level	30–OL Trip Level(%)		110		O	p.197
19	Overload warning time	OL Warn Time	0.0–30.0 (sec)		10.0		O	p.197
20	Motion at overload trip	OL Trip Select	0	None	1	Free-Run	O	p.197
			1	Free-Run				
			2	Dec				
21	Overload trip level	OL Trip Level	30–150 (%)		120		O	p.197
22	Overload trip time	OL Trip Time	0.0–60.0 (sec)		60.0		O	p.197
23	Under load detection Source	UL Source	0	Output Current	0	Output Current	Δ	p.199
			1	Output Power				
24	Under load detection band	UL Band	0.0–100.0 (%)		10.0		Δ	p.199
25	Under load warning selection	UL Warn Sel	0	No	0	No	O	p.199
			1	Yes				
26	Under load warning time	UL Warn Time	0.0–600.0 (sec)		10.0		O	p.199
27	Under load trip selection	UL Trip Sel	0	None	0	None	O	p.199
			1	Free-Run				
			2	Dec				
28	Under load trip timer	UL Trip Time	0.0–600.0 (sec)		30.0		O	p.199
31	Operation on no motor trip	No Motor Trip	0	None	1	Free-Run	O	p.200
			1	Free-Run				
32	No motor trip current level	No Motor Level	1–100 (%)		5		O	p.200
33	No motor detection time	No Motor Time	0.1–10.0 (sec)		3.0		O	p.200
34	Operation at motor overheat detection	Thermal-T Sel	0	None	0	None	O	p.201
			1	Free-Run				
			2	Dec				

Code	Name	LCD Display	Setting Range	Initial Value	Property*	Ref.
35	Thermal sensor input	Thermal In Src	0 Thermal In 1 V2	0 Thermal In	O	p.201
36	Thermal sensor fault level	Thermal-T Lev	0.0–100.0 (%)	50.0	O	p.201
37	Thermal sensor fault range	Thermal-T Area	0 Low 1 High	0 Low	O	p.201
38[2]	Motor overheat detection sensor	Thermal Monitor	-	-	X	p.201
40	Electronic thermal prevention fault selection	ETH Trip Sel	0 None 1 Free-Run 2 Dec	1 Free-Run	O	p.203
41	Motor cooling fan type	Motor Cooling	0 Self-cool 1 Forced- cool	0 Self-cool	O	p.203
42	Electronic thermal one minute rating	ETH 1 min	CON-43–150 (%)	115	O	p.203
43	Electronic thermal prevention continuous rating	ETH Cont	50–CON-42 (%)	100	O	p.203
44	Fire mode password	Fire Mode PW	0~9999	3473	O	p.205
45[3]	Fire mode setting	Fire Mode Sel	0 None 1 Fire Mode 2 Test Mode	0 None	O	p.205
46[4]	Fire mode direction setting	Fire Mode Dir	0 Reverse 1 Forward	1 Forward	O	p.205
47[5]	Fire mode frequency setting	Fire Mode Freq	0.00–max Freq	60.00	O	p.205
48	Number of fire mode operations	Fire Mode Cnt	-	0	X	p.205
50	Stall prevention and flux braking	Stall Prevent	bit 0000–1111 Bit 0 During acceleration Bit 1 At constant speed Bit 2 During deceleration Bit 3 During Flux braking (decel)	0000 bit 3 bit 2 bit 1 bit 0 1 1 1 1 0 0 0 0	Δ	p.207
51	Stall frequency 1	Stall Freq 1	Start frequency- Stall frequency2 (Hz)	60.00	O	p.207
52	Stall level 1	Stall Level 1	30-150 (%)	130	Δ	p.207
53	Stall frequency 2	Stall Freq 2	Stall frequency1- Stall frequency3 (Hz)	60.00	O	p.207
54	Stall level 2	Stall Level 2	30-150 (%)	130	Δ	p.207
55	Stall frequency 3	Stall Freq 3	Stall frequency2- Stall frequency 4 (Hz)	60.00	O	p.207
56	Stall level 3	Stall Level 3	30–150 (%)	130	Δ	p.207
57	Stall frequency 4	Stall Freq 4	Stall frequency3- Maximum frequency (Hz)	60.00	O	p.207
58	Stall level 4	Stall Level 4	30–150 (%)	130	Δ	p.207
59	Flux braking gain	Flux Brake Kp	7.5-125HP 0–150 (%) 150-800HP 0–10 (%)	0	O	p.207
60	Pipe break detection setting	PipeBroken Sel	0 None 1 Warning 2 Free-Run 3 Dec	0 None	O	p.211
61	Pipe break detection variation	PipeBroken Lev	0.0–100.0 (%)	97.5	O	p.211
62	Pipe break detection time	PipeBroken DT	0.0–6000.0 (Sec)	10.0	O	p.211
66	Braking resistor configuration	DB Warn % ED	0 Disabled 1–30 (%)	0 Disabled	O	p.212
70	Level detect mode selection	LDT Sel	0 None 1 Warning 2 Free-Run 3 Dec	0 None	O	p.214
71	Level detect range setting	LDT Area Sel	0 Below Level 1 Above Level	0 Below Level	O	p.214
72	Level detect source	LDT Source	0 Output Current 1 DC Link Voltage 2 Output Voltage	0 Output Current	O	p.214

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
			3	kW				
			4	HP				
			5	V1				
			6	V2				
			7	I2				
			8	PID Ref Value				
			9	PID Fdb Value				
			10	PID Output				
			11[6]	V3				
			12	I3				
73	Level detect delay time	LDT Dly Time	0–9999 (sec)		2		O	p.214
74	Level detect standard set value	LDT Level	Source setting		Source setting		O	p.214
75	Level detect band width	LDT Band width	Source setting		Source setting		O	p.214
76	Level detect frequency	LDT Freq	0.00–High Freq (Hz)		20.00		O	p.214
77	Level detect trip restart time	LDT Restart DT	0.0–3000.0 (Min)		60.0		O	p.214
79	Cooling fan fault selection	Fan Trip Mode	0	Trip	1	Warning	O	p.217
			1	Warning				
80	Operation mode on optional card trip	Opt Trip Mode	0	None	1	Free-Run	O	p.217
			1	Free-Run				
			2	Dec				
81	Low voltage trip decision delay time	LVT Delay	0.0–60.0 (sec)		0.0		Δ	p.218
82	Low voltage trip decision during operation	LV2 Trip Sel	0	No	0	No	Δ	p.218
			1	Yes				
90	Low battery voltage setting	Low Battery	0	None	0	None	O	p.218
			1	Warning				
91	Setting the function of Broken belt	BrokenBelt Sel	0	None	0	None		p.219
			1	Warning				
			2	Free-Run				
92	Operating the frequency of Broken belt	BrokenBelt Freq	15.00~MzxFreq		15.00			p.219
93	Motor torque current	Current Trq	-		-		X	p.219
94	Torque current of operating Broken belt	BrokenBelt Trq	0.0~100.0 (%)		10.0			p.219
95	Delay of operating Broken belt	BrokenBelt Dly	0~600.(sec)		10.0			p.219
96[7]	LDT Auto restart count	LDT Rst Cnt	0~6000		1			p.214
97	LDT Auto restart cycle count	LDT Rst Cnt M	-		-		X	p.214
98	LDT Auto restart cycle Initialization time	LDT Cnt Clr T	0~6000		60			p.214

[1] PRT-13~15 are dsiplayed when PRT-12 is not set to '0 (none)
[2] PRT-38 is displayed when PRT-34 is not set to '0 (NONE)'.
[3] PRT-45 can only be changegd when PRT-44 password is entered.
[4] PRT-46–47 are displayed when PRT-45 is not set to '0 (NONE)'.
[5] When Fire mode is set at PRT-45, PRT-46 is automatically set to forward and the frequency set at PRT-47 cannot be changed. When PRT-45 is set to Test mode, PRT-46 and PRT-47 can be changed.
[6] '11(V3)~12(I3)' of PID-21 are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.
[7] PRT-96-98 are displayed when PRT-70 is not set to '0 (NONE)'.

5 Parameter Descriptions

5.1 Drive Group (DRV)

5.1.1 DRV-01 Command Frequency

The following parameters are related to HAND-OFF-AUTO button operation. Refer to section 3.2.1 for details.

<table>
<tr><th>Codes / Functions</th><th>Description</th></tr>
<tr><td>DRV-01
Cmd Frequency</td><td>Frequency reference in AUTO mode when DRV-07 is set to’ KeyPad’.</td></tr>
<tr><td>DRV-02
KeyPad Run Dir</td><td>Rotation direction of the keypad start/run command in the HAND or AUTO mode.
<table>
<tr><th colspan="2">Settings</th></tr>
<tr><td>0</td><td>Forward</td></tr>
<tr><td>1</td><td>Reverse</td></tr>
</table></td></tr>
<tr><td>DRV-05
KPD H.O.A Lock</td><td>To make HAND-OFF-AUTO buttons enabled/disabled.
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>Locked</td><td>HAND-OFF-AUTO buttons are disabled. If pressed, Message displayed as:
KPD H.O.A Lock</td></tr>
<tr><td>1</td><td>During Run</td><td>If DRV-06, Cmd Source is Fx/Rx-1, Fx/Rx-2, Int485 or fieldbus, HAND-OFF-AUTO buttons are disabled during running.</td></tr>
<tr><td>3</td><td>Unlocked</td><td>HAND-OFF-AUTO buttons are enabled all the time.</td></tr>
</table></td></tr>
<tr><td>DRV-25
HAND Cmd Freq</td><td>Frequency displayed at the monitor display item (Monitor Line-1) when the HAND button is pressed in other modes (default frequency reference for HAND mode).</td></tr>
<tr><td>DRV-26
HAND Ref Mode</td><td>
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>Hand Parameter</td><td>The inverter operates based on the rotation direction set at DRV-02 (Keypad Run Dir) and the frequency reference set at DRV-25 (HAND Cmd Freq).</td></tr>
<tr><td>1</td><td>Follow Auto</td><td>The inverter takes over the rotation direction and the frequency reference from the settings for AUTO mode and keeps performing the same operation. If the inverter was stopped in AUTO mode, the operation direction is set as Fx and the frequency reference is set as 0 (no inverter output).</td></tr>
</table></td></tr>
<tr><td>OUT-31–36
Relay 1–5, Q1</td><td>Set AUTO State (36) to ensure that the inverter is in AUTO mode.</td></tr>
<tr><td>OUT-31–36
Relay 1–5, Q1</td><td>Set HAND State (37) to ensure that the inverter is in HAND mode.</td></tr>
</table>

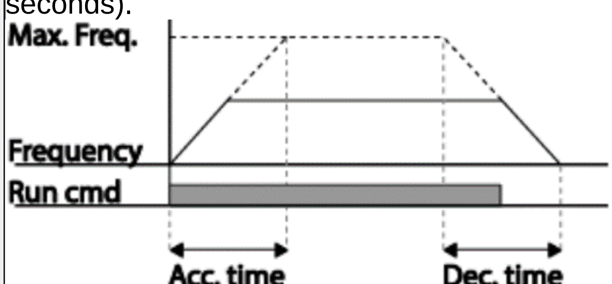
5.1.2 DRV-03, DRV-04 Acceleration and Deceleration Times

5.1.2.1 Acc/Dec Time Based on Maximum Frequency

Acc/Dec times are based on maximum frequency (BAS-08 set to ‘0, MaxFreq’). Acceleration time set at DRV-03 (Acceleration time) refers to the time required for the inverter to reach the maximum frequency from a stopped (0 Hz) state. Likewise, deceleration time set at DRV-04 refers to the time required to decelerate from the maximum frequency to a stopped state (0 Hz).

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="13">DRV</td><td rowspan="5">03</td><td rowspan="5">Acceleration time</td><td rowspan="5">Acc Time</td><td rowspan="2">20.0</td><td>240V:7.5~60HP</td><td rowspan="5">0.0–600.0</td><td rowspan="5">sec</td></tr>
<tr><td>480V,575V: 7.5~125HP</td></tr>
<tr><td rowspan="2">60.0</td><td>240V: 75~125HP</td></tr>
<tr><td>480V: 150~400HP</td></tr>
<tr><td>100.0</td><td>480V: 500~800HP</td></tr>
<tr><td rowspan="5">04</td><td rowspan="5">Deceleration time</td><td rowspan="5">Dec Time</td><td rowspan="2">30.0</td><td>240V:7.5~60HP</td><td rowspan="5">0.0–600.0</td><td rowspan="5">sec</td></tr>
<tr><td>480V,575V: 7.5~125HP</td></tr>
<tr><td rowspan="2">90.0</td><td>240V: 75~125HP</td></tr>
<tr><td>480V: 150~400HP</td></tr>
<tr><td>150.0</td><td>480V: 500~800HP</td></tr>
<tr><td>20</td><td>Maximum frequency</td><td>Max Freq</td><td colspan="2">60.00</td><td>40.00–400.00</td><td>Hz</td></tr>
<tr><td rowspan="2">BAS</td><td>08</td><td>Acc/Dec reference frequency</td><td>Ramp T Mode</td><td>0</td><td>Max Freq</td><td>0–1</td><td>-</td></tr>
<tr><td>09</td><td>Time scale</td><td>Time scale</td><td>1</td><td>0.1 sec</td><td>0–2</td><td>-</td></tr>
</table>

Acc/Dec Time Based on Maximum Frequency – Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">BAS-08
Ramp T Mode</td><td colspan="3">Set the parameter value to 0 (Max Freq) to setup Acc/Dec time based on maximum frequency.</td></tr>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>0</td><td>Max Freq</td><td>Set the Acc/Dec time based on maximum frequency.</td></tr>
<tr><td>1</td><td>Delta Freq</td><td>Set the Acc/Dec time based on operating frequency.</td></tr>
<tr><td colspan="3">Example: Maximum frequency is 60.00 Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30 Hz (half of 60 Hz), the time required to reach 30 Hz therefore is 2.5 seconds (half of 5 seconds).

</td></tr>
</table>

<table>
<tr><td rowspan="5">BAS-09
Time scale</td><td colspan="3">Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended.</td></tr>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>0</td><td>0.01 sec</td><td>Sets 0.01 second as the minimum unit.</td></tr>
<tr><td>1</td><td>0.1 sec</td><td>Sets 0.1 second as the minimum unit.</td></tr>
<tr><td>2</td><td>1 sec</td><td>Sets 1 second as the minimum unit.</td></tr>
</table>

Caution

Note that the range of maximum time values may change automatically when the units are changed. If for example, the acceleration time is set at 6000 seconds, a time scale change from 1 second to 0.01 second will result in a modified acceleration time of 60.00 seconds.

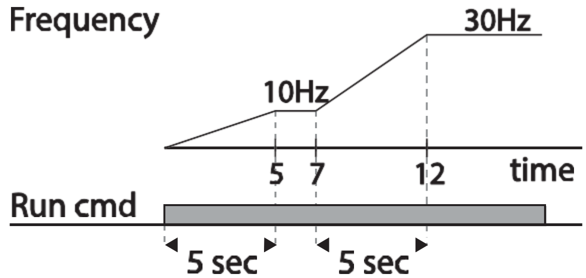
5.1.2.2 Acc/Dec Time based on Operating Frequency

Acc/Dec times can be set based on the time required to reach the next step frequency from the existing operation frequency. Set BAS-08 (acc/dec reference) to ‘1 (Delta Freq)’.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Settings</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="10">DRV</td><td rowspan="5">03</td><td rowspan="5">Acceleration time</td><td rowspan="5">Acc Time</td><td rowspan="2">20.0</td><td>240V:7.5~60HP</td><td rowspan="5">0.0 - 600.0</td><td rowspan="5">sec</td></tr>
<tr><td>480V,575V:
7.5~125HP</td></tr>
<tr><td rowspan="2">60.0</td><td>240V: 75~125HP</td></tr>
<tr><td>480V: 150~400HP</td></tr>
<tr><td>100.0</td><td>480V: 500~800HP</td></tr>
<tr><td rowspan="5">04</td><td rowspan="5">Deceleration time</td><td rowspan="5">Dec Time</td><td rowspan="2">30.0</td><td>240V: 7.5~60HP</td><td rowspan="5">0.0 - 600.0</td><td rowspan="5">sec</td></tr>
<tr><td>480V,575V:
7.5~125HP</td></tr>
<tr><td rowspan="2">90.0</td><td>240V: 75~125HP</td></tr>
<tr><td>480V: 150~400HP</td></tr>
<tr><td>150.0</td><td>480V: 500~800HP</td></tr>
<tr><td>BAS</td><td>08</td><td>Acc/Dec reference</td><td>Ramp T Mode</td><td>1</td><td>Delta Freq</td><td>0 - 1</td><td>-</td></tr>
</table>

Acc/Dec Time Based on Operation Frequency – Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4"></td><td colspan="3">Set the parameter value to 1 (Delta Freq) to set Acc/Dec times based on Maximum frequency.</td></tr>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>0</td><td>Max Freq</td><td>Set the Acc/Dec time based on Maximum frequency.</td></tr>
<tr><td>1</td><td>Delta Freq</td><td>Set the Acc/Dec time based on Operation frequency.</td></tr>
</table>

BAS-08 Ramp T Mode	If Acc/Dec times are set to 5 seconds, and multiple frequency references are used in the operation in 2 steps, at 10 Hz and 30 Hz, each acceleration stage will take 5 seconds (refer to the graph below). 

5.1.3 DRV-06 Command Source Configuration (Start/Stop)

The H2 Series inverter provides several methods to Start and Stop the inverter. Choices include the keypad, digital input terminals, RS-485 (Modbus), Fieldbus option cards and an Event Timer feature. Refer to *8.2 Application Group 3 (AP3) on page 269* details on the Event Timer.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command Source	Cmd Source	0	Keypad	0–5	-
				1	Fx/Rx-1		
				2	Fx/Rx-2		
				3	Int 485		
				4	Field Bus		
				5	Time Event		

5.1.3.1 The Keypad as a Command Source

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	0	Keypad	0–5	-

Set DRV-06 to ‘0 (Keypad)’ to select the keypad as the command source and set the operation direction at DRV-02 (Keypad Run Dir). Press the [AUTO] button to enter AUTO mode. The display goes to Monitor mode. The Auto LED flashes to show in Auto mode.

Since the keypad is now the command source, operation starts when the AUTO button is pressed again. The reference frequency (speed) is based on DRV-07 setting. If DRV-07 is set to ‘0 Keypad’, the frequency can be set at the Monitor mode, Line-1. Pressing the AUTO button again stops the inverter.

The OFF button may be used to stop the operation as well, but the inverter operation mode will be changed to OFF mode.

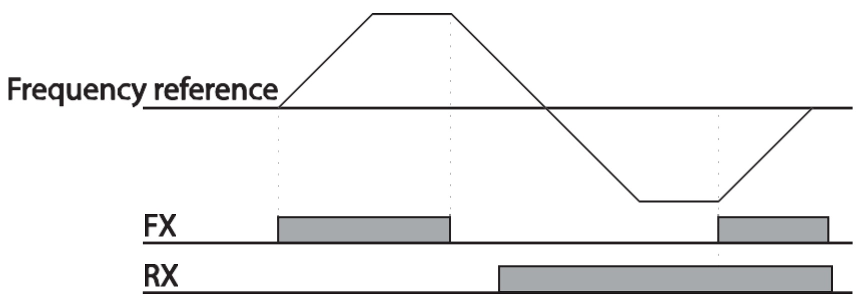
5.1.3.2 Terminal Block as a Command Source (Fwd/Rev Run)

Digital input terminals can be selected as the start/stop command source. Set DRV-06 (command source) to 1 (Fx/Rx-1). The default settings for terminals P1 and P2 are 1 (Fx) and 2 (Rx) respectively. Or set any (2) of the corresponding parameters (IN-65~IN-71) to 1 (Fx) and 2 (Rx). Activating either terminal constitutes a run command. Activating both terminals constitute a stop command.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–5	-
IN	65–71	Px terminal configuration	Px Define (Px: P1– P7)	1	Fx	0–42	-
				2	Rx		

Fwd/Rev Command by Multi-function Terminal – Setting Details

Code	Description
DRV-06 Cmd Source	Set to 1 (Fx/Rx-1).
IN-65–71 Px Define	Assign a terminal for forward (Fx) operation. Assign a terminal for reverse (Rx) operation.



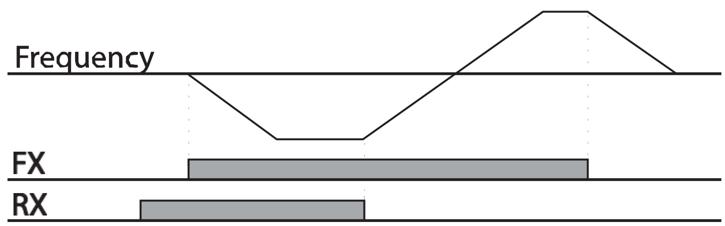
5.1.3.3 Terminal Block as a Command Source (Run and Direction)

Set parameter DRV-06 (command source) to 2 (Fx/Rx-2). This configuration (Fx/Rx-2) assigns the Fx terminal as the Start/Stop input terminal and assigns the Rx terminal as the rotational direction input terminal (Open: Fwd, Closed: Rev). Set (2) of the corresponding parameters (IN-65~IN-71) to 1 (Fx) and 2 (Rx) respectively.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	2	Fx/Rx-2	0–5	-
IN	65–71	Px terminal configuration	Px Define (Px: P1 – P7)	1	Fx	0–42	-
				2	Rx		

Run Command and Fwd/Rev Command Using Multi-function Terminal – Setting Details

Code	Description
DRV-06 Cmd Source	Set to '2 (Fx/Rx-2)'.
IN-65–71 Px Define	Assign a terminal for run command (Fx). Assign a terminal for changing rotation direction (Rx).



5.1.3.4 RS-485 Communication as a Command Source

Set DRV-06 (command source) in the to '3 (Int 485)'. Control the inverter with upper-level controllers (PCs or PLCs) via RS-485 communications using the S+, S- terminals. For more details, refer to *10 RS-485 Communication Features on page 299.*

Communication as the command source

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	3	Int 485	0–5	-
COM	01	Integrated communication inverter ID	Int485 St ID	1		1–MaxComID*	-
	02	Integrated communication protocol	Int485 Proto	0	ModBus RTU	0–6	-
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–8	-
	04	Integrated communication frame setup	Int485 Mode	0	D8 / PN / S1	0–3	-

*If COM-02 is set to '0' (Modbus RTU), MaxComID is '250'. If set to '4' (BACnet), MaxComID is '127'.

5.1.4 DRV-07 Frequency Reference Source

The H2 Series inverter provides several methods to setup and modify a frequency reference for operation. These include the keypad, analog inputs (V1, I2, V2 and TI) and RS-485 (digital signals from higher-level controllers, such as PC or PLC).

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="10">DRV</td><td rowspan="10">07</td><td rowspan="10">Frequency reference source</td><td rowspan="10">Freq Ref Src</td><td>0</td><td>KeyPad-1</td><td rowspan="10">0–11</td><td rowspan="10">-</td></tr>
<tr><td>1</td><td>KeyPad-2</td></tr>
<tr><td>2</td><td>V1</td></tr>
<tr><td>4</td><td>V2</td></tr>
<tr><td>5</td><td>I2</td></tr>
<tr><td>6</td><td>Int 485</td></tr>
<tr><td>7</td><td>Field Bus</td></tr>
<tr><td>9</td><td>Pulse</td></tr>
<tr><td>10*</td><td>V3</td></tr>
<tr><td>11</td><td>I3</td></tr>
</table>

* ‘10(V3)~11(I3)’ of DRV-07 are available when Extended IO option bd. is installed. Refer to Extended IO option manual for more detailed information.

5.1.4.1 Keypad as the Reference Source (KeyPad-1 setting)

You can modify frequency reference by using the keypad and apply changes by pressing the [ENT/PROG] button. To use the keypad as a frequency reference input source, go to DRV- 07 (Frequency reference source) and change the parameter value to ‘0 (Keypad-1)’. Input the frequency reference for at DRV-25 (HAND Cmd Freq) or at the Monitor mode (MON) Line-1.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="2">DRV</td><td>07</td><td>Frequency reference source</td><td>Freq Ref Src</td><td>0</td><td>KeyPad-1</td><td>0 - 11</td><td>-</td></tr>
<tr><td>25</td><td>Hand Command Frequency</td><td>HAND Cmd Freq</td><td colspan="2">0.00</td><td>0.00, Low Freq-Max Freq*</td><td>Hz</td></tr>
</table>

* You cannot set a frequency reference that exceeds the Max. Frequency, as configured with DRV-20.

5.1.4.2 Keypad as the Reference Source (KeyPad-2 setting)

You can use the [UP] and [DOWN] arrow buttons to modify a frequency reference. Go to DRV-07 (Frequency reference source) and change the parameter value to ‘1 (Keypad-2)’. This allows frequency reference values to be increased or decreased by pressing the [UP] and [DOWN] arrow buttons.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="2">DRV</td><td>07</td><td>Frequency reference source</td><td>Freq Ref Src</td><td>1</td><td>KeyPad- 2</td><td>0–11</td><td>-</td></tr>
<tr><td>01</td><td>Target Frequency</td><td>Cmd Frequency</td><td colspan="2">0.00</td><td>0.00, Low Freq– High Freq*</td><td>Hz</td></tr>
</table>

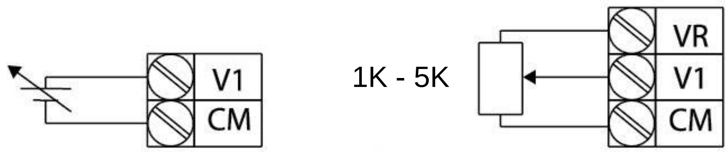
*You cannot set a frequency reference that exceeds the Max. Frequency, as configured with DRV-20.

5.1.4.3 IN-05 V1 Terminal as the Frequency Reference Source

You can set and modify a frequency reference by applying voltage inputs to the V1 terminal. Use voltage inputs ranging from 0–10 V (unipolar) for forward only operation. Also, voltage inputs ranging from -10 to +10 V (bipolar) can be applied for both directions, where negative voltage inputs are used in reverse operations.

5.1.4.3.1 Setting a Frequency Reference for 0–10 V Input

Set IN-06 (V1 Polarity) to ‘0 (unipolar)’. Use a voltage output from an external source or use the voltage output from the VR terminal to provide inputs to V1. Refer to the diagrams below for the wiring required for each application.

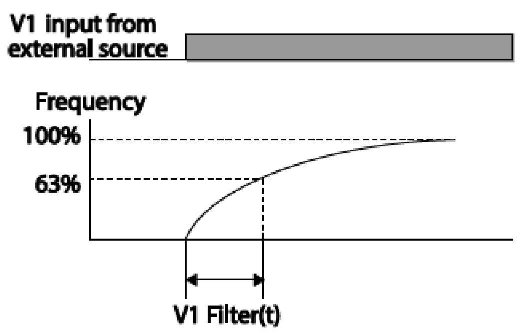
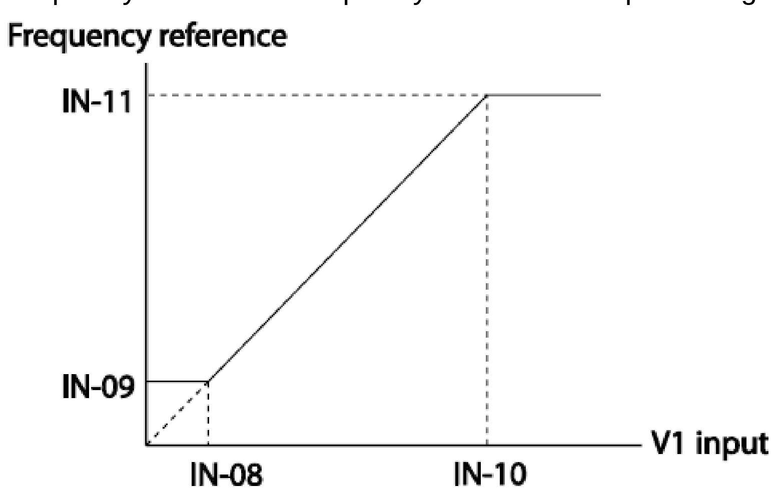


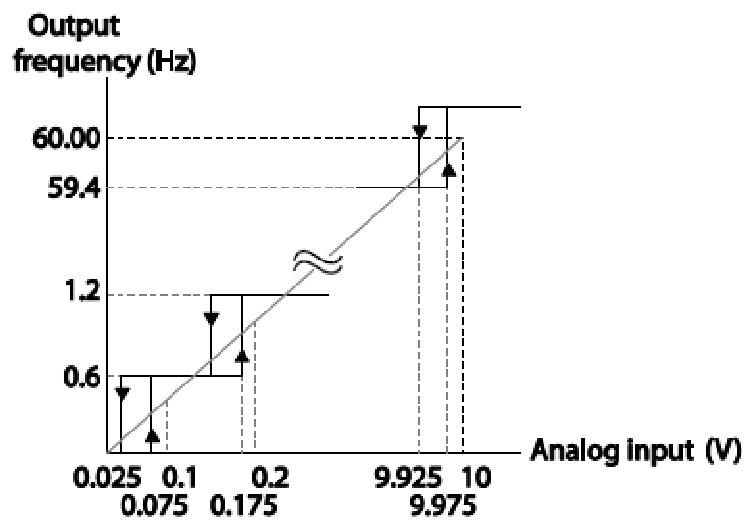
[External source application] [Internal source (VR) application]

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	2	V1	0–11	-
IN	01	Frequency at maximum analog input	Freq at 100%	Maximum frequency		0.00– Max. Frequency	Hz
	05	V1 input monitor	V1 Monitor[V]	0.00		0.00–12.00	V
	06	V1 polarity options	V1 Polarity	0	Unipolar	0–1	-
	07	V1 input filter time constant	V1 Filter	10		0–10000	msec
	08	V1 minimum input voltage	V1 volt x1	0.00		0.00–10.00	V
	09	Output at V1 minimum voltage (%)	V1 Perc y1	0.00		0.00–100.00	%
	10	V1 maximum input voltage	V1 Volt x2	10.00		0 .00– 12.00	V
	11	Output at V1 maximum voltage (%)	V1 Perc y2	100.00		0–100	%
IN	16	Rotation direction options	V1 Inverting	0	No	0–1	-
	17	V1 Quantizing level	V1 Quantizing	0.04		0.00, Low Freq– High Freq*	%

*Quantizing is disabled if ‘0’ is selected.

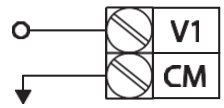
0–10 V Input Voltage Setting Details

Code	Description
IN-01 Freq at 100%	Configures the frequency reference at the maximum input voltage when a potentiometer is connected to the control terminal block. A frequency set with parameter IN-01 becomes the maximum frequency only if the value set in parameter IN-11 (or IN-15) is 100 (%). • Set parameter IN-01 to 60.00 and use default values for parameters IN-05–IN-16. Motor will run at 60.00 Hz when a 10 V input is provided at V1. • Set parameter IN-11 to 50.00 (%) and use default values for parameters IN-01–IN-16. Motor will run at 30.00 Hz (50% of the default maximum frequency 60 Hz) when a 10 V input is provided at V1.
IN-05 V1 Monitor[V]	Monitors the input voltage at V1.
IN-07 V1 Filter	V1 Filter may be used when there are large variations in the applied reference frequency (noise filter). Variations can be mitigated by increasing the time constant, but this will delay the response time when changing the reference frequency. The value t (time) indicates the time required for the frequency to reach 63% of the reference, when external input voltages are provided in multiple steps. 
IN-08 V1 Volt x1 IN-09 V1 Perc y1 IN-10 V1 Volt x2 IN-11 V1 Perc y2	These parameters are used to configure the slope and offset values of the Output Frequency based on a frequency reference of Input Voltage. 

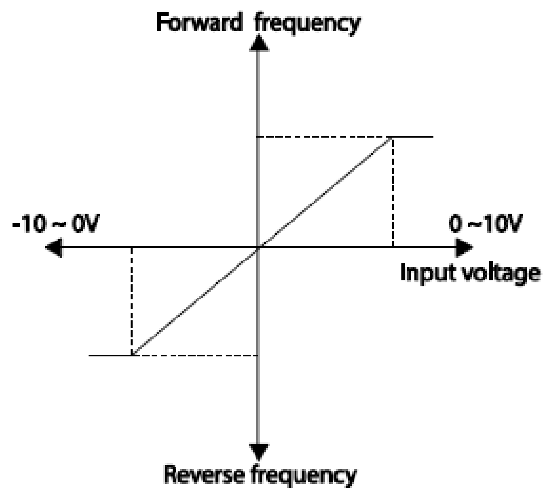
Code	Description
IN-16 V1 Inverting	Inverts the direction of rotation. Set this parameter to '1 (Yes)' if you need the motor to run in the opposite direction from the current rotation.
IN-17 V1 Quantizing	Quantizing may be used when the noise level is high in the analog input signal. The inverter output frequency changes in consistent intervals (steps) based on measuring (quantizing) the height (value) of the analog input signal. Delicate control (resolution) of the output frequency is not as good compared to standard resolution of 0.1%. Parameter values for quantizing refer to a percentage based on the maximum input. Therefore, when IN-17 is set to 1% of the analog maximum input of 10 V and with a maximum frequency of 60 Hz, the output frequency will increase or decrease by 0.6 Hz per 0.1V difference. With quantizing applied, changes to the inverter output frequency for analog signal increase and analog signal decrease are treated differently. When the input signal increases, the output frequency starts increasing when the height becomes equivalent to 3/4 of the quantizing value. From then on, the output frequency increases according to the quantizing value. When the input signal decreases, the output frequency starts decreasing when the height becomes equivalent to 1/4 of the quantizing value. Although the noise can be reduced using the low-pass filter (IN-07), the inverter output response to the input signal takes longer with higher filter times. It can become difficult to control the output frequency when the input signal is delayed, a period of long pulse (ripple) may occur on the output frequency. 

5.1.4.3.2 IN-12 Setting a Frequency Reference for -10–+10V Input

Set DRV-07 (Frequency reference source) to '2 (V1)', and then set IN- 06 (V1 Polarity) to '1 (bipolar)'. Use the output voltage from an external source to provide a bipolar input to V1.



V1 terminal wiring



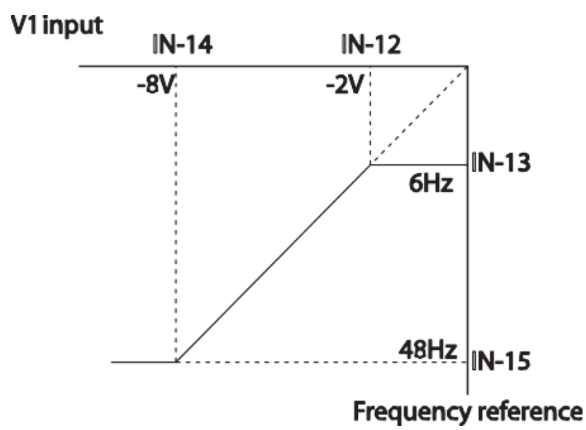
[Bipolar input voltage and output frequency]

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	2	V1	0–11	-
IN	01	Frequency at maximum analog input	Freq at 100%	60.00		0– Max Frequency	Hz
	05	V1 input monitor	V1 Monitor	0.00		-12.00–12.00 V	V
	06	V1 polarity options	V1 Polarity	1	Bipolar	0–1	-
	12	V1 minimum input voltage	V1- volt x1	0.00		-10.00–0.00 V	V
	13	V1 output at minimum voltage (%)	V1- Perc y1	0.00		-100.00–0.00%	%
	14	V1 maximum input voltage	V1- Volt x2	-10.00		-12.00 –0.00 V	V
	15	V1 output at maximum voltage (%)	V1- Perc y2	-100.00		-100.00–0.00%	%

Rotational Directions for Different Voltage Inputs

Command / Voltage Input	Input voltage	
	0–+10 V	-10–0 V
FWD	Forward	Reverse
REV	Reverse	Forward

-10–10 V Voltage Input Setting Details

Code	Description
IN-12 V1- Volt x1’ IN-13 V1 Perc y1’ IN-14 V1 Volt x2’ IN-15 V1- Perc y2’	These parameters are used to set the slope and offset value of the output frequency based on a frequency reference with a negative input voltage. These parameters are displayed only when IN-06 is set to ‘1 (bipolar)’. As an example, if the minimum input voltage (at V1) is set to -2 (V) with 10% output ratio, and the maximum voltage is set to -8 (V) with 80% output ratio respectively, the output frequency will vary within the range of 6–48 Hz.  For details about the 0–+10 V analog inputs, refer to the code descriptions IN-08 (V1 volt x1) – IN-11 (V1 Perc y2) on page 108.

5.1.4.4 IN-50 I2 Terminal as the Frequency Reference Source

You can set and modify a frequency reference by applying inputs to the I2 terminal. Inputs can be 0(4)-20mA or I2 can be used as a second voltage input (0-10VDC) based on the position of switch SW4.

5.1.4.4.1 Setting a Frequency Reference for 0(4) - 20mA Input

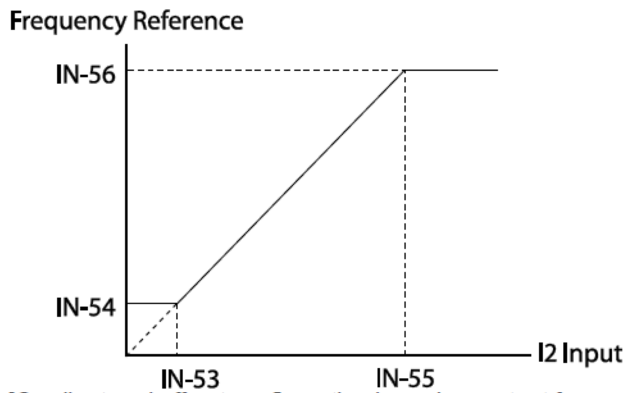
You can modify the frequency reference using the I2 input terminal. First with SW4, select I2 (left is default) for the current input. Set DRV-07 (Frequency reference source) to '5 (I2)' and apply 0(4)–20 mA input current to I2. Scaling of the input current is done with IN-53 ~ IN-56. View the input current at IN-50.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	5	I2	0–11	-
IN	01	Frequency at maximum analog input	Freq at 100%	60.00		0–Maximum Frequency	Hz
	50	I2 input monitor	I2 Monitor	0.00		0.00–24.00	mA
	52	I2 input filter time constant	I2 Filter	10		0–10000	ms
	53	I2 minimum input current	I2 Curr x1	4.00		0.00–20.00	mA
	54	I2 output at minimum current (%)	I2 Perc y1	0.00		0–100	%
	55	I2 maximum input current	I2 Curr x2	20.00		0.00–24.00	mA
	56	I2 output at maximum current (%)	I2 Perc y2	100.00		0.00–100.00	%
	61	I2 rotation direction options	I2 Inverting	0	No	0–1	-
	62	I2 Quantizing level	I2 Quantizing	0.04		0.00*, 0.04–10.00	%

Quantizing is disabled if '0' is selected.

Input Current (I2) Setting Details

Code	Description
IN-01 Freq at 100%	Configures the frequency reference for operation at the maximum current (when IN-56 is set to 100%). • If IN-01 is set to 60.00 Hz and default settings are used for IN-53–56, 20 mA input current (max) to I2 will produce a frequency reference of 60.00 Hz. • If IN-56 is set to 50.00%, and default settings are used for IN-01 (60 Hz) and IN-53–55, 20 mA input current (max) to I2 will produce a frequency reference of 30.00 Hz (50% of 60 Hz).
IN-50 I2 Monitor	Monitors input current at I2.
IN-52 I2 Filter	Configures the time for the operation frequency to reach 63% of target frequency based on the input current at I2.

<table>
<tr><td>IN-53 I2 Curr x1
IN-54 I2 Perc y1
IN-55 I2 Curr x2
IN-56 I2 Perc y2</td><td>Configures the slope and off-set values of the output frequency based on a mA input at the I2 terminal.


[Gradient and off-set configuration based on output frequency]</td></tr>
</table>

5.1.4.4.2 IN-35 Setting a Frequency Reference for 0-10V Input (I2 Terminal)

You can modify the frequency reference using a voltage input at the I2 terminal. First with SW4, select V2 (right) for the voltage input. Set DRV-07 (Frequency reference source) to '4 (V2)' and apply 0–12V input voltage to the I2 terminal. Scaling of the input voltage is done with IN-38 ~ IN-41. View the input voltage at IN-35. Parameters for voltage input (IN-35–47) will only be displayed when I2 is set to receive a voltage input (DRV-07 is set to '4' (V2)).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	4	V2	0–11	-
IN	35	V2 input display	V2 Monitor	0.00		0.00–12.00	V
	37	V2 input filter time constant	V2 Filter	10		0–10000	msec
	38	Minimum V2 input voltage	V2 Volt x1	0.00		0.00–10.00	V
	39	Output % at minimum V2 voltage	V2 Perc y1	0.00		0.00–100.00	%
	40	Maximum V2 input voltage	V2 Volt x2	10.00		0.00–10.00	V
	41	Output % at maximum V2 voltage	V2 Perc y2	100.00		0.00–100.00	%
	46	Invert V2 rotational direction	V2 Inverting	0	No	0–1	-
	47	V2 quantizing level	V2 Quantizing	0.04		0.00*, 0.04–10.00	%

Quantizing is disabled if '0' is selected.

5.1.4.5 IN-91 TI Terminal (Pulse) as the Frequency Reference Source

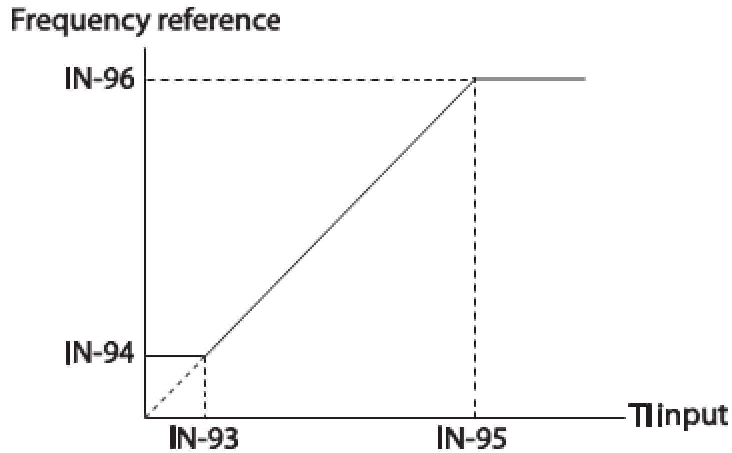
You can modify the frequency reference using a pulsed frequency input at the TI terminal. Set DRV-07 (Frequency reference source) to '9 (Pulse)' and apply a 0–32 kHz. input to TI. Scaling of the pulsed input is done with IN-93 ~ IN-96. View the pulsed input at IN-91. Parameters for a pulse input (IN-91–98) will only be displayed when TI is set to receive a pulsed input (DRV-07 is set to '9' (Pulse)).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	9	Pulse	0–11	-
IN	01	Frequency at maximum analog input	Freq at 100%	60.00		0.00–Maximum frequency	Hz
	91	Pulse input display	TI Monitor	0.00		0.00–50.00	kHz
	92	TI input filter time constant	TI Filter	10		0–9999	mse c
	93	TI input minimum pulse	TI Pls x1	0.00		0.00–32.00	kHz
	94	Output% at TI minimum pulse	TI Perc y1	0.00		0.00–100.00	%
	95	TI Input maximum pulse	TI Pls x2	32.00		0.00–32.00	kHz
	96	Output% at TI maximum pulse	TI Perc y2	100.00		0.00–100.00	%
	97	Invert TI direction of rotation	TI Inverting	0	No	0–1	-
	98	TI quantizing level	TI Quantizing	0.04		0.00*, 0.04–10.00	%

*Quantizing is disabled if '0' is selected.

TI Pulse Input Setting Details

Code	Description
IN-01 Freq at 100%	Configures the frequency reference at the maximum pulse input. The frequency reference is based on 100% of the value set with IN-96. • If IN-01 is set to 40.00 and parameters IN-93–96 are set at default, 32 kHz input to TI yields a frequency reference of 40.00 Hz. • If IN-96 is set to 50.00 and parameters IN-01, IN-93–95 are set at default, 32 kHz input to the TI terminal yields a frequency reference of 30.00 Hz.
IN-91 TI Monitor	Displays the pulse frequency supplied at TI.
IN-92 TI Filter	Sets the time for the pulse input at TI to reach 63% of its nominal frequency (when the pulse frequency is supplied in multiple steps).

IN-93 TI Pls x1 IN-94 TI Perc y1 IN-95 TI Pls x2 IN-96 TI Perc y2	Configures the slope and offset values for the output frequency based on a pulse input at the TI terminal. 
IN-97 TI Inverting IN-98 TI Quantizing	Identical to IN-16~17 (refer to *5.1.4.3.1 Setting a Frequency Reference for 0–10 V Input on page 108*, V1 Inverting and V1 Quantizing.

5.1.4.6 Setting a Frequency Reference via RS-485 Communication

Control the inverter with upper-level controllers, such as PCs or PLCs, via RS-485 communication. Set DRV-07 (Frequency reference source) to '6 (Int 485)' and use the RS-485 signal input terminals (S+/S-/SG) for communication. Refer to *10 RS-485 Communication Features on page 299*.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	6	Int 485	0–11	-
COM	01	Integrated RS-485 communication inverter ID	Int485 St ID	-	1	1–MaxComID*	-
	02	Integrated communication protocol	Int485 Proto	0	ModBus RTU	0–5	-
				4	BACnet		
				5	Metasys-N2		
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–8	-
	04	Integrated communication frame configuration	Int485 Mode	0	D8/PN/S1	0–3	-
				1	D8/PN/S2		
				2	D8/PE/S1		
				3	D8/PO/S1		

*If COM-02 is set to '0' (Modbus RTU), MaxComID is '250'. If set to '4' (BACnet), MaxComID is '127'.

5.1.5 DRV-09 Control Mode

5.1.5.1 V/F Control

The speed of an AC motor when powered by an inverter is controlled by a scalar method. The most common type of inverter control is referred to as V/F (or V/Hz). This ratio can be calculated by taking the rated output voltage of the inverter and dividing by the maximum frequency of the motor. EX: 460V/60 Hz. = 7.67 V/Hz. The ratio can be fixed (linear) or variable (squared) throughout the speed range. Refer to *5.3.3 BAS-07 V/F (Voltage/Frequency) Control on page 131* V/F Pattern.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	0	V/F	0–1	-
MOT	02	Base frequency	Base Freq	60.00		30.00–400.00	Hz

5.1.5.2 Slip Compensation Operation

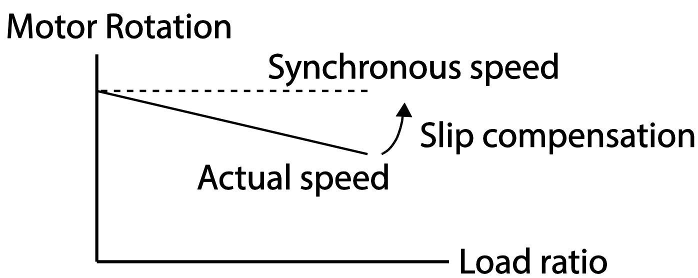
Slip refers to the variation between the set frequency (speed) and actual motor rotation speed. During operation at a set frequency, the slip will vary as the load changes. As the load increases, slip will increase. Slip compensation is used for loads that require compensation of these speed variations.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	1	Slip Compen	-	-
MOT	01	Motor capacity	Motor Capacity	2	0.75 kW (0.75kW based)	0-15	-
	03	Number of motor poles	Pole Number	4		2-48	-
	04	Rated slip speed	Rated Slip	90 (0.75kW based)		0-3000	rpm
	05	Rated motor current	Rated Curr	3.6 (0.75kW based)		1.0-1000.0	A
	06	Motor no-load current	Noload Curr	1.6 (0.75kW based)		0.5-1000.0	A
	08	Motor efficiency	Efficiency	72 (0.75kW based)		70-100	%

Slip Compensation Operation Setting Details

Code	Description
DRV-09 Control Mode	Set DRV-09 to 2 (Slip Compen) to operate in slip compensation mode.
MOT-01 Motor Capacity	Set the capacity of the motor connected to the inverter.
MOT-03 Pole Number	Enter the number of poles from the motor name plate.
MOT-04 Rated Slip	Enter the slip RPM's from the motor name plate. This may be shown in Hz. If so, convert to RPM's. Slip frequency may also be calculated. $f_s = f_r - \frac{Rpm \times P}{120}$ f_s=Rated slip frequency f_r=Rated frequency rpm=Number of the rated motor rotations P=Number of motor poles
MOT-05	Enter the rated current from the motor name plate.

Code	Description
Rated Curr	
MOT-06 Noload Curr	Enter the measured no-load current at the rated frequency. If no-load current is difficult to measure, enter a current equivalent to 30–50% of the rated motor current.
MOT-08 Efficiency	Enter the efficiency from the motor name plate.



For other DRV-09 control mode settings, refer to section *7 Sensorless Vector Control on page 239.*

5.1.6 DRV-11 Jog Frequency

The jog operation allows for temporary control of the inverter. There are two was to apply a jog and start command using the digital input terminals.

- Jog-1 using a digital input terminal set to JOG along with a start command (Fx or Rx).
- Jog-2 using a single digital input set to FWD JOG or REV JOG.

Refer to section *5.6.4.5 JOG operation on page165* for more details on Jog functions using digital inputs.

5.1.7 DRV-15 Torque Boost

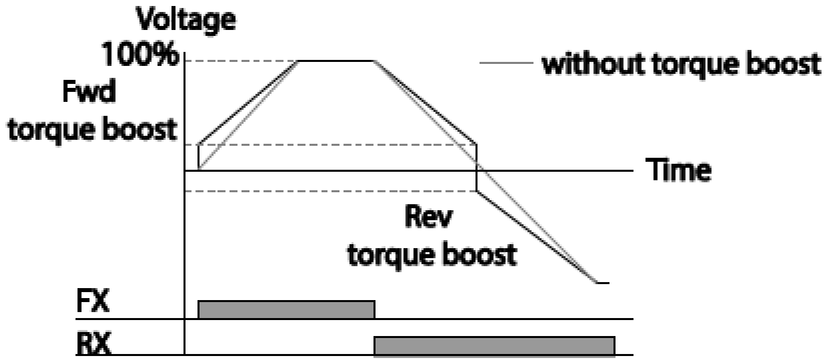
5.1.7.1 Manual Torque Boost

Manual torque boost enables users to adjust output voltage during starting and low speed operation. This setting improves motor starting properties and increases low speed torque. Configure manual torque boost for loads that require high starting torque.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	15	Torque boost options	Torque Boost	0	Manual	0–2	-
				1	Auto 1		
				2	Auto 2		
	16	Forward torque boost	Fwd Boost	2.0	240V, 480V: 7.5~125HP	0.0–15.0	%
				1.2	575V: 7.5~125HP		
				1.0	480V: 150~800HP		
	17	Reverse torque boost	Rev Boost	2.0	240V, 480: 7.5~125HP	0.0–15.0	%
				1.2	575V: 7.5~125HP		
				1.0	480V: 150~800HP		

Manual Torque Boost Setting Details

Code	Description
DRV-16 Fwd Boost	Set torque boost for forward operation.
DRV-17 Rev Boost	Set torque boost for reverse operation.



> **Caution**
> Too much torque boost can result in over-excitation and motor overheating. Over current faults may also occur.

5.1.7.2 Auto Torque Boost-1

Auto torque boost-1 enables the inverter to automatically calculate the amount of output voltage required for torque boost based on the entered motor parameters. Because auto torque boost-1 requires motor-related parameters such as stator resistance, inductance, and no-load current, auto tuning (MOT-11) has to be performed before auto torque boost-1 can be configured. Refer to section *5.2.5 MOT-11 Auto Tuning on pg, 124.*

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	15	Torque boost mode	Torque Boost	1	Auto 1	0–2	-
MOT	11	Auto tuning	Auto Tuning	3	Rs+Lsigma	0–3	-

5.1.7.3 Auto Torque Boost 2 (No Motor Parameter Tuning Required)

Auto torque boost-2 does not require Auto Tuning. DRV-23 (ATB Volt Gain) value is used to adjust the amount of compensation required for each load. It prevents stalls or overcurrent faults at start up.

Group	Code	Name	LCD Display	Settings		Setting Range	Unit
DRV	15	Torque boost mode	Torque Boost	2	Auto 2	0–2	-
DRV	22	Auto torque boost filter gain	ATB Filt Gain	10		1 - 9999	msec
DRV	23	Auto torque boost voltage gain	ATB Volt Gain	100.0		0 - 300.0	%

5.1.8 DRV-19 Start Frequency

The inverter output frequency can be limited by setting Start and Maximum frequencies. These include start frequency, maximum frequency, upper and lower frequency limits. Refer to *5.4.7 ADV-24 Frequency Limits - Upper/Lower Limit Frequency on page 147* for details on frequency limits.

5.1.8.1 Frequency Limit Using Max. Frequency and Start Frequency

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
DRV	19	Start frequency	Start Freq	0.50	0.01–10.00	Hz
	20	Maximum frequency	Max Freq	60.00	40.00–400.00 240V, 480V 40.00-120.00 575V 40.00-120.00 IM SVC 40.00-180.00 PM SVC	Hz

Frequency Limit Using Maximum Frequency and Start Frequency - Setting Details

Code	Description
DRV-19 Start Freq	Sets the start frequency. A start frequency is a frequency at which the inverter starts voltage output. The inverter does not produce output voltage while the frequency reference is lower than the set frequency. However, if a deceleration stop is made while operating above the start frequency, output voltage will continue until the operation frequency reaches a full-stop (0 Hz). If the reference frequency is lower than the start frequency, the parameter value will be 0.00.
DRV-20 Max Freq	All frequency selections are restricted to frequencies within the Start and Max limits. This restriction also applies when you in input a frequency reference using the keypad.

5.1.9 DRV-21 Changing the Displayed Units (Hz−Rpm)

You can change the units used to display the operational speed of the inverter by setting DRV- 21 (Speed unit selection) to 0 (Hz Display) or 1 (Rpm Display).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	21	Speed unit selection	Hz/Rpm Sel	0	Hz Display	0–1	-
				1	Rpm Display		

5.1.10 DRV-30 Changing the Displayed Units (kW/HP)

You can change the units used to display the inverter and motor capacity by setting DRV- 30 (kW/HP Unit Sel) to 0 (kW Display) or 1 (HP Display).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	30	Kw/HP Unit Selection	kW/HP Unit Sel	0	kW Display	0–1	-
				1	HP Display		

5.1.11 DRV-31 Quick Start

The inverter LCD boots up to the “Quick Start” menu on power up. The Quick Start menu contains basic parameter settings for control and protection of a standard induction motor. The default settings are used for a standard induction motor controlled with a linear (fixed) V/Hz. pattern with a base frequency of 60 Hz.

- During programming, use escape (ESC) to exit the Quick Start menu.
- To access the Quick Start menu when already powered up, set DRV-31 (PopUp Q. Start) to “Yes” to return to the Run Quick Start menu.
- The inverter will display the Quick Start menu on every power up. Parameter CNF-61 (Run Quick Start?) is set to “Yes” by default. To disable the Quick Start menu at power up, set CNF-61 to “No”.

DRV	31	Quick Start Pop Up menu	PopUp Q. Start	0	No	0 - 1
				1	Yes	
CNF	61	Quick Start menu setting	Run QuickStart?	0	No	0 - 1
				1	Yes	

Refer to section *2.6 Run Quick Start on page 52* for more details on the Quick Start Menu.

5.2 MOT Group (MOT)

5.2.1 MOT-01 Set the motor related parameters.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
MOT	01	Motor capacity	Motor Capacity	Varies	0-30	-
	02	Base Frequency	Base Freq	60.00(Hz.)	30.00–400.00 (Hz) 40.00-120.00(Hz) IM S/L 30.00–180.00 (Hz) PM S/L2	
	03	Number of motor poles	Pole Number	4	2-48	-
	04	Rated slip speed	Rated Slip	Based on MOT-01	0-3000	rpm
	05	Rated motor current	Rated Curr	Based on MOT-01	0.0-1000.0	A
	06	Motor no-load current	Noload Curr	Based on MOT-01	0.0-1000.0	A
	07	Motor rated voltage	Motor Volt	230V/460V/575V	0, 170-480 (V), 525-600 (V)	
	08	Motor efficiency	Efficiency	Based on MOT-01	70-100	%

Motor Data Setting Details

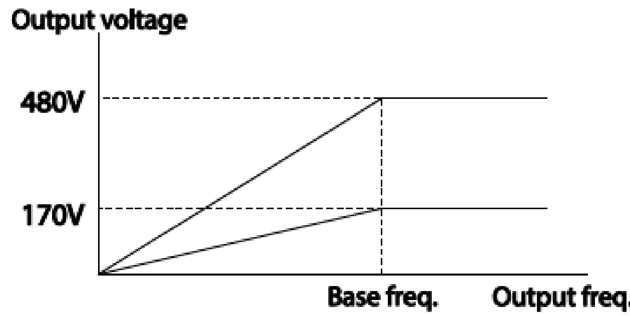
Code	Description
MOT-01 Motor Capacity	Set the capacity of the motor connected to the inverter.
MOT-02 Base Frequency	Set the name plate frequency of the motor connected to the inverter.
MOT-03 Pole Number	Enter the number of poles from the motor name plate.
MOT-04 Rated Slip	Enter the slip RPM's from the motor name plate. This may be shown in Hz. If so, convert to RPM's. Slip frequency may also be calculated. $$f_s = f_r - \frac{Rpm \times P}{120}$$ f_s=Rated slip frequency f_r=Rated frequency rpm=Number of the rated motor rotations P=Number of motor poles
MOT-05 Rated Curr	Enter the rated current from the motor name plate.
MOT-06 Noload Curr	Enter the measured no-load current at the rated frequency. If no-load current is difficult to measure, enter a current equivalent to 30–50% of the rated motor current.
MOT-07 Motor Volt	Enter the motor rated voltage. See Output Voltage Setting below.
MOT-08 Efficiency	Enter the efficiency from the motor name plate.

5.2.2 MOT-07 Output Voltage Setting

Output voltage settings are required when a motor's rated voltage differs from the input voltage to the inverter. Set MOT-07 to configure the motor's rated operating voltage. The set voltage becomes the output voltage of the inverter at the base frequency (MOT-02). When the inverter operates above the base frequency and when the motor's voltage rating is lower than the input voltage, the inverter adjusts the voltage and supplies the motor to the voltage set at MOT-07 (motor rated voltage). If the motor's rated voltage is set higher than the input voltage at the inverter, the inverter will output a voltage based on the input voltage.

If MOT-07 (motor rated voltage) is set to ‘0’, the inverter corrects the output voltage based on the input voltage in the stopped condition. If the output frequency is higher than the base frequency and the input voltage is lower than the MOT-07 setting, the inverter will output a voltage based on the input voltage. The default settings are 230V, 460V or 575V based on the inverter rating.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
MOT	07	Motor rated voltage	Rated Volt	0, 170-480 (V), 525-600 (V)	170-480 525-600	V



5.2.3 MOT-09 Trim Power %

When viewing “Output Power”, use Trim Power % (MOT-09) to scale the displayed power when compared to measured power.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
MOT	09	Trim Power display	Trim Power %	100 (%)	70-130	%

If the output power displayed on the keypad is lower than expected, increase the set value at MOT-09 (Trim Power %). If the output power displayed on the keypad is higher than expected, decrease this set value. The output power display is calculated using voltage and current. Use MOT-09 to correct the error that may occur when the power factor is low.

5.2.4 MOT-10 Power Source - Voltage and Frequency

Set inverter supply (input) voltage. The Low voltage fault level changes automatically based on the set voltage in MOT-10.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
MOT	10	Input power voltage	AC Input Volt	240V	240	170–240	V
				480V	480	320–480	
				600V	575	446-660	

Select the frequency of input power. When the frequency is set to 50 Hz, the frequencies set for 60 Hz (including the maximum frequency and base frequency) will change to 50 Hz. Likewise, changing the input frequency setting from 50 Hz to 60 Hz will change all related settings from 50 Hz to 60 Hz.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	10	Input power frequency	60/50 Hz Src	0	60Hz	0-1	-

5.2.5 MOT-11 Auto Tuning

The motor parameters can be measured automatically and are used for auto torque boost or sensorless vector control.

Example - Auto-Tuning Based on 7.5 HP (5.5kW), 230V, 60Hz, 4 Pole Motor

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
MOT	01	Motor capacity	Motor Capacity	1	7.5 HP (5.5 kW)	0-30	-
	03	Motor pole number	Pole Number	4		2-48	-
	04	Rated slip speed	Rated Slip	45		0-3000	rpm
	05	Rated motor current	Rated Curr	21.0		1.0-1000.0	A
	06	Motor no-load current	Noload curr	7.1		0.5-1000.0	A
	07	Motor rated voltage	Motor Volt	230		170-480	V
	08	Motor efficiency	Efficiency	85		70-100	%
	11	Auto tuning	Auto Tuning	0	None	-	-
	12	Stator resistance	Rs	.314		Depends on the motor setting	Ω
	13	Leakage inductance	Lsigma	3.19		Depends on the motor setting	mH
	14	Stator inductance	Ls	-		Depends on the motor setting	mH
	15	Rotor time constant	Tr	-		25-5000	ms

Auto Tuning Default Parameter Settings

Motor Voltage	kW	HP	Rated Current(A)	No-load Current(A)	Rated Slip Frequency(Hz)	Stator Resistance(Ω)	Leakage Inductance(mH)
230V	5.5	7.5	21	7.1	1.5	0.314	3.19
	7.5	10	28.2	9.3	1.33	0.169	2.844
	11	15	40	12.4	1	0.12	1.488
	15	20	53.6	15.5	1	0.084	1.118
	18.5	25	65.6	19	1	0.0676	0.819
	22	30	76.8	21.5	1	0.0560	0.948
	30	40	104.6	29.3	1	0.0422	0.711
	37	50	128.6	34.7	1	0.0338	0.568
	45	60	156	42.1	1	0.0281	0.474
	55	75	184.1	49.7	1	0.0231	0.389
	75	100	244.5	61.1	1	0.0169	0.284
	90	125	289.5	72.3	1	0.0140	0.25

Motor Voltage	kW	HP	Rated Current(A)	No-load Current(A)	Rated Slip Frequency(Hz)	Stator Resistance(Ω)	Leakage Inductance(mH)
460V	5.5	7.5	12.1	4.1	1.5	0.94	9.62
	7.5	10	16.3	5.4	1.33	0.52	8.53
	11	15	23.2	7.2	1	0.36	4.48
	15	20	31	9	1	0.25	3.38
	18.5	25	38	11	1	0.168	2.457
	22	30	44.5	12.5	1	0.168	2.844
	30	40	60.5	16.9	1	0.1266	2.133
	37	50	74.4	20.1	1	0.1014	1.704
	45	60	90.3	24.4	1	0.0843	1.422
	55	75	106.6	28.8	1	0.0693	1.167
	75	100	141.6	35.4	1	0.0507	0.852
	90	125	167.6	41.9	1	0.0399	0.715
	110	150	203.5	48.8	1	0.0326	0.585
	132	200	242.3	58.1	1	0.0272	0.488
	160	250	290.5	69.7	1	0.0224	0.403
	185	300	335	77	1	0.021	0.38
	250	400	467.8	104.9	1	0.1455	2.615
	315	500	604	132.8	1	0.114	2.04
	400	650	782	161.2	1	0.0906	1.616
	500	800	985.3	206.2	1	0.07	1.33

Motor Voltage	kW	HP	Rated Current(A)	No-load Current(A)	Rated Slip Frequency(Hz)	Stator Resistance(Ω)	Leakage Inductance(mH)
575V	5.5	7.5	7.5	3.6	1.0	1.330	21.83
	7.5	10	10.0	4.1	1.33	0.859	19.36
	11	15	14.6	6.0	1.16	0.521	10.17
	15	20	19.2	8.2	1	0.298	7.67
	18.5	25	24.0	8.2	1	0.276	5.58
	22	30	29.0	12.8	1	0.189	6.46
	30	40	37.0	13.7	0.83	0.1246	4.841
	37	50	45.0	14.2	1	0.1109	3.868
	45	60	55.0	18.7	0.66	0.1085	3.228
	55	75	68.7	20.9	0.66	0.0781	2.649
	75	100	89.6	22.9	0.5	0.0459	1.934
	90	125	115.0	35.8	0.5	0.0357	1.623

Auto Tuning Parameter Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>MOT-01 ~
MOT-08</td><td>Enter motor parameters prior to performing Auto Tuning.</td></tr>
<tr><td>MOT-11
Auto Tuning</td><td>Select one of the auto tuning options and then press the [ENT] button to run the auto tuning. After Auto Tuning is complete, the parameter value will return to ‘0’.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>Auto tuning function is not enabled.</td></tr>
<tr><td>1</td><td>All (rotating type)</td><td>Measures motor parameters during rotation. These include MOT-12 ~ MOT-15 (stator resistance (Rs), leakage inductance (Lsigma), stator inductance (Ls), and rotor time constant (Tr). If the load is connected to the motor, the parameters may not be measured accurately. For accurate measurements, remove the load attached to the motor. However, note that the rotor time constant (Tr) will be measured in a stopped position.</td></tr>
<tr><td>2</td><td>All (static type)</td><td>Measures all parameters while the motor is in the stopped position. These include MOT-12 ~ MOT-15 (stator resistance (Rs), leakage inductance (Lsigma), stator inductance (Ls),), rotor time constant (Tr). The measurements are not affected when the load is connected to the motor. However, do not rotate the motor from the load side.</td></tr>
<tr><td>3</td><td>Rs+Lsigma (rotating type)</td><td>Measures parameters while the motor is rotating. The measured motor parameters are used for auto torque boost or sensorless vector control.</td></tr>
<tr><td>4</td><td>Tr (static type)</td><td>Measures the rotor time constant (Tr) with the motor in the stopped position and Control Mode (DRV-09) is set to IM Sensorless</td></tr>
<tr><td>6</td><td>All PM*

*230V/460V only, not applicable to 575V motors</td><td>When DRV-09 (Control Mode) is set to 4 (PM Sensorless), the motor parameters are measured in the stopped position. Check the motor’s nameplate for motor specifications, such as the base frequency (MOT-02), motor rated voltage (MOT-07), pole number (MOT-03). Then, perform auto tuning by setting MOT-11 to 4 [All (PM)]. The auto tuning operation will configure parameters MOT-16 ~ MOT-19 (Rs PM, Ld PM, Lq PM, and PM Flux Ref).</td></tr>
</table></td></tr>
<tr><td>MOT-12~15 (IM)
MOT-16~22 (PM)</td><td>Displays motor parameters measured by auto tuning. For parameters that are not included in the auto tuning measurement list, the default setting will be displayed.</td></tr>
</table>

Caution

Perform auto tuning ONLY after the motor has completely stopped running.

Before you run auto tuning, enter the motor pole number, rated slip, rated current, rated voltage and efficiency from the motor’s name plate. The default parameter setting is used for values that are not entered.

Parameter values measured with static auto tuning may be less accurate compared with rotation type auto tuning where parameters are measured while the motor is rotating. Inaccuracy of the measured parameters may degrade the performance of sensorless operation. Therefore, only run static type auto tuning when the motor cannot be rotated (when gearing and belts cannot be separated easily, or when the motor cannot be separated mechanically from the load).

In PM synchronous motor sensorless control mode before performing auto tuning enter the motor’s name plate and other the motor specifications, such as the base frequency, pole number, rated current and voltage, and efficiency, as the detected parameter values may not be accurate if the motor’s base specifications are not entered.

5.3 Basic Group (BAS)

5.3.1 BAS-01 2nd Operating Mode - 2nd Source

Second (2nd) Operating Mode is commonly referred to as Hand-Off-Auto switching or Local-Off-Remote switching. The inverter can be operated (Start/Stop and Reference Frequency) by two different operating modes and switch between them as required. The first Start/Stop source and Reference Frequency source are set with parameters DRV-06 and DRV-07. The second Start/Stop source and Reference Frequency source are set with parameters BAS-01 and BAS-02. A digital input terminal set to ‘17, 2nd Source’ will provide the switching input. Set the reference frequency after switching between operating modes as the inverter will run at the selected reference frequency.

Select one of the digital input terminals (P1~P7) and set the corresponding parameter (IN-65 ~ IN-71) to ‘17 2nd Source’. When the digital input is open (or off), parameters DRV-06 and DRV-07 operate the inverter (start/stop and speed). When the input is closed (or on), parameters BAS-01 and BAS-02 operate the inverter (start/stop and speed).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–5	-
	07	Frequency reference source	Freq Ref Src	2	V1	0–11	-
BAS	01	2nd Command source	Cmd 2nd Src	0	Keypad	0–5	-
	02	2nd Frequency reference source	Freq 2nd Src	0	KeyPad-1	0–11	-
IN	65~71	Px terminal configuration	Px Define (Px: P1–P7)	17	2nd Source	0–42	-

2nd Operation Mode Setting Details

Code	Description
BAS-01 Cmd 2nd Src BAS-02 Freq 2nd Src	Select a 2nd Start/Stop source (BAS-01) and a 2nd Reference Frequency source (BAS-02). When the digital input set to 2nd source is closed, parameters BAS-01 and BAS-02 operate the inverter. The 2nd command source settings cannot be changed while operating with DRV-06 and DRV-07 (Main Sources).

Caution

Before switching operating modes using 2nd source, check that the 2nd command source (Start/Stop) is set correctly. The operating state will change based on the status of the Start/Stop input.

- Depending on the parameter settings, the inverter may stop operating when you switch the operating modes. If either DRV-06 (Start/Stop) or BAS-01 (2nd Start/Stop) are set to Keypad, when switching to Keypad with 2nd source, the inverter decels to a stop. If both sources are Fx/Rx-1, inverter keeps running when switched to 2nd source and back to Main (DRV-06).

5.3.2 BAS-03 Operating with Auxiliary References

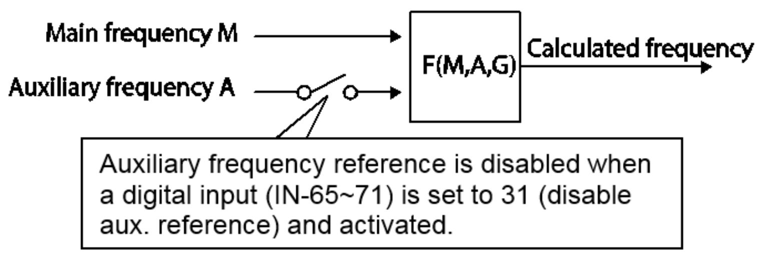
Frequency references can be configured with various calculated conditions that use the main frequency reference and an auxiliary frequency reference simultaneously. The main frequency reference (DRV-06) is used as the operating frequency, while the auxiliary reference is used to modify and fine-tune the main reference.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Frequency reference source	Freq Ref Src	0	Keypad-1	0–12	-
BAS	03	Auxiliary frequency reference source	Aux Ref Src	1	V1	0–4	-
	04	Auxiliary frequency reference calculation type	Aux Calc Type	0	M+(G*A)	0–7	-
	05	Auxiliary frequency reference gain	Aux Ref Gain	0.0		-200.0–200.0	%
IN	65–71	Px terminal configuration	Px Define	31	dis Aux Ref	0-42	-

Auxiliary Reference Setting Details

Code	Description
BAS-03 Aux Ref Src	Set the input type to be used for the auxiliary frequency reference. Setting / Description: 0 None – Auxiliary frequency reference is disabled. 1 V1 – Sets the V1 (voltage) terminal at the control terminal block as the source of auxiliary frequency reference. 3 V2 – Sets the V2 (voltage) terminal at the control terminal block as the source of auxiliary frequency reference (SW2 must be set to “voltage”). 4 I2 – Sets the I2 (current) terminal at the control terminal block as the source of auxiliary frequency reference (SW2 must be set to “current”). 5 Pulse – Sets the TI (pulse) terminal at the control terminal block as the source of auxiliary frequency reference.
BAS-04 Aux Calc Type	The table below list the available calculated conditions for the main and auxiliary frequency references. Set the auxiliary reference gain with BAS-05 (Aux Ref Gain) to configure the auxiliary reference and set the percentage to be reflected when calculating the main reference. Note that items 4–7 below may result in either plus (+) or minus (-) references (forward or reverse operation) even when unipolar analog inputs are used. Configuration / Formula for frequency reference: 0 M+(G*A) – Main reference+(BAS-05xBAS-03xIN-01) 1 M*(G*A) – x(BAS-05xBAS-03) 2 M/(G*A) – Main reference/(BAS-05xBAS-03) 3 M+{M*(G*A)} – Main reference+{Main reference x(BAS-05xBAS-03)} 4 M+G*2*(A-50) – Main reference+BAS-05x2x(BAS-03-50)x IN-01 5 M*{G*2*(A-50)} – Main reference x{BAS-05x2x(BAS-03-50)} 6 M/{G*2*(A-50)} – Main reference/{BAS-05x2x(BAS-03-50)} 7 M+M*G*2*(A-50) – Main reference+Main reference x BAS-05x2x(BAS-03-50) M: Main frequency reference (Hz or rpm) G: Auxiliary reference gain (%) A: Auxiliary frequency reference (Hz or rpm) or gain (%)

Code	Description
BAS-05 Aux Ref Gain	Adjust the gain of the auxiliary reference source selected in BAS-03 (Aux Ref Src).
IN-65–71 Px Define	Set one of the multi-function (digital) input terminals to 31 (dis Aux Ref) and activate it to disable the auxiliary frequency reference. The inverter will operate using the main frequency reference only.



The tables below provide examples of using the available calculated conditions for the main and auxiliary frequency references. Refer to the table to see how the calculations apply with each example. When the maximum frequency value is high, output frequency deviation may result due to analog input variation and deviations in the calculations.

Auxiliary Reference Operation Example #1

- Keypad Frequency Setting is Main Frequency and V1 Analog Voltage is Auxiliary Frequency
- Main frequency: Keypad (operation frequency 30Hz)
- Maximum frequency setting (DRV-20): 400Hz
- Auxiliary frequency setting (BAS-03): V1[Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]
- Auxiliary reference gain setting (BAS-05): 50%
- Analog Input scaling parameters IN-01–58 are at factory default settings

Example: an input voltage of 6V is supplied to V1, and the frequency corresponding to 10V is 60Hz. The table below shows the auxiliary frequency A as 36Hz[=60Hz X (6V/10V)] or 60%[= 100% X (6V/10V)].

Setting*		Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x36Hz(A))=48Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x60%(A))=9Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x60%(A))=100Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x60%(A))}=39Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(60%(A)–50%)x60Hz=36Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30Hz(M)x{50%(G)x2x(60%(A)–50%)}=3Hz
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%–50%)}=300Hz
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(60%(A)–50%)=33Hz

- *M: main frequency reference (Hz or rpm)
- G: auxiliary reference gain (%)
- A: auxiliary frequency reference (Hz or rpm) or gain (%).
- **If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

Auxiliary Reference Operation Example #2

- Keypad Frequency Setting is Main Frequency and I2 Analog Voltage is Auxiliary Frequency
- Main frequency: Keypad (Operation frequency 30Hz)
- Maximum frequency setting (DRV-20): 400Hz
- Auxiliary frequency setting (BAS-03): I2 [Display by percentage(%) or auxiliary frequency(Hz) depending on the operation setting condition]
- Auxiliary reference gain setting (BAS-05): 50%
- Analog Input scaling parameters IN-01–58 are at factory default settings

Example: an input current of 10.4mA is applied to I2, with the frequency corresponding to 20mA of 60Hz. The table below shows auxiliary frequency A as 24Hz(=60[Hz] X {(10.4[mA]-4[mA])/(20[mA] - 4[mA])} or 40%(=100[%] X {(10.4[mA] - 4[mA])/(20[mA] - 4[mA])}.

Setting*		Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x40%(A))=150Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(40%(A)–50%)x60Hz=24Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])	30Hz(M)x{50%(G)x2x(40%(A)-50%)} = -3Hz(Reverse)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%-40%)} = -300Hz(Reverse)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x (40%(A)–50%)=27Hz

- *M: main frequency reference (Hz or rpm)
- G: auxiliary reference gain (%)
- A: auxiliary frequency reference Hz or rpm) or gain (%).
- **If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

Auxiliary Reference Operation Example #3

- V1 is Main Frequency and I2 is Auxiliary Frequency
- Main frequency: V1 (frequency command setting to 5V and is set to 30Hz)
- Maximum frequency setting (DRV-20): 400Hz
- Auxiliary frequency (BAS-03): I2[Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]
- Auxiliary reference gain (BAS-05): 50%
- Analog Input scaling parameters IN-01–58 are at factory default settings

Example: an input current of 10.4mA is applied to I2, with the frequency corresponding to 20mA of 60Hz. The table below shows auxiliary frequency A as 24Hz(=60[Hz]x{(10.4[mA]-4[mA])/(20[mA]-4[mA])} or 40%(=100[%] x {(10.4[mA] - 4[mA]) /(20 [mA] - 4[mA])}.

Setting*		Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x40%(A))=150Hz

3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(40%(A)–50%)x60Hz=24Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30Hz(M)x{50%(G)x2x(40%(A)-50%)}=-3Hz(Reverse)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%-40%)}=-300Hz(Reverse)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(40%(A)–50%)=27Hz

- *M: main frequency reference (Hz or rpm)
- G: auxiliary reference gain (%)
- A: auxiliary frequency reference (Hz or rpm) or gain (%).
- **If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

Note

When the maximum frequency value is high, output frequency deviation may result due to analog input variation and deviations in the calculations.

5.3.3 BAS-07 V/F (Voltage/Frequency) Control

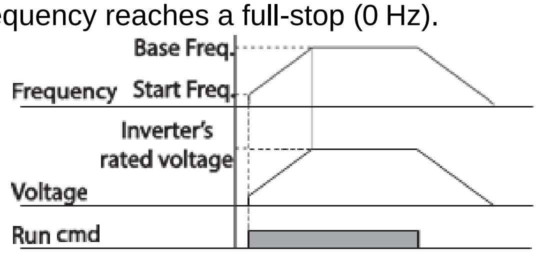
Configure the inverter's output voltages, slope, and output patterns to achieve a target output frequency with V/F control. The amount of torque boost used during low frequency operations can also be adjusted.

5.3.3.1 Linear V/F Pattern Operation

A linear V/F pattern configures the inverter output voltage and frequency to increase or decrease at a fixed rate throughout the speed range. This V/F characteristic is referred to as a constant V/Hz (or V/F) ratio and is applied to loads that require constant torque regardless of speed.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	0	V/F	0–1	-
MOT	02	Base frequency	Base Freq	60.00		30.00–400.00	Hz
DRV	19	Start frequency	Start Freq	0.50		0.01–10.00	Hz
BAS	07	V/F pattern	V/F Pattern	0	Linear	0–3	-

Linear V/F Pattern Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>MOT-02
Base Freq</td><td>Sets the base frequency. A base frequency is the inverter's output frequency when running at the motor's rated voltage. Refer to the motor's name plate to set this parameter value.</td></tr>
<tr><td>DRV-19
Start Freq</td><td>Sets the start frequency. A start frequency is the frequency at which the inverter starts to output voltage. If a deceleration stop is made while operating above the start frequency, output voltage will continue until the operating frequency reaches a full-stop (0 Hz).

</td></tr>
</table>

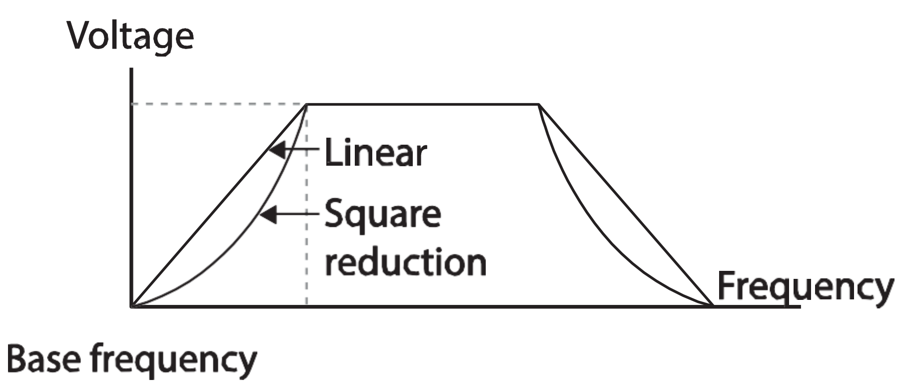
5.3.3.2 Square Reduction V/F Pattern Operation

Square reduction V/F pattern is ideal for variable torque loads such as fans and pumps that do not require high torque at frequencies lower than the base frequency. The inverter provides a non-linear V/F acceleration and deceleration pattern to sustain enough torque throughout the speed range.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	07	V/F pattern	V/F Pattern	1	Square	0–3	-
				3	Square2		

Square Reduction V/F pattern Operation - Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">BAS-07 V/F Pattern</td><td colspan="3">Sets the parameter value to ‘1 (Square)’ or ‘2 (Square2)’ according to the load’s start characteristics.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>1</td><td>Square</td><td>The inverter produces output voltage proportional to 1.5 square of the operating frequency.</td></tr>
<tr><td>3</td><td>Square2</td><td>The inverter produces output voltage proportional to 2 square of the operating frequency. This setup is ideal for variable torque loads such as fans or pumps.</td></tr>
</table>



5.3.3.3 User V/F Pattern Operation

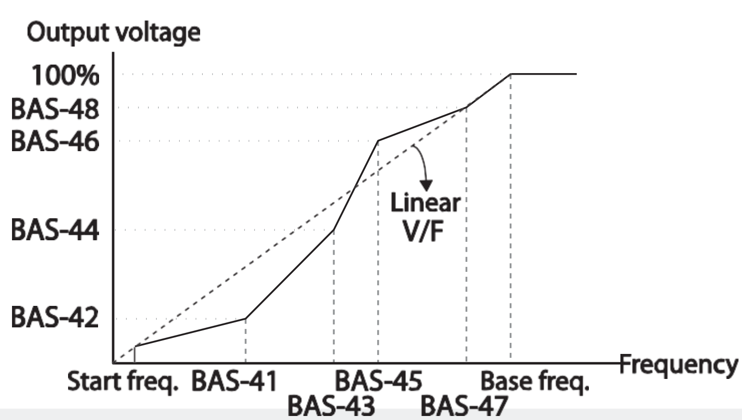
The H2 Series inverter allows the configuration of a user-defined V/F pattern to suit unique load characteristics of motors.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	07	V/F pattern	V/F Pattern	2	User V/F	0–3	-
	41	User Frequency 1	User Freq 1	15.00		0–Maximum frequency	Hz
	42	User Voltage 1	User Volt 1	25		0–100%	%
	43	User Frequency 2	User Freq 2	30.00		0–Maximum frequency	Hz
	44	User Voltage 2	User Volt 2	50		0–100%	%
	45	User Frequency 3	User Freq 3	45.00		0–Maximum frequency	Hz
	46	User Voltage 3	User Volt 3	75		0–100%	%
	47	User Frequency 4	User Freq 4	Maximum frequency		0–Maximum frequency	Hz
	48	User Voltage 4	User Volt 4	100		0–100%	%

User V/F pattern Setting Details

Code	Description
BAS-41 User Freq 1 – BAS-48 User Volt 4	Set the parameter values to assign arbitrary frequencies (User Freq x) for start and maximum frequencies. Voltages can also be set to correspond with each frequency, and for each user voltage (User Volt x).

The 100% output voltage in the figure below is based on the parameter settings of BAS-15 (motor rated voltage). If BAS-15 is set to ‘0’ it will be based on the input voltage.



Caution

- When a normal induction motor is in use, care must be taken not to configure the output pattern away from a linear V/F pattern. Non-linear V/F patterns may cause insufficient motor torque or motor overheating due to over-excitation.
- When a user V/F pattern is in use, forward torque boost (DRV-16) and reverse torque boost (DRV-17) do notoperate.

5.3.3.4 BAS-50 Multi-step Frequencies (Fixed Speed Inputs)

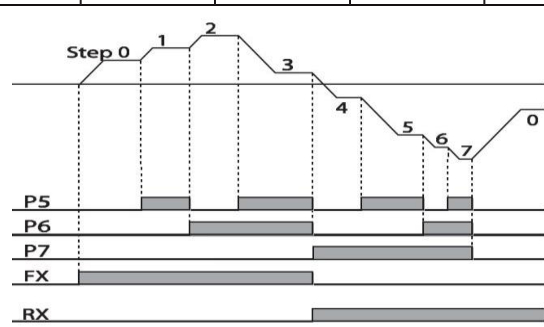
Multi-step operations (Fixed Speed Inputs) can be assigned to the Px terminals. Seven steps (1 through 7) can be configured using (3) digital input terminals. Step 0 uses the frequency reference source set with DRV-07. Set Px terminals to 7 (Speed-L), 8 (Speed-M) and 9 (Speed-H). These are recognized as binary inputs (000 ~ 111) and work in combination with Fx or Rx run commands. The inverter operates according to the frequencies set with parameters BAS-50–56 and the binary command combinations.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
BAS	50~56	Multi-step frequency 1–7	Step Freq - 1–7	10.00~60.00 Hz.	0.00, Low Freq– High Freq*	Hz
IN	65~71	Px terminal configuration	Px Define (Px: P1~P7)	7 Speed-L	0–42	-
				8 Speed-M		-
				9 Speed-H		-
	89	Multi-step command delay time	InCheck Time	1	1–5000	ms

Multi-step Frequency Setting Details

Code		Description
BAS-50 ~ 56		Configure multi-step frequencies 1~7.
IN-65~71	Px Define	Choose the terminals to setup as multi-step inputs. Set the relevant parameters (IN-65–71) to 7 (Speed-L), 8 (Speed-M), or 9 (Speed-H). Example below using terminals P5, P6, and P7 have been set to Speed-L, Speed- M and Speed-H respectively (default settings). The following multi-step operation will be available.

Speed	Fx/Rx	P7	P6	P5
0	✓	-	-	-
1	✓	-	-	✓
2	✓	-	✓	-
3	✓	-	✓	✓
4	✓	✓	-	-
5	✓	✓	-	✓
6	✓	✓	✓	-
7	✓	✓	✓	✓



IN-89 InCheck Time	Set a time interval for the inverter to check for additional terminal block inputs after receiving an input signal. After adjusting IN-89 to 100 ms and an input signal is received at P6, the inverter will search for inputs at other terminals for 100 ms, before proceeding to accelerate or decelerate based on the configuration at P6.

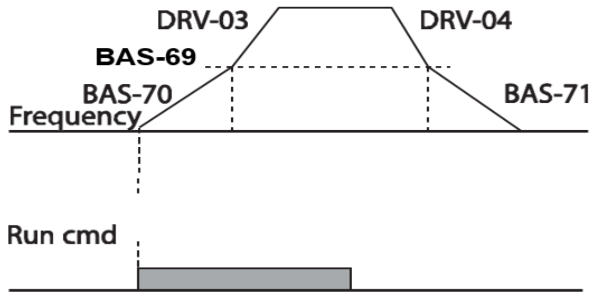
5.3.3.5 BAS-69 Configuring Acc/Dec Time - Switch Frequency

Set a switch frequency (BAS-69) to switch between 2 different Accel times and 2 different Decel times. Parameters BAS-70 (step accel time1) and BAS-71 (step decel time1) are in effect below the switch frequency. Parameters DRV-03 (Accel time) and DRV-04 (Decel time) are in effect above the switch frequency.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	240V: 7.5~60HP	0.0–600.0	sec
					480V,575V: 7.5~125HP		
				60.0	240V: 75~125HP		
					480V: 150~400HP		
				100.0	480V: 500~800HP		
	04	Deceleration time	Dec Time	30.0	240V: 7.5~60HP	0.0–600.0	sec
					480V,575V: 7.5~125HP		
				90.0	240V: 75~125HP		
					480V: 150~400HP		
				150.0	480V: 500~800HP		
BAS	70	Multi-step acceleration time1	Acc Time-1	20.0		0.0-600.0	sec
	71	Multi-step deceleration time1	Dec Time-1	20.0		0.0-600.0	sec
BAS	69	Acc/Dec time switch frequency	Xcel Change Fr	30.00		0-Max Frequency	Hz

Acc/Dec Time Switch Frequency Setting Details

Code	Description
BAS-69 Xcel Change Fr	Set the Acc/Dec transition frequency (BAS-69). Acc/Dec slopes configured at BAS-70 and BAS-71 will be used when the inverter's operating frequency is at or below the switch frequency. When the operating frequency exceeds the switch frequency, Acc/Dec slopes configured at DRV-03 and DRV-04 will be used. Multi-step digital inputs (XCEL-L, XCEL-M, XCEL-H) override the BAS-69 settings. The 'Xcel Change Fr' parameter is applied only when ADV-24 (Freq Limit Mode) is set to 'NO'.



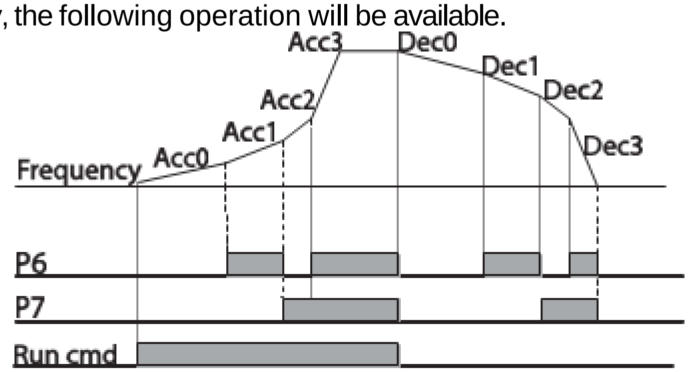
5.3.3.6 BAS-70 Multi-step Acc/Dec Time Configuration

Digital input terminals can be configured for different Acc and Dec times. Up to 7 acceleration times and 7 deceleration times can be set. Choose (up to 3) digital input terminals (P1 ~ P7) and set the corresponding parameters (IN-65~IN-71) to 11 (XCEL-L), 12 (XCEL-M) and 13 (XCEL-H). These are recognized as binary inputs (000 ~ 111). Acc times and Dec times are set with BAS-70 through BAS-83.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	240V:7.5~60HP	0.0–600.0	sec
					480V,575V: 7.5~125HP		
				60.0	240V: 75~125HP		
					480V: 150~400HP		
				100.0	480V: 500~800HP		
	04	Deceleration time	Dec Time	30.0	240V: 7.5~60HP	0.0–600.0	sec
					480V,575V: 7.5~125HP		
				90.0	240V: 75~125HP		
					480V: 150~400HP		
				150.0	480V: 500~800HP		
BAS	70~83	Multi-step Acceleration/ Deceleration time1–7	Acc Time 1–7	x.xx secs		0.0–600.0	sec
			Dec Time 1–7	x.xx secs		0.0–600.0	sec
IN	65~71	Px terminal configuration	Px Define (Px: P1–P7)	11	XCEL-L	0–42	-
				12	XCEL-M		
				13	XCEL-H		
	89	Multi-step command delay time	In Check Time	1		1–5000	ms

Acc/Dec Time Setup via Multi-function Terminals – Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>BAS-70–82
Acc Time 1–7</td><td>Set multi-step acceleration time1–7.</td></tr>
<tr><td>BAS-71–83
Dec Time 1–7</td><td>Set multi-step deceleration time1–7.</td></tr>
<tr><td>IN-65~71
Px Define (P1~P7)</td><td>Choose and configure the terminals to use for multi-step Acc/Dec time inputs
<table>
<tr><th colspan="2">Configuration</th><th>Description</th></tr>
<tr><td>11</td><td>XCEL-L</td><td>Acc/Dec command-L</td></tr>
<tr><td>12</td><td>XCEL-M</td><td>Acc/Dec command-M</td></tr>
<tr><td>13</td><td>XCEL-H</td><td>Acc/Dec command-H</td></tr>
</table>
Acc/Dec commands are recognized as binary code inputs and will control the acceleration and deceleration based on parameter values set with BAS-70–82 and BAS-71–83.
Example: The P6 and P7 terminals are set as XCEL-L and XCEL- M respectively, the following operation will be available.



<table>
<tr><th>Acc/Dec time</th><th>P7</th><th>P6</th></tr>
<tr><td>0</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>-</td><td>✓</td></tr>
<tr><td>2</td><td>✓</td><td>-</td></tr>
<tr><td>3</td><td>✓</td><td>✓</td></tr>
</table>
[Multi-function terminal P6, P7 configuration]</td></tr>
<tr><td>IN-89 In Check Time</td><td>Set the time for the inverter to check for other terminal block inputs. If IN-89 is set to 100 ms and a signal is supplied to the P6 terminal, the inverter searches for other inputs over the next 100 ms. When the time expires, the Acc/Dec time will be set based on the input received at P6.</td></tr>
</table>

5.4 Advance Group (ADV)

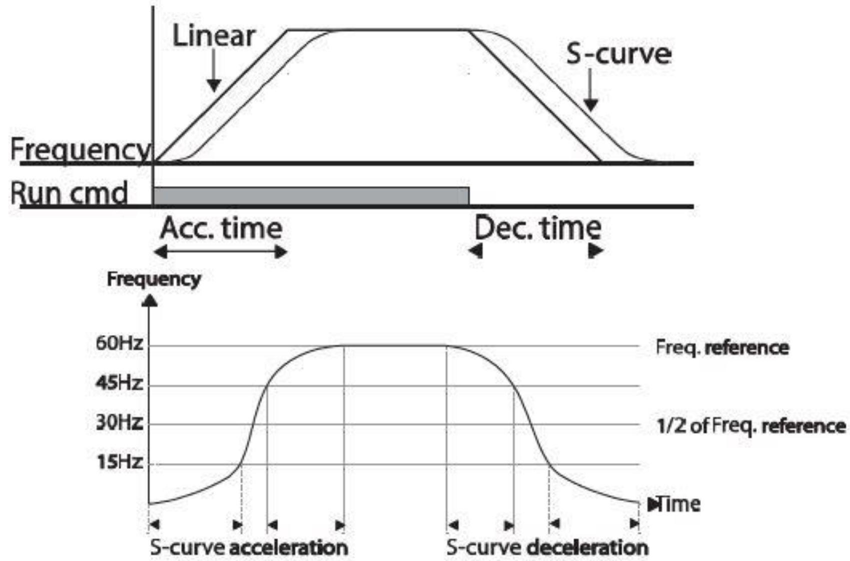
5.4.1 ADV-01 Acc/Dec Pattern Configuration

A Linear Accel and Decel pattern features a linear increase (and decrease) of the output frequency at a fixed rate. An S-curve pattern provides a smoother and more gradual increase (and/or decrease) of output frequency. Acc/Dec slope patterns can be configured to enhance and smooth the inverter's acceleration and deceleration curves. An S-curve can be set with ADV-01 (accel) and ADV-02 (decel) and slope can be adjusted using ADV-03 ~ ADV-06.

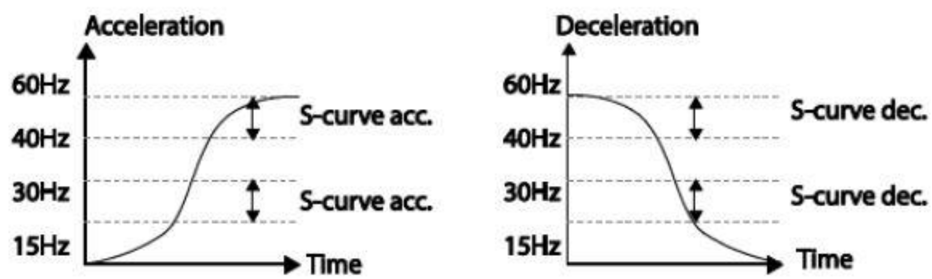
Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	08	Acc/Dec reference	Ramp T mode	0	Max Freq	0–1	-
ADV	01	Acceleration pattern	Acc Pattern	0	Linear	0–1	-
	02	Deceleration pattern	Dec Pattern	1	S-curve		-
	03	S-curve Acc start gradient	Acc S Start	40		1–100	%
	04	S-curve Acc end gradient	Acc S End	40		1–100	%
	05	S-curve Dec start gradient	Dec S Start	40		1–100	%
	06	S-curve Dec end gradient	Dec S End	40		1–100	%

Acc/Dec Pattern Setting Details

Code	Description
ADV-03 Acc S Start	ADV-03 sets the slope at the start of the acceleration curve. The set percentage applies to 50% below the first half of the total acceleration curve. When the frequency reference is set at 60 Hz and ADV-03 is set to 50%, S-Curve acceleration will be applied to 0–15 Hz. (50% below half the reference frequency). Linear acceleration will be applied to the 15-30 Hz. section.
ADV-04 Acc S End	ADV-04 sets the slope at the end of the acceleration curve. The set percentage applies to the second half of the total acceleration curve where operating frequency is reaching the reference frequency. When the reference frequency is 60 Hz. and ADV-04 is set to 50%, S-Curve acceleration will be applied to 45-60 Hz. (50% above half the reference frequency). Linear acceleration will be applied to the 30~45 Hz. section.
ADV-05 Dec S Start	Sets the slope at the start of S-curve deceleration. S-Curve deceleration is applied to the portion of the deceleration curve that is 50% above half the reference frequency (60-45 Hz.). Same as S-Curve End acceleration.
ADV-06 Dec S End	Sets the slope at the end of S-curve deceleration. S-Curve deceleration is applied to the portion of the deceleration curve that is 50% below half the reference frequency (15-0 Hz.). Same as S-Curve start acceleration.



[Acceleration / deceleration pattern configuration]



[Acceleration / deceleration S-curve pattern configuration]

Note
The Actual Acc/Dec time during an S-curve application
The actual Acc/Dec times become greater than user defined Acc/Dec times when S-curve Acc/Dec patterns are applied. Example: The Actual Acc/Dec time during an S-curve application.
Actual acceleration time = DRV-03 + (DRV-03 x ADV-03/2) + (DRV-03 x ADV-04/2)
Settings: DRV-03 = 10 secs., ADV-03 = 50%, ADV-04 = 50%
Actual acceleration time = 10 + (10 x .5/2) + (10 x .5/2) = 15 secs.
Actual deceleration time = DRV-04 + (DRV-04 x ADV-05/2) + (DRV-04 x ADV-06/2).

Caution

Note that actual Acc/Dec times become greater than user defined Acc/Dec times (DRV-03 and DRV-04) when S-curve Acc/Dec patterns are in use.

5.4.2 ADV-07 Start Mode Setting

Select the start mode to use when a run command is applied with the motor in the stopped condition. Select 0 (Acceleration Start) or 1 (DC Brake Start). Excitation current (Pre-Excite) can also be applied by activating a digital input.

5.4.2.1 Acceleration Start

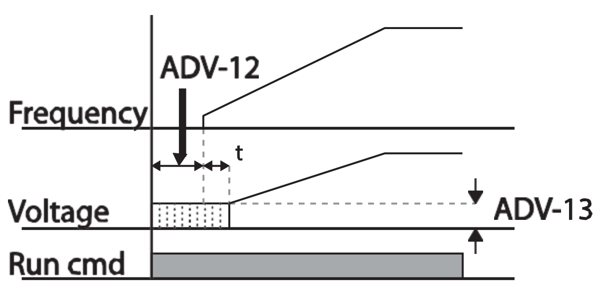
Acceleration start is the typical start mode used when starting a motor from a stopped condition. If there are no other settings applied, the motor accelerates to the frequency reference when the run command is applied.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	07	Start mode	Start mode	0	Acc	0–1	-

5.4.2.2 Start After DC Braking

This start mode supplies a DC voltage and current for a set amount of time to provide DC braking before the inverter starts to accelerate the motor. Use when the motor is rotating due to its inertia. DC braking will stop the motor allowing the motor to accelerate from a stopped condition. DC braking can also be used when a mechanical brake connected to a motor and constant torque is required after the release of the mechanical brake. DC Brake at start does not operate in sensorless vector mode (DRV-09 set to 3).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	07	Start mode	Start Mode	1	DC-Start	0–1	-
	12	Start DC braking time	DC-Start Time	0.00		0.00–60.00	sec
	13	DC Injection Level	DC Inj Level	50		0–200	%



> **Caution**
> The amount of DC braking required is based on the motor's rated current. If the DC Brake current is too high or brake time is too long, the motor may overheat or be damaged. The maximum amount of DC current is limited to the inverter rated current.

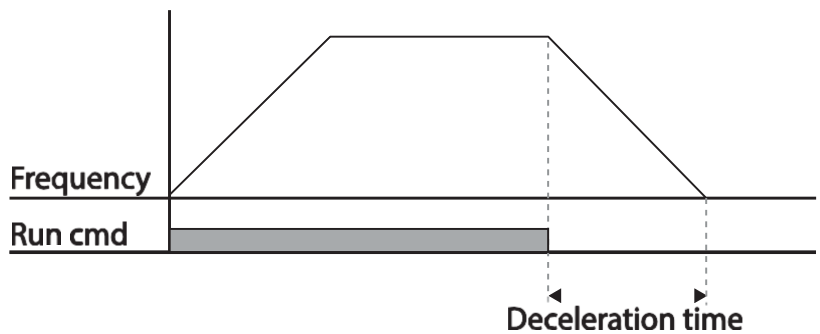
5.4.3 ADV-08 Stop Mode Setting

Select a stop mode to stop the inverter operation. Select from 0 (deceleration), 1 (DC Brake), 2 (Free-Run (coast)) or 4 (Power Braking).

5.4.3.1 Deceleration Stop

Deceleration stop is a typical stop mode used when stopping a motor. If there are no other settings applied, the inverter decelerates the motor from the reference frequency down to 0 Hz and stops.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	08	Stop mode	Stop Mode	0	Dec	0–4	-

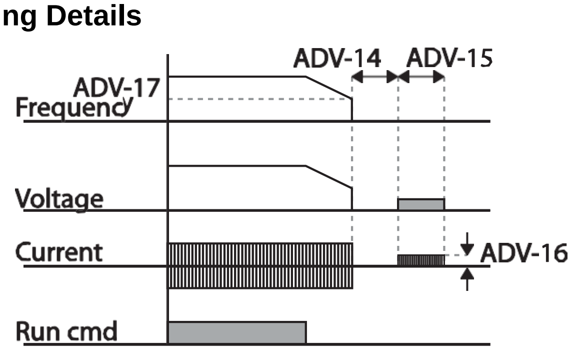


5.4.3.2 Stop After DC Braking

DC Braking can be applied to the motor during deceleration. The inverter stops the motor by supplying DC power to the motor. Settings include a delay time, a brake time, a brake current level and a brake frequency. During deceleration, when the inverter output frequency reaches the DC braking frequency, the inverter supplies DC power to the motor and stops it.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	08	Stop mode	Stop Mode	1	DC Brake	0–4	-
	14	Output block time before braking	DC-Block Time	0.00	240V:7.5~60HP	0.00–60.00	sec
					480V, 575V: 7.5~125HP		
				2.00	240V:75~125HP		
					480V: 150~800HP		
	15	DC braking time	DC-Brake Time	1.00		0–60	sec
	16	DC braking amount	DC-Brake Level	50		0–200	%
	17	DC braking frequency	DC-Brake Freq	5.00		0.00–60.00	Hz

DC Braking After Stop Setting Details



Code	Description
ADV-14 DC-Block Time	Set a delay time after the inverter output turns off and before applying DC braking. If the inertia of the load is high, or if DC braking frequency (ADV-17) is set too high, a fault may occur due to overcurrent conditions when the inverter supplies DC voltage to the motor. To prevent overcurrent fault, adjust the delay time before DC braking.
ADV-15 DC-Brake Time	Set the time duration for the DC voltage supplied to the motor.
ADV-16 DC-Brake Level	Set the amount of DC braking current to apply. The parameter setting is based on the rated current of the motor. The maximum value of the DC Brake current is limited to the inverter rated current. Maximum DC Brake Level = Inverter rated current / Rated current of motor X 100%.
ADV-17 DC-Brake Freq	Set the frequency to start DC braking. When the inverter output frequency is reached, the inverter starts DC Braking. If the dwell frequency is set lower than the DC braking frequency, dwell operation will not work and DC braking will start instead.

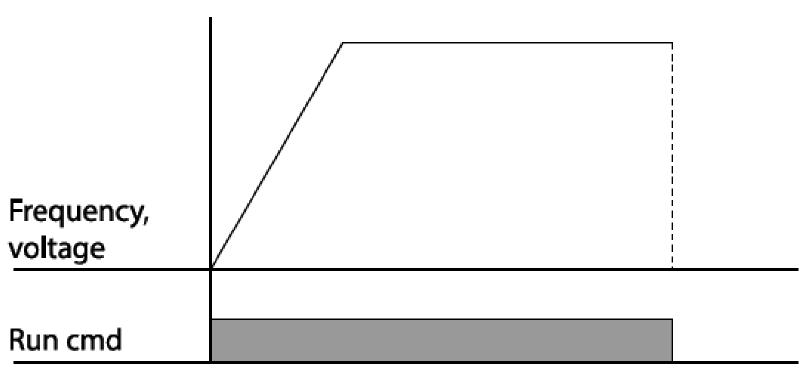
Caution

- Note that the motor can overheat or be damaged if excessive amount of DC braking is applied to the motor or DC braking time is set too long.
- DC braking is configured based on the motor's rated current. To prevent overheating or damaging motors, do not set the current value higher than the inverter's rated current.

5.4.3.3 Free Run Stop

When the run command is removed, the inverter output turns off and the motor/load coasts to a stop.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	08	Stop Method	Stop mode	2	Free-Run	0–4	-



Caution

Note: With high inertia loads the motor will continue to rotate. The inverter does not control the motor during Free-Run.

5.4.3.4 Power Braking

Power Braking is applied during deceleration when the inverter's DC voltage rises above a specified level due to motor regenerated energy. The inverter determines the optimum deceleration rate and will either adjust the deceleration rate or will reaccelerate the motor in order to reduce the regenerated energy. Power braking can be used when short deceleration times are needed without brake resistors, or when optimum deceleration is needed without causing an over voltage fault.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	08	Stop mode	Stop Mode	4	Power Braking	0–4	-

Caution

- To prevent overheating or damaging the motor, do not apply power braking to the loads that require frequent deceleration.
- Stall prevention and power braking only operate during deceleration.
- Power Braking takes priority over stall prevention. In other words, when both bit 3 of PRT-50 (stall prevention and flux braking) and ADV-08 (braking options) are set, Power Braking will take precedence and operate.
- Note that if deceleration time is too short or inertia of the load is too great, an overvoltage fault may still occur.
- Note when Power Braking is used, the actual deceleration time can be longer than the pre- set deceleration time.

5.4.4 ADV-09 Forward or Reverse Run Prevention

The rotation direction can be configured to prevent motors from rotating in a specific direction. Setting ADV-09 to '1 Reverse Prev' will prevent reverse rotation regardless of DRV-02 'Keypad Run Direction' setting or a digital input (Rx) command.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	09	Run prevention options	Run Prevent	0	None	0–2	-
				1	Forward Prev		
				2	Reverse Prev		

Forward/Reverse Run Prevention Setting Details

Code	Description		
ADV-09 Run Prevent	Choose a direction to prevent.		
	Setting		Description
	0	None	Run prevention not set.
	1	Forward Prev	Set forward run prevention.
	2	Reverse Prev	Set reverse run prevention.

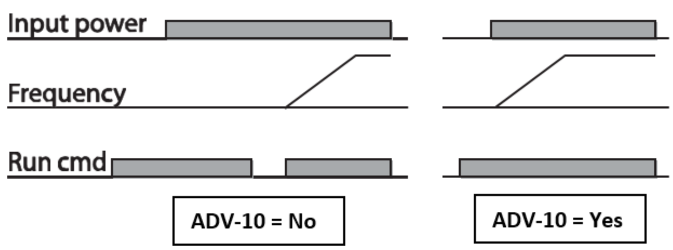
5.4.5 ADV-10 Power-on Run

The inverter can be set to start operating (output power to the motor) as soon as the inverter powers up or with some delay time. See caution below. If DRV-06 is set to Keypad, Power-on Run does not function. In AUTO mode, the inverter starts operating at power-on when the following conditions are met.

With command source set to terminal block (Fx/Rx-1 or Fx/Rx-2).
When ADV-10, Power-on Run is set to Yes with optional delay time.
and a run command remains enabled.

The inverter will start immediately upon power up. Parameter DRV-06 (command source) must be set to 1 (Fx/Rx-1) or 2 (Fx/Rx-2) along with an active run command.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1, 2	Fx/Rx-1 or Fx/Rx-2	0–5	-
ADV	10	Power-on Run	Power-on Run	1	Yes	0–1	-
	11	Power-on Delay	Power-on Delay	0.0		0.0 - 6000.0	sec



Power-on Run and Communications (Int 485 or other Field Bus).

With DRV-06 set to '3 (Int 485)' or '4 (Field Bus)' for communications, set COM-96 (PowerOn Resume) to 'YES'. If the power input to the inverter is cut off due to a power interruption, the inverter memorizes the run command, frequency reference, and the acc/dec time settings at the time of power interruption. With COM-96 (PowerOn Resume) set to 'Yes', the inverter starts operating based on these settings as soon as the power supply resumes.

Group	Code	Name	LCD Display	Settings		Setting Range	Unit
DRV	06	Command source	Cmd Source	3	Int 485	0 - 5	-
				4	Field Bus		
COM	96	Power-on resume	PowerOn Resume	0	No	0 - 1	-
				1	Yes		

Note

- Power on Run and Speed Search - If the speed search is not enabled, the inverter will start its operation in a normal V/F pattern and accelerate the motor. A fault may be triggered if the inverter starts operating while the load is still rotating. To prevent faults with Power-on Run, enable speed search. Set CON-71, bit 4 to 1. The inverter will perform a speed search at the beginning of the operation.
- If Power On Run is left disabled and the inverter powers up with an active run command, it will not start. The digital input (run command) must be first deactivated, and then reapplied to begin the inverter's operation.

Caution

Use caution when operating the inverter with Power-on Run enabled as the motor will begin rotating when the inverter starts up.

5.4.6 ADV-20 Dwell Operation

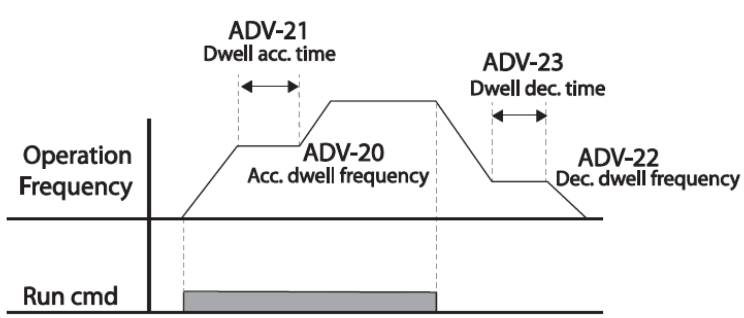
The dwell operation is used to maintain speed (torque) at programmed frequencies during the acceleration and deceleration process. This function is used in the application and release of the mechanical brakes on lift-type loads (elevators). Inverter dwell operation is based on the Acc/Dec dwell frequency (ADV-20, ADV-22) and the dwell time (ADV-21, ADV-23) set by the user. The following points also affect dwell operation:

Acceleration Dwell Operation
When a run command is applied, acceleration continues up to the acceleration dwell frequency (ADV-20) and constant speed is maintained for the acceleration dwell time (ADV-21, Acc Dwell Time). After the Acc Dwell Time has passed, acceleration is carried out based on the acceleration time and the operating speed that was originally set.

Deceleration Dwell Operation
When a stop command is applied, deceleration continues down to the deceleration dwell frequency (ADV-22) and constant speed is maintained for the deceleration dwell time (ADV-23, Dec Dwell Time). After the Dec Dwell Time has passed, deceleration is carried out based on the deceleration time that was originally set, then the operation stops.

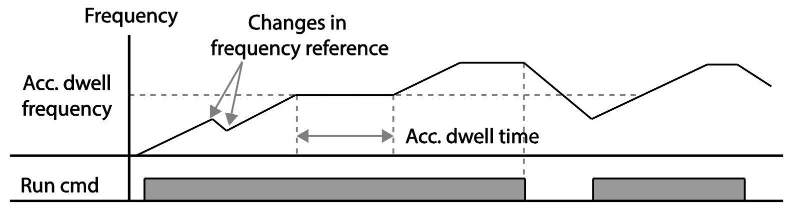
When DRV-09 (Control Mode) is set to 0 (V/F), the inverter can be used for applications requiring the use of dwell frequencies. An example is applying and releasing mechanical brakes on lift-type loads (elevators).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
ADV	20	Dwell frequency during acceleration	Acc Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	21	Operation time during acceleration	Acc Dwell Time	0.0	0.0–10.0	s
	22	Dwell frequency during deceleration	Dec Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	23	Operation time during deceleration	Dec Dwell Time	0.0	0 .0-60.0	s



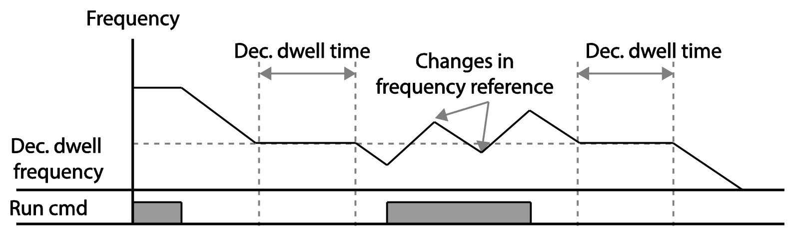
Note
Dwell operation does not function when:

- Dwell operation time is set to 0 sec.
- Re-acceleration is attempted from stop or from a deceleration. Only the first acceleration dwell operation is valid through the complete process.



[Acceleration dwell operation]

Deceleration dwell operation is carried out only when a stop command is issued, and the decelerating frequency passes through the dwell frequency. Dwell is not performed during a deceleration based on a frequency (speed reference) change. This is not considered a deceleration based on a stop operation.



[Deceleration dwell operation]

Caution

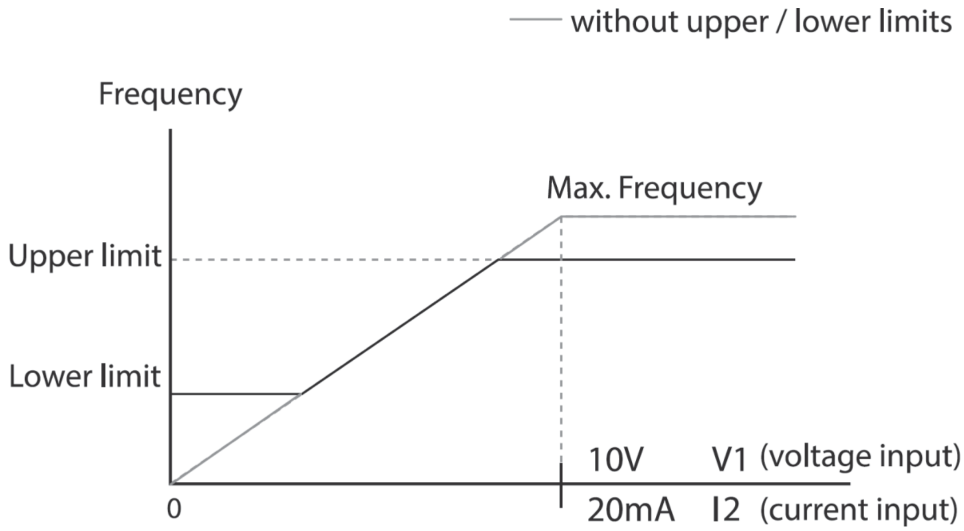
When a dwell operation is carried out for lift - type loads with mechanical brakes, motors can be damaged, or their life cycle reduced due to higher currents in the motor during the time the mechanical brake is applied.

5.4.7 ADV-24 Frequency Limits - Upper/Lower Limit Frequency

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	24	Frequency limit	Freq Limit	0	No	0–1	-
	25	Frequency lower limit value	Freq Limit Lo	0.50		0.0–maximum frequency	Hz
	26	Frequency upper limit value	Freq Limit Hi	Maximum frequency		min–max frequency	Hz

Frequency Limit Using Upper and Lower Limit Frequencies - Setting Details

Code	Description
ADV-24 Freq Limit	When set to ‘1 (Yes)’ frequency limits can be applied to the output of the inverter. Frequencies can be set above the lower limit frequency (ADV-25) and below the upper limit frequency(ADV-26). Operation is within the specified range.
ADV-25 Freq Limit Lo ADV-26 Freq Limit Hi	Set the lower and upper limits of the output frequency. Speed unit parameters are expressed in Hz or rpm based on DRV-21 setting except for the base frequency (MOT-02). The Base Frequency (MOT-02) remains the output frequency at motor rated voltage.



Caution

- When ADV-24 (Freq Limit) is set to 'Yes,' the frequency set at ADV-25 (Freq Limit Lo) is the minimum frequency (Low Freq). If ADV-24 (Freq Limit) is set to 'No,' the frequency set at DRV-19 (Start Freq) becomes the minimum frequency.
- When ADV-24 (Freq Limit) is set to 'Yes,' the frequency set at ADV-26 (Freq Limit Hi) is the maximum frequency (High Freq). If ADV-24 (Freq Limit) is set to 'No,' the frequency set at DRV-20 (Max Freq) becomes the maximum frequency.

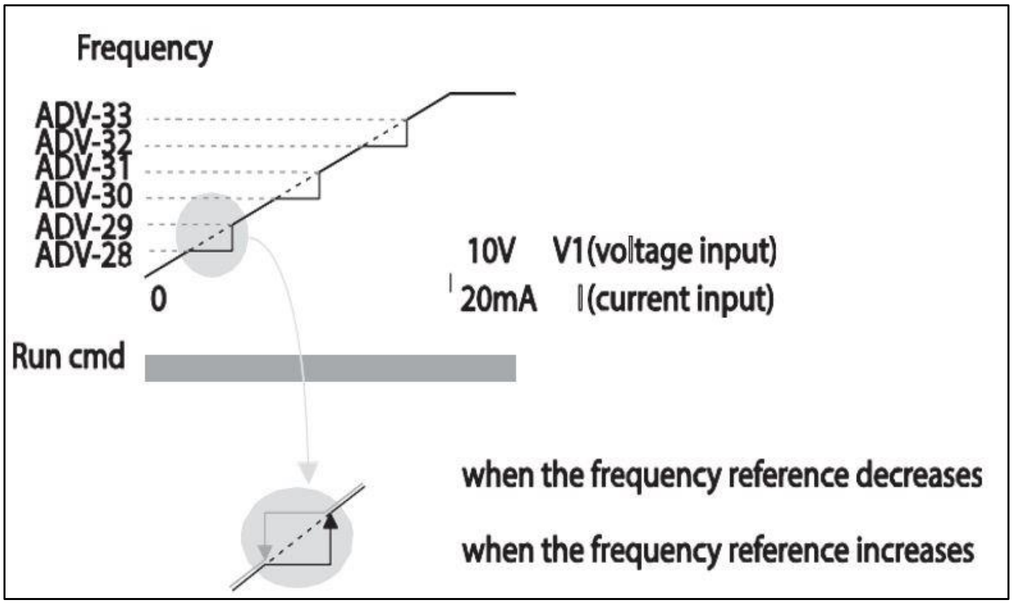
5.4.8 ADV-27 Frequency Jump

Use jump frequencies to avoid mechanical resonance frequencies. Jump through up to three frequency bands during acceleration and deceleration. Reference frequencies cannot be set within the pre-set jump frequency band.

When the reference frequency is increased it will be maintained at the lower limit of a jump frequency band. As the reference frequency continues to increase and exceeds the range of a jump frequency band, it will jump to the upper limit of the jump frequency band. Decreasing reference frequencies operate in the same it will manner, jumping from upper limit to lower limit. Jump frequencies apply to all reference frequency sources (voltage, current, RS-485 communication, keypad setting).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
ADV	27	Frequency jump	Jump Freq	0 No 1 Yes	0–1	-
	28	Jump frequency lower limit1	Jump Lo 1	10.00	0.00–Jump frequency upper limit 1	Hz
	29	Jump frequency upper limit1	Jump Hi 1	15.00	Jump frequency lower limit 1–Maximum frequency	Hz
	30	Jump frequency lower limit 2	Jump Lo 2	20.00	0.00–Jump frequency upper limit 2	Hz

	31	Jump frequency upper limit 2	Jump Hi 2	25.00	Jump frequency lower limit 2–Maximum frequency	Hz
	32	Jump frequency lower limit 3	Jump Lo 3	30.00	0.00–Jump frequency upper limit 3	Hz
	33	Jump frequency upper limit 3	Jump Hi 3	35.00	Jump frequency lower limit 3–Maximum frequency	Hz



5.4.9 ADV-41 Brake Control

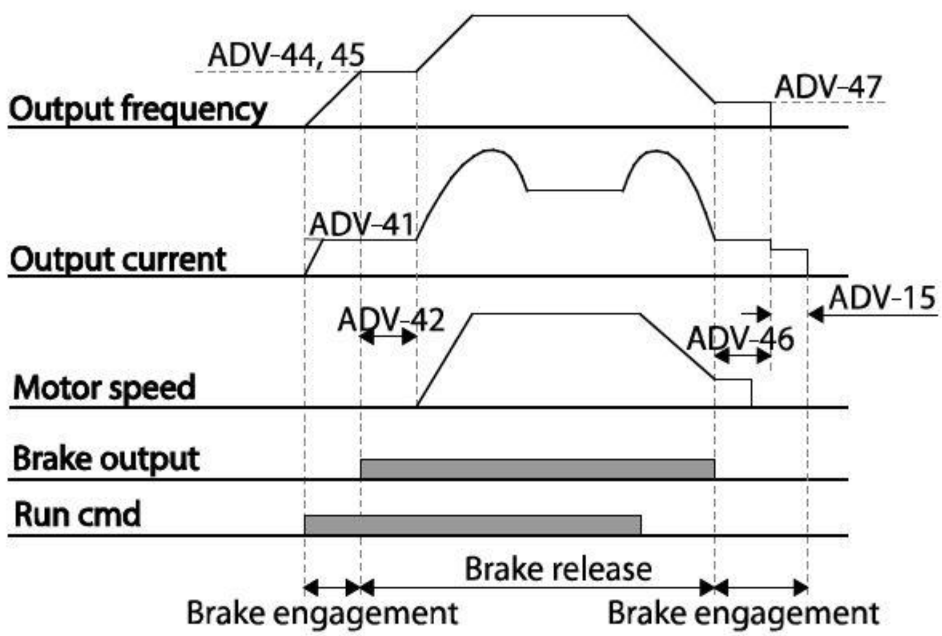
This feature controls the On/Off operation of the load's electro-mechanical braking system.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	0	V/F	-	-
ADV	41	Brake open current	BR Rls Curr	50.0		0.0–180%	%
	42	Brake open delay time	BR Rls Dly	1.00		0.0–10.0	sec
	44	Brake open forward frequency	BR Rls Fwd Fr	1.00		0-Maximum frequency	Hz
	45	Brake open reverse frequency	BR Rls Rev Fr	1.00		0-Maximum frequency	Hz
	46	Brake close delay time	BR Eng Dly	1.00		0.00–10.00	sec
	47	Brake close frequency	BR Eng Fr	2.00		0-Maximum frequency	Hz
OUT	31~35	Multi-function Relay1~Relay5	Relay 1	35	BR Control	-	-
	36	Multi-function output Q1 item	Q1 Define				

Activate Brake Control by setting one of OUT-31~OUT-36 to '42, BR Control'. When brake control is activated, DC braking (ADV-12) and Dwell operation (ADV-20~23) do not operate.

Brake release sequence: When a run command is applied, the inverter accelerates up to brake release frequency (ADV-44 Forward or ADV-45 Reverse). After reaching the brake release frequency, when the motor current reaches brake release current (ADV-41 BR Rls Curr), the output (OUT-31~35 or OUT-36) set to 35 (BR Control) sends a release signal. Once the signal has been sent, acceleration will begin after maintaining the frequency for the brake release delay time (ADV-42 BR Rls Dly).
If the output current is less than the release current (ADV-41 BR Rls Curr) for longer than the brake release delay time (ADV-42 BR Rls Dly), an Ext-Brake fault occurs.

Brake engage sequence: When a stop command is applied, the motor decelerates. When the output frequency reaches brake engage frequency (ADV-47 BR Eng Fr), the motor stops deceleration and the output (OUT-31~35 or OUT-36) set to 35 (BR Control) sends a brake engage signal. Frequency is maintained for the brake engage delay time (ADV-46 BR Eng Dly) and will become 0 afterwards. If Stop Mode (ADV-08) is set to 1 (DC brake), inverter output is blocked after DC braking. For DC injection braking, refer to section *5.4.3.2 Stop After DC Braking on page 141.*

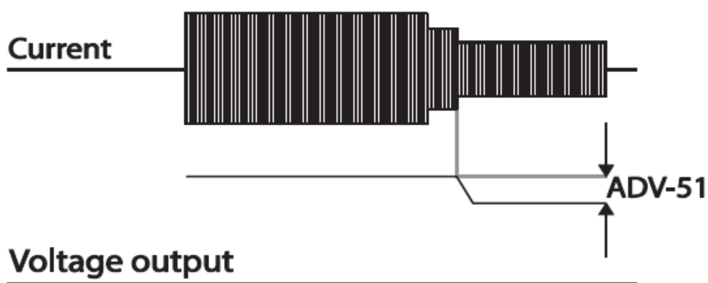


5.4.10 ADV-50 Energy Saving Operation

5.4.10.1 Manual Energy Saving Operation

If the inverter output current is lower than the current which is set at MOT-05 (Motor Rated Curr), the output voltage is reduced by the percentage set in ADV-51 (Energy Save). The voltage before the energy saving operation starts will become the base value of the percentage. Manual energy saving operation does not operate during acceleration and deceleration.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	50	Energy saving operation	E-Save Mode	1	Manual	-	-
	51	Energy saving level	Energy Save	0		0–30	%



<Manual Energy Saving Operation>

5.4.10.2 Automatic Energy Saving Operation

The inverter calculates the optimal energy saving point for the time set in ADV-52. The energy saving point is based on the rated current and the output power of the motor. The energy saving operation is effective for normal duty operations. It does operate when the load level is more than 80% of the rated motor current.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	50	Energy saving operation	E-Save Mode	2	Auto	-	-
	52	Energy saving point search time	E-Save Det T	20.0		0.0-100.0	sec

Caution

The inverter will exit the energy saving mode when the reference frequency is changed or during acceleration and deceleration. The actual Acc/Dec time may take longer than the set Acc/Dec time due to the time required to return to normal operation.

5.4.11 ADV-64 Cooling Fan Control

This function controls the operation of the inverter's heat-sink cooling fan. It is used in situations with frequent starting and stopping, or noise free environment is required. The correct use of cooling fan control can extend the life of the cooling fan.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	64	Cooling fan control	FAN Control	0	During Run	0-2	-

Cooling Fan Control Detail Settings

Code	Description		
ADV-64 Fan Control	Settings		Description
	0	During Run	Cooling fan runs when the inverter is running. The cooling fan stops when the inverter stops. If the inverter heat sink temperature is higher than a set value, the cooling fan will operate regardless of the inverter's operation status.
	1	Always On	Cooling fan runs continuously when power is supplied to the inverter.
	2	Temp Control	With power connected and the start command on, the cooling fan will not operate unless the temperature in the heat sink reaches a set temperature.

Note

Regardless of setting ADV-64 to 0 (During Run), if the heat sink temperature reaches a set level, the cooling fan may run as a protection function.

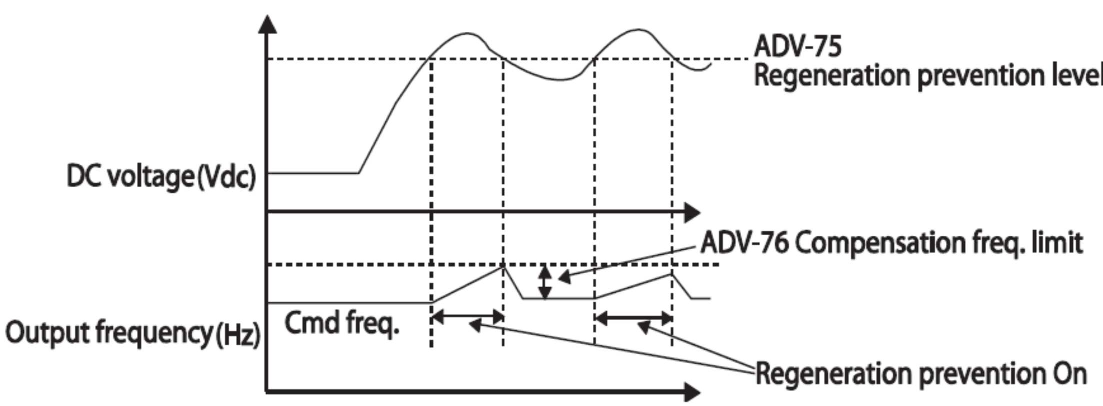
Inverters 150HP and larger have an internal cooling fan which operates in conjunction with the heat sink fans.

5.4.12 ADV-74 Press Regeneration Prevention

Press regeneration prevention is used during press operations to prevent braking during the regeneration process. When motor regeneration occurs during a press operation, motor operation speed automatically increases to avoid the regeneration zone.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	74	Select press regeneration prevention for press	RegenAvd Sel	0	No	0–1	-
	75	Press regeneration prevention operation voltage level	RegenAvd Level	350V 700V 870V		230V: 300-400V 460V: 600-800V 575V: 800-980V	V
	76	Press regeneration prevention compensation frequency limit	CompFreq Limit	1.00(Hz)		0.00– 10.00Hz	Hz
	77	Press regeneration prevention P gain	RegenAvd Pgain	50.0(%)		0 .0– 100.0%	%
	78	Press regeneration prevention I gain	RegenAvd Igain	500(ms)		20–30000ms	ms

Press Regeneration Prevention Setting Details

Code	Description
ADV-74 RegenAvd Sel	Frequent regeneration voltage from a press load during constant speed motor operation may force excessive work on the brake unit which may damage or shorten the brake life. To prevent this situation, select ADV-74 (RegenAvd Sel) to control DC bus voltage and disable the brake unit operation.
ADV-75 RegenAvd Level	Set the DC bus voltage level to activate Regen Avoidance.
ADV-76 CompFreq Limit	Set a frequency limit above operating frequency during Regen Avoidance.
ADV-77 RegenAvd Pgain ADV-78 RegenAvd Igain	Set the P gain and I gain in the DC bus voltage suppressor PI controller while in Regen Avoidance. 

Note

Press regeneration prevention only operates during constant speed motor operation. It does not operate during accelerations or decelerations. When regeneration prevention is activated, output frequency may change within the range set at ADV-76 (CompFreq Limit).

5.5 Control Group (CON)

5.5.1 CON-04 Carrier Frequency Settings

Group	Code	Name	LCD Display	Parameter Setting		Setting Range
CON	04	Carrier Frequency	Carrier Freq	3.0	240V: 7.5~25HP	1.0~15.0 (kHz)
					480V: 7.5~40HP	
				2.3	575V: 7.5~30HP	
				3.0	240V: 30~40HP	1.0~10.0 (kHz)
					480V: 50~75HP	
				2.3	575V: 40~75HP	
				3.0	240V: 50~60HP	1.0~7.0 (kHz)
					480V: 100~125HP	
				2.3	575V: 100~125HP	
				2.0	240V: 75~125HP	1.0~5.0 (kHz)
					480V: 150~500HP	
				1.5	480V: 650-800HP	1.0~4.0 (kHz)
	05	Switching Mode	PWM* Mode	0	Normal PWM	0–1
				1	Low Leakage PWM	

*PWM: Pulse width modulation

Operational Noise Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CON-04
Carrier Freq</td><td>Power transistors (IGBT) at the output of the inverter generate and supply a high frequency switching voltage to the motor. This switching speed is referred to as the carrier frequency. Adjustment of the carrier frequency affects motor operating noise. A higher carrier frequency reduces operational noise. A lower carrier frequency increases operational noise.</td></tr>
<tr><td>CON-05
PWM Mode</td><td>The heat loss and leakage current from the inverter can be reduced by changing the load rate option at CON-05 (PWM Mode). Selecting 1 (Low Leakage PWM) reduces heat loss and leakage current, compared to when 0 (Normal PWM) is selected. However, it increases the motor noise. Low leakage PWM uses 2 phase PWM modulation mode, which helps minimize degradation and reduces switching loss by approximately 30%.
<table>
<tr><td rowspan="3">Item</td><td colspan="2">Carrier frequency</td></tr>
<tr><td>1.0kHz</td><td>15kHz</td></tr>
<tr><td>Low Leakage PWM</td><td>Normal PWM</td></tr>
<tr><td>Motor noise</td><td>↑</td><td>↓</td></tr>
<tr><td>Heat generation</td><td>↓</td><td>↑</td></tr>
<tr><td>Noise generation</td><td>↓</td><td>↑</td></tr>
<tr><td>Leakage current</td><td>↓</td><td>↑</td></tr>
</table></td></tr>
</table>

Note

- Carrier Frequency at Factory Default Settings:
- H2 Series Inverter Derating Standard (Derating): The overload rate represents an acceptable load amount that exceeds rated load and is expressed as a ratio based on the rated load and the duration. The normal duty overload capacity on the H2 series inverter is 120%/1 min. The current rating differs from the load rating as it also has an ambient temperature limit. For derating specifications refer to *13.6 Continuous Rated Current Derating on page 379.*

5.5.2 CON-13 Anti-hunting Regulation (Resonance Prevention)

This function is used to prevent the hunting of a V/F controlled fan or motor caused by current distortion or oscillations due to mechanical resonance or other reasons.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
CON	13	Enable or disable anti- hunting regulation (resonance prevention)	AHR Sel	1	Yes	0	No	-
						1	Yes	
	14	Anti-hunting regulation P- Gain	AHR P-Gain	1000		0–32767		-
	15	Anti-hunting regulation start frequency	AHR Low Freq	0.5		0–AHR High Freq		Hz
	16	Anti-hunting regulation end frequency	AHR High Freq	400.00		AHR Low Freq–400.00		Hz
	17	Anti-hunting regulation compensation voltage limit	AHR Limit	2		0–20		%

Anti-hunting Regulation Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">CON-13 AHR Sel</td><td colspan="3">Selects the Anti-hunting regulator operation.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>No</td><td>Disable anti-hunting regulation.</td></tr>
<tr><td>1</td><td>Yes</td><td>Enable anti-hunting regulation.</td></tr>
<tr><td>CON-14 AHR P-Gain</td><td colspan="3">Increasing AHR proportional gain improves responsiveness of the anti-hunting regulation. However, current oscillation may result if AHR proportional gain is set too high.</td></tr>
<tr><td>CON-15 AHR Low Freq
CON-16 AHR High Freq</td><td colspan="3">Sets the lower limit frequency (CON-15) and the maxim limit frequency (CON-16) for anti-hunting regulation.</td></tr>
</table>

5.5.3 CON-70 Speed Search Operation

Speed Search is used to start the inverter while the motor/load are already spinning (idling). Speed Search synchronizes the inverter output (voltage and frequency) to that of the spinning motor. This is accomplished by ramping up the output voltage then ramping down the output frequency. Speed Search estimates the motor rotation speed based on the inverter output current; therefore, it may not match the exact speed. Speed Search can prevent faults that occur when starting the inverter while the motor/load are spinning.

There are three modes of Speed Search (Flying Start-1, Flying Start-2 and Flying Start-3 (PM)). The main difference between -1 and -2 is that Flying Start-2 can detect direction of motor rotation. Flying Start-3 is for PM Motors. Refer to *7.2 PM (Permanent-Magnet) Motors on pg. 246*). There are also four conditional settings of Speed Search. These include during accelerating (normal) starting, starting after a fault reset, starting after a power interruption, and auto starting with the initial application of power to the inverter.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CON	70	Speed search mode selection	SS Mode	0	Flying Start-1	-	-
	71	Speed search operation selection	Speed Search	0000	bit 3 bit 2 bit 1 bit 0 1 1 1 1 0 0 0 0	0000-1111	bit
	72	Speed search reference current	SS Sup-Current	90 80	7.5-125HP 150-800HP	80-200	%
	73	Speed search proportional gain	SS P-Gain	100		0–9999	-
	74	Speed search integral gain	SS I-Gain	200		0–9999	-
	75	Output block time before speed search	SS Block Time	1.0		0–60	sec
OUT	31-35	Multi-function relay 1 item	Relay 1	19	Speed Search	0-43	-
	36	Multi-function output 1 item	Q1 Define				

Speed Search Operation Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CON-70
SS Mode</td><td>Select a speed search type.

<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Flying Start-1</td><td>The speed search is carried out as it controls the inverter output current during idling below the CON-72 (SS Sup-Current) parameter setting. Use when the direction of the idling motor and the direction of operation command at restart are the same. A stable speed search function can be performed at about 10 Hz or lower. However, if the direction of the idling motor and the direction of the start command at restart are different, the speed search does not produce a satisfactory result. The direction of the idling motor cannot be established.</td></tr>
<tr><td>1</td><td>Flying Start-2</td><td>The speed search is carried out as it PI controls the ripple current which is generated by the counter electromotive force during no-load rotation. The counter electromotive force is proportional to the idle speed. This mode establishes the direction of the idling motor (forward/reverse) and the speed search function is stable regardless of the direction of the idling motor and direction of the start command. However, because the ripple current is used, the frequency is not determined accurately at low speeds (about 10-15 Hz). Re-acceleration may start from zero speed.</td></tr>
</table>
</td></tr>
<tr><td>CON-71
Speed Search</td><td>Type and Functions of Speed Search Setting
<table>
<tr><th colspan="4">Setting</th><th>Function</th></tr>
<tr><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td><td></td></tr>
<tr><td></td><td></td><td></td><td>✓</td><td>Speed search for general acceleration</td></tr>
<tr><td></td><td></td><td>✓</td><td></td><td>Initialization after a fault</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>Restart after instantaneous power interruption</td></tr>
<tr><td>✓</td><td></td><td></td><td></td><td>Starting with power-on</td></tr>
</table>

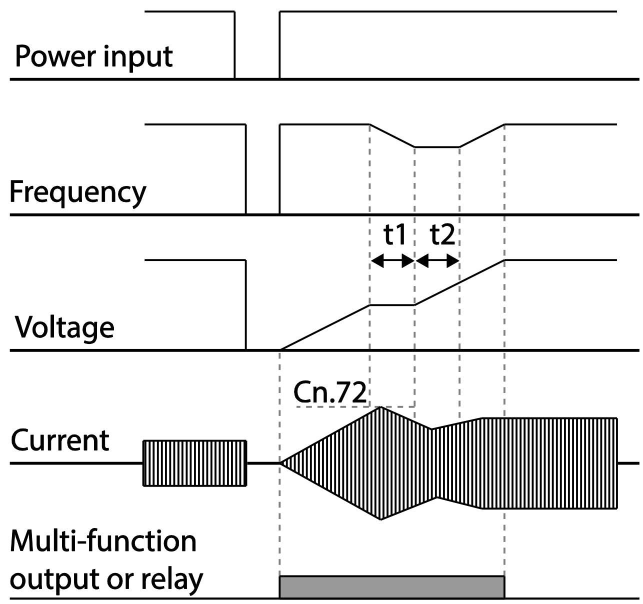
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><th>Item</th><th>Bit Status (On)</th><th>Bit Status (Off)</th></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>

Speed search can be selected to operate among the following 4 conditions.

Speed search for general acceleration: If bit 0 is set to 1 (enabled), speed search is enabled for normal accelerating starts with rotating motor/load. The speed search function prevents faults when starting the inverter with rotating motor/load.

Initialization after a fault: If Bit 1 is set to 1 (enabled) and PRT-08 (RST Restart) is set to 1 (Yes), after a fault reset, speed search accelerates the motor to the operating frequency used before the fault.

Automatic restart after reset of a fault: If bit 2 is set to 1, and if a low voltage trip occurs due to a power interruption but the power is restored before the
</td></tr>
</table>

Code	Description
	internal power shuts down, the speed search operation accelerates the motor back to its frequency reference before the low voltage trip. If the current increases above the value set at CON-72, the voltage stops increasing and the frequency decreases (t1 zone). If the current decreases below the value set at CON-72, the voltage increases again and the frequency stops decelerating (t2 zone). When the normal frequency and voltage are resumed, speed search accelerates the motor back to its operating frequency prior to the fault.  **Starting with power-on**: Set bit 3 to 1 (enabled) and ADV-10 (Power-on Run) to 1 (Yes). If inverter input power is applied and the run command is active (on), speed search accelerates the motor up to the frequency reference.
CON-72 SS Sup-Current	During Flying Start-1 (CON-70 set to 0), the amount of current is controlled. The percentage is based on the motor's rated current. If CON-70 (SS mode) is set to 1 (Flying Start-2), this parameter is not visible.
CON-73 SS P-Gain CON-74 SS I-Gain	The P/I gain of the speed search controller can be adjusted. If CON-70 (SS Mode) is set to 1 (Flying Start-2), different factory defaults are used based on motor capacity defined in MOT-01 (Motor Capacity).
CON-75 SS Block Time	CON-75 (SS Block Time) prevents overvoltage faults due to counter electromotive force (emf).

Note

If operated within the rated output, the inverter is designed to withstand instantaneous power interruptions within 8 ms and maintain normal operation. The DC voltage inside the inverter may vary depending on the output load. If the power interruption time is longer than 8 ms, a low voltage trip may occur.

Caution

Select the normal acceleration speed search for proper operation during free-run. If the speed search function is not set, an overcurrent trip or overload trip may occur.

5.5.4 CON-77 Kinetic Energy Buffering Operation

When the input power is disconnected, the inverter's DC bus voltage decreases, and a low voltage trip occurs blocking the output. Kinetic energy buffering operation can be used to decelerate the motor safely under these conditions. The inverter uses regenerative energy from the motor during the power outage to maintain the DC bus voltage. This extends the time for a low voltage trip to occur. For the KEB feature to operate properly, parameter MOT-10 (input voltage) must be set correctly.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="24">CON</td><td rowspan="2">77</td><td rowspan="2">Kinetic energy buffering selection</td><td rowspan="2">KEB Select</td><td>0</td><td>No</td><td rowspan="2">0~1</td><td rowspan="2">-</td></tr>
<tr><td>1</td><td>Yes</td></tr>
<tr><td rowspan="3">78</td><td rowspan="3">Kinetic energy buffering start level</td><td rowspan="3">KEB Start Lev</td><td>125.0</td><td>240V, 480V: 7.5~125HP</td><td rowspan="3">110.0~140.0</td><td rowspan="3">%</td></tr>
<tr><td>115.0</td><td>480V: 150~800HP</td></tr>
<tr><td>130.0</td><td>575V</td></tr>
<tr><td rowspan="3">79</td><td rowspan="3">Kinetic energy buffering stop level</td><td rowspan="3">KEB Stop Lev</td><td>130.0</td><td>240V, 480V: 7.5~125HP</td><td rowspan="3">Cn-78~145.0</td><td rowspan="3">%</td></tr>
<tr><td>125.0</td><td>480V: 150~800HP</td></tr>
<tr><td>135.0</td><td>575V</td></tr>
<tr><td rowspan="4">80</td><td rowspan="4">Energy buffering Slip gain</td><td rowspan="4">KEB Slip Gain</td><td rowspan="2">300</td><td>240V: 7.5~40HP</td><td rowspan="4">0-20000</td><td rowspan="4">-</td></tr>
<tr><td>480V: 7.5~800HP</td></tr>
<tr><td>100</td><td>240V: 50~125HP</td></tr>
<tr><td>25</td><td>575V</td></tr>
<tr><td rowspan="5">81</td><td rowspan="5">Energy buffering P gain</td><td rowspan="5">KEB P Gain</td><td rowspan="2">1000</td><td>240V: 7.5~40HP</td><td rowspan="5">0~20000</td><td rowspan="5">-</td></tr>
<tr><td>480V: 7.5~800HP</td></tr>
<tr><td>1800</td><td>240V: 50~125HP</td></tr>
<tr><td>3000</td><td>575V (7.5~50HP)</td></tr>
<tr><td>1500</td><td>575V (60~125HP)</td></tr>
<tr><td rowspan="4">82</td><td rowspan="4">Energy buffering I gain</td><td rowspan="4">KEB I Gain</td><td rowspan="2">500</td><td>240V: 7.5~40HP</td><td rowspan="4">1~20000</td><td rowspan="4">-</td></tr>
<tr><td>480V: 7.5~800HP</td></tr>
<tr><td rowspan="2">200</td><td>240V: 50~125HP</td></tr>
<tr><td>575V: All</td></tr>
<tr><td rowspan="3">83</td><td rowspan="3">Energy buffering acceleration time</td><td rowspan="3">KEB Acc Time</td><td>10.0</td><td>240V, 480V: 7.5~125HP</td><td rowspan="3">0.0~600.0(s)</td><td rowspan="3">-</td></tr>
<tr><td>30.0</td><td>480V: 150~800HP</td></tr>
<tr><td>5.0</td><td>575V All</td></tr>
</table>

Kinetic Energy Buffering Operation Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CON-77
KEB Select</td><td>Select the kinetic energy buffering operation when the input power is disconnected. When KEB Select is selected, it controls the inverter's output frequency and charges the DC bus with regenerative energy from the motor.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>General deceleration is carried out until a low voltage trip occurs.</td></tr>
<tr><td>1</td><td>Yes</td><td>Inverter operation charges the DC bus with regenerated energy. When the input power is restored, the inverter changes to normal operation from the KEB operation. The acceleration time set in CON-83 (KEB Acc Time) is applied when restoring to normal operation.</td></tr>
</table></td></tr>
<tr><td>CON-.78
KEB Start Lev,
CON-79
KEB Stop Lev</td><td>Sets the start and stop points of the kinetic energy buffering operation. The set values must be based on the low voltage trip level as 100% and the stop level (CON-79) must be set higher than the start level (CON-78).</td></tr>
<tr><td>CON-80
KEB Slip Gain</td><td>The slip gain is for preventing a low voltage trip when the kinetic energy buffering operation starts.</td></tr>
<tr><td>CON-81
KEB P Gain</td><td>The controller P Gain is for maintaining the voltage of the DC power section during the kinetic energy buffering operation. Increase the setting value when a low voltage trip occurs right after a power failure.</td></tr>
<tr><td>CON-82
KEB I Gain</td><td>The controller I Gain is for maintaining the voltage of the DC power section during the kinetic energy buffering operation. Sets the gain value to maintain the frequency during the kinetic energy buffering operation until the inverter stops.</td></tr>
<tr><td>CON-.83
KEB Acc Time</td><td>Sets the acceleration time of the operating frequency when the inverter returns to normal operation from KEB mode.</td></tr>
</table>

Caution

- Depending on the duration of Instantaneous power interruptions and the amount of load inertia, a low voltage trip may occur even during a kinetic energy buffering operation.
- If a low voltage trip occurs after a power interruption, it indicates the load inertia and level are high. In such cases, the KEB functions can perform better by increasing the KEB P Gain and the KEB Slip Gain.
- Motors may vibrate during kinetic energy buffering operation for some loads. Better performance can be achieved by increasing the P Gain and/or decreasing the I Gain.

5.6 Input Group (IN)

5.6.1 Analog Inputs

Refer to *5.1.4 DRV-07 Frequency Reference Source on page 107* for parameters related to the analog inputs.

Terminal	Range	Parameters	Section
V1	0-10V	IN-05~IN-11	*5.1.4.3*
V1'	0- (-10)V	IN-12~IN-15	*5.1.4.3.2*
I2	4-20mA	IN-50~IN-56	*5.1.4.4*
I2(V2)	0-10V	IN-35~IN-40	*5.1.4.4.2*
TI	Pulsed 32kHz	IN-91~IN-98	*5.1.4.5*
S+,S-	RS-485	COM-01~COM-04	*5.1.4.6*

5.6.2 IN-60 Safe Operation Mode

This safety feature is used as a Run Enable/Disable input. When a digital input is set to 15 (Run Enable), the inverter will only operate when the input is closed (Enabled). The input must be closed to recognize other digital input functions. This feature is useful for interlocking operation with other equipment.

A stop mode can be selected (IN-61, Run Dis Stop) when the Run Enable input is opened during operation. Selections include coasting to stop, Quick Stop and Quick Stop Resume. The deceleration time (IN-62, Q-Stop Time) can be set for the Quick Stop functions.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	60	Safe operation selection	Run En Mode	1	DI Dependent	-	-
	61	Safe operation stop mode	Run Dis Stop	0	Free-Run	0-2	-
				1	Q-Stop		
				2	Q-Stop Resume		
	62	Safe operation deceleration time	Q-Stop Time	5.0		0.0-600.0	sec
IN	65~71	Px terminal configuration	Px Define (Px: P1~P7)	15	RUN Enable	0-42	-

Safe Operation Mode Setting Details

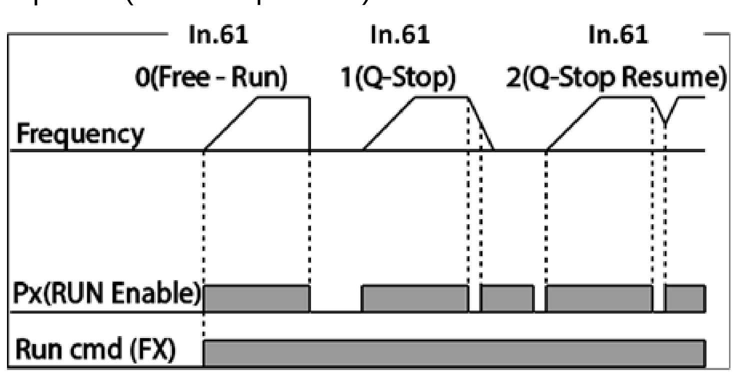
<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td>IN-65~71
Px Define</td><td colspan="3">Set one of the multi-function (digital) input terminals to 15 (RUN Enable) to operate in safe operation mode.</td></tr>
<tr><td rowspan="3">IN-60
Run En Mode</td><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Always Enable</td><td>Enables safe operation mode. Input must be closed (Enabled) to operate.</td></tr>
<tr><td>1</td><td>DI Dependent</td><td>Operation is in combination with the status of Run command (Fx input).</td></tr>
<tr><td rowspan="5">IN-61
Run Dis Stop</td><td colspan="3">Decelerates the motor based on the deceleration time (Q-Stop Time) set in IN-62. If the Enable input is re-applied during deceleration and the run command is maintained, the inverter will resume normal operation.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Free Run</td><td>Blocks the inverter output when the multi-function terminal is off.</td></tr>
<tr><td>1</td><td>Q-Stop</td><td>The deceleration time (Q-Stop Time) used in safe operation mode. It stops after deceleration and then the operation can resume only when the operation command is entered again. The operation will not begin if only the multi-function terminal is on.</td></tr>
<tr><td>2</td><td>Q-Stop Resume</td><td>The inverter decelerates to the deceleration time (Q-Stop Time) in safe operation mode. It stops after deceleration. Then if the multifunction terminal is on, the operation resumes as soon as the operation command is entered again.</td></tr>
<tr><td>IN-62
Q-Stop Time</td><td colspan="3">Sets the deceleration time when IN-61 (Run Dis Stop) is set to 1 (Q-Stop) or 2 (Q-Stop Resume).</td></tr>
</table>

Q-Stop Function

When IN-60 (Run En Mode) is set to 1 (DI Dependent) and IN-61 is set to 1 (Q-Stop), if the Run Enable input is opened during operation, the inverter will decelerate to a stop based on the time set in IN-62, Q-Stop Time. To re-start, the Enable input must be re-applied and the Run command (Fx) must be removed then re-applied.

Q-Stop Resume Function

When IN-60 (Run En Mode) is set to 1 (DI Dependent) and IN-61 is set to 2 (Q-Stop Resume), this allows operation (Start/Stop) of the inverter based on the Run Enable input. If the Run Enable is opened during operation and the Run command (Fx) is maintained, closure of the Run Enable input will allow the inverter to operate (resume operation).



5.6.3 Digital Inputs

The digital input terminals (P1 ~ P7) can be set to a variety of functions. The following table shows the default settings of parameters IN-65 ~ IN-71.

Code	Name	LCD Display	Setting	
IN-65	P1 terminal configuration	P1 Define	1	Fx
IN-66	P2 terminal configuration	P2 Define	2	Rx
IN-67	P3 terminal configuration	P3 Define	5	BX
IN-68	P4 terminal configuration	P4 Define	3	RST
IN-69	P5 terminal configuration	P5 Define	7	Speed-L
IN-70	P6 terminal configuration	P6 Define	8	Speed-M
IN-71	P7 terminal configuration	P7 Define	9	Speed-H
IN-72*	P8 terminal configuration	P8 Define	0	None
IN-73*	P9 terminal configuration	P9 Define	0	None

* IN-72 and IN-73 are shown when the Extended IO Card is installed.

The following table lists the various functions that can be assigned to the digital input terminals.

Setting		Description	Setting		Description
0	None	Not assigned	22	U/D Clear	Clear the saved U/D speed
1	Fx	Forward Start/Run	23	Analog Hold	Hold the analog input speed reference
2	Rx	Reverse Start/Run	24	I-Term Clear	Clear the accumulated I-Gains
3	RST	Reset	25	PID Openloop	Switch to V/Hz mode.
4	External Trip	External Trip	26	PID Gain2	Switch to PID Gain2 setting
5	BX	Disable Output	27	PID Ref Change	Switch PID reference
6	JOG	Jog Operation	28	Pre Excite	Apply DC to motor at start
7	Speed-L	Fixed Speed - Low	29	Timer In	Activate timer for relay output
8	Speed-M	Fixed Speed - Medium	31	dis Aux Ref	Disable the Auxiliary speed reference
9	Speed-H	Fixed Speed - High	32	FWD JOG	Start at forward jog speed
11	XCEL-L	Multi-Step Accel/Decel - Low	33	REV JOG	Start at reverse jog speed
12	XCEL-M	Multi-Step Accel/Decel - Medium	34	Fire Mode	Activate Fire Mode
13	XCEL-H	Multi-Step Accel/Decel - High	35	Time Event En	Activate Time Event schedule
14	XCEL Stop	Disable XCEL Steps	36	Pre Heat	Apply DC to motor while stopped
15	RUN Enable	Run enable/disable	37	Damper Open	Detect Open Damper state
16	3-Wire	3 wire control	38	Pump Clean	Perform Pump Clean operation
17	2nd Source	Switch to 2nd control and frequency reference sources	39	Sleep Wake Chg	Use 2nd Sleep/Wake settings
18	Exchange	Switch inverter output to line	40	PID Step Ref L	Step reference (Low) for PI Control
19	Up	Increase speed	41	PID Step Ref M	Step reference (Medium) for PI Control
20	Down	Decrease Speed	42	PID Step Ref H	Step reference (High) for PI Control

5.6.4 Digital Input Descriptions

5.6.4.1 Fx, Rx (Forward, Reverse) Command Input

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td rowspan="2">IN</td><td rowspan="2">65~71</td><td rowspan="2">Px terminal setting options</td><td rowspan="2">Px Define
(Px: P1–P7)</td><td>1</td><td>Fx</td><td rowspan="2">0-43</td><td rowspan="2">-</td></tr>
<tr><td>2</td><td>Rx</td></tr>
</table>

Assign a terminal for forward '1 (Fx)' operation. Assign a terminal for reverse '2 (Rx)' operation. Refer to *5.1.3.2 Terminal Block as a Command Source (Fwd/Rev Run) on page 105* for additional details.

5.6.4.2 RST, Reset command input

After a fault, the inverter can be reset with a digital input set to '3, (RST)' and activate the terminal to reset the trip. A fault can also be reset by pressing the OFF button on the LCD.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td>IN</td><td>65~71</td><td>Px terminal setting options</td><td>Px Define
(Px: P1–P7)</td><td>3</td><td>RST</td><td>0-43</td><td>-</td></tr>
</table>

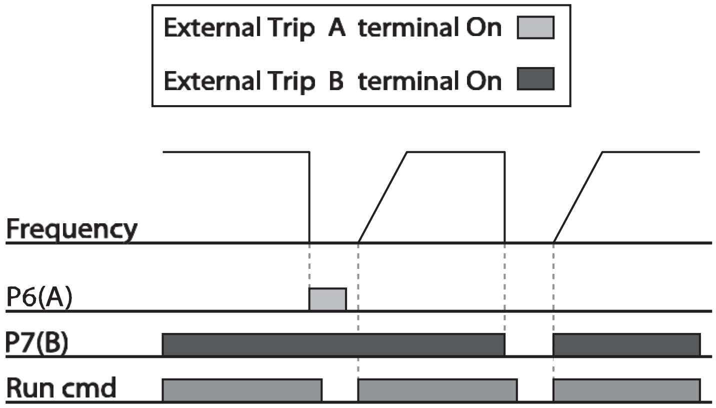
5.6.4.3 External Trip

Set one of the multi-function (digital) input terminals P1~P7 (IN-65 ~ IN-71) to '4 (External Trip)'. When activated, the inverter trips and blocks the output. The input terminals can be set independently as NO or NC with IN-87 to activate the trip when closed or when opened.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td rowspan="2">IN</td><td>65~71</td><td>Px terminal setting options</td><td>Px Define
(Px: P1–P7)</td><td>4</td><td>External Trip</td><td>0-42</td><td>-</td></tr>
<tr><td>87</td><td>Multi-function input contact selection</td><td>DI NC/NO Sel</td><td colspan="2">P9   P8 P7 P6 P5   P4 P3 P2 P
1   1 1 1 1   1 1 1 1
0   0 0 0 0   0 0 0 0</td><td>0 0000 0000
~
1 1111 1111</td><td>bit</td></tr>
</table>

External Trip Signal Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>IN-87
DI NC/NO Sel</td><td>Select terminal input contact types (NO or NC) for each input terminal. Type A designates a normally open (NO) contact input, close to activate. Type B designates a normally closed (NC) contact input, open to activate.
LCD bit representation in parameter view. When the bottom segment is black, bit is set to "OFF" (normally open).
<table>
<tr><td>Type</td><td>Type A
(NO)</td><td>Type B
(NC)</td></tr>
<tr><td rowspan="2">LCD
Display</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
<table>
<tr><td>P9</td><td></td><td>P8</td><td>P7</td><td>P6</td><td>P5</td><td></td><td>P4</td><td>P3</td><td>P2</td><td>P1</td><td></td></tr>
<tr><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>Type B</td></tr>
<tr><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>Type A</td></tr>
</table></td></tr>
</table>



[External Trip]

5.6.4.4 BX, Output Block

Set one of the digital input terminals (P1 ~ P7) to '5 (BX)'. When activated, the inverter output is blocked, and operation stops. The LCD displays 'BX". The "HAND" button is also disabled. **The BX input is not a latched fault.** When the digital input is deactivated, operation resumes.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	5	BX	0-42	-

Output Block by Multi-function Terminal Setting Details

Code	Description
IN-65~71 Px Define	When the operation of the digital input terminal is set to '5 (BX)' and is activated during operation, the inverter blocks the output and 'BX' is displayed on the keypad display. While 'BX' is displayed on the keypad screen, the inverter's operation information including the operation frequency and current at the time of the BX signal can be viewed but is not recorded in the TRP group (fault history). The inverter resumes operation when the BX terminal deactivated with the run command still applied.

5.6.4.5 JOG operation

The jog operation allows for temporary control of the inverter. There are two was to apply a jog and start command using the digital input terminals.

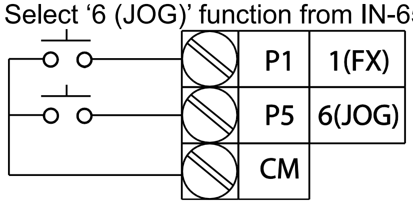
- Jog-1 using a digital input terminal set to JOG along with a start command (Fx or Rx).
- Jog-2 using a single digital input set to FWD JOG or REV JOG.

5.6.4.5.1 Jog Operation 1-Forward Jog by Multi-function Terminal

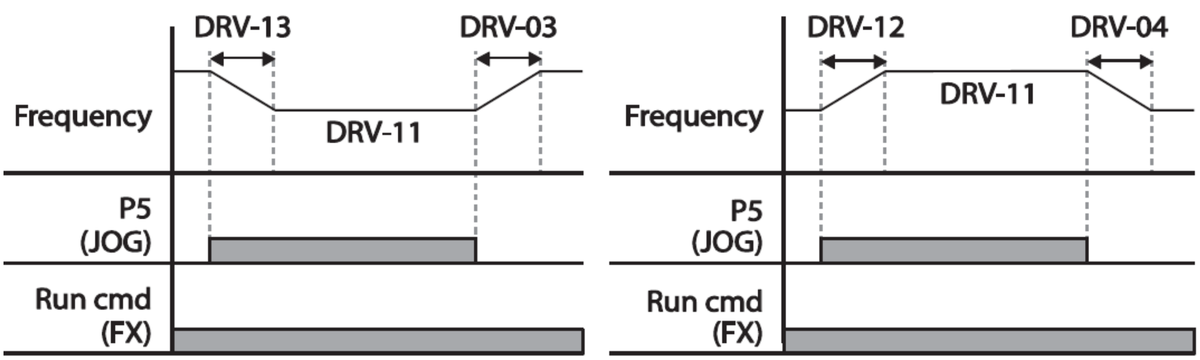
The jog operation is available in the forward (or reverse) direction, using two input terminals (Fx and JOG). The table below lists parameter settings for a forward jog operation with a separate Run (Fx) command.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	11	Jog frequency	JOG Frequency	10.00		0.50-Maximum frequency	Hz
	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00-600.00	sec
	13	Jog operation deceleration time	JOG Dec Time	30.00		0.00-600.00	sec
IN	65~71	Px terminal configuration	Px Define (Px: P1–P7)	6	JOG	0-42	-

Forward Jog Description Details

Code	Description
IN-65–71 Px Define	Select ‘6 (JOG)’ function from IN-65 ~ 71 for one of the inputs.  [Terminal settings for jog operation]
DRV-11 JOG Frequency	Set the operation frequency.
DRV-12 JOG Acc Time	Set the acceleration speed.
DRV-13 JOG Dec Time	Set the deceleration speed.

If a signal is applied to the jog terminal while running (FX applied), the operating frequency changes to the jog frequency.



Operation frequency > Jog frequency   Operation frequency < Jog frequency

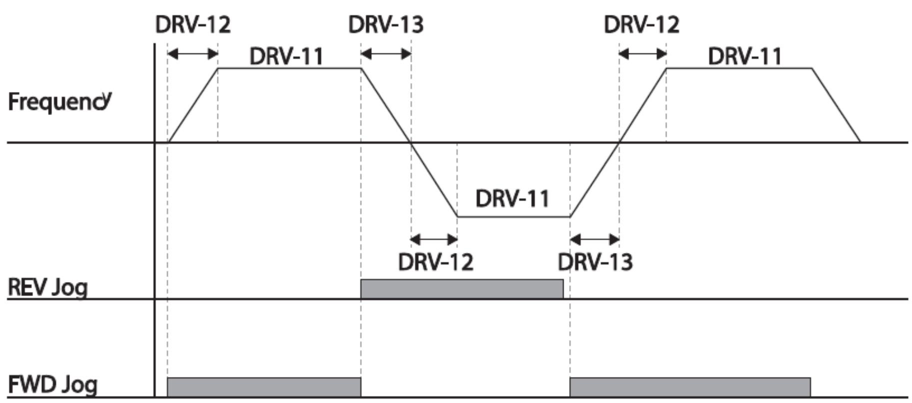
5.6.4.5.2 Jog Operation 2-Fwd/Rev Jog by Multi-function Terminal

A terminal that is set for ‘32 (FWD JOG)’ or ’33 (REV JOG)’ also starts the inverter. The table below lists parameter settings for a forward (or reverse) jog operation. A separate Run (Fx) command is not required.

Group	Code	Name	LCD Display	Parameter setting	Setting Range	Unit
DRV	11	Jog frequency	JOG Frequency	10.00	0.50-Maximum frequency	Hz
	12	Jog operation acceleration time	JOG Acc Time	20.00	0.00-600.00	sec
	13	Operation deceleration time	JOG Dec Time	30.00	0.00-600.00	sec
IN	65~71	Px terminal configuration	Px Define (Px: P1~P7)	32 FWD JOG 33 REV JOG	0-42	-

NOTE: The priorities for speed reference inputs and associated Acc/Dec times via digital inputs are as follows:

Dwell overrides Jog overrides Up/Down overrides Fixed Speed inputs overrides Frq setting. If a different operation command is entered during a jog operation (other than dwell), it is ignored, and the operation maintains the jog frequency.



5.6.5 Multi-Step Frequencies, Speed-L, Speed-M, Speed-H

Multi-step operations (Fixed Speed Inputs) can be assigned to the Px terminals. Seven steps (1 through 7) can be configured using (3) digital input terminals. Refer to section *5.3.3.4*, BAS-50 Multi-step Frequencies (Fixed Speed Inputs) for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	7	Speed-L	0-42	-
				8	Speed-M		
				9	Speed-H		

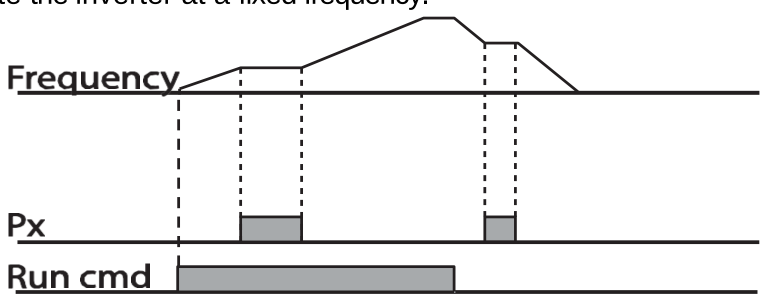
5.6.6 Multi-Step Accel/Decel Times, XCEL-L, XCEL-M, XCEL-H

Digital input terminals can be configured for different Acc and Dec times. Up to 7 acceleration times and 7 deceleration times can be set. Refer to section 5.3.3.6
BAS-70 Multi-step Acc/Dec Time Configuration for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	11	XCEL-L	0-42	-
				12	XCEL-M		
				13	XCEL-H		
				14	XCEL Stop		

5.6.7 Stopping the Acc/Dec Operation

Configure a digital input terminal to ‘14 (XCEL Stop)’ and when activated, stop acceleration or deceleration to operate the inverter at a fixed frequency.



Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	65~71	Px terminal configuration	Px Define (Px: P1– P7)	14	XCEL Stop	0–42	-

5.6.8 RUN Enable (Safety Stop)

When a digital input is set to ‘15 (Run Enable)’, the inverter will only operate when the input is closed (Enabled). Refer to section *5.6.2 IN-60 Safe Operation Mode* for more details. **NOTE:** this does not disable “HAND” button operation.

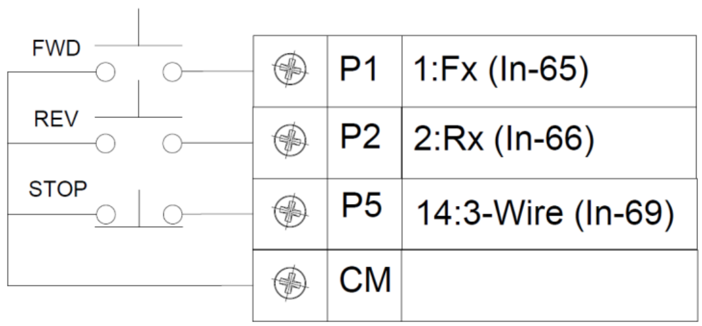
Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	15	RUN Enable	0-42	-

5.6.9 3-Wire

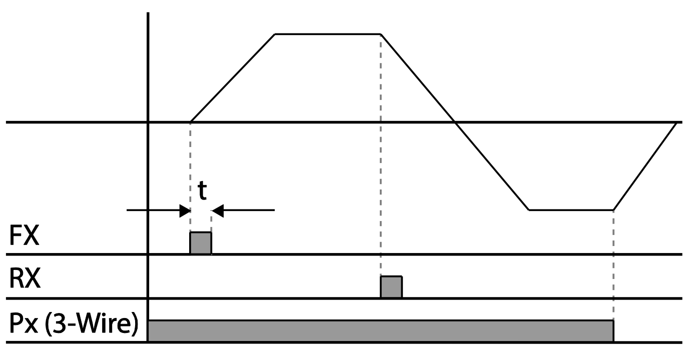
3-wire operation is used to latch the run command input signal (FWD or REV) when using a momentary contact input. This configuration is commonly used to operate the inverter with a set of momentary push buttons.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source*	1	Fx/Rx - 1	-	-
IN	65~71	Px terminal configuration	Px Define (Px: P1~P7)	16	3-Wire	0-42	-

To enable the 3-wire operation, the following circuit is necessary. The minimum input time (t) for 3-wire operation is 1ms. The operation stops if both forward and reverse operation commands are entered at the same time.



[Terminal connections for 3-wire operation]



[3-wire operation]

5.6.10 2nd Source

The inverter can be operated (Start/Stop and Reference Frequency) by two different operating modes and switch between them as required. Refer to *5.3.1 BAS-01 2nd Operating Mode - 2nd Source* for more details.

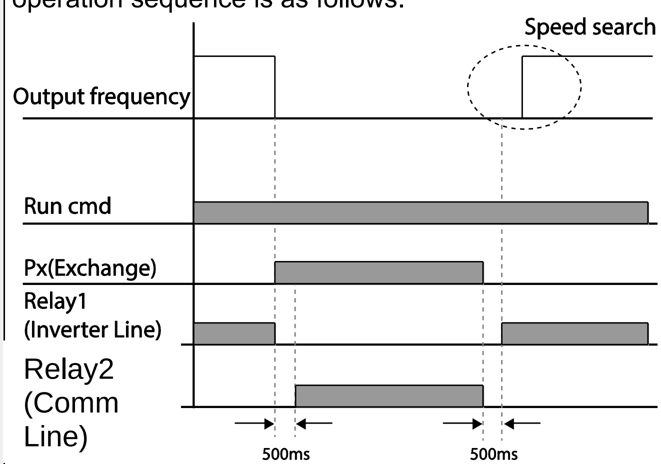
Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	17	2nd Source	0-42	-

5.6.11 Exchange

Power Source Transition can be used to switch the power source to the motor from the inverter output to the main supply power source (commercial power source), and vice versa.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	18	Exchange	0-42	-
OUT	31-35	Multi-function relay items	Relay1-5	17	Inverter Line	0-43	-
	36	Multi-function output1 items	Q1 Define	18	Comm Line	0-43	-

Supply Power Transition Setting Details

Code	Description
IN-65–71 Px Define	Set one of the digital input terminals (P1~P7) to '18 (Exchange)'. Set the two output relays (Relay1 ~ Relay5) to '17 (Inverter)' and '18 (Comm Line)' respectively. When the digital input is activated, the output relays will change state. An external method of switching the inverter output to the commercial line is required. To reverse the transition, deactivate the digital input terminal.
OUT-31~35 Relay 1~5 Define OUT-36 Q1 Define	Set Relay1 to 17 (inverter line) and Relay2 to 18 (comm line). Relay operation sequence is as follows. 

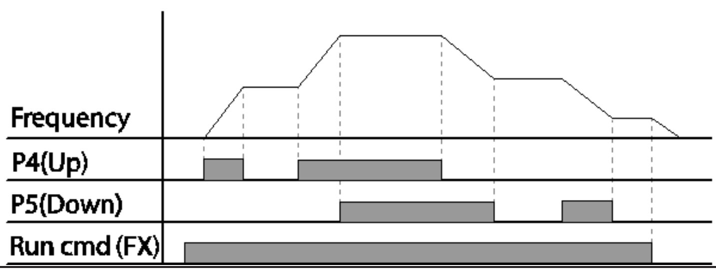
5.6.12 Up-Down Operation

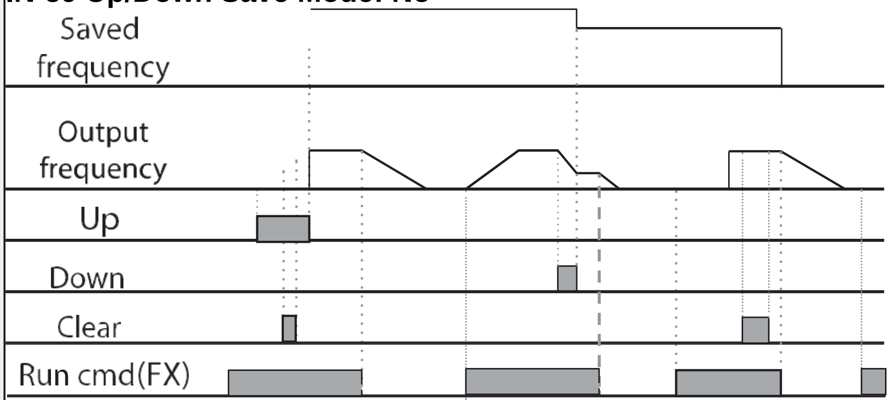
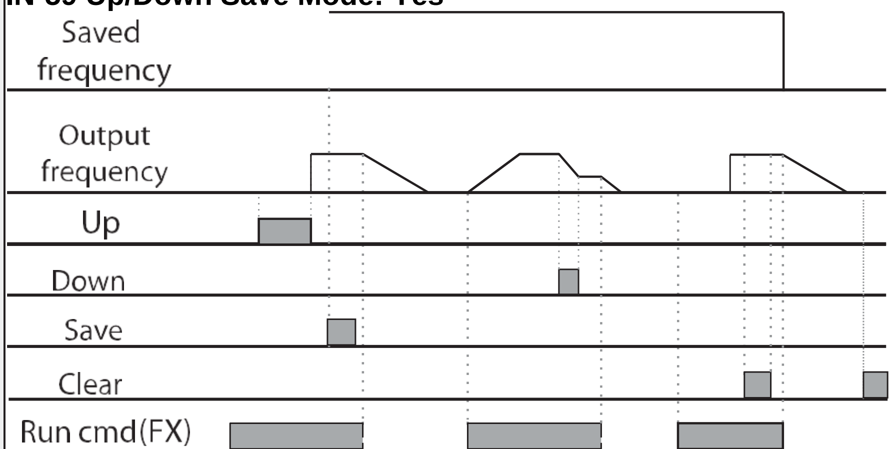
The inverter can control the speed of the motor using digital inputs set to the Up and Down functions. The Up/Down operation can be applied to systems that use upper-lower limit switches. Two digital inputs are required. One set to Up (increase speed) and one set to Down (decrease speed) operation.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	59	Up/down operation frequency save	U/D Save Mode	0	No	0 - 1	-
				1	Yes		
IN	65–71	Px terminal configuration	Px Define (P1~P7)	19	Up	0–42	-
				20	Down		
				22	U/D Clear		

The operation will follow the Up or Down inputs and will override other speed reference inputs.

Up-down Operation Setting Details

Code	Description
IN-65~71 Px Define	Select two terminals for up-down operation and set them to ‘19 (Up)’ and ‘20 (Down)’, respectively. With the run command active, acceleration begins when the Up terminal signal is activated. Acceleration stops and constant speed operation begins when the signal is deactivated. During operation, deceleration begins when the Down terminal signal is activated. Deceleration stops and constant speed operation begins when the signal is deactivated. Also, when both Up and Down signals are entered at the same time, constant speed operation begins. 
IN-59 U/D Save Mode	When set to Yes, the operating frequency is saved automatically in the following conditions: the run command (Fx or Rx) is removed, a fault occurs, or the inverter is powered off. When the run command is reapplied, or when the fault is cleared, or when power is restored, the inverter resumes operation at the saved frequency. To delete the saved frequency, set one of the multi-function (digital) terminals to 22 (U/D Clear) and activate the input during constant speed operation. The saved frequency will be deleted.

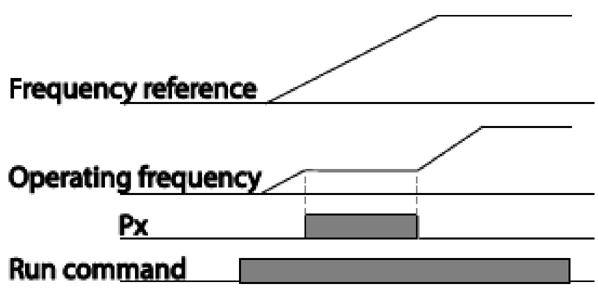
Code	Description
IN-59 U/D Save Mode	**IN-59 Up/Down Save Mode: No**  **IN-59 Up/Down Save Mode: Yes**  • When the inverter resumes normal operation from: • Run command applied • Power Up with Run command • Fault Reset with Auto Re-Start • it resumes operation at the saved frequency. To delete the saved frequency, apply a digital input set to “22 (U/D Clear)” during normal operation. The saved frequency and the up/down operation configuration will be deleted.

5.6.13 Frequency Hold by Analog Input

When using an analog input as the frequency reference, you can apply a hold of the inverter output frequency by applying a digital input any point even though the analog input continues to change. Set a digital input to '23 (Analog Hold)'. When the input is activated, the output frequency will be maintained (held constant) until the input is deactivated.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	2	V1	0–11	-
				4	V2		
				5	I2		
				9	Pulse		
				10*	V3		
				11	I3		
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	23	Analog Hold	0–42	-

*'10(V3)~11(I3)' of DRV-07 are available when Extended IO option is installed. Refer to Extended IO option manual for more detailed information.



5.6.14 I-Term Clear

When operating in PI Control mode, a digital input can be set to '24 (I-Term Clear)'. When activated, all of the accumulated errors are deleted. Refer to section *6 PID Control Group (PID)*.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	24	I-Term Clear	0-42	-

5.6.15 PID Openloop

When operating in PI Control mode, a digital input can be set to '25 (PID Openloop)'. When activated, the inverter disables the PI Control. Refer to section *6.3.4 PID Switching (PID Open loop)* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	25	PID Openloop	0-42	-

5.6.16 PID PGain2

When operating in PI Control mode, a digital input can be set to '26 (PID Gain2)'. When activated, the inverter switches from the PID PGain1 setting to the PID PGain2 setting. Refer to section *6 PID Control Group (PID)* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	26	PID Gain2	0-42	-

5.6.17 PID Ref Change

When operating in PI Control mode, a digital input can be set to '27 (PID Ref Change)'. When activated, the inverter switches from the PID Ref 1 settings (PID-10 ~ PID-14) to the PID Ref 2 settings (PID-15 ~ PID-19). Refer to section *6 PID Control Group (PID)* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	27	PID Ref Change	0-42	-

5.6.18 Pre-Excite

A digital input can be set to '28 (Pre Excite)' to stop and hold the motor prior to starting. Refer to section *5.4.2.2 Start After DC Braking* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	28	Pre Excite	0-42	-

5.6.19 Timer In

Add a timer function to the inverter. Set a digital input to activate the timer. Set outputs (Relay1 ~ 5 or Q1) to respond to the input. Add On/Off delay times to the outputs.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	29	Timer In	0~42	-
OUT	31	Multi-function relay1	Relay 1	22	Timer Out	0~43	-
	33	Multi-function output1	Q1 Define				
	55	Timer on delay	TimerOn delay	3.00		0.00–100	sec
	56	Timer off delay	TimerOff delay	1.00		0.00–100	sec

Timer Setting Details

Code	Description
IN-65~71 Px Define	Choose one of the digital input terminals and set it to 29 (Timer In). Activate the terminal to start the timer function.
OUT-31 ~ 35 Relay1~Relay5, OUT-36 Q1 Define	Set multi-function output terminals to be used as the timer output to 22 (Timer out).
OUT-55 TimerOn Delay, OUT-56 TimerOff Delay	Set the On Delay time. When the digital input is activated, the output relay will change state after the On Delay time has passed. Set the Off Delay time. When the digital input is deactivated, the output relay will change state after the Off Delay time has passed.

5.6.20 Dis Aux Ref

When using an Auxiliary Reference along with a Main Frequency Reference, a digital input can be set to '29 (dis Aux Ref)'. When activated, the inverter ignores the Auxiliary Reference. Refer to section *5.3.2 BAS-03 Operating with Auxiliary References* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	29	dis Aux Ref	0-42	-

5.6.21 FWD JOG / REV JOG

A digital input that is set to '32 (FWD JOG)' and/or '33 (REV JOG)' also starts the inverter. Refer to section *5.6.4.5.2 Jog Operation 2-Fwd/Rev Jog by Multi-function Terminal* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	32	FWD JOG	0-42	-
				33	REV JOG		

5.6.22 Fire Mode

A digital input that is set to '34 (Fire Mode)' to operate the inverter under emergency situations. See section *5.8.10 PRT-44 Fire Mode on page 205* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	34	Fire Mode	0-42	-

5.6.23 Time Event En

A digital input can be set to '35 (Time Event En)'. When activated, the scheduling set in the Event Timer of Application Group 3 (AP3) is performed. Refer to *8.2 Application Group 3 (AP3) on page 269* for details on the Event Timer.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	35	Time Event En	0-42	-

5.6.24 Pre Heat

A digital input can be set to '36 (Pre Heat)'. When activated, current is applied to the motor to remove moisture and prevent freezing. Refer to *8.1.8 AP2-48 Pre-Heat Function on page 267* for details on setting the current level and time.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	36	Pre Heat	0-42	-

5.6.25 Damper Open

A digital input may be set to '45 (Damper Open)' to receive the damper open status input. Refer to section *8.1 AP2-45 Damper Operation on page 265* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	37	Damper Open	0-42	-

5.6.26 Pump Clean

A digital input can be set to '38 (Pump Clean)' to perform the Pump Cleaning Operation. Refer to section *8.1.3 AP2-15 Pump Clean Operation on page 259* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	38	Pump Clean	0-42	-

5.6.27 Sleep Wake Chg

A digital input can be set to '39 (Sleep Wake Chg)' to switch between two different Sleep/Wake Up settings, Sleep/Wake Up 1 (AP1-07~AP1-10) and Sleep/Wake Up 2 (AP1-11 ~ AP1-14). Refer to section *6.3.2 PID Sleep Mode on page 233* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	39	Sleep Wake Chg	0-42	-

5.6.28 PID Step Ref L, PID Step Ref M, PID Step Ref H

Three digital inputs can provide up to 7 different Step References (setpoints). Refer to section *6 PID Control Group (PID) on page 220* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65~71	Px terminal setting options	Px Define (Px: P1–P7)	40	PID Step Ref L	0-42	-
				41	PID Step Ref M		
				42	PID Step Ref H		

5.6.29 Digital Input Terminal Control

An On Delay and/or Off Delay time can be applied to all digital input terminals. The default setting for all terminals is enabled "1" (On) which applies one On Delay (IN-85) and one Off Delay (IN-86) filter time to all terminals. To disable the delay time for a specific terminal, set the bit for the terminal to "0" (Off). Note: Longer time settings will delay the response of the input.

Additionally, the digital inputs can be configured independently as a normally open input or a normally closed input (IN-87). The status of the inputs can be viewed at IN-90.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
IN	83	Enable On Delay	DI On DelayEn	P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 - 1 1111 1111	-
	84	Enable Off Delay	DI Off DelayEn	P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 - 1 1111 1111	-
	85	Multi-function input terminal On filter	DI On Delay	10	0–10000	msec
	86	Multi-function input terminal Off filter	DI Off Delay	3	0–10000	msec
	87	Multi-function input terminal selection	DI NC/NO Sel	P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 - 1 1111 1111	-
	90	Multi-function input terminal status	DI Status	P9 P8 P7 P6 P5 P4 P3 P2 P1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 - 1 1111 1111	-

P8 and P9 terminals are on the Extended I/O PCB.

Multi-function Input Terminal Control Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>IN-83
DI On Delay En
IN-84
DI Off Delay En</td><td>Each input terminal (P1~P9) can be set to function with an On Delay and/or an Off Delay. Apply an “On Delay” function for selected terminals with IN-83. Apply an “Off Delay” function for selected terminals with IN-84.
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><th>Item</th><th>Bit Status (On)</th><th>Bit Status (Off)</th></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>
<table>
<tr><td>P9</td><td></td><td>P8</td><td>P7</td><td>P6</td><td>P5</td><td></td><td>P4</td><td>P3</td><td>P2</td><td>P1</td></tr>
<tr><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table></td></tr>
<tr><td>IN-85
DI On Delay
IN-86
DI Off Delay</td><td>Set the On/Off delay times for all of the enabled terminals in IN-83 and IN-84. When the terminal receives a change of state input it is recognized as On or Off after the set time.</td></tr>
<tr><td>IN-87
DI NC/NO Sel</td><td>Select terminal input contact types (NO or NC) for each input terminal. Type A designates a normally open (NO) contact input, close to activate. Type B designates a normally closed (NC) contact input, open to activate.
LCD bit representation in parameter view. When the bottom segment is black, bit is set to "OFF" (normally open).
<table>
<tr><th>Type</th><th>Type A (NO)</th><th>Type B (NC)</th></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>
<table>
<tr><td>P9</td><td></td><td>P8</td><td>P7</td><td>P6</td><td>P5</td><td></td><td>P4</td><td>P3</td><td>P2</td><td>P1</td><td></td></tr>
<tr><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>Type B</td></tr>
<tr><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>Type A</td></tr>
</table></td></tr>
<tr><td>IN-90
DI Status</td><td>Display the status of each input terminal. In parameter view, when the bottom segment is black, bit is "OFF" (status is open). When the top segment is black, bit is "ON" (status is closed).
<table>
<tr><th>Type</th><th>Type A (Open)</th><th>Type B (Closed)</th></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>
<table>
<tr><td>P9</td><td></td><td>P8</td><td>P7</td><td>P6</td><td>P5</td><td></td><td>P4</td><td>P3</td><td>P2</td><td>P1</td><td></td></tr>
<tr><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>Closed</td></tr>
<tr><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>Open</td></tr>
</table></td></tr>
</table>

5.7 Output Group (OUT)

5.7.1 OUT-01, OUT-07 Analog Outputs

Each of the analog output terminals (AO1, AO2) can represent one of a variety of functions. AO1 is switchable (SW5 on IO TB PCB) between 0/4-20mA or 0-10V outputs. AO2 is 0-10V output only. Scaling and filtering can also be applied to the output signals. A 0-32kHz pulsed output can be provided at terminal Q1 (OUT-36 set to '38 (TO)'.

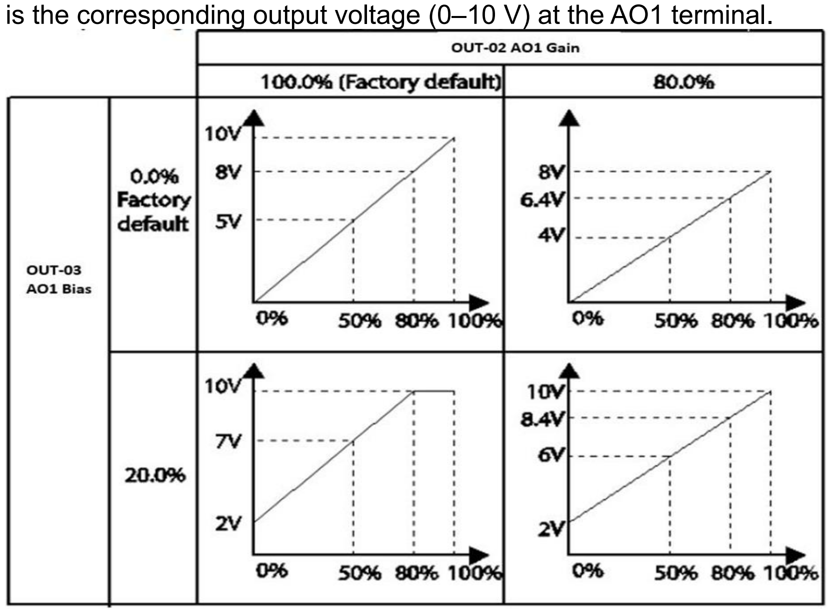
5.7.1.1 Voltage and Current Analog Output

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	01	Analog output1	AO1 Mode	0	Frequency	0–12	-
	02	Analog output1 gain	AO1 Gain	100.0		-1000.0–1000.0	%
	03	Analog output1 bias	AO1 Bias	0.0		-100.0–100.0	%
	04	Analog output1 filter	AO1 Filter	5		0-10000	ms
	05	Analog constant output1	AO1 Const %	0.0		0.0-100.0	%
	06	Analog output1 monitor	AO1 Monitor	0.0		0.0-1000.0	%
	07	Analog output2	AO2 Mode	0	Frequency	0–12	-
	08	Analog output2 gain	AO2 Gain	100.0		-1000.0–1000.0	%
	09	Analog output2 bias	AO2 Bias	0.0		-100.0–100.0	%
	10	Analog output2 filter	AO2 Filter	5		0-10000	ms
	11	Analog constant output2	AO2 Const %	0.0		0.0-100.0	%
	12	Analog output2 monitor	AO2 Monitor	0.0		0.0-1000.0	%

Voltage and Current Analog Output Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>OUT-01
AO1 Mode

OUT-07
AO2 Mode</td><td>Select the function of the signal to output.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Frequency</td><td>Outputs operation frequency as a standard. 10V output is made from the frequency set at DRV-20 (Max Freq)</td></tr>
<tr><td>1</td><td>Output Current</td><td>A 10V output represents 150% of inverter rated current.</td></tr>
<tr><td>2</td><td>Output Voltage</td><td>Sets the outputs based on the inverter output voltage. 10V output is made from a set voltage in MOT-07 (Motor Voltage).
If '0' is set in MOT-07, 230V/460V inverter's output 10V based on the actual input voltages.</td></tr>
<tr><td>3</td><td>DC Link Volt</td><td>Outputs inverter DC bus voltage as a standard. Outputs 10V when the DC bus voltage is 410Vdc for 230V inverters, and 820Vdc for 460V models.</td></tr>
<tr><td>4</td><td>Output Power</td><td>Monitors output wattage. A 10V output represents 150% of inverter rated power.</td></tr>
<tr><td>7</td><td>Target Freq</td><td>Outputs set frequency as a standard. Outputs 10V at the maximum frequency (DRV-20).</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td>8</td><td>Ramp Freq</td><td>Outputs frequency calculated with Acc/Dec function as a standard. May vary with actual output frequency. Outputs 10V.</td></tr>
<tr><td>9</td><td>PID Ref Value</td><td>Outputs command value of a PID controller as a standard. Outputs approximately 6.6V at 100%.</td></tr>
<tr><td>10</td><td>PID Fdk Value</td><td>Outputs feedback amount of a PID controller as a standard. Outputs approximately 6.6V at 100%.</td></tr>
<tr><td>11</td><td>PID Output</td><td>Outputs the output value of a PID controller as a standard. Outputs approximately 10V at 100%.</td></tr>
<tr><td>12</td><td>Constant</td><td>Outputs a fixed amount based on the setting of OUT-05 (AO1 Const %).</td></tr>
</table>
</td></tr>
<tr><td>OUT-02 AO1 Gain,
OUT-03 AO1 Bias
OUT-08 AO2 Gain
OUT-09 AO2 Bias</td><td>
The following example uses a 0-10V output at the AO1 terminal.
The Gain and Bias settings provide scaling adjustment of the analog outputs. The graphs below illustrate adjustments of OUT-02 (AO1 Gain) and OUT-03 (AO1 Bias) percentages and the effect on the analog output (AO1). The X-axis is the % value of the selected output item and the Y-axis is the corresponding output voltage (0–10 V) at the AO1 terminal.


Frequency setting example: Using default values of 100% Gain and 0% Bias and the maximum frequency set at DRV-20 (Max Freq) is 60 Hz. When the output frequency is 30 Hz, the corresponding X-axis value is 50% or 5V output at AO1 terminal.
The percent value of the analog output is based on the following equation.
$$AO1 = \frac{Frequency}{MaxFreq} \times AO1\ Gain + AO1\ Bias$$
</td></tr>
<tr><td>OUT-04 AO1 Filter
OUT-10 AO2 Filter</td><td>Set filter time constant on the analog outputs.</td></tr>
<tr><td>OUT-05
A01 Const %
OUT-11
AO2 Const %</td><td>If analog output at OUT-01 (AO1 Mode) is set to 12 (Constant), a fixed current output can be set between 0-100% for calibration and other uses.
If analog output at OUT-07 (AO2 Mode) is set to 12 (Constant), a fixed voltage output can be set between 0 - 100% for calibration and other uses.</td></tr>
<tr><td>OUT-06
AO1 Monitor
OUT-12
AO2 Monitor</td><td>Monitors analog output values. Displays the output voltage (or current) as a percentage (%) with 10V or 20 mA as 100%.</td></tr>
</table>

Note

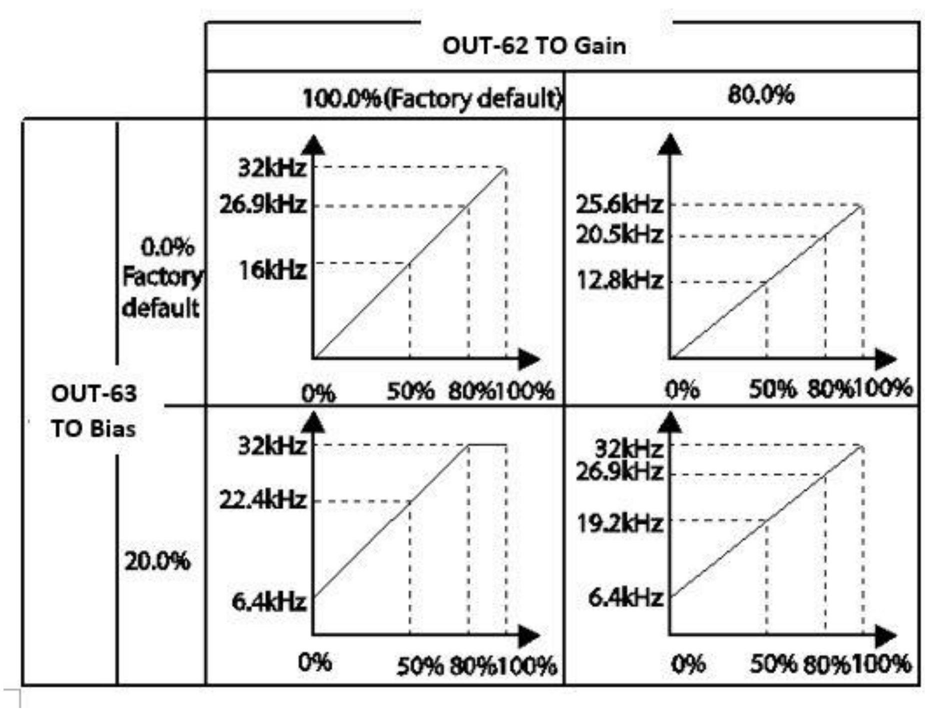
AO1 Current Output Tuning Mode on 4-20mA output, OUT-02 (AO1 Gain) and OUT-03 (AO1 Bias)
Bias Tuning
Set OUT-01 (AO1 Mode) to constant and set OUT-05 (AO1 Const %) to 0.0 %.
Set OUT-03 (AO1 Bias) to 20.0% and then check current output. 4mA output should be displayed. If the value is less than 4mA, gradually increase OUT-03 (AO1 Bias) until 4mA is measured. If the value is more than 4mA, gradually decrease OUT-03 (AO1 Bias) until 4mA is measured.
Gain Tuning
Set OUT-05 (AO1 Const %) to 100.0%
Set OUT-02 (AO1 Gain) to 80.0% and measure current output at 20mA. If the value is less than 20mA, gradually increase OUT-02 (AO1 Gain) until 20mA is measured. If the value is more than 20mA, gradually decrease OUT-02 (AO1 Gain) until 20mA is measured.
AO2 Output Tuning
The functions of each parameter for AO2 voltage output (parameters OUT-07~ OUT-12) are identical to the descriptions for the above AO1, 4-20mA outputs.

5.7.1.2 OUT-61 Analog Pulse Output

The pulse output terminal (Q1/TO) can represent one of a variety of functions (OUT-61). Scaling and filtering can also be applied to the signal.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	36	Multi-function output Q1	Q1 define	38	TO	0–42	-
	61	Pulse output setting	TO Mode	0	Frequency	0-12	-
				1	Output Current		
				2	Output Voltage		
				3	DCLink Voltage		
				4	Output Power		
				7	Target Freq		
				8	Ramp Freq		
				9	PID Ref Value		
				10	PID Fdb Value		
				11	PID Output		
				12	Constant		
	62	Pulse output gain	TO Gain	100.0		-1000.0–1000.0	%
	63	Pulse output bias	TO Bias	0.0		-100.0-100.0	%
	64	Pulse output filter	TO Filter	5		0–10000	ms
	65	Pulse output constant output2	TO Const %	0.0		0.0-100.0	%
	66	Pulse output monitor	TO Monitor	0.0		0.0–1000.0	%

Analog Pulse Output Setting Details

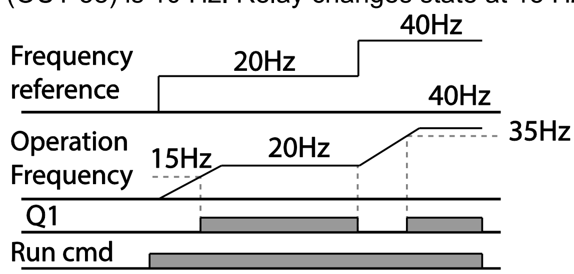
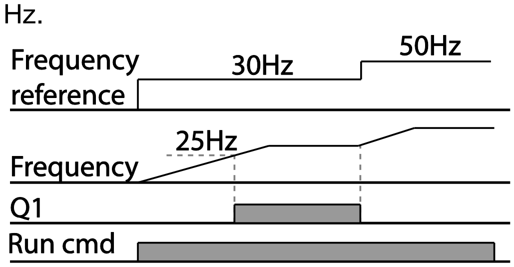
Code	Description
OUT-36 Q1 Define	Pulse output TO and multi-function output Q1 share the same terminal. Set OUT-36 to ‘38’, TO for a 0-32kHz pulsed output at Q1 terminal. When connecting the pulse signal between the inverters, connect pulse output (Q1/TO-EG) to pulse input (TI-CM) directly.
OUT-62 TO Gain OUT-63 TO Bias	The Gain and Bias settings provide scaling adjustment of the pulse output signal. The graphs below illustrate adjustments of OUT-62 (TO Gain) and OUT-63 (TO Bias) percentages and the effect on the pulse output signal (TO). The X-axis is the % value of the selected output item and the Y-axis is the corresponding frequency (0–32kHz) at the Q1/TO terminal.  For example, if the maximum frequency set with DRV-20 (Max Freq) is 60Hz and present output frequency is 30Hz, then the x-axis value on the next graph is 50%. The frequency output is based on the following equation: $TO = \frac{Frequency}{MaxFreq} \times TO\ Gain + TO\ Bias$
OUT-64 TO Filter	Sets filter time constant on the analog output.
OUT-65 TO Const %	Displays a fixed output kHz signal as a percentage (%) with 32 kHz. as 100%.
OUT-66 TO Monitor	Monitors output pulse rate. Displays the output pulse rate as a percentage (%) with 32 kHz as 100%.

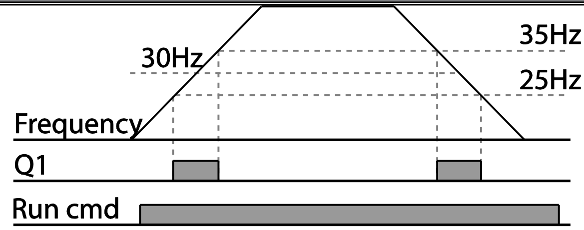
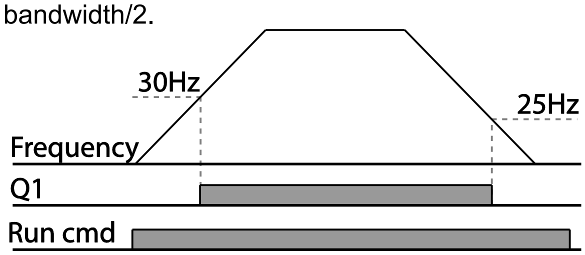
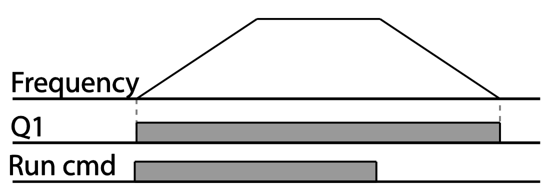
5.7.2 OUT-31 Digital Outputs

Multi-function Output Terminals (Relay1 ~ Relay5 and Q1) Settings

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	30	Fault output item	Trip Out Mode	010	bit 2 bit 1 bit 0	000-111	bit
	31	Multi-function relay1 setting	Relay 1	23	Trip	0-43	-
	32	Multi-function relay2 setting	Relay 2	14	Run	0-43	-
	33	Multi-function relay3 setting	Relay 3	0	None	0-43	-
	34	Multi-function relay4 setting	Relay 4	0	None	0-43	-
	35	Multi-function relay5 setting	Relay 5	0	None	0-43	-
	36	Multi-function output Q1 setting	Q1 Define	0	None	0-43	-
	41	Multi-function output monitor	DO Status	R8 R7 R6 Q1 R5 R4 R3 R2 R1		0 0000 0000 ~ 1 1111 1111	bit
	57	Detection frequency	FDT Frequency	30.00		0.00- Maximum frequency	Hz
	58	Detection frequency band	FDT Band	10.00			

Multi-function Output Terminal and Relay Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>OUT-31 Relay1
~
OUT-35 Relay5</td><td>Select Relay 1 ~ Relay 5 output functions.</td></tr>
<tr><td>OUT-36 Q1 Define</td><td>Select terminal (Q1) output options. Q1 is open collector TR output.</td></tr>
<tr><td></td><td>Set output functions.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>No output signals.</td></tr>
<tr><td>1</td><td>FDT-1</td><td>Relay changes state when the output frequency reaches the reference frequency within frequency bandwidth / 2.
Conditions are: Absolute value (Ref frequency - output frequency) <= frequency bandwidth/2 (OUT-58 / 2).
Example: Frequency Reference is 20 Hz. Bandwidth (OUT-58) is 10 Hz. Relay changes state at 15 Hz.

</td></tr>
<tr><td>2</td><td>FDT-2</td><td>Relay changes state when the reference frequency and detection frequency (OUT-57) are equal and fulfills FDT-1 condition at the same time.
Conditions are: [Absolute value (Ref frequency-detection frequency) < frequency bandwidth/2] & [FDT-1]
Example: Frequency Reference is 30 Hz. Detection frequency (OUT-57) is 30 Hz. Frequency bandwidth (OUT-58) is 10 Hz. Relay changes state at 25 Hz.

</td></tr>
<tr><td>3</td><td>FDT-3</td><td>Relay changes state when the output frequency is within the frequency bandwidth (OUT-58) centered around the detection frequency (OUT-57).
Conditions are: Absolute value (output frequency–operating frequency) < frequency bandwidth/2
Example: Detection frequency (OUT-57) is 30 Hz. Frequency bandwidth (OUT-58) is 10 Hz. Relay changes state when the output frequency is between 25 Hz. and 35 Hz.</td></tr>
</table></td></tr>
</table>

Code	Description		
			
	4	FDT-4	Relay changes state based on separate conditions for acceleration and deceleration. In acceleration: Operation frequency≧ Detected frequency In deceleration: Operation frequency>(Detected frequency-Detected frequency width/2) Example: Detection frequency (OUT-57) is 30 Hz. Frequency bandwidth (OUT-58) is 10 Hz. During acceleration, relay changes state when output frequency reaches detection frequency. During deceleration, the relay changes state when the output frequency is below the frequency bandwidth/2. 
	5	Overload	Relay changes state when inverter trips on motor overload.
	6	IOL	Relay changes state when inverter trips on inverter overload. See section 5.8.5.1 for more details.
	7	Underload	Relay changes state when inverter trips on motor underload.
	9	Stall	Relay changes state when the inverter detects a motor stall condition.
	10	Over voltage	Relay changes state when the inverter trips on Over Voltage.
	11	Low Voltage	Relay changes state when the inverter trips on Low Voltage.
	12	Over Heat	Relay changes state when the inverter trips on Overheat.
	13	Lost command	Relay changes state when the inverter trips on Lost Command. Lost command includes lost reference frequency from: Analog input RS-485 communication Option Cards (Extended I/O and communications) Note When using communications or RS-485 for speed reference, if speed reference is lost the protection operates based on the time set at PRT-13 (Lost Cmd Time).
	14	RUN	Relay changes state when a run command is applied and the inverter outputs voltage. There is no output when reference frequency is at zero or during DC braking. 

Code	Description		
	15	Stop	Relay changes state when a stop command is applied and when there is no inverter output voltage.
	16	Steady	Relay changes state during steady state operation.
	17	Inverter line	Used in combination with “Comm Line” function. Relay maintains state while the motor is driven by the inverter output. For details, refer to *5.6.11 Exchange on page 170.*
	18	Comm line	Relay changes state when a digital input set to “18, exchange” function is applied. For details, refer to *5.6.11 Exchange on page 170.*
	19	Speed Search	Relay changes state during speed search operation. For details, refer to *5.5.3 CON-70 Speed Search Operation on page 156*.
	20	Ready	Relay changes state when the inverter is powered up, in stop mode and in run mode. Opens with inverter faults.
	22	Timer Out	Used in combination with a digital input set to “Timer In” function. The relay changes state when the digital input is activated and after the time delay settings. For more details, refer to *5.6.19 Timer In on page 174.*
	23	Trip	Relay changes state after a fault condition. Refer to *5.7.4 OUT-30 Fault Output using Relay or Q1 Terminals on page 187.*
	25	DB Warn %ED	Relay changes state when the Dynamic Brake Duty Cycle (PRT-66) is exceeded. Refer to *5.8.13 on page 212*.
	26	On/Off Control	Relay changes state based on the analog input signal levels set with OUT-68~OUT-69. Refer to *5.7.6 OUT-67 on page 190.*
	27	Fire Mode	Relay changes state when Fire Mode is activated. Refer to *5.8.10 PRT-44 Fire Mode on page 205.*
	28	Pipe Broken	Outputs a signal when a broken pipe is detected. Refer to *5.8.12 PRT-60 Pipe Break Detection on page 211.*
	29	Damper Err	Outputs a signal when damper open signal is not entered. For more details, refer to *8.1 AP2-45 Damper Operation on page 256*.
	30	Lubrication	Outputs a signal when a lubrication function is in operation.
	31	Pump Clean	Outputs a signal when a pump cleaning function is in operation.
	32	Level Detect	Outputs a signal when an LDT trip occurs.
	33	Damper Control	Outputs a signal when a damper open signal is set at IN-65~71 multi-function terminals and run command is active.
	36	AUTO State	Outputs a signal in AUTO mode.
	37	HAND State	Outputs a signal in HAND mode.
	38	TO	Outputs a signal at Q1 as a pulsed output.
	39	Except Date	Outputs a signal when operating the exception day schedule.
	40	KEB Operating	Relay changes state when the inverter is operating in KEB mode. This outputs in the energy buffering state before the input power restoration regardless of KEB mode settings. Refer to *5.5.4 CON-77 Kinetic Energy Buffering Operation on page 159*.
	41	Broken Belt	Outputs a signal when a Broken belt is detected.
	42	BR Control	Used for external electro-mechanical brake control. Relay operates based on ADV-41~ADV-47 settings. Refer to *5.4.9 ADV-41 Brake Control on page 149.*
	43	2nd Source	Relay changes state when Auxiliary Mode is selected. Refer to *5.3.1 BAS-01 2nd Operating Mode - 2nd* Source *on page 127.*

Caution

- FDT-1 and FDT-2 functions are related to the frequency setting of the inverter. If the inverter enters standby mode by pressing the off button during auto mode operation, FDT-1 and FDT-2 function operation may be different because the set frequency of the inverter is different compared to the set frequency of the auto mode.
- If monitoring signals such as 'Under load' or' LDT' are configured at multi-function output terminals, signal outputs are maintained unless certain conditions defined for signal cutoff are met.

5.7.3 OUT-41 Digital Output Status

Display the status of each output terminal. In parameter view, when the bottom segment is black, bit is "OFF" (status is open). When the top segment is black, bit is "ON" (status is closed).

LCD bit representation in parameter view. When the bottom segment is black, bit is set to "OFF", status is open. When top segment is black, bit is set to "ON", status is closed.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OUT	41	Multi-function output monitor	DO Status	R8 R7 R6 Q1 R5 R4 R3 R2 R1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 ~ 1 1111 1111	bit

5.7.4 OUT-30 Fault Output using Relay or Q1 Terminals

With Relay1 ~ Relay5 or Q1 set to 23 (Trip), OUT-30 (Fault Output Mode) can further define relay activation during low voltage faults, all faults and auto restart functions. Additionally, On and Off delay times can also be applied to the outputs when set to 23 (Trip).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	30	Fault output mode	Trip Out Mode	010	bit 2 bit 1 bit 0 1 1 1 0 0 0	000-111	bit
	31	Multi-function relay1	Relay 1	23	Trip	0-43	-
	32	Multi-function relay2 setting	Relay 2	14	Run	0-43	-
	33	Multi-function relay3 setting	Relay 3	0	None	0-43	-
	34	Multi-function relay4 setting	Relay 4	0	None	0-43	-
	35	Multi-function relay5 setting	Relay 5	0	None	0-43	-
	36	Multi-function output1	Q1 Define	0	None	0-43	-
	53	Fault output on delay	TripOut OnDly	0.00		0.00–100.00	sec
	54	Fault output off delay	TripOut OffDly	0.00		0.00–100.00	sec

Fault Output by Multi-function Output Terminal and Relay - Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>OUT-30
Trip Out Mode</td><td>
<table>
<tr><td colspan="3">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr>
<tr><td></td><td></td><td>✓</td><td>Operates when low voltage faults occur</td></tr>
<tr><td></td><td>✓</td><td></td><td>Operates when faults other than low voltage occur</td></tr>
<tr><td>✓</td><td></td><td></td><td>Operates when auto restart fails (PRT-08, PRT-09)</td></tr>
</table>
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><td>Item</td><td>Bit Status (On)</td><td>Bit Status (Off)</td></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>
<table>
<tr><td>bit 2</td><td>bit 1</td><td>bit 0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>OUT-31~OUT-35
Relay1~Relay5</td><td>Configure Relay1~ Relay5 output function. Set OUT-31~35 (Relay1-Relay5) to ‘23 (Trip)’. When a fault occurs, the output will be activated.</td></tr>
<tr><td>OUT-36
Q1 Define</td><td>Configure the open collector output (Q1) to ‘23 (Trip)’. When a fault occurs, the output will be activated.</td></tr>
<tr><td>OUT-53
TripOut On Dly,
OUT-54
TripOut OffDly</td><td>When a trip occurs, the relays will be activated after the delay time set in OUT-53 (On Dly). After a reset, the relays will be initialized after the delay time set in OUT-54 (Off Dly).</td></tr>
</table>

5.7.5 OUT-50 Multi-function Output Terminal Delay Time Settings

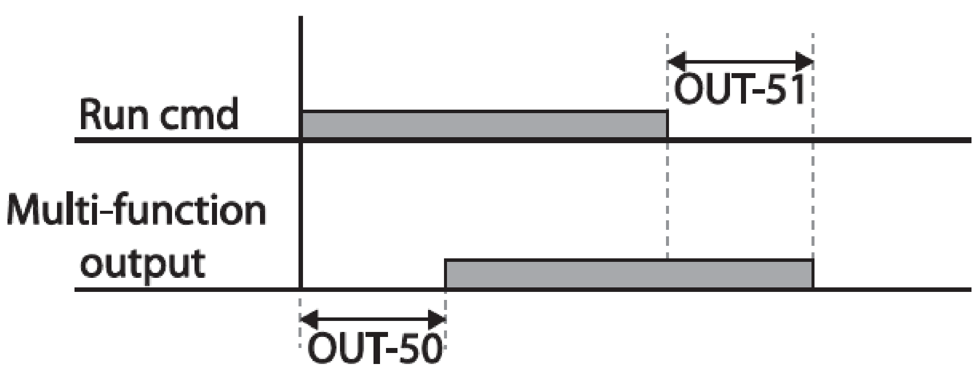
Set On/Off delay times to adjust the relay operation time. The delay times set in OUT-50 and OUT-51 will be applied to all Relays (1~5) and Q1 except when any are set to '23 (Trip)'. Additionally, a NO or NC setting can be individually applied to the outputs.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OUT	50	Multi-function output On delay	DO On Delay	0.00	0.00-100.00	sec
	51	Multi-function output Off delay	DO Off Delay	0.00	0.00-100.00	sec
	52	Select multi-function output terminal	DO NC/NO Sel	R8, R7, R6, Q1, R5, R4, R3, R2, R1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0	0 0000 0000 ~ 1 1111 1111	bit

Output Terminal Delay Time and NO/NC Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>OUT-50
DO On Delay</td><td>When the output is operated based on OUT-31~36 settings, it will activate after the delay time set in OUT-50.</td></tr>
<tr><td>OUT-51
DO Off Delay</td><td>When the output is initialized based on OUT-31~36 settings, it will deactivate after the delay time set in OUT-51.</td></tr>
<tr><td>OUT-52
DO NC/NO Sel</td><td>Select relay output contact types (NO or NC) for each output relay. Type A designates a normally open (NO) relay output. Type B designates a normally closed (NC) relay output. LCD bit representation in parameter view. When the bottom segment is black, bit is set to "OFF" (normally open relay).
<table>
<tr><td>Type</td><td>Type A (NO)</td><td>Type B (NC)</td></tr>
<tr><td rowspan="2">LCD Display</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
<table>
<tr><td>R8</td><td></td><td>R7</td><td>R6</td><td>Q1</td><td>R5</td><td></td><td>R4</td><td>R3</td><td>R2</td><td>R1</td><td></td></tr>
<tr><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>Type B (NC)</td></tr>
<tr><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>Type A (NO)</td></tr>
</table>
</td></tr>
</table>

Output Terminal Delay Times



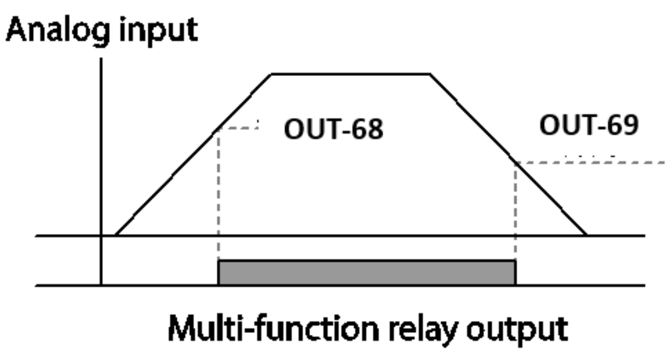
5.7.6 OUT-67 Relay Output On/Off Control

This feature operates a digital output (Relay1~Relay5 or Q1) based on the analog input level. Set the On level (OUT-68) to activate the output and the Off level (OUT-69) to deactivate the output.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	67	Output terminal on/off control mode	On/Off Ctrl Src	1	V1	-	-
	68	Output terminal on level	On-C Level	90.00		Output terminal off level– 100.00%	%
	69	Output terminal off level	Off-C Level	10.00		0.00–Output terminal on level	%
OUT	31~35	Multi-function Relay1~Relay5	Relay 1~5	26	On/Off	-	-
	36	Multi-function output Q1 item	Q1 Define				

Multi-function Output On/Off Control Setting Details

Code	Description
OUT-67 On/Off Ctrl Src	Select an analog input to be used for On/Off control.
OUT-68 On-C Level, OUT-69 Off-C Level	Set the On/Off levels for the output (Relay1~5 or Q1).



5.8 Protection Group (PRT)

Protection features provided by the H2 Series inverter include both motor and inverter protections.
Motor Protection - Overload, Underload, Over Heat (ETH), Stall Prevention, etc.
Inverter Protection - Open Phase, Inverter Overload, Fan Fault, etc.

5.8.1 PRT-01 Backspin Timer

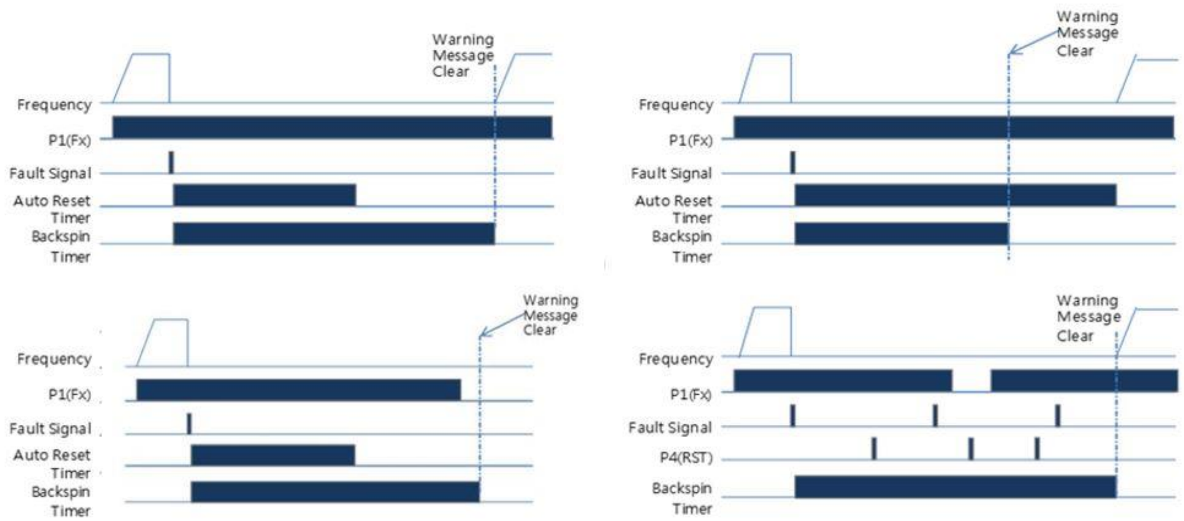
The Backspin Timer is used to prevent starting for a specified time. When the inverter stops (or trips), the backspin timer prevents the inverter from starting into a back spinning load. For pumps, the run signal is blocked for the time it takes for the remaining flow rate to discharge completely when the net head of the pump is lower.

Code	Keypad Display	Description	Setting Range	Default	Units
PRT-01	Backspin Time	Time to block Run command	0.0~6000.0	0	sec

Backspin Timer Setting Details

When any value is set in PRT-01, a warning message will be displayed, and all start or reset/restart signals will be ignored for the set time. The time is based on time after stop, not time since start was issued.

- When [PRT-01 Backspin Time] is set as “0.0”, the function is deactivated.
- When output frequency reaches “0” after a stop command or trip, the inverter cannot run for the [PRT-01 Backspin Time] and will display warning message of {Backspin Time}.
- If a start command is re-entered during deceleration, the inverter will operate immediately without applying the [PRT-01 Backspin Time] time.
- After the [PRT-01 Backspin Time], the inverter will automatically restart according to the [Reset Restart] setting values. Refer to below diagram.



5.8.2 PRT-05 Phase Loss Protection

5.8.2.1 Open Phase Protection

Open-phase monitoring and protection can be set for both the input and output of the inverter. The protection is used to prevent overcurrent levels at the inverter output due to an open phase. An open phase at output may cause the motor to stall due to a lack of torque. Input phase open detection is determined by DC Bus ripple voltage. The level can be set with PRT-06.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
PRT	05	Input/output open-phase protection	Phase Loss Chk	00 (bit 1 bit 0: 1 1 / 0 0)	Bits 00-11	bit
	06	Open-phase input voltage band	IPO V Band	15 (240V, 480V) 40 (575V)	1–100 V	V

Input and Output Open-phase Protection Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-05
Phase Loss Chk</td><td>Input and output phase loss protection can be set independently.
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><td>Item</td><td>Bit Status (On)</td><td>Bit Status (Off)</td></tr>
<tr><td>LCD Display</td><td>1 / 0</td><td>1 / 0</td></tr>
</table>
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>Bit 1</td><td>Bit 0</td><td></td></tr>
<tr><td></td><td>✓</td><td>Output Open Phase protection</td></tr>
<tr><td>✓</td><td></td><td>Input Open Phase Protection</td></tr>
</table>
</td></tr>
<tr><td>PRT-06
IPO V Band</td><td>The initial value of the ripple voltage is 15V with a setting range of 0 ~ 100V.</td></tr>
</table>

5.8.3 PRT-08 Automatic Reset and Restart

For continued operation, the inverter can be automatically reset and restarted after a fault. Enable the auto reset/restart function with parameter PRT-08. The number of reset/restart attempts and the time delay between attempts are set with parameters PRT-09 and PRT-10. Certain faults cannot be auto reset. These include inverter overheating, and hardware diagnostic faults.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–5	-
PRT	08	Reset restart setup	RST Restart	00	bit 1 bit 0: 1 1 / 0 0	00–11	Bit
	09	No. of auto restart	Retry Number	6		0–10	-
	10	Auto restart delay time	Retry Delay	5.0		0.1–600.0	sec

Automatic Reset and Restart - Setting details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-08
RST Restart

PRT-09
Retry Number

PRT-10
Retry Delay</td><td>
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><th>Item</th><th>Bit Status (On)</th><th>Bit Status (Off)</th></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>

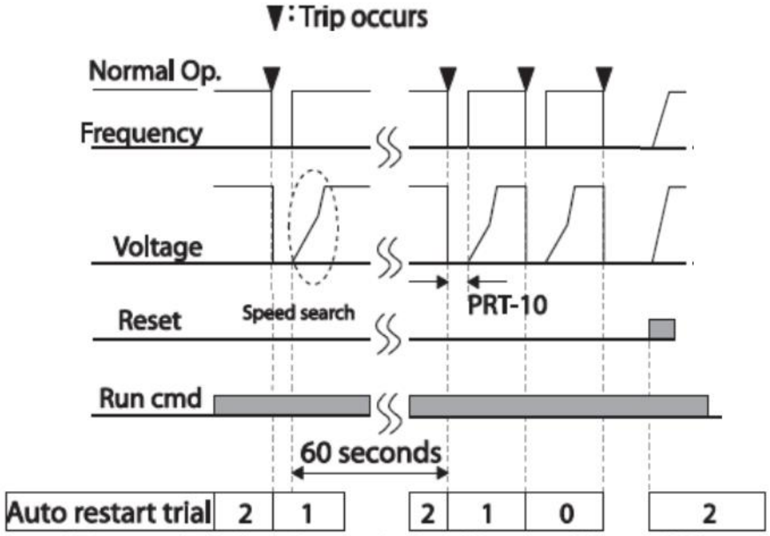
Reset Restart function
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>Bit 1</td><td>Bit 0</td><td></td></tr>
<tr><td>0</td><td>1</td><td>For faults other than LV</td></tr>
<tr><td>1</td><td>0</td><td>For LV faults</td></tr>
<tr><td>1</td><td>1</td><td>For both</td></tr>
</table>

The RST Restart function can be performed by two different methods based on the “bit” settings (00~11).

For faults other than LV: If Bit 0 is turned on, the inverter resets and restarts after a trip occurs.
For LV faults: If the Bit 1 is turned on, the inverter restarts after a LV Fault.

The number of attempts to reset and restart is set at PRT-09 (Auto Restart Count). If a fault occurs during operation, the inverter automatically restarts after the set time programmed at PRT-10 (Retry Delay). At each restart, the inverter counts the number of attempts and subtracts it from the number set at PRT-09 until the retry number count reaches 0.
After an auto restart, if a fault does not occur within 60 sec, it will increase the restart count number.

At auto restart, the acceleration options are identical to those of speed search operation. Parameters CON-72‑75 can be set based on the load. Information about the speed search function refer to 5.5.3 CON-70 Speed Search Operation on page 156.
</td></tr>
</table>



[Example of auto restart with PRT-09 setting of 2]

Normally when a fault occurs, the inverter cuts off the output and the motor will free run. Another fault may be triggered if the inverter begins its operation while motor load is in a free-run state.

Note

• Using Speed Search: See CON-71~ CON-75. During Auto reset/restart, a fault may be triggered when the inverter restarts into a spinning load. To prevent faults, set speed search CON-71, bit 1 to “ON” (set to 1). The inverter will perform a speed search after a fault reset.

• In HAND mode, the auto restart resets the trip but does not restart the inverter.

Caution

When auto reset/restart is enabled and a run command applied, the inverter will reset from a fault and the motor will automatically start to rotate.

5.8.4 PRT-11 Keypad Loss and Speed Reference Loss

When setting operating speed using an analog input, a pulsed input, through communications or the keypad, the inverter can detect a keypad loss (PRT-11) and/or a speed reference loss based on the settings of the following parameters.
A digital output can be used to provide a signal when communications with the keypad are lost and/or the speed reference is lost. Set OUT-31~35 or OUT-36 to ‘24 (Lost Keypad)’ or ‘13 (Lost Command)’.

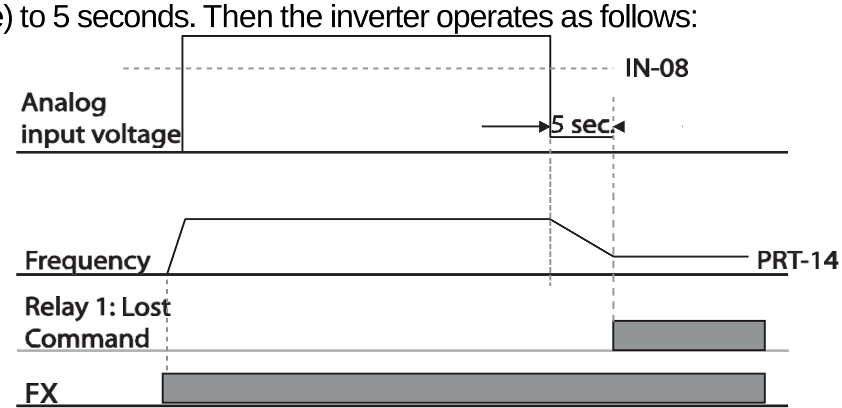
Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
PRT	11	Keypad command loss operation mode	Lost KPD Mode	0	None	0	None	-
						1	Warning	
						2	Free-Run	
						3	Dec	
	12	Speed command loss operation mode	Lost Cmd Mode	1	Free-Run	-		-
	13	Time to determine speed command loss	Lost Cmd Time	1.0		0.1–120.0		sec
	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency–Max. frequency		Hz
	15	Analog input loss decision level	AI Lost Level	0	Half of x1			-
OUT	31~35	Multi-function Relay 1–5	Relay 1–5	13	Lost Command	-		-
	36	Multi-function output 1	Q1 Define					

Keypad Loss and Speed Reference Loss Setting Details

Code	Description		
PRT-11 Lost KPD Mode	**Keypad Loss** - Set the inverters response to a loss of keypad communications with the inverter.		
	Setting		Function
	0	None	The speed command immediately becomes the operation frequency without any protection function.
	1	Warning	Set OUT-31~35 or OUT-36 to 24: Lost keypad. The inverter outputs a warning signal when abnormal operating conditions arise.
	2	Free-Run	The inverter blocks output. The motor performs in free-run condition.
	3	Dec	The motor decelerates and then stops at the time set at PRT-07 (Trip Dec Time).
PRT-12 Lost Cmd Mode	**Speed Reference Loss** - The inverter responds to a speed reference loss based on the setting of PRT-12.		
	Setting		Function
	0	None	The speed reference immediately becomes the operating frequency without any protection function.
	1	Free-Run	The inverter blocks the output. The motor coasts to a stop.
	2	Dec	The inverter decelerates the motor and then stops at the time set at PRT-07 (Trip Dec Time).
	3	Hold Input	The inverter calculates the average input value for

			10 seconds before the loss of the speed reference and uses it as the speed reference.
	4	Hold Output	The inverter calculates the average output value for 10 seconds before the loss of the speed reference and uses it as the speed reference.
	5	Lost Preset	The inverter operates at the frequency set at PRT- 14 (Lost Preset F).
PRT-15 AI Lost Level PRT-13 Lst Cmd Time	Configure the voltage level and time delay for speed reference loss detection when using analog input.		
	Setting		Function
	0	Half of x1	Based on the minimum analog input values set at IN-08 (V1), IN-12 (V1’), IN-38 (V2) and IN-53 (I2), protection operates when the input signal is reduced to half of the initial value of the analog input and after the time (PRT-13) has expired. **Example:** Set the speed reference to ‘5 (I2)’ at DRV-07, and set IN-53 (I2 min.) to 4 mA. When the 4mA input drops to less than half (2mA), the protective function is activated after the set time (PRT-13).
	1	Below of x1	The protective function operates when the analog input signal falls below the minimum values set at IN-08 (V1), IN-12 (V1’), IN-38 (V2) and IN-53 (I2) and after the time (PRT-13) has expired.
	NOTE: If the minimum value of the analog input is ‘0’, the LostCmd function does not operate.		
PRT-14 Lost Preset F	To run at a fixed speed, set the operation mode (PRT-12 Lost Cmd Mode) to ‘5 (Lost Preset)’. When the protection function operates, this sets the frequency for continued operation.		

EX: Speed Ref Loss below 5V. Set IN-06 (V1 Polarity) to ‘Unipolar’ and IN-08 to ‘5 (V)’. Set PRT-15 (AI Lost Level) to ‘1 (Below x1)’ and PRT-12 (Lost Cmd Mode) to ‘2 (Dec)’ and then set PRT-13 (Lost Cmd Time) to 5 seconds. Then the inverter operates as follows:



Note
When using communications or RS-485 for speed reference, if speed reference is lost the protection operates based on the time set at PRT-13 (Lost Cmd Time).

5.8.5 PRT-17 Overload Trip and Early Warning

The inverter provides motor overload protection and will trip on an Overload Fault based on amount of current (% motor amps) and time. The inverter responds to an overload fault based on the setting of parameter PRT-20 (OL Trip Select). Select ‘1 (Free-Run)’ or ‘2 (Dec)’ to activate the overload function and to determine the stop method when an overload fault occurs. Relay1~ Relay5 (OUT-31~35) or Q1 (OUT-36) can be set to ‘5 (Overload)’ to provide an output signal.

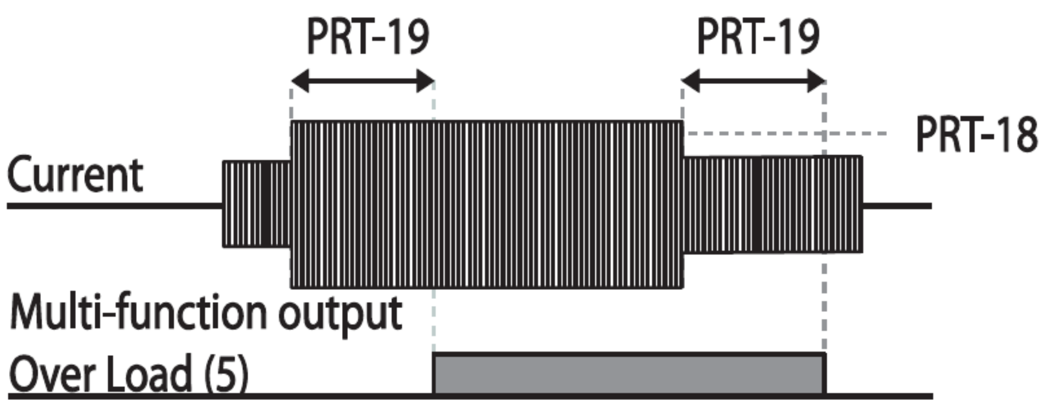
The inverter can also provide an overload warning (OLW) based on the settings of parameters PRT-17 (OL Warn Select), PRT-18 (OL Warn Level) and PRT-19 (OL Warn Time). Set parameter PRT-17 to ‘1 (Yes)’ to activate the overload warning function. Set the output current level in parameter PRT-18, set the time in PRT-19. Relay1~ Relay5 (OUT-31~35) or Q1 (OUT-36) can be set to ‘5 (Overload)’ to provide an output warning signal. **The inverter does not trip when warning levels are reached.**

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	04	Load Level Setting	Load Duty	0	Normal Duty	0-1	-
				1	Heavy Duty		
	17	Overload warning selection	OL Warn Select	1	Yes	0–1	-
	18	Overload warning level	OL Warn Level	110		30–120	%
	19	Overload warning time	OL Warn Time	10.0		0–30	sec
	20	Motion at overload trip	OL Trip Select	1	Free-Run	-	-
	21	Overload trip level	OL Trip Level	120		30–150	%
	22	Overload trip time	OL Trip Time	60.0		0–60.0	sec
OUT	31~35	Multi-function relay1–relay5 item	Relay 1–5	5	Over Load	-	-
	36	Multi-function output Q1 item	Q1 Define				

A fault or warning occurs when the motor reaches an overload state based on the motor’s rated current and the PRT settings. The amount of current for trips and warnings can be set separately.

Overload Early Warning and Trip Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">PRT-04
Load Duty</td><td colspan="3">Select the Overload Level.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Normal Duty</td><td>Used in light loads like fans and pumps (overload tolerance: 110%/120% of rated underload current for 1 minute).</td></tr>
<tr><td>1</td><td>Heavy Duty</td><td>Used in heavy loads, like hoists and cranes (overload tolerance: 150% of rated heavy load current for 1 minute).</td></tr>
<tr><td>PRT-17
OL Warn Select</td><td colspan="3">Set to ‘1 (Yes)’ to activate the overload warning function. If ‘0 (No)’ is selected, it will not operate.</td></tr>
<tr><td>PRT-18
OL Warn Level
PRT-19
OL Warn Time</td><td colspan="3">When the input current to the motor is greater than the overload warning level (OL Warn Level) and continues at that level during the overload warning time (OL Warn Time), the output (Relay 1~5 or Q1) can send a warning signal when set to ‘5’ Overload’. The inverter does not trip when warning levels are reached.</td></tr>
<tr><td rowspan="5">PRT-20
OL Trip Select</td><td colspan="3">Select the inverter protective action in the event of an overload fault.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>No protective action is taken.</td></tr>
<tr><td>1</td><td>Free-Run</td><td>The inverter output is blocked, and the motor will coast to a stop.</td></tr>
<tr><td>3</td><td>Dec</td><td>The inverter decelerates the motor to a stop.</td></tr>
<tr><td>PRT-21
OL Trip Level
PRT-22
OL Trip Time</td><td colspan="3">When the current supplied to the motor is greater than the value of the overload trip level (OL Trip Level) and continues for the overload trip time (OL Trip Time), the inverter output is either blocked or decelerates according to the PRT-20 selection.</td></tr>
</table>



Note
Overload warnings warn of an overload before an overload fault occurs. The overload warning signal will not operate if the overload warning level (OL Warn Level) and the overload warning time (OL Warn Time) are set higher than the overload trip level (OL Trip Level) and the overload trip time (OL Trip Time).

5.8.5.1 Inverter Overload Protection (IOLT) and Warning

In addition to motor overload settings, the inverter has built in inverter overload protection. When the inverter output current exceeds the rated current, a protective function is activated to prevent damage to the inverter. This inverter overload protection is based on inverse proportional characteristics.

An inverter overload warning signal (relay output) can be provided before the inverter overload protection function operates. Set OUT-31~35 or OUT-36 to '6 (IOL)'. When the overcurrent time reaches 60% of the allowed overcurrent time (120%, 1 min), the output relay will change state (signal output at 120%, 36 sec).

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
OUT	31~35	Multi-function relay 1–5	Relay 1–5	6	IOL	-	-
	36	Multi-function output 1	Q1 Define				

5.8.6 PRT-23 Under Load Fault and Warning

The inverter can be set to trip and/or provide a warning when low motor current conditions exist during operation. This will protect against pump cavitation, deadhead, and dry running operating conditions. Set PRT-27, Under load fault selection to '1 (Free-Run)' or '2 (Decelerate)' to enable the protection. Current detection level is set with PRT-24. A digital output (OUT-31~35 or OUT-36) can be set to '7 (Under Load)' to provide an output signal. The following table lists the under-load fault and warning features of the H2 series inverter.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	23	Under load detection Source	UL Source	0	Output Current	0–1	-
	24	Under load detection Band	UL Band	10.0		0.0–100.0	%
	25	Under load warning selection	UL Warn Sel	1	Yes	0–1	-
	26	Under load warning time	UL Warn Time	10.0		0–600.0	sec
	27	Under load trip selection	UL Trip Sel	1	Free-Run	0-2	-
	28	Under load trip timer	UL Trip Time	30.0		0–600.0	sec

Under Load Trip and Warning Setting Details

Code	Description
PRT-23 UL Source	Select a source to detect the under-load trip. An under-load trip can be detected using output current or output power.
PRT-24 UL Band	Set a value for the under-load fault occurrence. This value (UL Band) applies to each frequency of the load characteristics curve made by the AP2-01 Load Tune.
PRT-25 UL Warn Sel	Select the under-load warning options. Set an output at OUT-31–35 and 36) to '7 (Under load)'. The warning signals are output when under load conditions occur.

PRT-26 UL Warn Time	A protective function operates when under load level condition explained above is maintained for the warning time set.
PRT-27 UL Trip Sel	Sets the inverter operation mode for situations when an under-load trip occurs. If set to '1 (Free-Run)', the output is blocked in an under-load fault event. If set to '2 (Dec)', the inverter decelerates the motor and stops when an under-load fault occurs.
PRT-28 UL Trip Time	A protective function operates when under load level conditions explained above are maintained for the trip time set.

Caution

To operate under load trip properly, a load tuning (AP2-01 Load Tune) must be performed in advance. If you cannot perform a load tuning, manually set the load fit frequencies (AP2-02 Load Fit Lfreq–AP2-10 Load Fit Hfreq). The Under Load protection does not operate while the Energy Save function is in operation.

5.8.7 PRT-31 No Motor Trip

The inverter can detect a low motor current condition and will trip on "No Motor trip" if the output current is below the PRT-32 detection level for the PRT-33 detection time. The inverter responds to a no motor trip condition when PRT-31 (No Motor detection) is set to '1 (Free-Run)'. PRT-31 may be set to (0) None (default) for testing with no motor connected.

Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
PRT	31	Operation for no motor trip	No Motor Trip	0	None	0	None	-
						1	Free-Run	
	32	No motor trip current level	No Motor Level	5		1–100		%
	33	No motor detection time	No Motor Time	3.0		0.1–10		sec

No Motor Trip Setting Details

Code	Description
PRT-32 No Motor Level PRT-33 No Motor Time	If the output current value [based on the rated current (MOT-05)] is lower than the value set at PRT-32 (No Motor Level), and if this continues for the time set at PRT-33 (No Motor Time), a 'no motor trip' occurs.

Caution

If BAS-07 (V/F Pattern) is set to '1 (Square)', set PRT-32 (No Motor Level) to a value lower than the factory default. Otherwise, a 'no motor trip,' may occur due to a lack of output current

5.8.8 PRT-34 Motor Over Heat Sensor

A motor thermistor (PTC) can be connected to the inverter to monitor and protect the motor. The source of current through the PTC can be provided by the 20mA output (AO1) of the inverter. The voltage from the PTC can be applied to the inverter input terminals V1 or I2 (set as V2). Values for monitoring and protection are in percent (%). The inverter will trip on a “Thermal Trip” fault when the PTC input goes above the set fault level (PRT-36).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PRT	34	Selecting inverter operation after detection of motor overheat	Thermal-T Sel	0 1 2	None Free-Run Dec	0–2	-
	35	Selecting the input of the PTC sensor	Thermal In Src	0 1	Thermal In (V1) V2 (I2 terminal)	0–1	
	36	Fault level of the PTC sensor	Thermal-T Lev	50.0		0.0–100.0	%
	37	Fault area of the PTC sensor	Thermal-T Area	0 1	Low High	0–1	
OUT	01	Analog output 1 item	AO1 Mode	14	Constant	0–18	
	02	Analog output 1 gain	AO1 Gain	100		0–100	%

Motor Overheat Protect Sensor Input Detail Settings

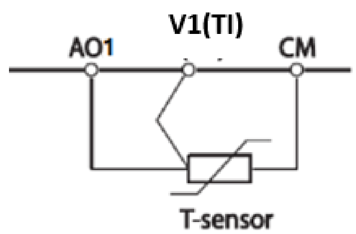
<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">PRT-34
Thermal-T Sel</td><td colspan="3">Sets the inverter operation when motor overheat (Thermal Trip) is detected.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Does not operate when motor overheat is detected.</td></tr>
<tr><td>1</td><td>Free-Run</td><td>When motor overheat is detected, the inverter output is blocked, and the motor will free-run (coast).</td></tr>
<tr><td>2</td><td>Dec</td><td>When motor overheat is detected, the motor decelerates and stops.</td></tr>
<tr><td rowspan="4">PRT-35
Thermal In Src</td><td colspan="3">Selects the terminal when the PTC sensor signal is connected to the inverter.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Thermal In</td><td>Configure the PTC sensor connection to terminal V1. Set SW3 to the right as TI.</td></tr>
<tr><td>1</td><td>V2</td><td>Configure the PTC sensor connection to terminal I2. Set SW4 to the right as V2.</td></tr>
<tr><td>PRT-36
Thermal-T Lev</td><td colspan="3">Configure the fault level (in %) of the PTC sensor.</td></tr>
<tr><td rowspan="3">PRT-37
Thermal-T Area</td><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Low</td><td>Thermal Trip fault when the PTC sensor input is lower than PRT-36.</td></tr>
<tr><td>1</td><td>High</td><td>Thermal Trip fault when the PTC sensor input is higher than PRT-36.</td></tr>
<tr><td>IN-20
Thermal Monitor</td><td colspan="3">Monitor PTC level at IN-20.</td></tr>
<tr><td>OUT-01 AO1 Mode
OUT-02 AO1 Gain</td><td colspan="3">Used when supplying the constant current to the PTC sensor from the analog output terminal (A01).</td></tr>
</table>

Connections of a motor thermistor (PTC sensor).

When the AO1 (analog output) terminal is connected to the PTC thermistor (temperature sensor installed in a motor), the inverter supplies constant current to the temperature sensor. Connect the PTC signal wire (voltage) to one of the inverter's analog input terminals. This allows the inverter to detect the changes in the PTC resistance and translates it into voltage. When the inverter detects a motor overheat, a "Thermal Trip" occurs after a fixed delay time. The "Thermal Trip" cannot be reset until the PTC input goes below the PRT-36 level.

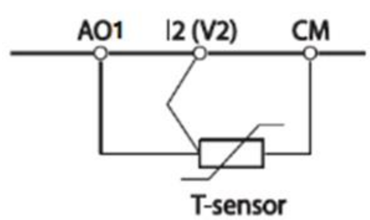
To receive the PTC signal at V1 input terminal:

1. Set switch SW3 (Analog Input V1/TI) on the IO TB PCB to T1 (right). The sensor does not operate if SW3 is set to 'V1'.
2. Set PRT-34 to Free-Run or Decel to activate monitoring and trip function.
3. Set PRT-35 (Thermal InSrc) to '0 (Thermal In)'.
4. Set PRT-36 to a % above which will cause a "Thermal Trip".
5. Set PRT-37 to high.



To receive the PTC signal at I2 input terminal:

1. Set switch SW4 (Analog Input I2/V2) on the IO TB PCB to V2 (right). The sensor does not operate if SW4 is set to 'I2'.
2. Set PRT-35 (Thermal InSrc) to '1 (V2)'.

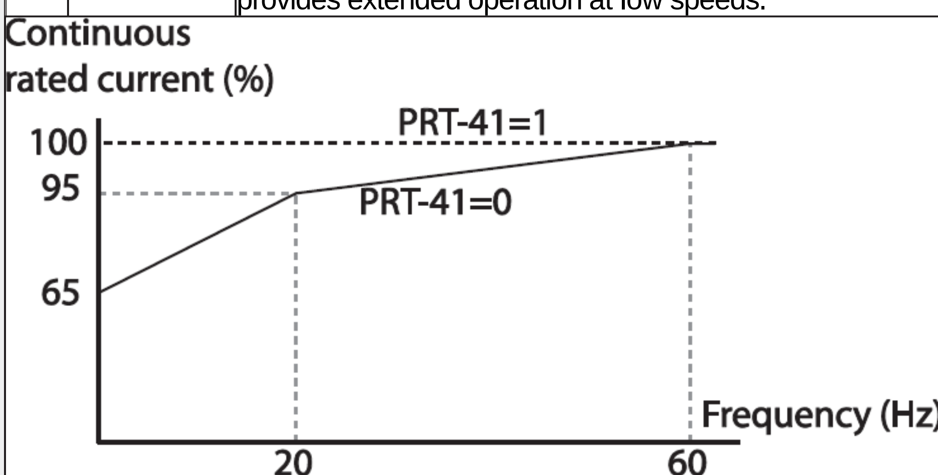


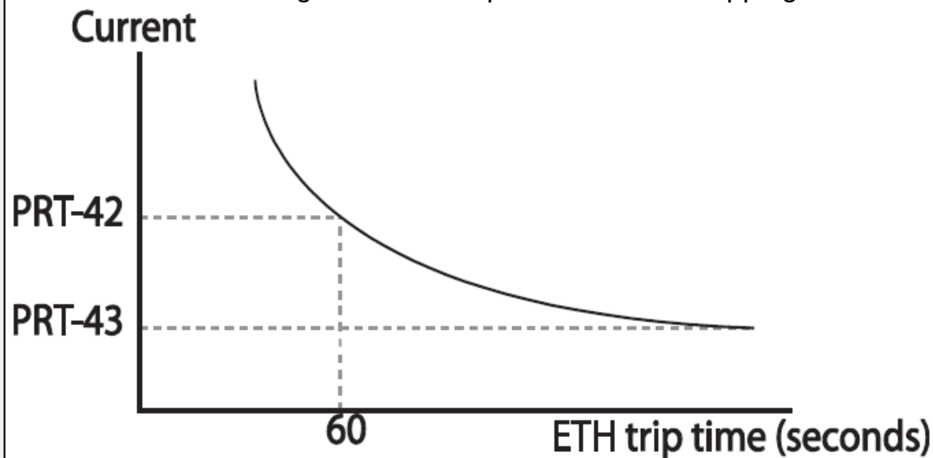
5.8.9 PRT-40 Electronic Thermal Prevention (ETH)

ETH is an electronic thermal protective function that uses the output current and the speed of the motor to predict a rise in motor temperature without a separate temperature sensor. Protection of the motor is based on current, time and speed. The inverter responds to an ETH fault based on the setting of parameters PRT-40 (ETH Trip) through PRT-43 (ETH Continuous).

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	40	Electronic thermal prevention fault selection	ETH Trip Sel	0	None	0–2	-
	41	Motor cooling fan type	Motor Cooling	0	Self-cool	-	-
	42	Electronic thermal one minute rating	ETH 1 min	120		100–150	%
	43	Electronic thermal prevention continuous rating	ETH Cont	100		50–150	%

Electronic Thermal (ETH) Prevention Function Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">PRT-40
ETH Trip Sel</td><td colspan="3">ETH can be selected to provide motor thermal protection. Select 1 (Free-Run) or 2 (Dec) to activate the ETH function and to determine the stop method when an ETH fault occurs. The LCD screen displays “E-Thermal”.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>The ETH function is not activated.</td></tr>
<tr><td>1</td><td>Free-Run</td><td>The inverter output is blocked. The motor coasts to a stop (free-run).</td></tr>
<tr><td>2</td><td>Dec</td><td>The inverter decelerates the motor to a stop.</td></tr>
<tr><td rowspan="5">PRT-41
Motor Cooling</td><td colspan="3">Select motor cooling type (fan configuration) attached to the motor.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Self-cool</td><td>The cooling fan is connected to the motor shaft and the cooling effect varies with motor speed. Most universal induction motors have this design.</td></tr>
<tr><td>1</td><td>Forced- cool</td><td>Motor includes a separately powered cooling fan which provides extended operation at low speeds.</td></tr>
<tr><td colspan="3">
</td></tr>
</table>

PRT-42 ETH 1 min	The 1 minute trip level. The amount of current that can be continuously supplied to the motor for 1 minute, Percentage is based on the motor-rated current (MOT-05).
PRT-43 ETH Cont	Sets the amount of continuous rated current (including service factor) with the ETH function activated. The range below details the set values that can be used during continuous operation without tripping. 

5.8.10 PRT-44 Fire Mode

Fire Mode operation is for use in emergency situations. When enabled, Fire Mode allows the inverter to provide continuous operation ignoring most faults. Primarily used for fire pump operation but can be applied when continuous operation is required due to emergencies.

When enabled, Fire Mode forces the inverter to ignore all minor faults and repeats a Reset/Restart of major faults, regardless of the Reset/Restart count limit. In Fire Mode, the inverter continues to operate based on the Fire Mode run direction and frequency set at PRT-46 and PRT-47.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
PRT	44	Fire mode password	Fire Mode PW	3473	-		-
	45	Fire mode setting	Fire Mode Sel	0: None	0	None	-
					1	Fire Mode	
					2	Test Mode	
	46	Fire mode run direction	Fire Mode Dir	0: Forward	0	Forward	-
					1	Reverse	
	47	Fire mode run frequency	Fire Mode Freq	60.00	0–max Freq		Hz
	48	Fire mode operation count	Fire Mode Cnt	0	-		-
IN	65–71	Digital input configuration	Px Define	34: Fire Mode	0-42		-
OUT	31–35	Digital output configuration	Relay1-5	27: Fire Mode	0-43		-
	36	TR output configuration	Q1 define	27: Fire Mode	0-43		-

The inverter runs in Fire mode when PRT-45 (Fire Mode Sel) is set to ‘1 (Fire Mode)’, and the multi-function terminal (IN-65~71) configured for Fire mode (34: Fire Mode) is activated. The inverter ignores all other commands and operates in the direction set at PRT-46 (Fire mode run direction) at the speed set at PRT-47 (Fire mode run frequency). In Fire mode, the inverter ignores most faults except ‘Over Current 1’, ‘Over Voltage’ and ‘Ground Fault’ and continues to operate. If any of these faults occur, the inverter automatically performs a reset-restart to continue the operation.

Fire Mode Function Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td>PRT-44
Fire Mode PW</td><td colspan="3">Fire mode password is 3473.
A password must be created to enable Fire mode. PRT-45 (Fire Mode Sel) can be modified only after the password is entered.</td></tr>
<tr><td rowspan="5">PRT-45
Fire Mode Sel</td><td colspan="3">Sets the Fire Mode.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Fire mode is not used.</td></tr>
<tr><td>1</td><td>Fire Mode</td><td>Normal Fire mode. When set to 1 (Fire Mode), enables Fire Mode operation controlled with a digital input..</td></tr>
<tr><td>2</td><td>Test Mode</td><td>Fire mode test mode. When set to 2 (Fire Mode Test), allows testing of Fire Mode operation. In Fire test mode, faults are normally processed. Using test</td></tr>
</table>

Code	Description		
			mode does not increase the count value at PRT-48 (Fire Mode Cnt).
PRT-46 Fire Mode Dir	Sets the run direction for Fire mode operation.		
PRT-47 Fire Mode Freq	Sets the operation frequency for Fire mode.		
PRT-48 Fire Mode Cnt	Counts the number of the Fire mode operations. The number increases only when PRT-45 (Fire Mode Sel) is set to ‘Fire Mode’. The count increases up to 99, then it does not increase any more. Does not increase the count during Fire Mode testing.		

Caution

If damper or lubrication operations are set for the inverter, Fire mode operation is performed after the delay times set in the relevant operations**. Note that Fire mode operation voids the product warranty.**

In Fire mode test mode, the inverter does not ignore the faults or perform a reset restart. All the faults will be processed normally. Fire mode test mode does not increase the Fire mode count (PRT-48). When the Fire mode operation is complete, the inverter stops operating and is turned off.

5.8.11 PRT-50 Stall Prevention and Flux Braking

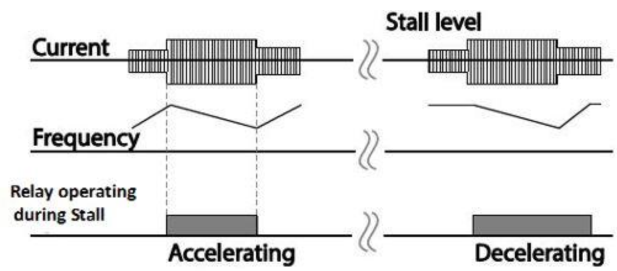
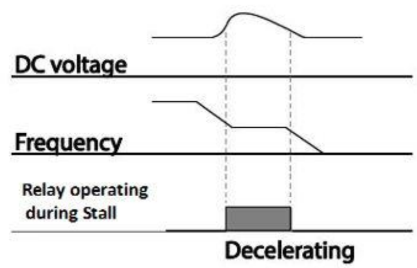
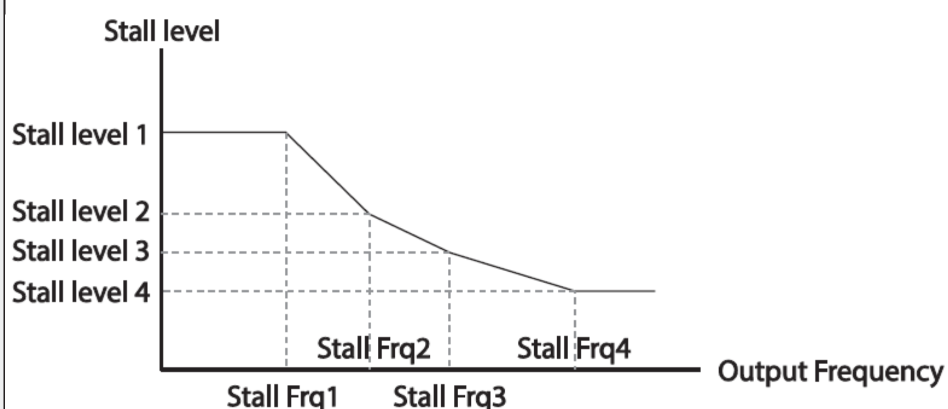
The stall prevention function is a protective function that prevents motor stall caused by overloads. When high currents are sensed during acceleration and/or constant speed, the output frequency is decreased automatically to reduce current. Also, during deceleration, as the DC bus voltage increases, the deceleration time is extended.

Flux braking is used to determine the optimum deceleration time to avoid overvoltage trips and without utilizing brake resistors. When using flux braking, the output frequency is increased and the regenerative energy is expended at the motor.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
PRT	50	Stall prevention and flux braking	Stall Prevent	0000 bit 3 bit 2 bit 1 bit 0 1 1 1 1 0 0 0 0	0000 - 1111	bit
	51	Stall frequency 1	Stall Freq 1	60.00	Start Freq– Stall Freq 1	Hz
	52	Stall level 1	Stall Level 1	130	30–150	%
	53	Stall frequency 2	Stall Freq 2	60.00	Stall Freq 1– Stall Freq 3	Hz
	54	Stall level 2	Stall Level 2	130	30–150	%
	55	Stall frequency 3	Stall Freq 3	60.00	Stall Freq 2– Stall Freq 4	Hz
	56	Stall level 3	Stall Level 3	130	30–150	%
	57	Stall frequency 4	Stall Freq 4	60.00	Stall Freq 3– Max Freq	Hz
	58	Stall level 4	Stall Level 4	130	30–150	%
	59	Flux Braking Gain	Flux Brake kp	0	7.5 - 125HP: 0–150 150 - 800HP: 0–10	%
OUT	31~35	Multi-function relay 1–5 item	Relay 1–5	9 Stall	-	-
	36	Multi-function output 1 item	Q1 Define	9 Stall	-	-

Stall Prevention Function and Flux Braking Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-50
Stall Prevent</td><td>
Stall prevention can be configured for acceleration, deceleration, or while operating a motor at constant speed.
<table>
<tr><td colspan="4">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td></td><td></td><td></td><td>✓</td><td>Stall protection during acceleration</td></tr>
<tr><td></td><td></td><td>✓</td><td></td><td>Stall protection while operating at a constant speed</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>Stall protection during deceleration</td></tr>
<tr><td>✓</td><td></td><td></td><td></td><td>Flux braking during deceleration</td></tr>
</table>
LCD bit representation in parameter view. When the top segment is black, bit is set to "ON".
<table>
<tr><td>Item</td><td>Bit Status (On)</td><td>Bit Status (Off)</td></tr>
<tr><td>LCD Display</td><td>1
0</td><td>1
0</td></tr>
</table>
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0001</td><td>Stall protection during acceleration</td><td>If inverter output current exceeds the preset stall level (PRT- 52, 54, 56, 58) during acceleration, the motor stops accelerating and starts decelerating. If current stays above the stall level, the motor decelerates to the start frequency (DRV-19). If the current decreases below the stall level (PRT-52, 54, 56, 58), the inverter and motor resume acceleration.</td></tr>
<tr><td>0010</td><td>Stall protection while operating at constant speed</td><td>Like stall protection function during acceleration, the output frequency automatically decelerates when the current exceeds the preset stall level while operating at constant speed. When the current decreases below the stall level, the inverter and motor resume acceleration.</td></tr>
<tr><td>0100</td><td>Stall protection during deceleration</td><td>The inverter decelerates and keeps the DC bus voltage below the trip level to prevent an over voltage fault during deceleration. As a result, deceleration times can be longer than the set time depending on the load.</td></tr>
<tr><td>1000</td><td>Flux braking during deceleration</td><td>When using flux braking, deceleration time may be reduced because regenerative energy is expended at the motor.</td></tr>
<tr><td>1100</td><td>Stall protection and flux braking during deceleration</td><td>Stall protection and flux braking operate together during deceleration to achieve the shortest and most stable deceleration performance.</td></tr>
</table>
</td></tr>
</table>

	 
PRT-51 Stall Freq 1 ~ PRT-58 Stall Level 4	Additional stall protection levels can be configured for different frequencies, based on the load type. As shown in the graph below, the stall level can be set above the base frequency. The lower and upper limits are set using numbers that correspond in ascending order. For example, the range for Stall Frequency 2 (Stall Freq 2) becomes the lower limit for Stall Frequency 1 (Stall Freq 1) and the upper limit for Stall Frequency 3 (Stall Freq 3). 
PRT-59 Flux Brake Kp	A gain used to decelerate without over voltage fault. It compensates for the inverter output voltage.

Note

Stall protection and flux braking operate together only during deceleration. Turn on the third and fourth bits of PRT-50 (Stall Prevention) to achieve the shortest and most stable deceleration performance without triggering an over voltage fault for loads with high inertia and short deceleration times. Do not use this function when frequent deceleration of the load is required, as the motor can overheat and be easily damaged.

Caution

- Use caution when decelerating while using stall protection since the deceleration time can take longer than the time set, depending on the load.
- Acceleration stops when stall protection operates. This may make the actual acceleration time longer than the preset acceleration time.
- When the motor is operating, Stall Level 1 applies and determines the operation of stall protection.
- If the input voltage exceeds the nominal voltage, there is a possibility that the deceleration stall does not work properly.

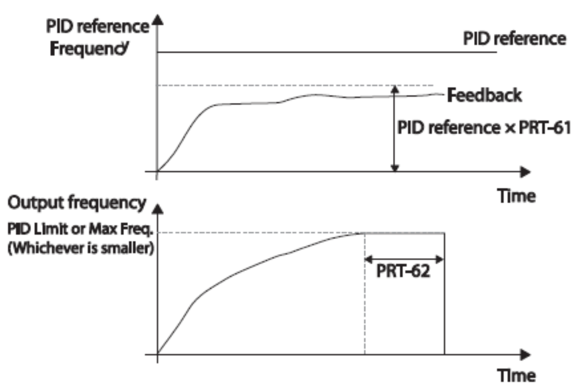
5.8.12 PRT-60 Pipe Break Detection

This function detects Pipe Breaks during PID operation. The fault or a warning signal will occur if the feedback does not reach the level set by users during the operation with the maximum output (PID maximum output or the maximum speed set).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
PRT	60	Pipe Break Detection setting	PipeBroken Sel	0	0	None	
					1	Warning	
					2	Free-Run	
					3	Dec	
	61	Pipe Break Detection variation	PipeBroken Dev	97.5	0–100		%
	62	Pipe Break Detection time	PipeBroken DT	10.0	0–6000.0		Sec
OUT	31~36	Relay output 1–5	Relay1–5	28	Pipe Broken		-

Pipe Break Detection Details

Code	Description		
PRT-60 PipeBroken Sel	Select the operation when detecting Pipe Breaks.		
	Setting		Function
	0	None	No operation
	1	Warning	The inverter displays a warning message.
	2	Free-Run	The inverter free-runs, then stops.
	3	Dec	The inverter decelerates, then stops.
PRT-61 PipeBroken Dev	Sets the Pipe Break Detection level. Set the detect level by multiplying the set value for PRT-61 by PID Reference.		
PRT-62 PipeBroken DT	Sets the detect delay time. Pipe Break operates if the Pipe Break situation is maintained for a set amount of time.		
OUT-31~36 Define	An output relay or Q1 can be set to '28 (Pipe Broken)'. When a Pipe Break occurs, the Relay is activated.		



In the graph above, Pipe Break detection occurs if the feedback is smaller than the value calculated by multiplying the two values set at PID-04 and PRT-61 (PID-04 x PRT-61) at the inverter's maximum output (when PID output is the maximum set value, or the inverter is running at the frequency set at MOT-02).

5.8.13 PRT-66 Dynamic Braking (DB) Resistor Configuration

240V, 30 HP and larger inverters
480V, 50 HP and larger inverters
575V, 30 HP and larger inverters
The above require both an external Dynamic Brake Unit (DBU) and Dynamic Brake Resistor (DBR). Refer to *13.5 Dynamic Braking Resistor Specification on page 376.*

240V, 7.5 HP ~ 25 HP
480V, 7.5 HP ~ 40 HP
575V, 7.5 HP ~ 25 HP
For the above, the braking unit (transistor, IGBT) and monitoring/control circuit is integrated inside the inverter. ***An external brake resistor (DBR) is required***, connected externally to the inverter. Resistor data is provided for Brake Torque (BT) of 100% and 150% at a working rate of 5% and 10% (PRT-66, %ED or duty cycle). If PRT-66, %ED is increased to 10%, the rated capacity (W) of the brake resistor must be doubled***. NOTE:*** When PRT-66, %ED is set to 0 (default), the braking unit (transistor, IGBT) is disabled.

A digital output can be used to provide a warning when the duty cycle (%ED) has been exceeded. Set OUT-31~35 or OUT-36 to 31 (DB Warn %ED).

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	66	Braking resistor configuration	DB Warn %ED	0 5	Disabled (575V only)	0, 1–30	%
OUT	31~35	Multi-function relay 1–5 item	Relay 1–5	25	DB Warn %ED	-	-
	36	Multi-function output 1 item	Q1 Define				

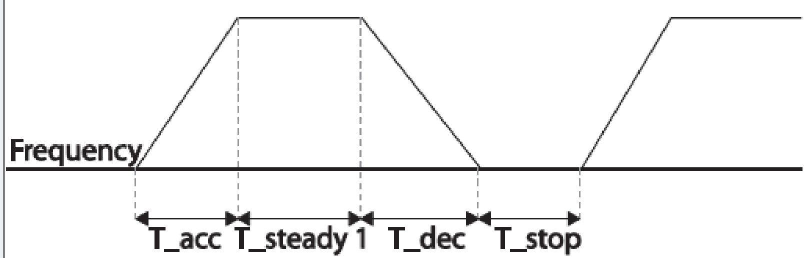
Dynamic Breaking Resistor Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td rowspan="2">PRT-66
DB Warn %ED</td><td>

Set the braking resistor configuration (%ED: Enable Duty). The braking resistor configuration sets the rate at which the braking resistor operates for one operation cycle. The maximum time for continuous braking is 15 sec and the braking resistor signal is not output from the inverter after the 15 sec period elapses. An example of braking resistor set up is as follows:

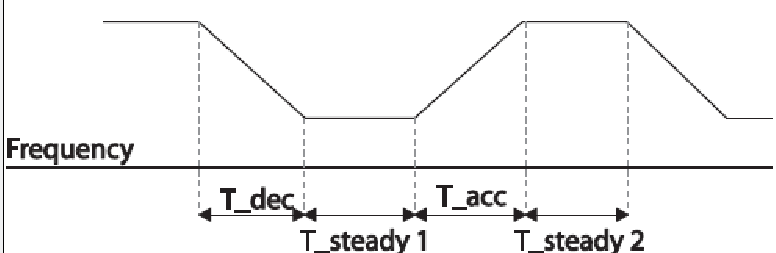
[Example 1]

$$\%ED = \frac{T\_dec}{T\_acc + T\_steady + T\_dec + T\_stop} \times 100\%$$



[Example 2]

$$\%ED = \frac{T\_dec}{T\_dec + T\_steady1 + T\_acc + T\_steady2} \times 100\%$$



</td></tr>
<tr><td>

- T_acc: Acceleration time to set frequency
- T_steady: Constant speed operation time at set frequency
- T_dec: Deceleration time to a frequency lower than constant speed operation or the stop time from constant speed operation frequency
- T_stop: Stop time until operation resumes

</td></tr>
</table>

Caution

Do not set the braking resistor to exceed the resistor's power rating. If overloaded; it can overheat and cause a fire. When using a resistor with a heat sensor, the sensor output can be used as an external trip signal for the inverter's multi-function input.

5.8.14 PRT-70 Level Detection

When the inverter is operating at or above the frequency set at PRT-74 (LDT Level), this function is used to trigger a fault or set a relay output if the source value is out of the range of the user-defined values. If the reset restart feature is turned on, the inverter continues to operate based on the run command after the LDT fault is reset.

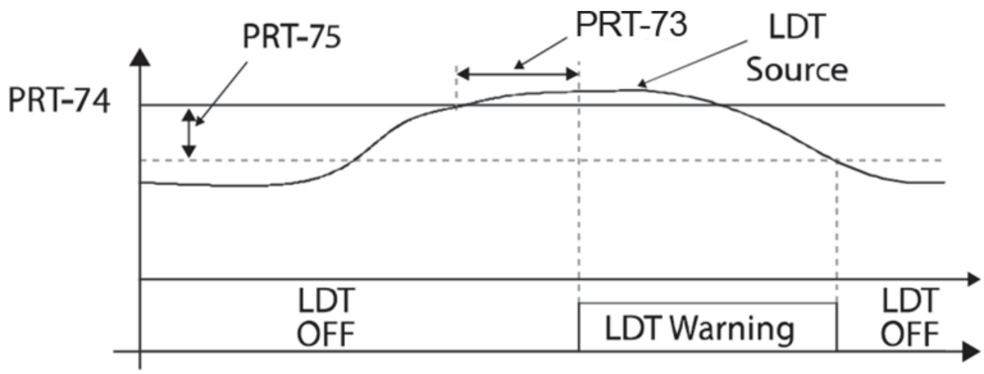
Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PRT	70	Level detection mode	LDT Sel	Warning	None/Warning/Trip	
	71	Level detection range	LDT Area Sel	1: Above Level	0–1	-
	72	Level detection source	LDT Source	0: Output Current	0–12	-
	73	Level detection delay time	LDT Dly Time	2.0	0–9999	Sec
	74	Level detection reference value	LDT Level	Source setting is used	Source setting is used	-
	75	Level detection bandwidth	LDT Band width	Source setting is used	Source setting is used	-
	76	Level detection frequency	LDT Freq	20.00	0.00–Max Freq (Hz)	Hz
	77	Level detection trip restart time	LDT Restart DT	60.0	0.0–3000.0	Min
	96	LDT Auto restart count	LDT Rst Cnt	1	0~6000	-
	97	LDT Auto restart cycle count	LDT Rst Cnt M	-	0~6000	-
	98	LDT Auto restart cycle Initialization time	LDT Cnt Clr T	60	0~6000	Sec

Level Detection Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">PRT-70
LDT Sel</td><td colspan="3">Determines the inverter operation when a level detection trip occurs.</td></tr>
<tr><td colspan="2">Setting</td><td>Functions</td></tr>
<tr><td>0</td><td>None</td><td>No operation</td></tr>
<tr><td>1</td><td>Warning</td><td>The inverter displays a warning message.</td></tr>
<tr><td>2</td><td>Free-Run</td><td>The inverter free-runs, then stops.</td></tr>
<tr><td>3</td><td>Dec</td><td>The inverter decelerates, then stops.</td></tr>
<tr><td rowspan="4">PRT-71
Level Detect</td><td colspan="3">Sets the level detection range.</td></tr>
<tr><td colspan="2">Setting</td><td>Operation</td></tr>
<tr><td>0</td><td>Below</td><td>Triggers a level detect fault when the inverter operates below the frequency set by the user.</td></tr>
<tr><td>1</td><td>Above</td><td>Triggers a level detect fault when the inverter operates above the frequency set by the user.</td></tr>
<tr><td rowspan="3">PRT-72
LDT Source</td><td colspan="3">Selects a source for level detection.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Output Current</td><td>Sets the output current as the source.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td>1</td><td>DC Link Voltage</td><td>Sets the DC link voltage as the source.</td></tr>
<tr><td>2</td><td>Output Voltage</td><td>Sets the output voltage as the source.</td></tr>
<tr><td>3</td><td>kW</td><td>Sets the output power as the source.</td></tr>
<tr><td>4</td><td>hp</td><td>Sets the output power as the source.</td></tr>
<tr><td>5</td><td>V1</td><td>Sets the V1 terminal input as the source.</td></tr>
<tr><td>6</td><td>V2</td><td>Sets the V2 terminal input as the source.</td></tr>
<tr><td>7</td><td>I2</td><td>Sets the I2 terminal input as the source.</td></tr>
<tr><td>8</td><td>PID Ref Value</td><td>Sets the PID reference as the source.</td></tr>
<tr><td>9</td><td>PID Fdb Val</td><td>Sets the PID feedback as the source.</td></tr>
<tr><td>10</td><td>PID Output</td><td>Sets the PID output as the source.</td></tr>
</table>
</td></tr>
<tr><td>PRT-73
LDT Dly Time</td><td>Sets the delay time for the operation set at PRT-70.</td></tr>
<tr><td>PRT-74
LDT Level</td><td>Sets the source for the level detection.
The following are the setting ranges and default values by the source.
<table>
<tr><td>Source</td><td>Default Value</td><td>Setting Range</td></tr>
<tr><td>Output Current</td><td>Rated current</td><td>0–150% of the rated current</td></tr>
<tr><td>DC Link Voltage</td><td>350
700</td><td>0–450 V
0–900 V</td></tr>
<tr><td>Output Voltage</td><td>230
460</td><td>0–250
0–500</td></tr>
<tr><td>kW</td><td>90% of the Inverter rated power</td><td>0–150% of the Inverter rated power</td></tr>
<tr><td>V1</td><td>9.00 V</td><td>0.00–12.00</td></tr>
<tr><td>V2</td><td>9.00</td><td>-12.00–12.00</td></tr>
<tr><td>I2</td><td>18.00</td><td>0.00–25.00</td></tr>
<tr><td>PID Ref Value</td><td>50</td><td>PID Unit Min–PID Unit Max</td></tr>
<tr><td>PID Fdb Val</td><td>50</td><td>PID Unit Min–PID Unit Max</td></tr>
<tr><td>PID Output</td><td>50</td><td>-100.00%–100.00%</td></tr>
</table>
</td></tr>
<tr><td>PRT-75
LDT Band Width</td><td>If the source is detected below the set level, it must be adjusted to be above the ‘LDT Level + LDT Band Width’ value to release the level detection fault. If the source is detected above the set level, it must be adjusted to be below the ‘LDT Level - LDT Band Width’ value to release the level detection fault. The level detection trip bandwidth is 10% of the maximum source value.</td></tr>
<tr><td>PRT-76
LDT Freq</td><td>Sets the start frequency for the level detection. When setting the level detection frequency, take into consideration the source type and the LDT level.</td></tr>
<tr><td>PRT-77
LDT Restart DT</td><td>If PRT-08 (RST restart) is set to ‘YES,’ the inverter restarts after the time set at PRT-77 elapses when an LDT trip is reset. The LDT Restart operates each time an LDT trip is reset.
If PRT-77 is set to any other value than ‘0’ and the inverter is operating in HAND mode, the inverter resets and the LDT trip is reset. However, the inverter stays in OFF mode and does not restart the operation instantly.</td></tr>
<tr><td>PRT-96
LDT Rst Cnt
PRT-97
LDT Rst Cnt M
PRT-98
LDT Cnt Clr T</td><td>When the LDT trip occurs, the number of automatic restarts is set by PRT- 96. If an LDT trip occurs, the inverter automatically restarts after the time set in PRT-77 (LDT Restart DT) has elapsed. The PRT-97 is incremented by 1 each time it is automatically restarted.
When the value of PRT-97 becomes equal to PRT-96, it does not try to restart automatically.
The LDT trip will be restarted within the time set in PRT-98 after auto restart. If not, PRT-97 is initialized to 0.</td></tr>
</table>

Code	Description
OUT-31~35 Relay 1–5	Sets one of the output relays to ‘32 (LDT)’ to monitor the level detection status.



<An example of PRT-71 set to (1: Above Level)>

As shown in the figure above, level detection can be carried out (relay output is ‘on’) as the output frequency is above PRT-76 frequency for the PRT-73 time and above the PRT-74 detection level. The LDT operation is reset if the LDT Source (PRT-72) value is less than the PRT-74 level subtracted from the PRT-75 value (band width).

Caution

- The LDT operation is carried out if the inverter operation is above PRT-74.
- Modify PRT-74 and PRT-75 appropriately when modifying LDT Source of PRT-71.
- PRT-74 and PRT-75 become default value if the LDT Source is modified.
- PRT-77 (Restart DT) and PRT-08 (RST restart) features operate separately.
- The inverter waits until the delay time set at PRT-73 (LDT Dly Time) before it operates based on the setting in LDT-70 when the level detection time condition is met.

5.8.15 PRT-79 Fan Fault Detection

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	79	Cooling fan fault selection	Fan Trip Mode	Warning		0-1	-
OUT	31~35	Multi-function relay 1–5	Relay 1–5	8	Fan Warning	0-43	-
OUT	36	Multi-function output 1	Q1 Define				

* 150 HP and larger have internal cooling fans. These fans are also included in the Fan Fault Detection. A warning “InFan Warning” will appear.

Fan Fault Detection Setting Details

Code	Description		
PRT-79 Fan Trip Mode	Set the cooling fan fault mode.		
	Setting		Function
	0	Trip	The inverter output is blocked, and the fan trip is displayed when a cooling fan error is detected.
	1	Warning	When OUT-31–35 (Relay1–5) or OUT-36 (Q1 Define) are set to ‘8 (FAN Warning)’, the fan error signal is output, and the operation continues.
OUT-31–35 Relay1–5 OUT-36 Q1 Define	When the parameter value is set to ‘8 (FAN Warning)’, the fan error signal is output, and operation continues. However, when the inverter inside temperature rises above a certain level, output is blocked due to activation of overheat protection.		

5.8.16 PRT-80 Option Card Trip

The inverter monitors communication between installed option cards and will fault when a communication error occurs between the option card and the inverter. The inverter responds to an Option Trip based on the setting of PRT-80 (motion at option trip).

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	80	Operation mode for option card trip	Opt Trip Mode	1	Free-Run	0–2	-

Operation Mode on Option Trip Setting Details

Code	Description		
PRT-80 Opt Trip Mode	Setting		Function
	0	None	No operation
	1	Free-Run	The inverter output is blocked, and fault information is shown on the keypad.
	2	Dec	The inverter decelerates the motor based on the value set at PRT-07 (Trip Dec Time).

5.8.17 PRT-81 Low Voltage Fault

When the internal DC bus voltage drops due to a power loss, the inverter turns off the output and a low voltage fault occurs after the delay time set in PRT-81 (Low voltage fault delay time). When the voltage recovers, the fault clears, and the inverter is ready to resume operation. Relay 1~5 (OUT-31~35) or Q1 (OUT-36) can be set to 11 (Low Voltage) to provide an output signal.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	81	Low voltage trip decision delay time	LVT Delay	0.0		0–60.0	sec
OUT	31~35	Multi-function relay 1–5	Relay 1–5	11	Low Voltage	0-43	-
	36	Multi-function output 1	Q1 Define				

Low Voltage Fault Setting Details

Code	Description
PRT-81 LVT Delay	If the parameter value is set to ‘11 (Low Voltage)’, the inverter stops the output first when a low voltage trip condition occurs, then a fault occurs after the low voltage trip decision time elapses. The warning signal for a low voltage fault can be provided using the outputs. However, the low voltage trip delay time (LVT Delay time) does not apply to warning signals.

5.8.18 PRT-82 Selecting Low Voltage 2 Fault During Operation

Group	Code	Name	LCD Display	Setting		Setting range	Unit
PRT	82	Low voltage trip decision during operation	LV2 Trip Sel	0	No	0–1	-

Setting PRT-82 to ‘1 (Yes)’ which makes a low voltage condition a latched fault requiring a manual reset. If the internal DC voltage decreases lower than a certain voltage, the inverter disconnects the output and displays low voltage ‘2 (Low Voltage 2)'. Even if the voltage increases and goes back to the normal state, unlike a low voltage fault, it remains in a fault state until manually reset.

5.8.19 PRT-90 Low Battery Voltage Warning

The H2 series has a battery used for the Real Time Clock (RTC). If the low battery voltage warning function is set to ‘Yes,’ a low battery voltage warning occurs when the battery voltage is lower than 2 V (normal voltage is 3 V). Replace the battery when the low battery warning is displayed.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
PRT	90	Low battery voltage detection	Low Battery	0	None	0	None	-
						1	Warning	

Low Battery Voltage Warning Detail Settings

Code	Description
PRT-90 Low Battery	The low battery voltage warning for the RTC function installed in the inverter can be enabled or disabled. The low battery voltage warning occurs when the battery voltage is lower than 2 V.

Caution

- For battery replacement, refer to *2.2.1 Battery Access on page 24*.
- Make sure that the battery doesn't fall inside of the inverter.

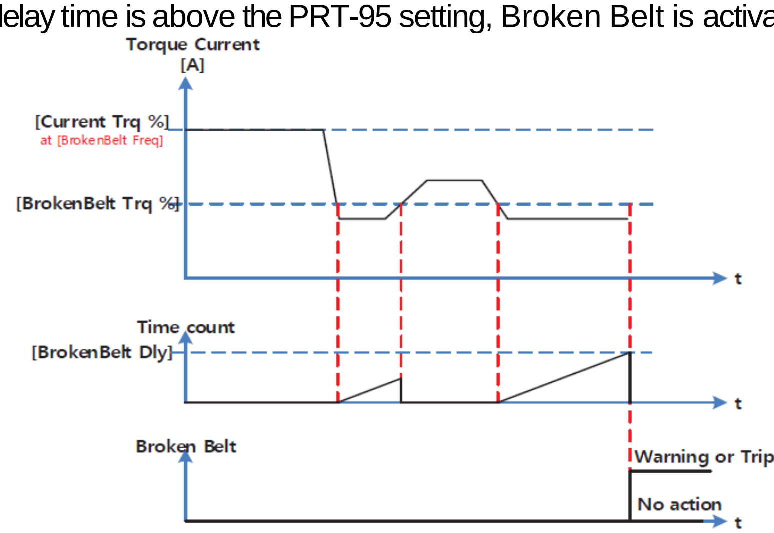
5.8.20 PRT-91 Broken Belt

Broken belt is used to detect problems when a Belt or Coupling is broken while a pump is running.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
PRT	91	Set broken belt function	BrokenBelt Sel	0 None	0 None 1 Warning 2 Free-Run	-
	92	Function frequency of broken belt	BrokenBelt Freq	15.00	15.00~MaxFreq	Hz
	93*	Motor torque current	Current Trq	-	0~100.0	%
	94**	Function torque current of broken belt	BrokenBelt Trq	10.0	0~100.0	%
	95	Function Delay time of broken belt	BrokenBelt Dly	10.0	0.0~600.0	sec

* Current output torque value compared to motor rated torque (%)
** Broken belt operation torque compared to motor rated torque (%)

After inverter is operating above the frequency set at PRT-92 and current torque reaches the limit set at PRT-94 and delay time is above the PRT-95 setting, Broken Belt is activated.



6 PID Control Group (PID)

PID control is one of the most common auto-control methods. It uses a combination of proportional, integral, and differential (PID) controls that provide more effective control for automated systems. The functions of PID control that can be applied to the inverter operation are as follows:

Purpose	Function
Speed Control	Control speed by using feedback of the existing speed comparing it to a target speed. The inverter adjusts the output to maintain a constant speed (the target speed).
Pressure Control	Control pressure by using feedback of the existing pressure comparing it to a target pressure. The inverter adjusts the output to maintain a constant pressure.
Flow Control	Control flow by using feedback of the existing flow comparing it to a target flow. The inverter adjusts the output to maintain a constant flow.
Temperature Control	Control temperature by using feedback of the existing temperature comparing it to a target temperature. The inverter adjusts the output to maintain a constant temperature.

6.1 PID Parameter List

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
00	Jump Code	Jump Code	1–99		50		O	p.74
01	PID mode selection	PID Sel	0	No	0	No	Δ	p.224
			1	Yes				
03	PID output monitor	PID Output	-		-		X	p.224
04	PID reference monitor	PID Ref Value	-		-		X	p.224
05	PID feedback monitor	PID Fdb Value	-		-		X	p.224
06	PID error monitor value	PID Err Value	-		-		X	p.224
10	PID reference 1 source selection	PID Ref 1 Src	0	KeyPad	0	Keypad	Δ	p.224
			1	V1				
			3	V2				
			4	I2				
			5	Int485				
			6	Fieldbus				
			8	Pulse				
			10[1]	V3				
			11	I3				
11	PID reference 1 keypad value	PID Ref 1 Set	Unit Min–Unit Max		Unit Default		O	p.224
12	PID reference 1 auxiliary source selection	PID Ref1AuxSrc	0	None	0	None	Δ	p.224
			1	V1				
			3	V2				
			4	I2				
			6	Pulse				
			7	Int 485				
			8	FieldBus				
			10[1]	V3				
			11	I3				
13	PID reference 1 auxiliary mode selection	PID Ref1AuxMod	0	M + (G*A)	0	M+(G*A)	O	p.224
			1	M * (G*A)				
			2	M / (G*A)				
			3	M + (M * (G*A))				
			4	M + G * 2 * (A- 50)				

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
			5	M * (G * 2 * (A- 50))				
			6	M / (G * 2 * (A-50))				
			7	M + M * G * 2 * (A-50)				
			8	(M-A)^2				
			9	M^2 + A^2				
			10	MAX (M,A)				
			11	MIN (M,A)				
			12	(M + A) / 2				
			13	Root (M+A)				
14	PID reference auxiliary gain	PID Ref1 Aux G	-200.0–200.0 (%)		0.0		O	p.224
15	PID reference 2 auxiliary source selection	PID Ref 2 Src	0	Keypad	0	KeyPad	Δ	p.224
			1	V1				
			3	V2				
			4	I2				
			5	Int 485				
			6	Fieldbus				
			8	Pulse				
			9[1]	V3				
			10	I3				
16	PID reference 2 keypad setting	PID Ref 2 Set	Unit Min–Unit Max		Unit Default		O	p.224
17	PID reference 2 auxiliary source selection	PID Ref2AuxSrc	0	None	0	None	Δ	p.224
			1	V1				
			3	V2				
			4	I2				
			6	Pulse				
			7	Int 485				
			8	FieldBus				
			10[1]	V3				
			11	I3				
18	PID reference 2 auxiliary mode selection	PID Ref2AuxMod	0	M + (G*A)	0	M+(G*A)	O	p.224
			1	M * (G*A)				
			2	M / (G*A)				
			3	M + (M * (G*A))				
			4	M + G * 2 * (A- 50)				
			5	M * (G * 2 * (A- 50))				
			6	M / (G * 2 * (A-50))				
			7	M + M * G * 2 * (A-50)				
			8	(M-A)^2				
			9	M^2 + A^2				
			10	MAX (M,A)				
			11	MIN (M,A)				
			12	(M + A) / 2				
			13	Root (M+A)				
19	PID reference 2 auxiliary gain	PID Ref2 Aux G	-200.0–200.0 (%)		0.0		O	p.224
20	PID feedback selection	PID Fdb Source	0	V1	0	V1	Δ	p.224
			2	V2				
			3	I2				
			4	Int 485				
			5	FieldBus				
			7	Pulse				
			8[1]	V3				
			9	I3				
21	PID feedback auxiliary source selection	PID Fdb Aux Src	0	None	0	None	Δ	p.224
			1	V1				
			3	V2				
			4	I2				
			6	Pulse				
			7	Int 485				
			8	FieldBus				
			10[1]	V3				
			11	I3				
22	PID feedback auxiliary mode selection	PID FdbAuxMod	0	M + (G*A)	0	M+(G*A)	O	p.224
			1	M * (G*A)				

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
			2	M / (G*A)				
			3	M + (M * (G*A))				
			4	M + G * 2 * (A- 50)				
			5	M * (G * 2 * (A- 50))				
			6	M / (G * 2 * (A-50))				
			7	M + M * G * 2 * (A-50)				
			8	(M-A)^2				
			9	M^2 + A^2				
			10	MAX (M,A)				
			11	MIN (M,A)				
			12	(M + A) / 2				
			13	Root (M+A)				
23	PID feedback auxiliary gain	PID Fdb Aux G	-200.0–200.0 (%)		0.0		O	p.224
24	PID feedback band	PID Fdb Band	0.00 – Unit Band (%)		0.00		O	p.224
25	PID controller proportional gain 1	PID P-Gain 1	0.00–300.00 (%)		50.00		O	p.224
26	PID controller integral time 1	PID I-Time 1	0.0–200.0 (sec)		10.0		O	p.224
27	PID controller differential time 1	PID D-Time 1	0.00–1.00 (sec)		0.00		O	p.224
28	PID controller feed forward gain	PID FF-Gain	0.0–1000.0 (%)		0.0		O	p.224
29	PID output filter	PID Out LPF	0.00–10.00 (sec)		0.00		O	p.224
30	PID output upper limit	PID Limit Hi	PID Limit Lo– 100.00 (%)		100.00		O	p.224
31	PID output lower limit	PID Limit Lo	-100.00–PID Limit Hi		0.00		O	p.224
32	PID controller proportional gain 2	PID P-Gain 2	0.00–300.00 (%)		50.0		O	p.224
33	PID controller integral time 2	PID I-Time 2	0.0–200.0 (sec)		10.0		O	p.224
34	PID controller differential time 2	PID D-Time 2	0.00–1.00 (sec)		0.00		O	p.224
35	PID output mode	PID Out Mode	0	PID Output	2	PID or Main	O	p.224
			1	PID+ Main Freq				
			2	PID or Main				
36	PID output inverse	PID Out Inv	0	No	0	No	Δ	p.224
			1	Yes				
37	PID output scale	PID Out Scale	0.1–1000.0 (%)		100.0		Δ	p.224
40	PID multi-step reference setting 1	PID Step Ref 1	Unit Min–Unit Max		Unit Default		O	p.224
41	PID multi-step reference setting 2	PID Step Ref 2	Unit Min–Unit Max		Unit Default		O	p.224
42	PID multi-step reference setting 3	PID Step Ref 3	Unit Min–Unit Max		Unit Default		O	p.224
43	PID multi-step reference setting 4	PID Step Ref 4	Unit Min–Unit Max		Unit Default		O	p.224
44	PID multi-step reference setting 5	PID Step Ref 5	Unit Min–Unit Max		Unit Default		O	p.224
45	PID multi-step reference setting 6	PID Step Ref 6	Unit Min–Unit Max		Unit Default		O	p.224
46	PID multi-step reference setting 7	PID Step Ref 7	Unit Min–Unit Max		Unit Default		O	p.224
50	PID controller unit selection	PID Unit Sel	Refer to the Unit List		1	%	O	p.224
			0	CUST				
			1	%				
			2	PSI				
			3	˚F				
			4	˚C				
			5	inWC				
			6	inM				
			7	mBar				
			8	Bar				
			9	Pa				
			10	kPa				
			11	Hz				
			12	rpm				
			13	V				
			14	A				

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
			15	kW				
			16	HP				
			17	mpm				
			18	ft				
			19	m/s				
			20	m3/s				
			21	m3/m				
			22	m3/h				
			23	l/s				
			24	l/m				
			25	l/h				
			26	kg/s				
			27	kg/m				
			28	kg/h				
			29	gl/s				
			30	gl/m				
			31	gl/h				
			32	ft/s				
			33	f3/s				
			34	f3/m				
			35	f3/h				
			36	lb/s				
			37	lb/m				
			38	lb/h				
			39	ppm				
			40	pps				
51	PID unit scale	PID Unit Scale	0	x 100	2	x 1	O	*p.224*
			1	x 10				
			2	x 1				
			3	x 0.1				
			4	x 0.01				
52	PID control 0% setting figure	PID Unit 0%	X100	-30000 - Unit Max	Varies depending on PID-50 setting		O	*p.224*
			X10	-3000.0 - Unit Max				
			X1	-300.00 - Unit Max				
			X0.1	-30.000 - Unit Max				
			X0.01	-3.0000 - Unit Max				
53	PID control 100% setting figure	PID Unit 100%	X100	Unit Min - 30000	Differs depending on PID-50 setting		O	*p.224*
			X10	Unit Min - 3000.0				
			X1	Unit Min - 300.00				
			X0.1	Unit Min - 30.000				
			X0.01	Unit Min - 3.0000				

[1] 'V3 and I3' are available when Extended IO Bd. is installed. Refer to Extended IO option manual for more detailed information.

6.2 PID Basic Operation

PID operates by controlling the output frequency of the inverter in automated process control systems to maintain speed, pressure, flow, or temperature.

Note

- Normal PID output (PID OUT) is bipolar and is limited by PID-30 (PID Limit Hi) and PID- 31 (PID Limit Lo) settings. DRV-20 (MaxFreq) value equals a 100% of PID OUT.
- The following are the variables used in PID operation, and how they are calculated:
  - Unit MAX = PID Unit 100% (PID-53)
  - Unit Min = (2xPID Unit 0% (PID-52)–PID Unit 100%)
  - Unit Default = (PID Unit 100%-PID Unit 0%)/2
  - Unit Band = Unit 100%-Unit 0%
- PID control may be utilized for the following operations:
  Pre-PID/Soft fill, Auxiliary PID reference compensation, Flow compensation, Pipe breakage detection.
- During a PID operation, the PID output becomes the frequency reference. The inverter accelerates or decelerates to the frequency reference based on the Acc/Dec times.

PID Basic Operation Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td>PID-01
PID Sel</td><td colspan="3">Set to ‘1 (Yes)’ to enable PID control and use functions for the process PID.</td></tr>
<tr><td>PID-03
PID Output</td><td colspan="3">Displays the existing output value of the PID controller. The unit, gain, and scale that were set in the PID group are applied on the display.</td></tr>
<tr><td>PID-04
PID Ref Value</td><td colspan="3">Displays the existing reference value set for the PID controller. The unit, gain, and scale that were set in the PID group are applied on the display.</td></tr>
<tr><td>PID-05
PID Fdb Value</td><td colspan="3">Displays the latest feedback value as input to the PID controller. The unit, gain, and scale that were set in the PID group are applied on the display.</td></tr>
<tr><td>PID-06
PID Err Value</td><td colspan="3">Displays the difference between the existing reference and the feedback (error value). The unit, gain, and scale that were set in the PID group are applied on the display.</td></tr>
<tr><td rowspan="8">PID-10
PID Ref 1 Src</td><td colspan="3">Selects the reference input (Setpoint source) for the PID control. The default setting is to enter the setpoint at the Keypad, see PID-11 although other sources may be used. The setpoint source cannot be set to the same source as the PID feedback source (PID-20, PID Fdb Source).</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Keypad</td><td>Keypad</td></tr>
<tr><td>1</td><td>V1</td><td>-10-10 V input voltage terminal</td></tr>
<tr><td>3</td><td>V2</td><td rowspan="2">I2 analog input terminalWhen the analog voltage/current input terminal selection switch (SW4) at the terminal block is set to I (current), input 0-20 mA current. If it is set to V (voltage), input 0–10 V.</td></tr>
<tr><td>4</td><td>I2</td></tr>
<tr><td>5</td><td>Int. 485</td><td>RS-485 input terminal</td></tr>
<tr><td>7</td><td>FieldBus</td><td>Communication command via a communication option card</td></tr>
</table>

Code	Description		
	8	Pulse	TI Pulse input terminal (0-32 kHz Pulse input)
	10	V3	V3 analog input terminal of Extended IO option card.
	11	I3	When the analog voltage/current input terminal selection switch (SW2) at the terminal block is set to I3 (current), input 0-20 mA current. If it is set to V3 (voltage), input 0–10 V.
PID-11 PID Ref Set	Enter a reference value (setpoint) if the PID Ref 1 Src (PID-10) is set to ‘0 (Keypad)’.		
PID-12 PID Ref1AuxSrc	Selects an auxiliary reference source (a second feedback source) if used with the PID control. If an auxiliary source is selected, the reference is determined using the input value at the Ref 1 source (set at PID-10) and the value set at PID-13 PID Ref1AuxMod.		
	Setting		Function
	0	None	Not used
	1	V1	-10-10 V input voltage terminal
	3	V2	I2 analog input terminal
	4	I2	If the analog voltage/current input terminal selection switch (SW4) at the terminal block is set to I (current), input 0-20 mA current. If it is set to V (voltage), input 0–10 V
	6	Pulse	TI Pulse input terminal (0-32 kHz Pulse input)
	7	Int. 485	RS-485 input terminal
	8	FieldBus	Communication command via a communication option card
	12	V3	V3 analog input terminal of Extended IO option card.
	13	I3	When the analog voltage/current input terminal selection switch (SW2) at the terminal block is set to I3 (current), input 0-20 mA current. If it is set to V3 (voltage), input 0–10 V.
PID-13 PID Ref1AuxMod	PID-13 (PID Ref1AuxMod) provides formulas to calculate the reference 1 value. If PID-12 (PID Ref1AuxSrc) is set to any other value than ‘None,’ the final reference 1 value is calculated using the input value at the source (set at PID-10) and the input value set at PID-12).		
	0	M+(G*A)	
	1	M*(G*A)	
	2	M/(G*A)	
	3	M+(M*(G*A))	
	4	M+G*2*(A-50)	
	5	M*(G*2*(A-50))	
	6	M/(G*2*(A-50))	
	7	M+M*G*2*(A-50)	
	8	(M-A)^2	
	9	M^2+A^2	
	10	MAX(M,A)	
	11	MIN(M,A)	
	12	(M+A)/2	
	13	Square Root(M+A)	
	M= Value by the PID Ref 1 source set at PID-10		
	G= Gain value set at PID-14		
	A= Value input by the Ref1 Aux Src set at PID-12		
PID-14 PID Ref1 Aux G	Gain value for the formulas provided by PID-13.		
PID-20 PID Fdb Src	Selects the source of the feedback input for PID control. PID-20 (feedback) cannot be set to the same source as PID-10 (PID Ref1 source) .		

Code	Description		
	Setting		Function
	0	V1	-10-10 V input voltage terminal
	2	V2	I2 analog input terminal
	3	I2	If the analog voltage/current input terminal selection switch (SW4) at the terminal block is set to I (current), input 0-20 mA current. If it is set to V (voltage), input 0–10 V
	4	Int. 485	RS-485 input terminal
	5	FieldBus	Communication command via a communication option card
	7	Pulse	TI Pulse input terminal (0-32 kHz Pulse input)
PID-21 PID Fdb AuxSrc	Selects the external input source to be used as an auxiliary feedback source for PID control. When the external input source is selected, the reference is determined using the input value at the source (set at PID-10) and the value set at PID-13 PID Ref1AuxMod.		
	Setting		Function
	0	None	Not used
	1	V1	-10-10 V input voltage terminal
	3	V2	I2 analog input terminal
	4	I2	When the analog voltage/current input terminal selection switch (SW4) at the terminal block is set to I (current), input 0-20 mA current. If it is set to V (voltage), input 0–10 V
	6	Pulse	TI Pulse input terminal (0-32 kHz Pulse input)
	7	Int. 485	RS-485 input terminal
	8	FieldBus	Communication command via a communication option card
PID-22 PID Fdb AuxMod	The PID-22 (PID Fdb AuxMod) provides formulas to calculate the final feedback value (PID-20 and PID-21). If PID-21 (PID Fdb AuxSrc) is set to any other value than ‘None,’ the final feedback is calculated using the input values at the two feedback sources (set at PID-20 and PID-21).		
	0	M+(G*A)	
	1	M*(G*A)	
	2	M/(G*A)	
	3	M+(M*(G*A))	
	4	M+G*2*(A-50)	
	5	M*(G*2*(A-50))	
	6	M/(G*2*(A-50))	
	7	M+M*G*2*(A-50)	
	8	(M-A)^2	
	9	M^2+A^2	
	10	MAX(M,A)	
	11	MIN(M,A)	
	12	(M+A)/2	
	13	Square Root(M+A)	
	M= Value by the Feedback Src set at PID-20		
	G= Gain value set at PID-23		
	A= Value by the feedback auxiliary source set at PID-21		
PID-23 PID Fdb Aux G	Gain value used in a formula set at PID-22.		
PID-24 PID Fdb Band	Sets the maximum and minimum value by adding or subtracting the PID Fdb Band value (PID-24) from the reference value. When the feedback value is between the maximum and minimum value, this parameter maintains the PID output.		

Code	Description
PID-25 PID P-Gain1 PID-32 PID P-Gain2	Set the output ratio for differences (errors) between the reference (setpoint) and feedback. As P-Gain is increased, the error is more quickly corrected. However, if P-Gain is set too high, the mechanical system will begin to overshoot and at some point may begin to oscillate and become unstable. EX: If the P Gain 1 is set to 50%, then 50% of the error is output.
PID-26 PID I-Time 1 PID-33 PID I-Time 2	I-Time sets the time to output accumulated errors. When the error is 100%, the time taken for 100% output is set. When the integral time (PID I-Time) is set to 1 second, 100% output occurs after 1 second of the error remaining at 100%. Differences in a normal state can be reduced by PID I-Time. When the multi-function terminal is set to ‘24 (I-Term Clear)’ and is activated, all of the accumulated errors are deleted. PID output (final frequency reference) is affected by the gains set at PID-25, PID-32, and the Acc/Dec times (DRV-03 and DRV-04) to achieve the PID output change. Therefore, consider the relationship between these values when configuring the gains and the Acc/Dec times.
PID-27 PID D-Time 1 PID-34 PID D-Time 2	Sets the output amount for the rate of change in errors of the error signal by the D-Time and uses the result as a corrective signal to the system. Since this type of control acts to stabilize the transient response of the system, it may be thought of as electronic damping. EX: If the differential time (PID D-Time 1) is set to 1 ms and the rate of change in errors per sec is 100%, output occurs at 1% per 10 ms.
PID-28 PID FF-Gain	Sets the ratio that adds the target to the PID output. Adjusting this value leads to a faster response.
PID-29 PID Out LPF	Used when the PID controller output changes too quickly or the entire system is unstable, due to severe oscillation. In general, a lower value (default value=0) is used to speed up response time, but in some cases a higher value increases stability. The higher the value, the more stable the PID controller output is, but the slower the response time.
PID-30 PID Limit Hi PID-31 PID Limit Lo	Used to set limits of the output of the inverter during PID control. The % is based on the 60 Hz. setting of the inverter.
PID-35 PID Out Mode	Selects one of the PID output modes to modify the final PID output. Modifications can be made by adding input values and the main operation frequency of the PID output to the final PID output value. The following table lists the 3 modes that are available. Setting 0 PID Output 1 PID+Main Freq 2 PID or Main
PID-36 PID Out Inv	Set to “No” for normal PI Control. The inverters output will increase when the feedback signal decreases. (EX: Pressure Control). Set to “Yes” for inverse PI Control. The inverters output will increase when the feedback signal increases. (EX: Temperature Control).
PID-37 PID Out Scale	Adjusts the amount of the controller output.
PID-40~46 Step Ref 1~7	Three digital inputs can provide up to 7 different Step References (setpoints) depending on which inputs are closed (001~111). See settings at IN-65~71 for PID Step Ref’s L, M and H. With no inputs closed (000), Setpoint is from PID-10 and PID-11.

Code	Description
	The 7 different setpoint settings can be entered at parameters PID-40 through PID-46. See below table. These inputs when closed **override the Reference (setpoint**) assigned in PID-10 and PID-11 (Keypad setpoint).

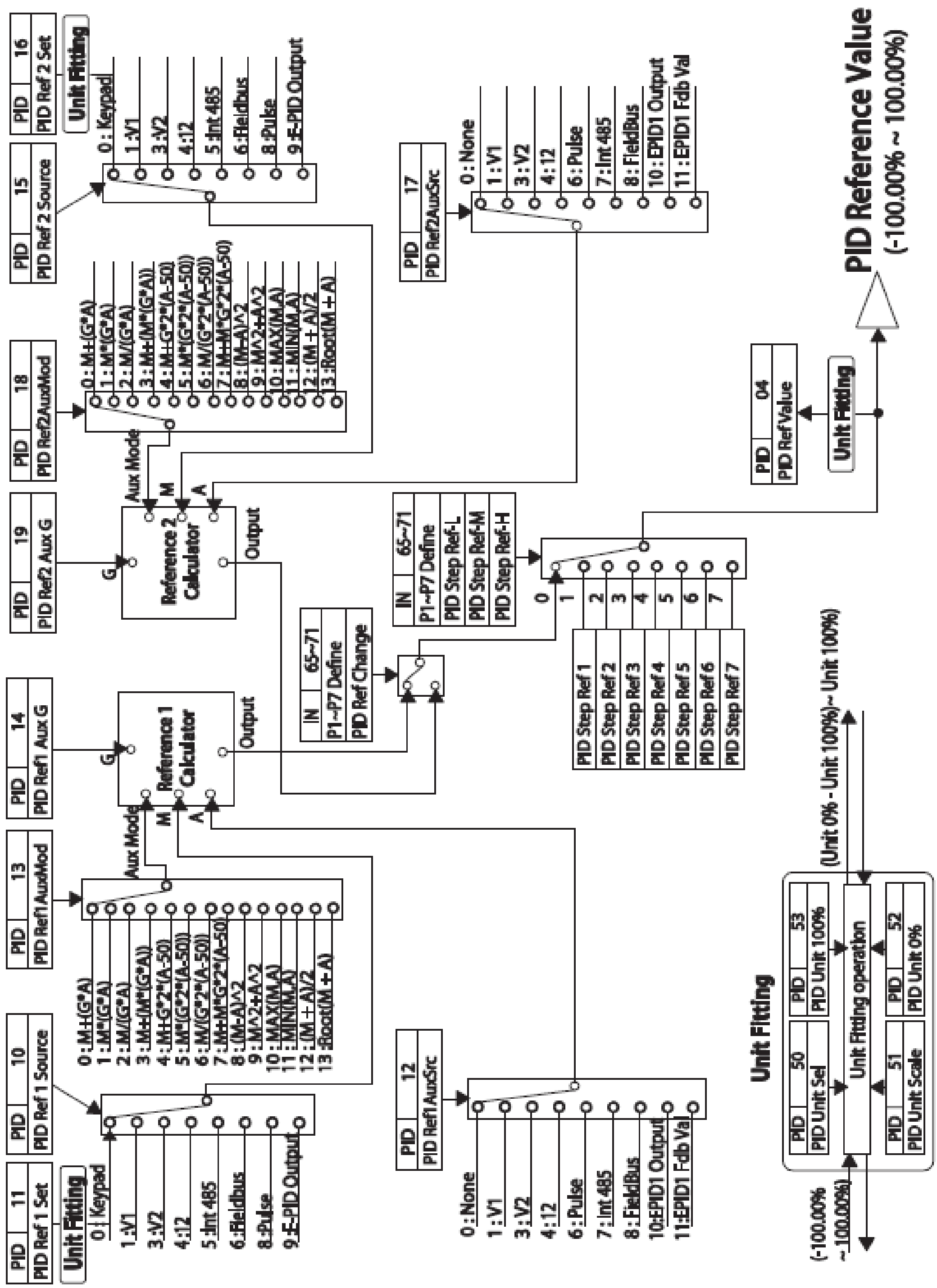
Terminals			Setpoint		
P5	P6	P7			
IN-69	IN-70	IN-71			
PID Step Ref L	PID Step Ref M	PID Step Ref H	#	Code	Desc
0	0	0	0	PID-11	PID Ref 1 Set
1	0	0	1	PID-40	PID Step Ref 1
0	1	0	2	PID-41	PID Step Ref 2
1	1	0	3	PID-42	PID Step Ref 3
0	0	1	4	PID-43	PID Step Ref 4
1	0	1	5	PID-44	PID Step Ref 5
0	1	1	6	PID-45	PID Step Ref 6
1	1	1	7	PID-46	PID Step Ref 7

Code	Description
PID-50 PID Unit Sel	Sets the unit for the control variable. 0: CUST is a custom unit defined by the user. Setting

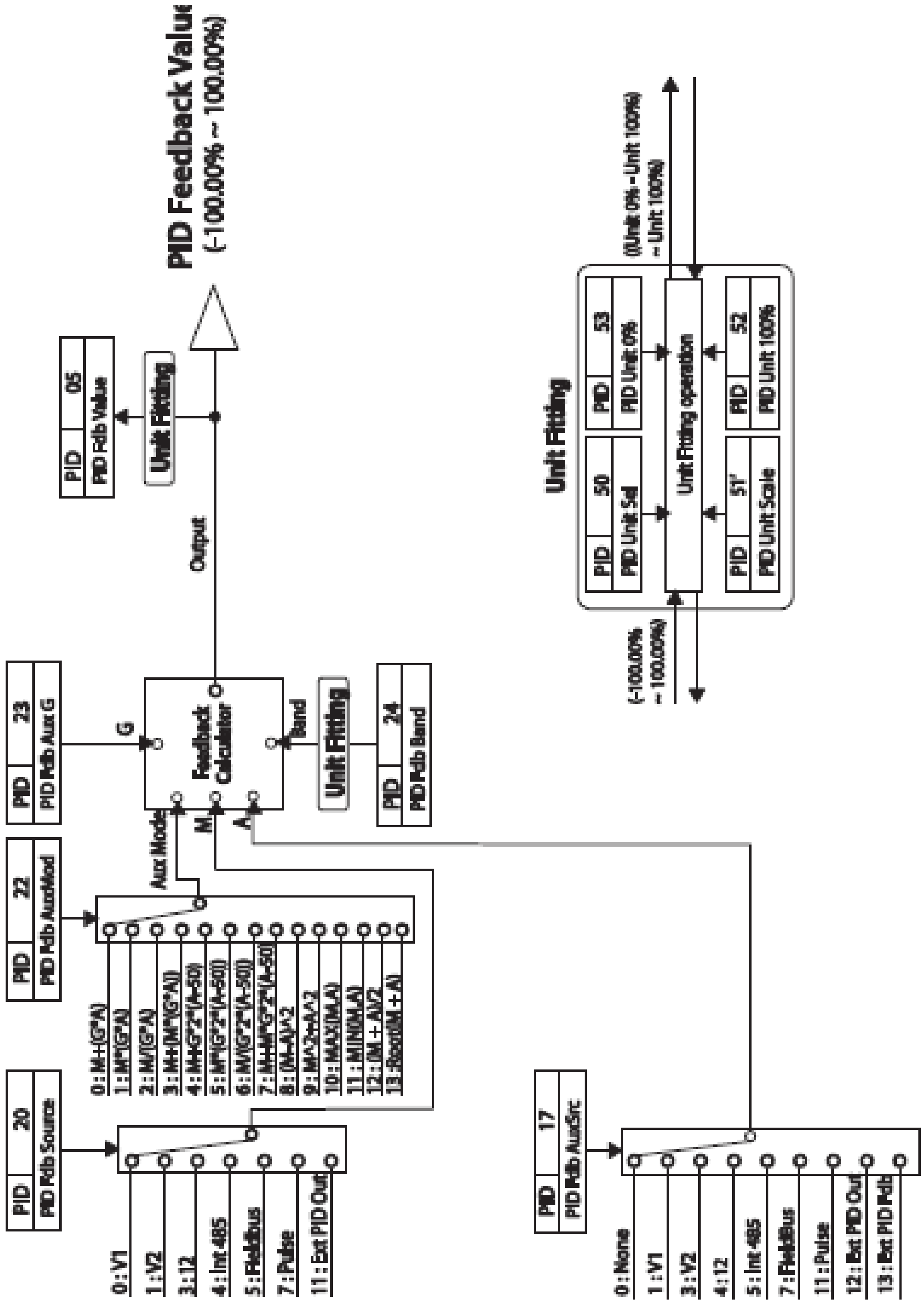
0	CUST	21	m 3/m(m 3/min)
1	%	22	m 3/h(m 3/h)
2	PSI	23	l/s
3	OF	24	l/m
4	OC	25	l/h
5	inWC	26	kg/s
6	inM	27	kg/m
7	Bar	28	kg/h
8	mBar	29	gl/s
9	Pa	30	gl/m
10	kPa	31	gl/h
11	Hz	32	ft/s
12	Rpm	33	f3/s(ft3/min)
13	V	34	f3/h (ft3/h)
14	I	35	lb/s
15	kW	36	lb/m
16	HP	37	lb/m
17	mpm	38	lb/h
18	ft	39	ppm
19	m/s	40	pps
20	m3/s(m3/S)		

Code	Description
PID-51 PID Unit Scale	Multiplies all PID Units (PID-50) by the scale factor. EX PSI: With initial settings of PID-11 (setpoint) at 50 PSI and PID-53 (PID Unit 100%) at 100 PSI, changing PID-51 scale to “x10” now shows a setpoint of 500 PSI and a max. of 1000 PSI.
PID-52 PID Unit 0 % PID-53 PID Unit 100%	Sets the Unit 0% and Unit 100% values as the minimum and maximum values set at PID-50.

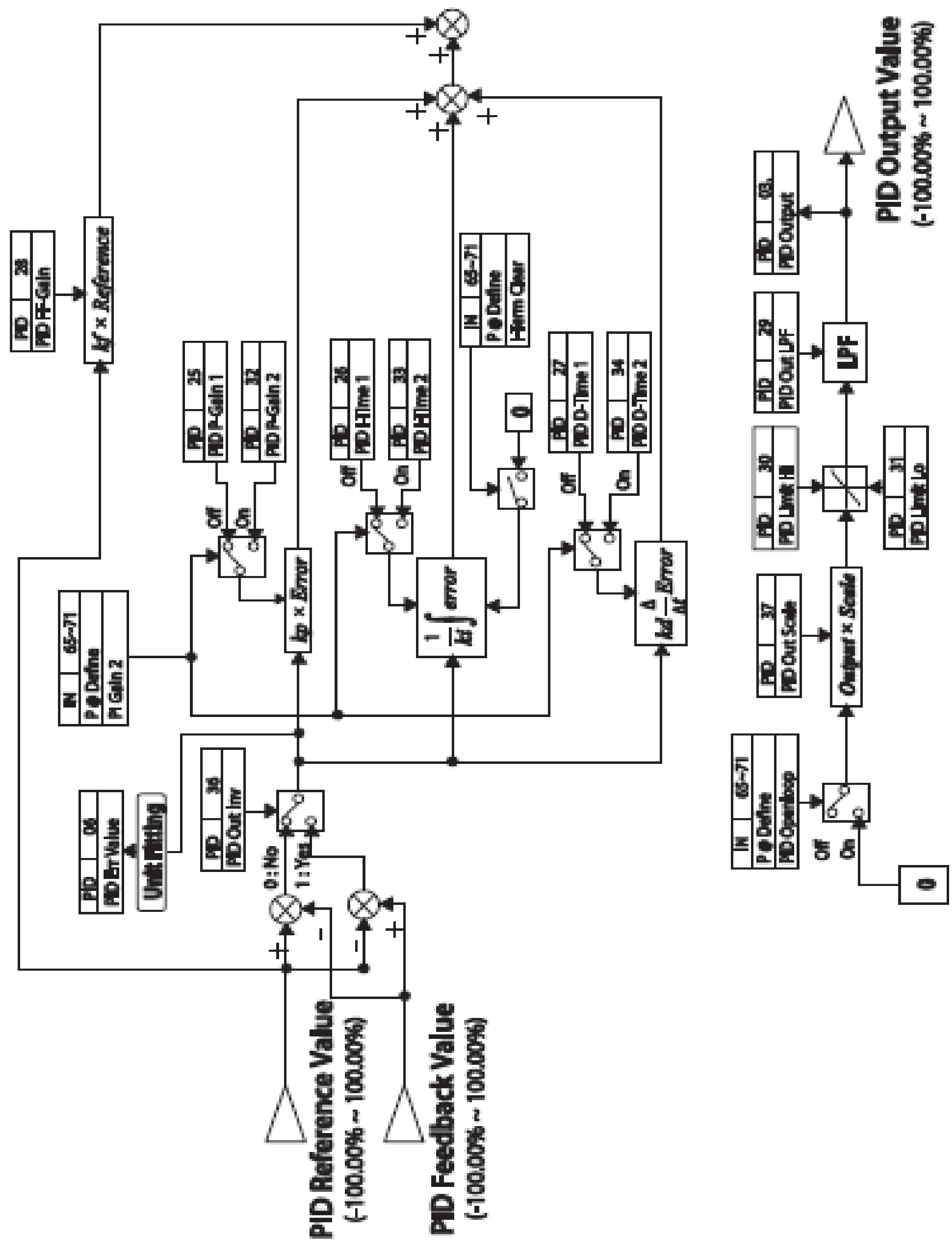
PID Command Block



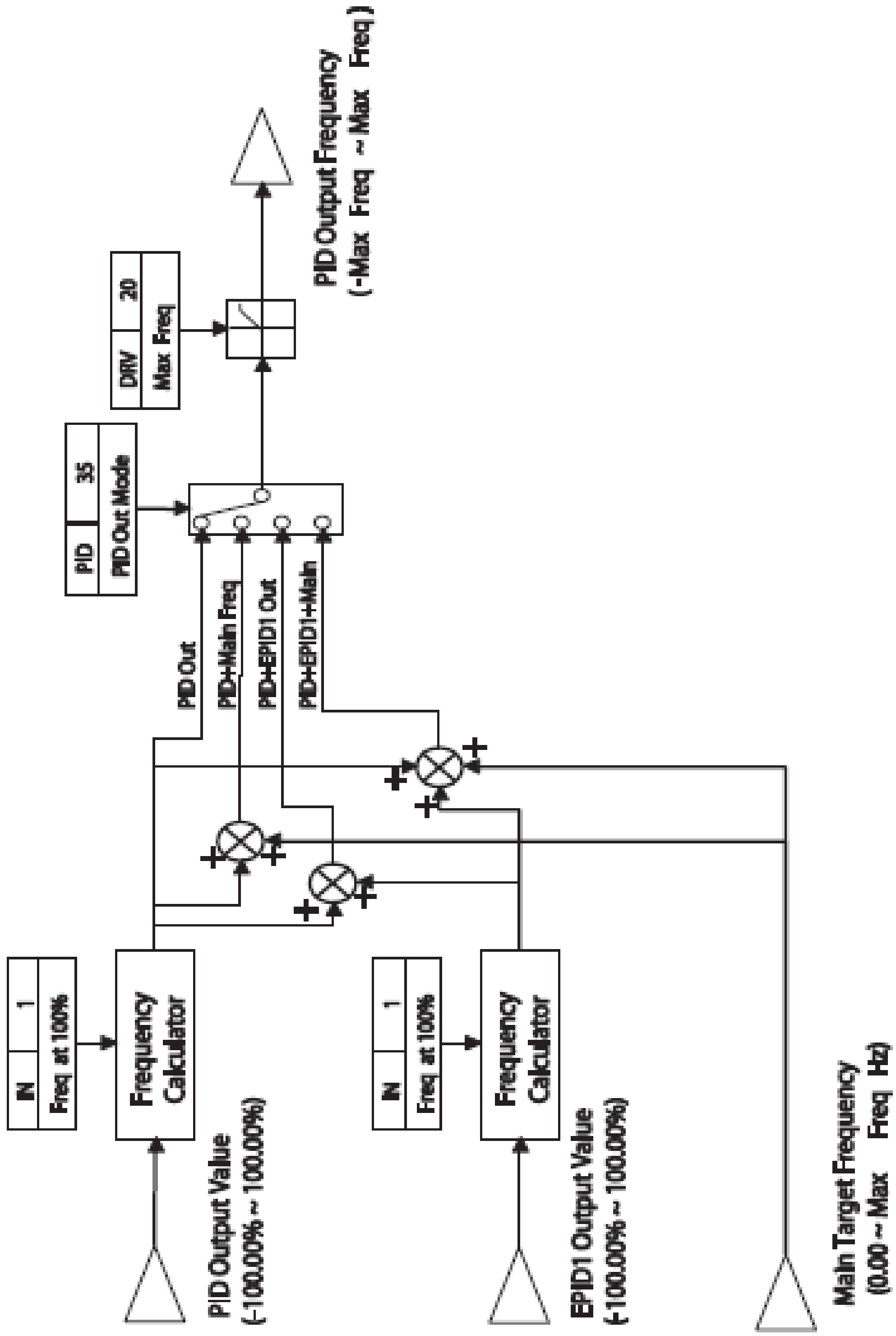
PID Feedback Block



PID Output Block



PID Output Mode Block



6.3 Application Group 1 (AP1)

Application Group 1 (AP1) includes additional PID control related parameters and are described below.

6.3.1 AP1 Parameter List

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
00	Jump Code	Jump Code	1–99		20		O	p.74
05	Sleep boost amount	Sleep Bst Set	0.00–Unit Max		0.00		O	p.233
06	Sleep boost speed	Sleep Bst Freq	0.00, Low Freq– High Freq		60.00		O	p.233
07	PID sleep mode 1 delay time	PID Sleep 1 DT	0.0–6000.0 (sec)		20.0		O	p.233
08	PID sleep mode 1 frequency	PID Sleep1Freq	0.00, Low Freq– High Freq		0.00		O	p.233
09	PID wakeup 1 delay time	PID WakeUp1 DT	0.0–6000.0 (sec)		20.0		O	p.233
10	PID wakeup 1 value	PID WakeUp1Dev	0.00–Unit Band		20.00		O	p.233
11	PID sleep mode 2 delay time	PID Sleep 2 DT	0.0–6000.0 (sec)		20.0		O	p.233
12	PID sleep mode 2 frequency	PID Sleep2Freq	0.00, Low Freq– High Freq		0.00		O	p.233
13	PID wakeup 2 delay time	PID WakeUp2 DT	0.0–6000.0 (sec)		20.0		O	p.233
14	PID wakeup 2 value	PID WakeUp2Dev	0.00–Unit Band		20.00		O	p.233
20	Soft Fill function options	Soft Fill Sel	0	No	0	No	O	p.235
			1	Yes				
21	Pre- PID operation frequency	Pre-PID Freq	Low Freq– High Freq		30.00		O	p.235
22	Pre- PID delay time	Pre-PID Delay	0.0–600.0 (sec)		60.0		O	p.235
23	Soft Fill escape value	Soft Fill Set	Unit Min–Unit Max		20.00		O	p.235
24	Soft Fill reference increasing value	Fill Step Set	0.00–Unit Band		2.00		O	p.235
25	Soft Fill reference increasing cycle	Fill Step Time	0–9999 (sec)		20		O	p.235
26	Soft Fill changing amount	Fill Fdb Diff	0.00–Unit Band		0.00		O	p.235
30	Flow Comp function options	Flow Comp Sel	0	No	0	No	O	p.238
			1	Yes				
31	Max Comp amount	Max Comp Value	0.00–Unit Band		0.00		O	p.238

6.3.2 PID Sleep Mode

With normal PI Control, when operation continues at a frequency lower than the PID operating conditions, the inverter can enter sleep mode. A boost operation can be performed before sleep to extend sleep mode. In PID sleep mode, when the PID feedback falls below the PID Wakeup level and maintains the condition for the time set at AP1-09 (PID WakeUp1 DT), the inverter wakes up and resumes PID operation.

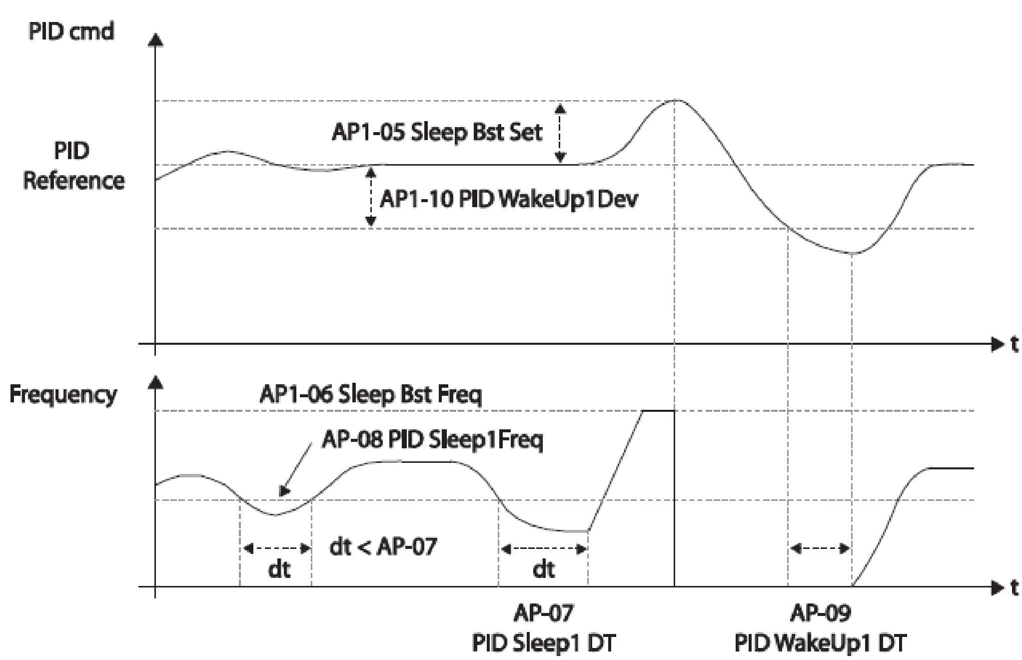
Two configurations are available for PID sleep mode.
Sleep/Wake Up 1 (AP1-07~AP1-10) and Sleep/Wake Up 2 (AP1-11 ~ AP1-14). Each has settings for sleep frequency, sleep delay time, wakeup variation, and wakeup delay time. A digital input set to ’39 (Sleep Wake Chg)’ can be configured to switch between the two configurations.

PID Operation Sleep Mode Setting Details

Code	Description
AP1-05 Sleep Bst Set	Sets the sleep boost amount before entering Sleep Mode. Feedback must reach the boost level (PID Reference+Sleep Bst Set) above the setpoint before entering Sleep Mode.
AP1-06 Sleep Bst Freq	Sets the inverter operating frequency to reach sleep boost level.
AP1-07 PID Sleep1 DT AP1-08 PID Sleep1Freq	If the operating frequency stays below the sleep mode frequency (AP1-08) for the set time (AP1-07), the inverter accelerates to the PID sleep boost frequency (AP1-06). Then, when the feedback reaches the boost amount (AP1-05) above the setpoint, the inverter enters sleep mode.
AP1-09 PID WakeUp1 DT AP1-10 PID WakeUp1Dev	Set the Wake Up delay time and Wake Up deviation amount. When the PID feedback amount falls below the setpoint by the deviation amount (AP1-10) for the delay time (AP1-09), the inverter wakes up and resumes PID operation.
IN-65~71 P1–P7 Define	When a digital input is set to '39 Sleep Wake Chg' and activated, PID Sleep/Wake Up is operated based on the parameter settings at AP1-11~14.
AP1-11 PID Sleep2 DT AP1-12 PID Sleep2Freq AP1-13 PID WakeUp2 DT AP1-14 PID WakeUp2Dev	Sleep/Wake Up 2 settings (AP1-11 ~ AP1-14) operate the same as Sleep/Wake Up 1 (AP1-07 ~ AP1-10).

Note

PID Wakeup level may be calculated using the following formula:
PID Wakeup Level = PID-04 (PID Ref Value)–AP1-10 (PID WakeUp1Dev).
Or if using Sleep/Wake Up 2, PID-04 (PID Ref Value) - AP1-14 PID (WakeUp2Dev).



6.3.3 Pre-PID and Soft Fill Operation

Pre-PID and Soft Fill are two separate operations. Both are used to prevent excessive pressure from building in the pipe system during the initial stages of pump operation.

Pre-PID - At start, Pre-PID (without PID control) begins and continues at the Pre-PID frequency (AP1-21) for the time set at AP1-22. The Pre-PID operation continues until either the feedback value reaches the Soft Fill Set (escape value, AP1-23) or the time (AP1-22) expires. If the system has built up enough pressure (or other units) to meet the AP1-23 escape value, Normal PI Control will begin. If the system has not built-up pressure (or other units) to meet the AP1-23 escape value, Soft Fill operation begins.

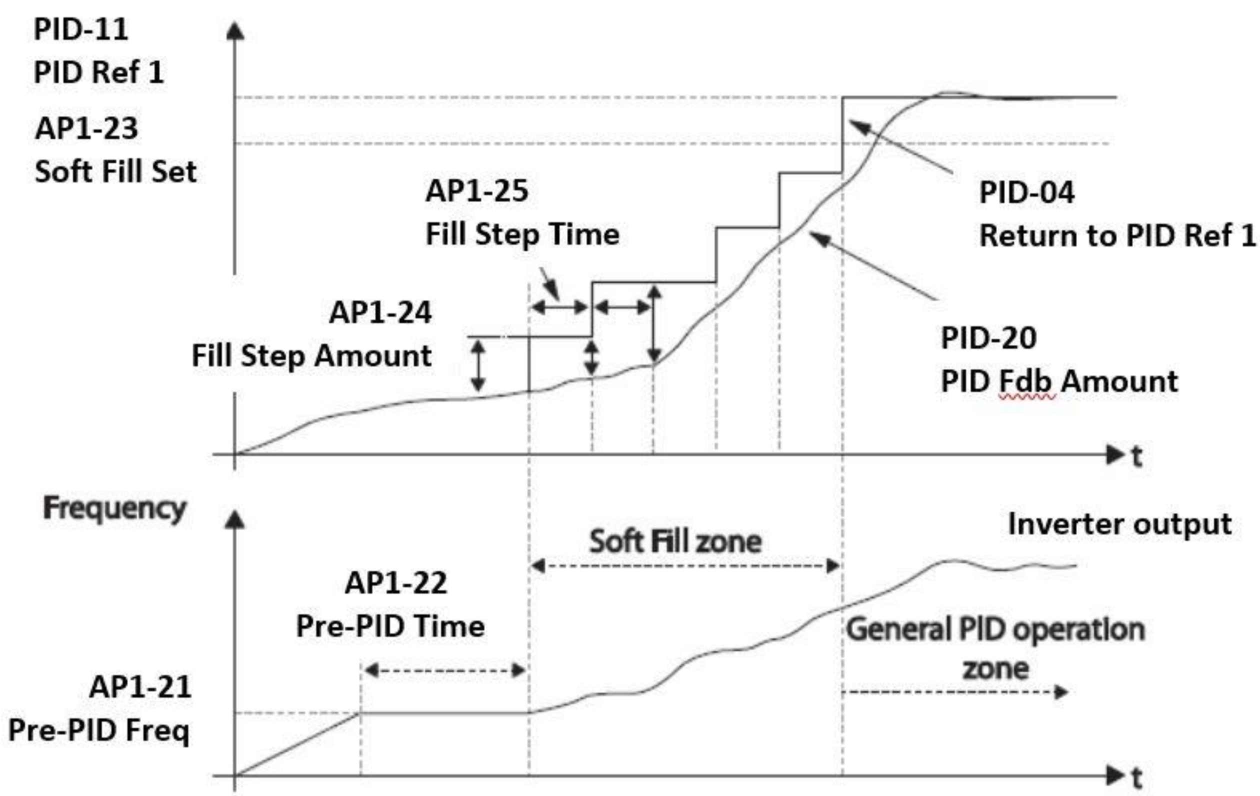
Soft Fill operation automatically changes the PI Reference (setpoint) set in PID-10 and PID-11 to a "Soft Fill" PI Reference (setpoint). The Soft Fill PI Reference performs a series of steps that increase over time to slowly fill a piping system. The steps are defined by parameters AP1-24 (Fill Step Set) and AP1-25 Fill Step Time) as defined below. When the system has built up enough pressure (or other units) to meet the AP1-23 escape value, Normal PI Control will start.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
AP1	20	Soft Fill options	Soft Fill Sel	0	No	0–1	-
	21	Pre PID operation frequency	Pre-PID Freq	30.00		Low Freq– High Freq	Hz
	22	Pre-PID duration	Pre-PID Delay	60.0		600.0	sec
	23	Soft fill escape value	Soft Fill Set	20.00		Unit Min–Unit Max	%
	24	Soft fill reference increment	Fill Step Set	2.00		0–Unit Band	%
	25	Soft fill reference increment cycle	Fill Step Time	20		0–9999	sec
	26	Soft fill feedback difference	Fill Fdb Diff	0.00		0–Unit Band	%

Soft Fill Operation Setting Details

Code	Description
AP1-20 Soft Fill Sel	Set to ‘Yes’ to enable both Pre-PID and Soft Fill operation. Set to ‘No’ to disable Pre-PID and Soft Fill operation.
AP1-21 Pre-PID Freq	Set the inverter output frequency during Pre-PID. The Pre-PID operation continues until either the feedback value reaches the Soft Fill Set (escape value, AP1-23) or the time (AP1-22) expires.
AP1-22 Pre-PID Delay	Set the Pre-PID time. The Pre-PID operation continues for this time period until either the feedback value reaches the Soft Fill Set (escape value, AP1-23) or this time expires.
AP1-23 Soft Fill Set	Set the feedback amount. When feedback reaches this amount at any time during Pre-PID or Soft Fill, the inverter exits the operation and normal PI Control begins.

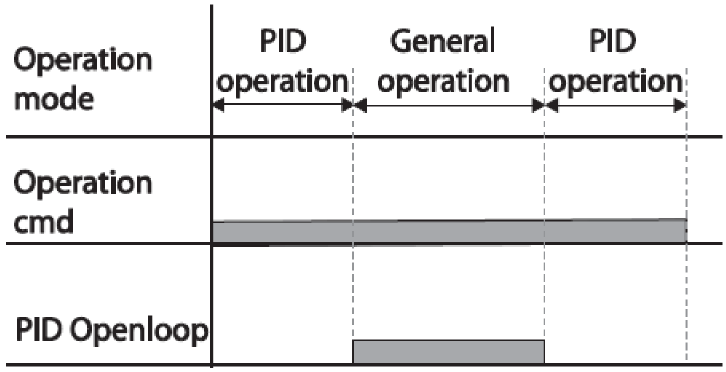
Code	Description
AP1-24 Fill Step Set	Set the amount of each Soft Fill step. After Pre-PID operation time, if feedback amount has not reached the Soft Fill Set (exit) amount (AP1-23), Soft Fill operation begins. The PI Reference (setpoint) will automatically change to this "Soft Fill PI Reference" (AP1-24) amount and start the Soft Fill operation. The "Soft Fill PI Reference" becomes the new PI Ref (setpoint). Soft Fill steps are based on AP1-24 and AP1-25.
AP1-25 Fill Step Time	Set the time for each Soft Fill step. This is the time of each Soft Fill PI Ref step (AP1-24). The steps will increase by AP1-24 amount when the feedback reaches the Fill Feedback Difference (AP1-26). If the feedback remains below the Soft Fill PI Ref., the inverter does not increase to the next step.
AP1-26 Fill Fdb Diff	Set a difference amount to increase to the next Soft Fill step. This amount is the difference between the Soft Fill PI Reference (AP1-24) amount and the feedback amount. When the feedback increases to the AP1-26 amount below the step amount (whichever step it is on), the inverter increases the Soft Fill PI Ref. to the next step. If the feedback remains below the AP1-26 amount, the Soft Fill PI Ref. does not increase to the next step.



After Pre-PID and Soft Fill operation, normal PI Control begins. The PID Reference value (setpoint) becomes the PID-11, PID Ref1 Set value.

6.3.4 PID Switching (PID Open loop)

When one of the multi-function terminals (IN-65~71) is set to ‘25 (PID Openloop)’ and is activated, the PID operation stops and is switched to general operation. When the terminal is deactivated, the PID operation starts again.



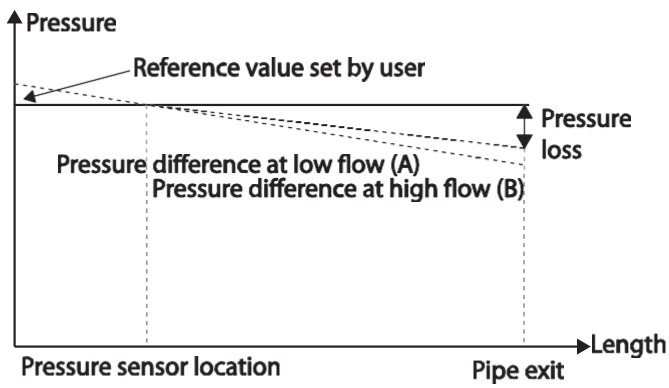
6.3.5 Flow Compensation

In a system with a pipeline, longer pipes and higher flow rate cause greater pressure loss. A flow compensation operation can compensate for pressure loss by increasing the value of the PID reference.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP1	30	Flow Comp function options	Flow Comp Sel	-	0	No	-
					1	Yes	
	31	Max Comp amount	Max Comp Value	-	0–Unit Band		-

Flow Compensation Setting Details

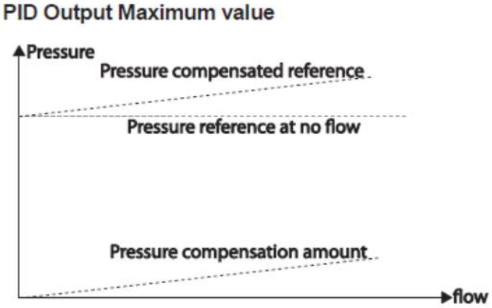
Code	Description
AP1-30 Flow Comp Sel	Sets the Flow Compensation function options.
AP1-31 Max Comp Value	Sets the maximum compensation amount. This function is based on a PID operation. The amount is in the same units used for the PID reference.



Longer pipes cause the actual pressure to decrease which in turn increases the difference between the pressure reference and the actual pressure. When comparing two systems of equal pipe lengths, more pressure loss is caused in the system with greater flow. This explains the pressure difference between (A) and (B) in the figure (when the flows are different). To compensate for the pressure loss, the value of AP1-31 is set to the maximum amount of compensation when the inverter has the maximum frequency and adds to the PID reference after calculating compensation amount based on the output frequency.
The **final PID reference=PID-11+Compensation amount**. Compensation amount is shown below.

$$\text{Compensation amount} = \frac{\text{Out Freq} - \text{Start Freq}}{\text{MaxFreq} - \text{Start Freq}} * (\text{PID}-53) * \frac{(\text{AP1} - 31)}{100\%}$$

PID-53: PID Output Maximum value



7 Sensorless Vector Control

7.1 IM (Induction Motors)

Sensorless vector control provides a more accurate estimation of the motor rotation speed compared to V/F control. When auto tuning is completed, the inverter calculates motor speed and does not require any rotating speed feedback from the motor. Sensorless vector control can also generate greater torque at a lower level of current.

Note
240V, 30 HP ~ 125 HP inverters do not include SVC Control of IM motors.

Caution

- For high-performance operation, the parameters of the motor connected to the inverter output must be measured. Configure the motor-related function group parameters (MOT Group) by entering the motor specification values from the name plate
- Then, perform auto tuning by setting MOT-11 (Auto Tuning) to 1 (All - rotation type) or 2 (All - static type) to automatically measure other parameters before operating a synchronous motor in sensorless vector control mode.
- To run high-performance sensorless vector control, the inverter and the motor must have the same capacity. If the motor capacity is smaller than the inverter capacity by more than two levels, control may be inaccurate. In that case, change the control mode to V/F control.
- When operating with sensorless vector control, do not connect multiple motors to the inverter output.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	3	IM Sensorless	-	-
MOT	01	Motor capacity	Motor Capacity	Depends on the motor capacity		0-15	-
	02	Base frequency	Base Freq	60		40-120	Hz
	03	Motor pole number	Pole Number	4		2 - 48	-
	04	Rated slip speed	Rated Slip	Depends on the motor capacity		0-3000	Hz
	05	Rated motor current	Rated Curr	Depends on the motor capacity		1-1000	A
	06	Motor no-load current	Noload curr	Depends on the motor capacity		0.5-1000	A
	07	Rated motor voltage	Motor Volt	230/460/575		170-600	V
	08	Motor efficiency	Efficiency	Depends on the motor capacity		70-100	%
	11	Auto tuning	Auto Tuning	1	All	-	-
CON	09	Pre-Excite time	PreExTime	1		0.0-60.0	s
	11	Hold Time	Hold Time	0.00		0.0-60.0	s
	24	Sensorless speed controller proportional gain1	ASR-SL P Gain1	Depends on the motor capacity		0-5000	%

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	25	Sensorless speed controller integral gain 1	ASR-SL I Gain1	Depends on the motor capacity	10-9999	ms
	26	Sensorless speed controller proportional gain 2	ASR-SL P Gain2	Depends on the motor capacity	1-1000	%
	27	Sensorless speed controller integral gain 2	ASR-SL I Gain2	Depends on the motor capacity	1-1000	%
CON	29	Flux estimator proportional gain	Flux P Gain	Depends on the motor capacity	10-200	%
	30	Flux estimator integral gain	Flux I Gain	Depends on the motor capacity	10-200	%
	31	Speed estimator proportional gain	S-Est P Gain1	Depends on the motor capacity	0-32767	-
	32	Speed estimator integral gain1	S-Est I Gain1	Depends on the motor capacity	100-1000	-
	33	Speed estimator integral gain2	S-Est I Gain2	Depends on the motor capacity	100-10000	-
	48	Sensorless current controller proportional gain	ACR P-Gain	75	0-1000	-
	49	Sensorless current controller integral gain	ACR I-Gain	120	10-1000	-
	50	Voltage controller limit	V Con HR	10	0-100.0	%
	51	Voltage controller I Gain	V Con Ki	10	0~1000.0	%
	52	Torque Controller Output Filter	Torque Out LPF	0	0-2000	msec
CON	53	Torque limit setting	Torque Lmt Src	0 Keypad-1	0-11	-
	54	Forward direction retrograde torque limit	FWD +Trq Lmt	180	0.0-200.0	%
	55	Forward direction regenerative torque limit	FWD -Trq Lmt	180	0.0-200.0	%
	56	Reverse direction retrograde torque limit	REV +Trq Lmt	180	0.0-200.0	%
	57	Reverse direction regenerative torque limit	REV -Trq Lmt	180	0.0-200.0	%
	85	Flux estimator proportional gain 1	Flux P Gain 1	370 (230V,460V) 170 (575V	100-700	-
	86	Flux estimator proportional gain 2	Flux P Gain 2	0 (230V, 460V) 90 (575V)	0-100 (230V,460V) 70-120 (575V)	-
	87	Flux estimator proportional gain 3	Flux P Gain 3	100	0-500	-
CON	88	Flux estimator integral gain 1	Flux I Gain 1	50	0-200	-
	89	Flux estimator integral gain2	Flux I Gain 2	50	0-200	-
	90	Flux estimator integral gain 3	Flux I Gain 3	50	0-200	-
	91	Sensorless voltage compensation 1	SL Volt Comp 1	35 (230V,460V) 110 (575V)	0-60	-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	92	Sensorless voltage compensation 2	SL Volt Comp 2	20 (230V, 460V) 110 (575V)	0-60	-
	93	Sensorless voltage compensation 3	SL Volt Comp 3	20 (230V,460V)	0-60	-
	94	Sensorless field weakening start frequency	SL FW Freq	100	0.0-110.0	%
	95	Sensorless gain switching frequency	SL Fc Freq	2	0.00-8.00	Hz
	97	Sensorless Slip Compensation1	SL Slip Comp 1	100 (575V only)	0-200	-
	98	Sensorless Slip Compensation2	SL Slip Comp 2	50 (575V only)	0-200	-

7.1.1 Sensorless Vector Control Operation Setting

To run sensorless vector control operation, set DRV-09 (Control Mode) to 3 (IM sensorless), select the capacity of the motor at MOT-01 (Motor Capacity), and enter the nameplate information of the motor in the below parameters.

Code	Input (Motor Name Plate Information)
MOT-02 Base Freq	Base frequency
MOT-03 Pole Number	Motor pole number
MOT-04 Rated Slip	Rated slip
MOT-05 Rated Curr	Rated current
MOT-07 Motor Volt	Motor rated voltage
MOT-08 Efficiency	Efficiency (when no information is on the name plate, default values are used.)

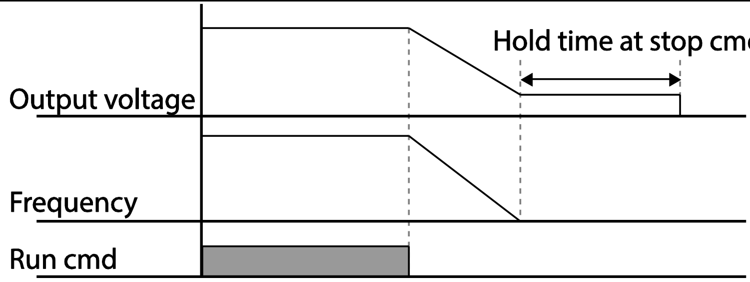
After setting the above, set MOT-11 (Auto tuning) to 1 (All - rotation type) or 2 (All - static type) and run auto tuning. Rotation type auto tuning is more accurate than Static type. Set 1 (All -Rotation type) if the motor can be rotated.

Note

Excitation Current
A motor can be operated only after magnetic flux is generated by current flowing through the stator. When the motor is connected to the output of the inverter, excitation current flowing in the stator creates the magnetic flux required to operate the motor.

Sensorless Vector Control Operation Setting Details

Code	Description
CON-09 PreExTime	Sets the excitation current application time. Pre-excitation is used at the start of the operation to perform excitation up to the motor’s rated flux.
CON-11 Hold Time	Sets the zero-speed control time (hold time) after deceleration in the stopped position. The inverter applies an output (at zero speed) to hold the motor for the Hold Time, CON-11. The output is blocked after the Hold Time.

Code	Description
	
CON-24 ASR-SL P Gain1, CON-25 ASR-SL I Gain1	**Speed Controller P Gain1 and I Gain1** - Changes the speed PI controller gains during sensorless vector control. P Gain1 is a proportional gain for the speed deviation. If speed deviation becomes higher than the torque, the output command increases accordingly. As the P Gain1 value is increased, the faster the speed deviation decreases. I Gain1 is the integral gain for the speed deviation. It is the time taken for the gain to reach the rated torque output command while a constant speed deviation continues. As the I Gain1 value is decreased, the faster the speed deviation decreases. Note Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If speed deviation does not decrease quickly, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain is increased too high or I gain is decreased too low, severe vibration may occur. If oscillation occurs in the speed waveform, try to increase I gain (ms) or reduce P gain to adjust the waveform.
CON-26 ASR-SL P Gain2, CON-27 ASR-SL I Gain2	**Speed Controller P Gain2 and I Gain2** - The speed controller gain can be increased to more than the medium speed for sensorless vector control. P Gain2 is set as a percentage of the low speed gain CON-24 ASR-SL P Gain1. If P Gain2 is less than 100.0%, the responsiveness decreases. For example, if CON-24 ASR-SL P Gain1 is 50.0% and CON-26 ASR-SL P Gain2 is 50.0%, the actual middle speed or faster speed controller P Gain is 25.0%. CON-27 ASR-SL I Gain2 is also set as a percentage of the CON-25 ASR-SL I Gain1. For I Gain, the smaller the I Gain2 is set, the slower the response time becomes. For example, if CON-25 ASR-SL I Gain1 is 100ms and CON-27 ASR-SL I Gain2 is 50.0%, the middle speed or faster speed controller I Gain is 200 ms. The controller gain is set according to the default motor parameters and Acc/Dec times.
CON-29 Flux P Gain, CON-30 Flux I Gain, CON-.85-87 Flux P Gain1~3, CON-88-90 Flux I Gain1~3	**Flux Estimator P Gain and I Gain** - Sensorless vector control requires the rotor flux estimator. For adjustments of the flux estimator gains, refer to *Sensorless Vector Control Operation Guide*
CON-31 S-Est P Gain1, CON-32 S-Est I Gain1, CON-33 S-Est I Gain2	**Speed Estimator P Gain1 and I Gain1** - Speed estimator gain for sensorless vector control can be adjusted. For adjustments of the speed estimator gains, refer to *Sensorless Vector Control Operation Guide on pg. 239.*
CON-48 ACR SL P Gain, CON-49	**Current Controller P Gain and I Gain -** Adjusts the P and I gains of the sensorless current controller. For adjustments of the sensorless current controller gains, refer to *Sensorless Vector Control.*

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>ACR SL I Gain</td><td></td></tr>
<tr><td>CON-50
V Con HR
CON-51
V Con Ki</td><td>Voltage Controller - Adjusts the limit and I Gain of the sensorless voltage controller. Used for maximum voltage output at 60 Hz. For adjustments of the voltage controller, refer to Sensorless Vector Control Operation Guide.</td></tr>
<tr><td>CON-52
Torque Out LPF</td><td>Sets the time constant for torque command by setting the torque controller output filter.</td></tr>
<tr><td>CON-53
Torque Lmt Src</td><td>Select a source for torque limit setting among keypad, analog inputs (V1, V2 or I2), communications or pulsed input. Setting torque limits adjusts the torque amount by limiting the speed controller output.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>KeyPad-1</td><td rowspan="2">Sets the torque limit with the LCD display.</td></tr>
<tr><td>1</td><td>KeyPad-2</td></tr>
<tr><td>2</td><td>V1</td><td rowspan="3">Sets the torque limit with the analog input terminal of the terminal block.</td></tr>
<tr><td>4</td><td>V2</td></tr>
<tr><td>5</td><td>I2</td></tr>
<tr><td>6</td><td>Int 485</td><td>Sets the torque limit with the communication terminal of the terminal block.</td></tr>
<tr><td>8</td><td>FieldBus</td><td>Sets the torque limit with the FieldBus communication option.</td></tr>
<tr><td>9</td><td>UserSeqLink</td><td>This enters the torque reference by linking the common area with the user sequence output.</td></tr>
<tr><td>12</td><td>Pulse</td><td>Sets the torque limit with the pulse input of the terminal block.</td></tr>
</table>
When CON-53 is set to “0 (Keypad-1)” or “1 (Keypad-2)”, set the torque limits with CON-54 ~ CON-57. The torque limit can be set up to 200% of the motor rated torque. Set the retrograde (motoring) and regenerative limits for forward and reverse operation.</td></tr>
<tr><td>CON-54
FWD +Trq Lmt</td><td>Sets the torque limit for forward retrograde (motoring) operation.</td></tr>
<tr><td>CON-55
FWD –Trq Lmt</td><td>Sets the torque limit for forward regenerative operation.</td></tr>
<tr><td>CON-56
REV +Trq Lmt</td><td>Sets the torque limit for reverse retrograde (motoring) operation.</td></tr>
<tr><td>CON-57
REV –Trq Lmt</td><td>Sets the torque limit for reverse regenerative operation.</td></tr>
<tr><td>CON-91
CON-92
CON-93
SL Volt Comp1-3</td><td>Sensorless Motoring Dead Time Compensation Ratio
Sensorless Generating Dead Time Compensation Ratio
Adjust output voltage compensation values for sensorless vector control. For output voltage compensation, refer to Sensorless Vector Control Operation Guide.</td></tr>
<tr><td>CON-94
SL FW Freq</td><td>Field Weakening Start Frequency</td></tr>
<tr><td>CON-95
SL Fc Freq</td><td>Gain Switching Frequency</td></tr>
<tr><td>CON-97
SL Slip Comp1</td><td>Sensorless Motoring Slip Compensation Ratio</td></tr>
<tr><td>CON-98
SL Slip Comp2</td><td>Sensorless Generating Slip Compensation Ratio</td></tr>
</table>

Caution

Adjust the controller gain according to the load’s characteristics. However, the motor can overheat or the system may become unstable depending on the controller gain settings.

Note

Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If speed deviation does not decrease quickly, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain is increased too high or I gain is decreased too low, severe vibration may occur. If oscillation occurs in the speed waveform, try to increase I gain (ms) or reduce P gain to adjust the waveform

7.1.2 Sensorless Vector Control Operation Guide

Problem	Function code	Troubleshooting
The amount of starting torque is insufficient.	MOT-15 Tr CON-09 PreExTime CON-48 ACR SL P Gain CON-54–57 Trq Lmt CON-93 SL Volt Comp3	For large motors, increase CON-09. Set the value of CON-09 to be more than 3 times the value of MOT-15. Reduce the value of CON-48 by decrements of 10.
		Increase the value of Trg Lmt (CON-54~57) by increments of 10%.
		Increase the value of CON-93 by increments of 5.
The output frequency is higher than the base frequency during no-load operation at low speed (10Hz or lower).	CON-91 SL Volt Comp1	Decrease the value of CON-91 by decrements of 5.
The motor hunts (irregular vibration) or the amount of torque is not sufficient while the load is increasing at low speed (10Hz or lower).	CON-04 Carrier Freq CON-24 ASR-SL P Gain1 CON-25 ASR-SL I Gain1 CON-91 SL Volt Comp1	If the motor hunts at low speed, lower CON-24 or increase CON-25 by increments of 50m/s. If hunting does not occur, increase the value of CON-24 to find the optimal operating condition.
		If the amount of torque is insufficient, increase the value of CON-91 by increments of 5.
		In the 5-10Hz range, decrease the value of CON-04 by increments of 1kHz (if CON-04 is set to exceed 3kHz).
		Note that vibration may result if the set P-gain value is too high or the set I-gain value is too low. If oscillation is observed in the waveform, first increase the I-gain, and then increase the P-gain to find the optimal values.
The motor hunts or overcurrent trip occurs in regenerative load at low speed (10 Hz or lower).	CON-92 SL Volt Comp2 CON-93 SL Volt Comp3	Increase the value of CON-92 and CON-93 in increments of 5.
Over voltage trip occurs due to sudden acceleration/deceleration or sudden load fluctuation (with no brake resistor installed) at mid speed (30Hz or higher).	CON-27 ASR-SL I Gain2	Decrease the value of CON-27 by decrements of 5%.
Over current trip occurs due to sudden load fluctuation at high speed (50 Hz or higher).	CON-54–57 Trq Lmt CON-94 SL FW Freq	Decrease the values of CON-54-57 by decrements of 10% (if the parameter setting is 150% or higher).
		Increase/decrease the value of CON-94 by increments/decrements of 5% (set below 100%).
The motor hunts when the load increases from the base frequency or higher.	CON-25 ASR-SL I Gain1 CON-26 ASR-SL I Gain2	Increase the value of CON-25 by increments of 50m/s or decrease the value of CON-26 by decrements of 5%.
The motor hunts as the load increases.	CON-31 S-Est P Gain1	At low speed (10Hz or lower), increase the value of CON-32 by increments of 5.

Problem	Function code	Troubleshooting
	CON-32 S-Est I Gain1 CON-33 S-Est I Gain2	At mid speed (30 Hz or higher), increase the value of CON-31 by increments of 500. If the parameter setting is too extreme, over current trip may occur at low speed, lower CON-31 and increase CON-32.
The motor speed level decreases.	MOT-11 Auto Tuning	Select 4, Tr (static type) from MOT-11 and run Rotor time constant tuning.
If over current trip occurs at starting.	CON-48 ACR P Gain CON-49 ACR I Gain	Lower both the CON-48 and CON-49.
The motor cannot reach the speed reference when it is operated at or above the rated speed, or when the acceleration is not responsive.	CON-50 V Con HR CON-51 V Con Ki	Increase the value at CON-50 in 1% increments if the motor cannot reach the speed reference. Increase the value at CON-51 in 10% increments if the motor acceleration is not responsive.
Speed variation occurs at rated motor speed, or when excessive current flows due to insufficient voltage during high speed operation.	CON-50 V Con HR CON-51 V Con Ki	If the motor is operated at the rated speed, decrease the value at CON-50 in 5% increments. If the motor response is slow, increase the value at CON-51 in 5% increments.
Control is unstable.	CON-85 Flux P Gain1 CON-86 Flux P Gain2 CON-87 Flux P Gain3	Increase P Gains, Decrease I Gains.
If speed loss or OC trip occurs.	CON-88 Flux I Gain1 (below CON-95)	Decrease I Gains.
If current imbalance occurs	CON-89 Flux I Gain2 (CON-95 below 9Hz) CON-90 Flux I Gain3	Increase I Gains. If OLT occurs due to high I gains, lower I gains.
If Speed error is negative (-), compensate by increasing Slip Comp.	CON-97 SL Slip Comp1 CON-98 SL Slip Comp2	For 575V inverter only. Comp1 is for motoring mode, Comp2 is for generating mode. Increase to reduce speed error.

*Hunting: Symptom of irregular vibration of the equipment.

7.2 PM (Permanent-Magnet) Motors

Sensorless vector control is an operation that carries out vector control without speed feedback from the motor but, instead, with an estimation of the motor rotation speed calculated by the inverter.

Note

240V, 30 HP ~ 125 HP, 480V, 150 HP ~ 800 HP, and all 575V inverters do not include SVC control of PM motors.

Caution

- For high-performance operation, the parameter values of the motor connected to the inverter output must be estimated. Configure the motor-related function group parameters (MOT Group) by entering the motor specification values from the name plate.
- Then, perform auto tuning by setting MOT-11 (Auto Tuning) to 4 [All (PM)] to automatically measure other parameters before operating a PM synchronous motor in sensorless vector control mode.
- For high-performance PM sensorless vector control, the inverter and the motor must have the same capacity. The inverter control may be inaccurate if the motor capacity and the inverter capacity do not match.
- In sensorless vector control mode, do not connect multiple motors to the inverter output.

Code	Keypad Display	Description	Setting Range	Factory Default	Units
DRV-09	Control Mode	Control Mode	0~4 4:PM Sensorless	0: V/F	Msg
DRV-20	Max Freq	Maximum frequency	40.00~180.00Hz (PM Sensorless)	60	Hz
MOT-01	Motor Capacity	Motor Capacity	1~20 (1HP-125HP	Depends on inverter capacity	Msg
MOT-02	Base Freq	Base frequency	30~180	60	Hz
MOT-03	Pole Number	Motorpole number	2~48	4	-
MOT-05	Rated Curr	Rated motor current	1.0~1000.0A	Depends on motor capacity	A
MOT-07	Rated Volt	Motor-rated voltage	0, 170~480V	230V/460V	V
MOT-09	Motor Efficiency	Efficiency	Depends on motor capacity	64-100	%
MOT-10	AC Input Volt	Motor input voltage	170~528V	240V/480V	V
MOT-11	Auto Tuning	Auto Tuning	0~6 6:All PM	0: None	Msg
MOT-16	Rs (PM)	PM Stator resistance	0.000~9.999Ω	Depends on motor capacity	Ω
MOT-17	Ld (PM)	D-axis inductance	0.000~1000.0	0	mH
MOT-18	Lq (PM)	Q-axis inductance	0.000~1000.0	0	mH
MOT-19	PM Flux Ref	Flux reference	0.000~1.000	0.147	Wb
MOT-20	Lq(PM) Scale	Q-axis inductance scale	50~150%	100	%
MOT-21	Ld,Lq Tune Lev	Auto tuning level for Ld and Lq	20.0~50.0%	33.3	%

Code	Keypad Display	Description	Setting Range	Factory Default	Units
MOT-22	Ld,Lq Tune Hz	Auto tuning frequency for Ld and Lq	80.0~150.0%	150.0/100.0	%
BAS-94	Init Angle Sel	Initial pole position estimation type	0~2	1: Angle Detect	Msg
BAS-95	PD Repeat Num	Initial pole position estimation retry	0~10	2	-
BAS-96	Pulse Interval	Initial pole position estimation interval	1~100msec	20	msec
BAS-97	Pulse Curr %	Initial pole position estimation pulse current (%)	10~100%	25	%
BAS-98	Pulse Volt %	Initial pole position estimation pulse voltage (%)	100~4000	500	-
CON-11	Hold Time	Hold Time	0	0-60	sec
CON-34	ASR P Gain 1	PM speed controller P gain 1	0~5000	100	-
CON-35	ASR I Gain 1	PM speed controller I gain 1	0~5000	150	-
CON-36	ASR P Gain 2	PM speed controller P gain 2	0~5000	100	-
CON-37	ASR I Gain 2	PM speed controller I gain 2	0~9999	150	-
CON-38	PM Flux FF %	Speed estimator feedforward high speed range (%)	0~1000%	300	%
CON-39	PM SpdEst Kp 0	PM speed estimator proportional gain 0	0~200%	30	%
CON-40	PM SpdEst Ki 0	PM speed estimator integral gain 0	0~200%	30	%
CON-41	PM SpdEst Kp 1	PM speed estimator proportional gain 1	0~300%	70	%
CON-42	PM SpdEst Ki 1	PM speed estimator integral gain 1	0~300%	70	%
CON-43	PM SpdEst Kp 2	PM speed estimator proportional gain 2	0~300%	100	%
CON-44	PM SpdEst Ki 2	PM speed estimator integral gain 2	0~300%	100	%
CON-45	PM EdGain Perc	PM D-axis back-EMF estimated gain (%)	0~300%	100	%
CON-46	PM EqGain Perc	PM Q-axis back-EMF estimated gain (%)	0~300%	100	%
CON-47	PMdeadVolt Per	PM dead-time voltage (%)	50~200%	100	%
CON-48	ACR P-Gain	Current controller proportional gain	0~10000	1200	-
CON-49	ACR I-Gain	Current controller integral gain	10~1000	120	-
CON-50	V Con HR	Voltage controller limit	0~100.0%	10	%
CON-51	V Con Ki	Voltage controller I Gain	0~1000.0%	10	%
CON-52	Torque Out LPF	Torque Controller Output	0-2000	0	msec

<table>
<tr><th>Code</th><th>Keypad Display</th><th>Description</th><th colspan="2">Setting Range</th><th>Factory Default</th><th>Units</th></tr>
<tr><td></td><td></td><td>Filter</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td rowspan="10">CON-53</td><td rowspan="10">Torque Lmt Src</td><td rowspan="10">Torque Limit setting options</td><td>0</td><td>Keypad-1</td><td rowspan="10">0:Keyypad-1</td><td rowspan="10">-</td></tr>
<tr><td>1</td><td>Keypad-2</td></tr>
<tr><td>2</td><td>V1</td></tr>
<tr><td>4</td><td>V2</td></tr>
<tr><td>5</td><td>I2</td></tr>
<tr><td>6</td><td>Int 485</td></tr>
<tr><td>7</td><td>FieldBus</td></tr>
<tr><td>9</td><td>Pulse</td></tr>
<tr><td>10</td><td>V3</td></tr>
<tr><td>11</td><td>I3</td></tr>
<tr><td>CON-54</td><td>FWD +Trq Lmt</td><td>Forward direction retrograde torque limit</td><td colspan="2">0-200%</td><td>180% [4]</td><td>%</td></tr>
<tr><td>CON-55</td><td>FWD -Trq Lmt</td><td>Forward direction regenerative torque limit</td><td colspan="2">0-200%</td><td>180.00%</td><td>%</td></tr>
<tr><td>CON-56</td><td>REV +Trq Lmt</td><td>Reverse direction regenerative torque limit</td><td colspan="2">0-200%</td><td>180.00%</td><td>%</td></tr>
<tr><td>CON-57</td><td>REV -Trq Lmt</td><td>Reverse direction retrograde torque limit</td><td colspan="2">0-200%</td><td>180.00%</td><td>%</td></tr>
</table>

7.2.1 Sensorless Vector Control Operation for PM motor

To operate a PM synchronous motor in sensorless vector control mode, set DRV-09 (Control Mode) to 4 (PM Sensorless), select the motor capacity at MOT-01 (Motor Capacity), and enter the appropriate parameters in the motor (MOT) group with the motor specification values found on the motor's name plate. If a specific motor capacity does not exist in the setting options, select a higher motor capacity that is closest to the actual motor capacity.

Code	Keypad Display	Description	Setting Value	Setting Range	Units
DRV-09	Control Mode	Control mode	4: PM Sensorless	0~4	-
MOT-01	Motor Capacity	Motor capacity	Depends on the motor capacity	1~20 (1HP-125HP	-
MOT-02	Base Freq	Base frequency	Depends on the motor capacity	30~180	Hz
MOT-03	Pole Number	Motor pole number	Depends on the motor capacity	2~48	-
MOT-05	Rated Curr	Rated motor current	Depends on the motor capacity	1.0~1000.0A	A
MOT-07	Rated Volt	Motor-rated voltage	Depends on the motor capacity	170~480V	V
MOT-10	AC Input Volt	AC input voltage		170~528V	V
DRV-20	Max Freq	Max	Depends on the motor capacity	40.00~180.00Hz	Hz

7.2.2 PM Auto Tuning

After entering the parameters, set MOT-11 (Auto tuning) to 4 [All(PM)] and perform the auto tuning operation. When auto tuning is complete, the MOT-16 (Rs), MOT-17 Ld (PM), MOT-18 Lq (PM), and MOT-19 (PM Flux Ref) parameters are automatically measured and saved.

Code	Keypad Display	Description	Setting Value	Setting Range	Units
MOT-11	Auto Tuning	Auto Tuning	0: None	0~6 6:All PM	Msg
MOT-16	Rs (PM)	PM Stator resistance	Depends on motor capacity	0.000~9.999Ω	Ω
MOT-17	Ld (PM)	D-axis inductance	0	0.000~1000.0	mH
MOT-18	Lq (PM)	Q-axis inductance	0	0.000~1000.0	mH
MOT-19	PM Flux Ref	Flux reference	0.147	0.000~1.000	Wb
MOT-20	Lq(PM) Scale	Q-axis inductance scale	100	50~150%	%
MOT-21	Ld,Lq Tune Lev	Auto tuning level for Ld, Lq	33.3	20.0~50.0%	%
MOT-22	Ld,Lq Tune Hz	Auto tuning frequency for Ld and Lq	150.0/100.0	80.0~150.0%	%

PM Sensorless Vector Control Operation Setting Details

Code	Description
CON-34 ASR P Gain 1 CON-35 ASR I Gain 1 CON-36 ASR P Gain 2 CON-37 ASR I Gain 2	Changes the speed PI controller gain during a PM synchronous motor operation in sensorless vector control mode. For a PI speed controller, P gain is a proportional gain for the speed deviation. If the speed deviation becomes greater than the torque, the output command will increase accordingly. The higher the value becomes, the faster the speed deviation will decrease. The speed controller I gain is the integral gain for speed deviation. It is the time taken for the gain to reach the rated torque output command while constant speed deviation continues. The lower the value becomes, the faster the speed deviation will decrease. As the motor inertia varies by motor, the gain values should be changed according to the motor speeds. CON-34 and CON-35 set the low speed P/I controller gain values, while CON-36 and CON-37 set the high speed P/I controller gain values, so that an appropriate gain value can be used for different motor speeds.
CON-38 PM Flux FF %	Sets the high-speed portion of the feed forward rate against the back-EMF during a PM synchronous motor operation in sensorless vector control mode. Feed forwarding enhances operation of the speed estimator. Increase the value at CON-38 in 10% increments to suppress motor oscillation under load. A fault may occur if this value is set too high.

Code	Description
CON-39 PM SpdEst Kp 0 CON-40 PM SpdEst Ki 0 CON-41 PM SpdEst Kp 1 CON-42 PM SpdEst Ki 1 CON-43 PM SpdEst Kp 2 CON-44 PM SpdEst Ki 2	Set these parameters to change the speed estimator gain during a PM synchronous motor operation in sensorless vector control mode. CON-39, 40 is applied at starting. If faults occur or excessive oscillation is observed at starting and low speeds, decrease the value at CON-39, 40 until the motor operates stably. CON-41, 42 Gain is applied from low speed to medium speed. CON-43, 44 gain is applied at medium speed or higher. When oscillation is occurring, lower the gain value appropriate for the speed. And when pulsation is occurring in normal status, the value of I gain should be set higher.
CON-45 PM EdGain Perc CON-46 PM EqGain Perc	To ensure that the back-EMF with rotor position information can be appropriately estimated during a PM synchronous motor operation in sensorless vector control mode, set these values as a percentage of the proportional gain, which is designed to have stable estimator polarity. Higher values result in faster responses, with higher chances of increased motor vibration. Excessively low values may result in motor startup failure due to slow response rate.
CON-47 PMdeadVolt Per	Sets the output compensation values during a PM synchronous motor operation in sensorless vector control mode. If the motor fails to operate at low speeds at or below 5% of the rated motor speed, increase the values set at CON-47 by 10% increments. Decrease the values in 10% decrements if a clanking noise occurs at motor startup and motor stop.
CON-48 ACR P-Gain CON-49 ACR I-Gain	Sets the gain values for the PI current controller in a synchronous motor. The P gain is the proportional gain for the current deviation. The current deviation decreases faster with higher values, as the deviation in voltage output command increases with increased deviation. The I gain is the integral gain for the current deviation. Deviation in normal operation decreases with higher values. However, the gain values are limited by the carrier frequency. A fault may occur due to interference if you set the gain values too high

7.2.3 Detecting the Initial Pole Position

Initial pole position detection is a process to match the rotor position calculated by the inverter and the actual rotor position in a motor. In a permanent-magnet (PM) synchronous motor, rotor flux is generated from the permanent magnet attached to the rotor. Therefore, to run the motor in vector control mode, the exact rotor position (flux position) must be detected for accurate control of the torque generated by the motor.

Code	Keypad Display	Description	Setting Value	Setting Range	Units
BAS-94	Init Angle Sel	Initial pole position estimation type	0: None 1: Angle Detect 2: Alignment	0~2	-
BAS-95	PD Repeat Num	Pole position estimation retry count	2	0~10	-
BAS-96	Pulse Interval	Pole position detection interval	20	1~100msec	msec
BAS-97	Pulse Curr %	Pole position detection pulse current (%)	25	10~100%	%
BAS-98	Pulse Volt %	Pole position detection pulse voltage %	500	100~4000	-

Pole Position Setting Details

Code	Description
BAS-94 Init Angle Sel	Select the type of initial pole position detection.
	When BAS-94 is set to 0 (None), the motor is operated according to the pole position estimated by the inverter's sensorless control algorithm, instead of actually detecting the physical position of the rotor pole.
	When BAS-94 is set to 1 (Angle Detect), the motor is operated according to the pole position detected by changes in the current. The voltage pulse input is used to detect the pole position and results in a small amount of noise at motor startup.
	When BAS-94 is set to 2 (Alignment), the inverter forcefully align the rotor position by supplying DC current for a certain period of time.

7.2.4 CON-69 Speed Search Operation for PM motor

This operation is used to prevent faults that can occur when the inverter starts a motor that is idling. Because this feature estimates the motor rotation speed based on the inverter output current, it does not give the exact speed.

Code	Keypad Display	Description	Setting Value	Setting Range	Units
CON-69	SS Pulse Curr	PM speed search pulse current	15%	10~100	%
CON-70	SS Mode	Speed search mode	2: Flying Start-3	2 Flying Start-3	-
CON-71	Speed Search	Speed Search operation selection	0000 bit 3 bit 2 bit 1 bit 0 1 1 1 1 0 0 0 0	0000-1111	bit
CON-75	SS Block Time	Output block time before speed search	1.0sec	0~60.0	sec

Speed Search Setting Details

Code	Description
CON-69 SS Pulse Curr	Sets the speed search current based on the motor's rated current.
CON-70 SS Mode	2: Flying Start-3 This speed search is available when operating a PM synchronous motor. It is used when DRV-09 (Control Mode) is set to 4 (PM Sensorless).
CON-71 Speed Search	Refer to *5.5.3 CON-70 Speed Search Operation on pg.156* for details on bit settings.
CON-75 SS Block Time	This setting helps prevent overvoltage faults due to counter electromotive force.

Guidelines for Running a PM Synchronous Motor in Sensorless Vector Control Mode

Problem	Relevant function code	Troubleshooting
Starting torque is insufficient.	CON-48 ACR P-Gain CON-47 PMdeadVolt Per	If an overcurrent trip occurs at startup, try decreasing the value at CON-48 in 10% decrements. Try increasing the value at CON-47 in 10% increments.
The motor hunts when starting up.	CON-47 PMdeadVolt Per	Try decreasing the value at CON-47 in 10% decrements.
The motor hunts with regenerative load at low speed (10Hz or lower), or an "OCT" fault occurs.	CON-47 PMdeadVolt Per	Try increasing the value at CON-47 in 10% increments.
The motor hunts* or the torque is not sufficient while the load is increasing at low speed (10Hz or lower).	CON-04 Carrier Freq CON-34 ASR P Gain 1 CON-35 ASR I Gain 1	If the motor hunts at low speeds, try increasing the value at CON-35 in 50 msec increments. If the motor does not hunt, try increasing the value at CON-34 in 10% increments until the motor runs in an optimal operation condition. If the motor hunts and the torque is not sufficient at 5–10Hz speed range, and if the carrier frequency at CON-04 is set to more than 3 kHz, try decreasing the value in 1 kHz decrements.
The motor hunts excessively during no-load operation when rated current is supplied to the motor.	CON-34 ASR P Gain 1 CON-35 ASR I Gain 1 CON-36 ASR P Gain 2 CON-37 ASR I Gain 2	Try decreasing the speed controller gains at CON-34–37 in 30% decrements.
The value at MOT-19 (PM Flux Ref) becomes "0" after performing an auto tuning operation by setting MOT-11 to 6 [All (PM)].	MOT-03 Pole Number MOT-07 Rated Volt MOT-02 Base Freq	Refer to the motor's name plate and set the pole number at MOT-03 (Pole Number), or enter a calculated pole number: Pole Number = (120 x BaseFreq/BaseRPM) Refer to the motor's name plate and set the rated voltage MOT-07 and base frequency MOT-02 and then run auto tuning again by setting MOT-110 (Auto Tuning) to 6 All (PM).
Faults occur after a static auto tuning.	MOT-16 Rs MOT-17 Ld (PM) MOT-18 Lq (PM) MOT-19 PM Flux Ref	Motor operation may fail if a static PM auto tuning result is not accurate. Refer to the motor's name plate and set the motor-related parameters again.
"OVT" occurs due to abrupt acceleration, deceleration, or massive load change while the	CON-37 ASR I Gain 2	Try decreasing the value at CON-37 in 5% decrements.

Problem	Relevant function code	Troubleshooting
motor is operated at mid-speed (above 30Hz).		
Speed variation occurs during an operation at rated motor speed, or during an overloaded high speed operation.	CON-38 PM Flux FF % CON-50 V Con HR CON-51 V Con Ki	If the motor is operated at the rated speed, try decreasing the value at CON-50 in 5% increments. If the motor response is slow, try increasing the value at CON-51 in 5% increments (or, try increasing the value at CON-38 in 100% increments).
“OC1” fault or jerking occurs during a high speed operation.	CON-43 PM SpdEst Kp 2 CON-44 PM SpdEst Ki 2	Try increasing the value at CON-43 in increments of 10 and the value at CON-4 in increments of 1. Note that a fault may occur if the values at CON-43 and CON-44 are set too high.
Jerking occurs during a low speed operation.	CON-35 ASR I Gain 1	Try increasing the value at CON-35 (low speed range speed controller I gain) to eliminate jerking.
A “clanking” noise is heard at the beginning of startup or during deceleration.	CON-34 ASR P Gain 1 CON-35 ASR I Gain 1 CON-47 PMdeadVolt Per	Try increasing the values at CON-34 and CON-35 in 10% increments, or try decreasing the value at CON-47 in 10% decrements.
The motor cannot reach the speed reference when it is operated at or above the rated speed, or when the acceleration is not responsive.	CON-50 V Con HR CON-51 V Con Ki	Try increasing the value at CON-50 in 1% increments if the motor cannot reach the speed reference. Try increasing the value at CON-51 in 10% increments if the motor acceleration is not responsive.
“OC1” trip occurs after an abrupt regenerative load (over 100%).	CON-34 ASR P Gain 1 CON-35 ASR I Gain 1	Try decreasing the values at CON-34 and CON-35 in 10% decrements.
The motor jerks during acceleration.	CON-40 PM SpdEst Ki 0	Try increasing the speed estimator proportional gain 0 at CON-40 in increments of 5.
A massive current rises when the motor is stopped during a 20:1 speed startup.	CON-35 ASR I Gain 1	Try increasing the value at CON-35 in 10% increments.
An oscillation occurs when an abrupt load is applied to the motor during a low speed operation.	CON-39 PM SpdEst Kp 0 CON-40 PM SpdEst Ki 0	Try increasing the values at CON-39 and CON-40 in 10% increments.
During a PM speed search, the speed search stops at around 20% of the base frequency, and the motor is stopped and starts again after a massive current rises.	CON-69 SS Pulse Curr	Try decreasing the value at CON-69 in 5% decrements.
During a high-speed operation in PM control mode utilizing the kinetic energy buffering, a massive current rises at around 20% of the base frequency, the motor is stopped, and it fails to start.	CON-78 KEB Start Lev CON-79 KEB Stop Lev CON-81 KEB P Gain CON-82 KEB I Gain	Try increasing the values at CON-78 and CON-79 in 5% increments, or try doubling the gain values at CON-81 and CON-82.
1. When the motor is overloaded, the maximum torque limit current is supplied to the motor at startup, and the motor fails to	MOT-17 Lq (PM) MOT-20 Lq (PM Scale	This happens when the Lq parameter value is decreasing due to certain causes, such as self-saturation.

Problem	Relevant function code	Troubleshooting
operate due to an inverter overload fault. 2. Speed search fails when the a load exceeding the rated load is applied to the motor at each speed section, or a current equal to or exceeding 150% of the rated current is supplied to the motor.		Try increasing the value (100%) at MOT-20 in 5% increments.
A fault occurs when the motor tries to start up or accelerate from a free run at certain speed range.	CON-71 Speed Search	During a PM synchronous motor operation in sensorless vector mode, the motor starts up after the initial pole position detection is made. To accelerate the motor in a free-run state, enable speed search at acceleration by setting bit 0 (0001) at CON-71 (Speed Search).
During a low speed operation, the output speed search becomes unstable when a massive load exceeding the rated load is abruptly applied to the motor.	CON-35 ASR I Gain 1 CON-47 PMdeadVolt Per	The motor control may become unstable due to input voltage deviation during a low-speed operation with low voltage input. Try decreasing the values at CON-35 and CON-47 in 10% decrements.

8 Application Groups

The H2 Series inverter includes three Application Groups (AP1, AP2 and AP3). AP1 includes additional PID control related parameters and can be found in the PID group, section 6.3. Application Groups 2 & 3 include the following additional pump related features.
AP2 - Load tuning, Pump cleaning operation, Damper control, Oil Pump control and Motor Pre-Heat functions.
AP3 includes the Time Event scheduler that allows the inverter to be programmed to operate at specific times over a 7-day period.

8.1 Application Group 2 (AP2)

Application Group 2 includes additional pump and fan related parameters. These are Pump Load Curve Tuning, Pump Clean Operation, Check Valve timing, Damper status monitoring, Oil Pump starter control and Motor Pre-Heat function.

8.1.1 AP2 Parameter List

Code	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
00	Jump Code	Jump Code	1–99		40		O	p.74
01[1]	Load curve Tuning	Load Tune	0	No	0	No	Δ	p.257
			1	Yes				
02	Load Curve - Low Freq	Load Fit Lfreq	Base Freq*15%–Load Fit Hfreq (AP2-08)		30.00		Δ	p.257
03	Current at Low Freq	Load Fit LCurr	0.0–80.0 (%)		40.0		Δ	p.257
04	Power at Low Freq	Load Fit LPwr	0.0–80.0 (%)		30.0		Δ	p.257
08	Load Curve - High Freq	Load Fit HFreq	Load Fit LFreq– HighFreq		51.00		Δ	p.257
09	Current at High Freq	Load Fit HCurr	Load Fit LCurr – 200.0 (%)		80.0		Δ	p.257
10	Power at High Freq	Load Fit HPwr	Load Fit LPwr – 200.0 (%)		80.0		Δ	p.257
11	Load curve - Current	Load Curve Cur	-		-		X	p.257
12	Load curve - Power	Load Curve Pwr	-		-		X	p.257
15	Pump clean setting 1	Pump Clean Mode1	0	None	0	None	O	p.259
			1	DI Dependent				
			2	Output Power				
			3	Output Current				
16	Pump clean setting2	Pump Clean Mode2	0	None	0	None	Δ	p.259
			1	Start				
			2	Stop				
			3	Start and Stop				
17	Pump clean load setting	PC Curve Rate	0.1–200.0 (%)		100.0		O	p.259
18	Pump clean reference band	PC Curve Band	0.0–100.0 (%)		5.0		O	p.259
19	Pump clean operation delay time	PC Curve DT	0.0–6000.0 (sec)		60.0		O	p.259
20	Pump clean start delay time	PC Start DT	0.0–6000.0 (sec)		10.0		O	p.259
21	0 speed operating time at Fx/Rx switching	PC Step DT	0.1–6000.0 (sec)		5.0		O	p.259
22	Pump clean Acc time	PC Acc Time	0.0–600.0 (sec)		10.0		O	p.259
23	Pump clean Dec time	PC Dec Time	0.0–600.0 (sec)		10.0		O	p.259
24	Forward step maintaining time	Fwd SteadyTime	0.0–600.0 (sec)		10.0		O	p.259
25	Forward step maintaining frequency	Fwd SteadyFreq	0.00, Low Freq– High Freq		30.00		O	p.259
26	Reverse step running time	Rev SteadyTime	0.0–600.0 (sec)		10.0		O	p.259
27	Reverse step running frequency	Rev SteadyFreq	0.00, Low Freq– High Freq		30.00		O	p.259
28	Pump clean number of Fx/Rx steps	PC Num of Steps	1–10		2		O	p.259
29	Pump clean function cycle monitoring	Repeat Num Mon	-		-		X	p.259
30	Number of pump clean repetitions	Repeat Num Set	0–10		2		O	p.259
31	Operation after pump clean end	PC End Mode	0	Stop	0	Stop	Δ	p.259
			1	Run				
32	Pump clean continuous limit time	PC Limit Time	6–60 (min)		10		O	p.259
33	Pump clean continuous limit numbers	PC Limit Num	0–10		3		O	p.259
38	Dec Valve operation frequency	Dec Valve Freq	Low Freq– High Freq		40.00		O	p.263
39	Dev Valve Dec time	Dev Valve Time	0.0–6000.0 (sec)		0.0		O	p.263
40	Start and End ramp settings	Start&End Ramp	0	No	0	No	Δ	p.264

Code	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
			1	Yes			
41	Start Ramp Acc time	Start Ramp Acc	0.0–600.0 (sec)		10.0	O	p.264
42	End Ramp Dec time	End Ramp Dec	0.0–600.0 (sec)		10.0	O	p.264
45	Damper check time	Damper check T	0.0–600.0 (sec)		5.0	O	p.265
46	Lubrication operation time	Lub Op Time	0.0–600.0 (sec)		5.0	O	p.266
48[2]	Pre heat level	Pre Heat Level	1–100 (%)		20	O	p.267
49	Pre-heat duty	Pre-Heat Duty	1–100 (%)		30	O	p.267
50	DC input delay time	DC Inj Delay T	0.0–600.0 (sec)		60.0	O	p.267

8.1.2 AP2-01 Load Tuning

Load tuning refers to an operation that detects the load applied to a specific section of the inverter operation (current and voltage) and creates an ideal load curve for the under load and pump clean operations. The two set points to define the section are user-definable and are set at 50% and 85% of the base frequency (MOT-02 Base Freq) by default. The load tuning result values are saved at parameters AP2-02~AP2-10. These values are user definable as well.

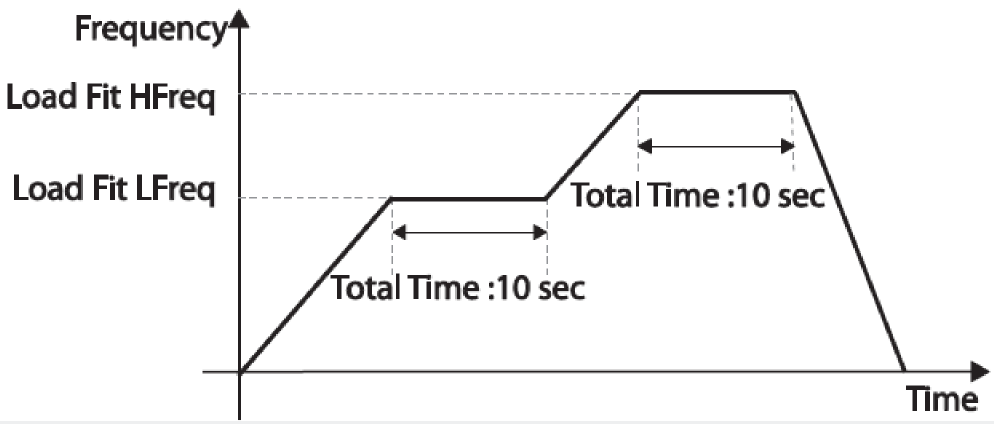
The minimum set point for the load tuning begins at 15% of the base frequency (MOT-02 Base Freq), and the maximum set point can be set up to the base frequency. If the frequency limit is set to ‘1 (Yes)’ at ADV-24 (Freq Limit), the range is limited within the frequencies set at ADV-25 (Freq Limit Lo) and ADV-26 (Freq Limit Hi).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP2	01	Load curve Tuning	Load Tune	No	0	No	-
					1	Yes	
	02	Load curve Low Freq	Load Fit LFreq	30.00	Base Freq*15%–Load Fit HFreq		Hz
	03	Current for Low Freq	Load Fit LCurr	40.0	0.0–200.0		%
	04	Power for Low Freq	Load Fit LPwr	30.0	0.0–200.0		%
	08	Load curve High Freq	Load Fit HFreq	51.00	Load Fit LFreq–High Freq		Hz
	09	Current for High Freq	Load Fit HCurr	80.0	0.0–200.0		%
	10	Power for High Freq	Load Fit HPwr	80.0	0.0–200.0		%
	11	Load current for frequency	Load Curve Cur	-	-		%
	12	Load power for frequency	Load Curve Pwr	-	-		%

Load Tuning Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">AP2-01 Load Tune</td><td colspan="3">The inverter performs an automatic tuning to generate an ideal system load curve.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Load tuning is not used.</td></tr>
<tr><td>1</td><td>Load Tune</td><td>Start load tuning.</td></tr>
<tr><td>AP2-02 Load Fit LFreq</td><td colspan="3">Defines the first frequency set point for load tuning (user definable).</td></tr>
<tr><td>AP2-03 Load Fit LCurr
AP2-04 Load Fit LPwr</td><td colspan="3">Displays the current and power measured at the frequency set at AP2-02 as a percentage (%) value, based on motor rated current and rated power. Values for AP2-03 and AP2-04 are user definable.</td></tr>
<tr><td>AP2-08 Load fit HFreq</td><td colspan="3">Defines the second frequency set point for load tuning (user definable).</td></tr>
<tr><td>AP2-09 Load Fit HCurr
AP2-10 Load Fit HPwr</td><td colspan="3">Displays the current and power measured at the frequency set at AP2-08 as a percentage (%) value, based on motor rated current and rated power. Values for AP2-09 and AP2-10 are user definable.</td></tr>
<tr><td>AP2-11 Load Curve Cur
AP2-12 Load Curve PWR</td><td colspan="3">Monitors the load curve value set at AP2-1 (Load Tune) based on the current output frequency.</td></tr>
</table>

When a load tuning is performed, the inverter measures for 10 seconds the motor current and power, at the frequencies set at AP2-02 and AP2-09. The motor current and power values measured here are used to generate an ideal load curve.



Note
Load tuning is not available while the inverter is operating.

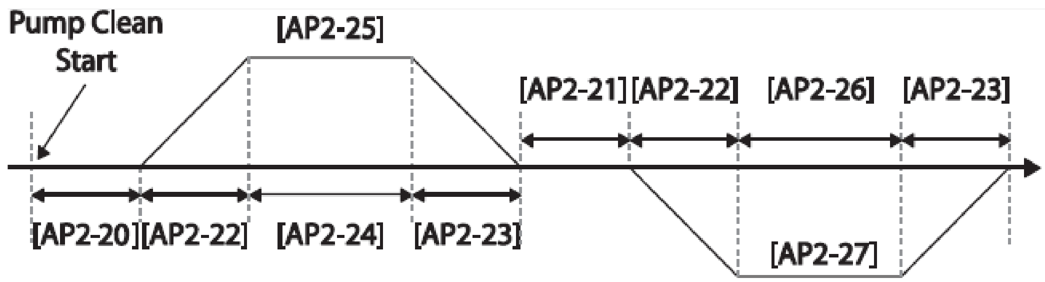
Caution

- If the frequencies for AP2-02 (Low Freq) and AP2-08 (High Freq) are set too close to each other, the resulting load curve may not reflect the actual (ideal) load curve. Therefore, it is recommended that you keep the AP2-02 and AP2-08 frequencies as close to the factory defaults as possible.
- If a secondary motor is in use, note that the existing load curve for the main motor will be applied to the secondary motor unless a load tuning has been performed for the secondary motor.

8.1.3 AP2-15 Pump Clean Operation

The pump clean operation is used to remove the scales and deposits attached on the impeller inside a pump. This operation keeps the pump clean by performing a repetitive run-and-stop operation of a pump. This prevents loss in pump performance and premature pump failures.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP2	15	Pump clean mode 1	Pump Clean Mode1	0: None	0	None	-
					1	DI Dependent	
					2	Output Power	
					3	Output Current	
	16	Pump clean mode 2	Pump Clean Mode2	0: None	0	None	-
					1	Start	
					2	Stop	
					3	Start & Stop	
	17	Pump clean load setting	PC Curve Rate	100	100.0–200.0		%
	18	Pump clean reference band	PC Curve Band	5	0.0–100.0		%
	19	Pump clean operation delay time	PC Curve DT	60	0–6000.0		sec
	20	Pump clean start delay time	PC Start DT	10	0–6000.0		Sec
	21	0 speed operating time at Fx/Rx switching	PC Step DT	5	1.0–6000.0		Sec
	22	Pump clean Acc time	PC Acc Time	10	0–600.0		Sec
	23	Pump clean Dec time	PC Dec Time	10	0–600.0		Sec
	24	Forward step run time	Fwd Steady T	10	1.0–6000.0		Sec
	25	Forward step run frequency	Fwd SteadyFreq	30	0.00, Low Freq–High Freq		Hz
	26	Reverse step run time	Rev Steady T	10	1.0–6000.0		Sec
	27	Reverse step run frequency	Rev SteadyFreq	30	0.00, Low Freq–High Freq		Hz
	28	Number of Fx/Rx steps for pump clean	PC Num of Steps	5	0–10		-
	29	Pump clean cycle monitoring	Repeat Num Mon	-	-		-
	30	Pump clean repeat number	Repeat Num Set	5	0–10		-
	31	Operation after pump clean	PC End Mode	0	0	Stop	-
					1	Run	
	32	Pump clean continuous time limit	PC Limit Time	10	6-60		min
	33	Pump clean continuous number limit	PC Limit Num	3	0-10		



<Basic Pump Clean Operation>

When a pump clean start command is given, the inverter waits until the delay time set at AP2-19 elapses, accelerates by the acceleration time set at AP2-22, and operates at the frequency set at AP2-25. The pump runs for the time set at AP2-24, decelerates by the time set at AP2-23, and then stops. This operation repeats in the forward and reverse directions (one after another) for the number of times set at AP2-28 (PC Num of Step). Each time the steps (Fx/Rx) switch, the inverter waits at a stop state for the time set at AP2-21 before going on with the next step. One step in the forward direction and another step in the reverse direction makes one cycle. The number of pump clean cycles is set at AP2-30. In the figure above, AP2-28 is set to ‘1’, and AP2-30 is set to ‘1’.

Pump Clean Function Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">AP2-15
PumpClean Mode</td><td colspan="3">Sets the pump mode.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Pump Clean function is not used.</td></tr>
<tr><td>1</td><td>DI defendant</td><td>Set one of the terminal inputs to ‘46 (Pump Clean Sel)’ and performs the pump clean operation by turning on the terminal.</td></tr>
<tr><td>2</td><td>Power</td><td>Performs a pump clean operation when a pump consumes more power than it is supposed to consume in a normal operation.</td></tr>
<tr><td>3</td><td>Current</td><td>Performs a pump clean operation when a pump consumes more current than it is supposed to consume in a normal operation.</td></tr>
<tr><td rowspan="6">AP2-16
PumpClean Sel</td><td colspan="3">Sets the pump clean start mode.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Pump clean is performed only by the function set at AP2-20.</td></tr>
<tr><td>1</td><td>Start</td><td>Pump clean is performed each time the inverter starts operating.</td></tr>
<tr><td>2</td><td>Stop</td><td>Pump clean is performed each time the inverter stops operating.</td></tr>
<tr><td>3</td><td>Start & Stop</td><td>Pump clean is performed each time the inverter starts or stops operating.</td></tr>
<tr><td>AP2-17
PC Curve Rate

AP2-18
PC Curve Band

AP2-19
PC Curve DT</td><td colspan="3">If AP2-15 is set to ‘Power’ or ‘Current,’ multiply the load characteristic curve set at AP2-2–AP2-10 by the value set at AP2-17 (100[%]+AP2-17[%]), and reset the load characteristic curve for the pump clean operation (refer to the load tune features for AP2-2–AP2-10 setting values).
Apply (rated inverter current x AP2-18 setting value) and (rated motor x AP2-18 setting value) to the pump clean load curve calculated by AP2-17 to calculate the final pump clean load curve. The inverter performs pump clean operation when the inverter continues operating for the time set at AP2-19.</td></tr>
<tr><td>AP2-20
Clean Start DT</td><td colspan="3">When AP2-15 is set to ‘Power’ or ‘Current’, a pump clean is performed if the inverter operation power or current stays above the pump clean load characteristic curve (defined by AP2-17 and AP2-18) for the time set at AP2-19.</td></tr>
<tr><td>AP2-21
Clean Step DT</td><td colspan="3">Sets the time for the inverter to maintain 0 speed (stop) before the inverter switches from forward to reverse operation during pump clean.</td></tr>
<tr><td>AP2-22 PumpClean AccT
AP2-23 PumpClean DecT</td><td colspan="3">Sets the Acc/Dec times for pump clean operations.</td></tr>
<tr><td>AP2-24 Fwd Steady Time
AP2-26 Rev Steady Time</td><td colspan="3">Sets the time to maintain forward and reverse operations.</td></tr>
<tr><td>AP2-25 Fwd SteadyFreq
AP2-27 Rev SteadyFreq</td><td colspan="3">Sets the forward and reverse operation frequencies.</td></tr>
<tr><td>AP2-28
PC Num of Steps</td><td colspan="3">Determines the number of steps (acceleration/deceleration/stop) in one cycle. Each operation, either in the forward or reverse direction, constitutes one step. If set to ‘2,’ one forward step and one reverse step constitute one cycle.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>AP2-31
PC End Mode</td><td>Determines the inverter operation after pump clean operation.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Stop</td><td>This stops the inverter after pump cleaning.</td></tr>
<tr><td>1</td><td>Start</td><td>The inverter operates based on the inverter’s command status after the pump cleaning. (If a terminal command is received, the inverter performs the operation it was performing before the pump clean operation.)</td></tr>
</table></td></tr>
<tr><td>AP2-29 Repeat Num Mon</td><td>Displays the number of the current pump cleaning cycle.</td></tr>
<tr><td>AP2-30
Repeat Num Set</td><td>Sets the number of cycles for one pump clean operation set at AP2-21–AP2-28.</td></tr>
<tr><td>AP2-32
PC Limit Time
AP2-33
PC Limit Num</td><td>Frequent pump clean operations may indicate a serious system problem. To warn the users of potential system problems, an error (CleanRPTErr) occurs if the number of pump clean operation exceeds the number set at AP2-33 within the time period set at AP2-32.</td></tr>
</table>

Note

- When the run prevent feature is active and an operation in the prevented direction is required to perform a pump clean operation, the inverter operates at the 0 speed for the time set at AP2-24 and AP2-26 (Steady Time).
- To stop the pump clean operation, press the OFF button on the keypad or turn it off at the terminal input.
- If the pump clean operation is configured for terminal input and it is turned on, and if ADV- 10 (PowerOn Resume) is set to ‘Yes’, a pump clean operation is performed when the inverter is turned on.
- When performing a pump clean operation via terminal input,
  - if the terminal input is turned off instantly after it is turned on (the operation is triggered), 1 pump clean cycle is operated.
  - if ADV-10 (PowerOn Resume) is set to ‘Yes’, and the terminal input is turned off instantly after it is turned on (the operation is triggered), and if the inverter is turned off during a pump clean then is turned back on again, the pump clean operation is not resumed (because the input terminal is not on when the inverter is turned on).
  - if the terminal input is kept on after it is initially turned on, 1 pump clean cycle is operated.

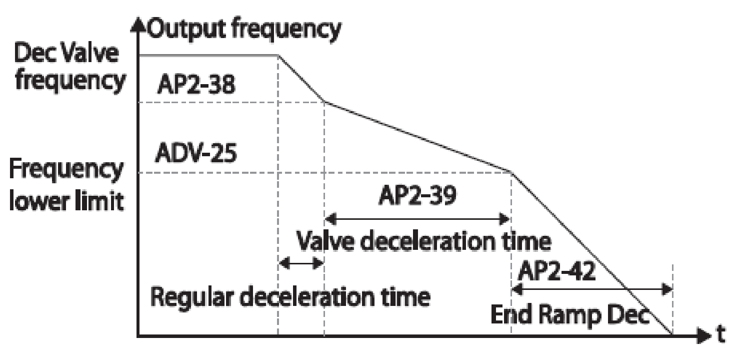
8.1.4 AP2-38 Decelerating Valve Ramping

This function is used to prevent pump damage due to abrupt deceleration. When the pump operation frequency reaches the valve ramp frequency (AP2-38 Dec Valve Freq) while decelerating rapidly based on the deceleration ramp time (set at AP2-42), it begins to slow down the deceleration based on the deceleration valve ramp time (set at AP2-39 DecValve Time). Decelerating valve ramp operates when ADV-24 (Freq Limit) is set to '1 (Yes)'.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP2	38	Dec valve ramping start frequency	Dec Valve Freq	40.00	Low Freq– High Freq		Hz
	39	Dec valve ramping time	DecValve Time	0.0	0–6000.0		Sec
ADV	24	Frequency limit options	Limit Mode	0: No	0	No	-
					1	Yes	
	25	Low Freq minimum value	Freq Limit Lo	30.00	Start Freq– Max Freq		Hz
	26	Low Freq maximum value	Freq Limit Hi	60.00	Freq Limit Lo– Max Freq		Hz

Deceleration Valve Ramping Setting Details

Code	Description
AP2-38 DecValve Freq	Sets the start frequency where the slow deceleration begins in order to prevent pump damage when the inverter stops. Decelerating valve ramping is performed from the frequency set at AP2-38 to the frequency limit set at ADV-25 (low frequency limit for pump operation).
AP2-39 DecValve Time	Sets the time it takes to decelerate from the frequency set at AP2-38 to the frequency limit set at ADV-25 (low frequency limit for pump operation).



The time set at AP2-39 refers to the absolute time that it takes for the pump to decelerate from the frequency set at AP2-38 to the frequency limit set at ADV-25.

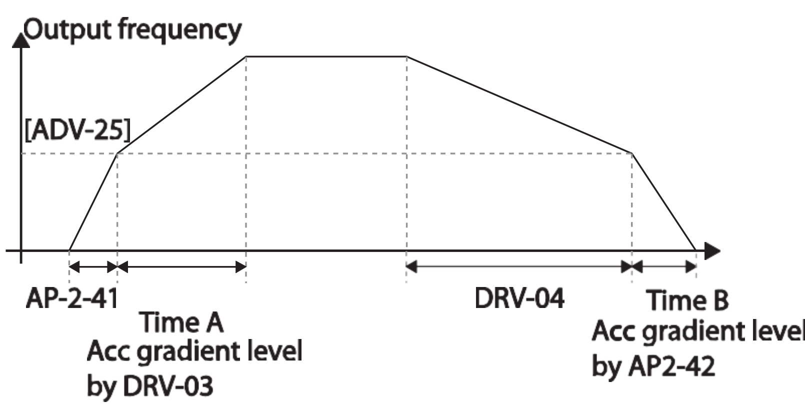
8.1.5 AP2-40 Start & End Ramp Operation

This function is used to rapidly accelerate the pump to the normal operating level, or to rapidly decelerate the pump and stop it. Start & End ramp operation is performed when ADV-24 (Freq Limit) is set to '1 (Yes).'

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP2	40	Start & End Ramp Gradient	Start&End Ramp	0: No	0	No	-
					1	Yes	
	41	StartRampAcc	StartRampAcc	10.0	0–600.0		Sec
	42	EndRampDec	EndRampDec	10.0	0–600.0		Sec
ADV	24	Frequency limit options	Freq Limit	0: No	0	No	-
					1	Yes	
	25	Low Freq minimum value	Freq Limit Lo	30.00	Start Freq– Max Freq		Hz
	26	Low Freq maximum value	Freq Limit Hi	60.00	Freq Limit Lo– Max Freq		Hz

Start & End Ramp Operation Setting Details

Code	Description		
AP2-40 Start&End Ramp	Sets the pump Start & End Ramp options.		
	Setting		Function
	0	No	The Start & End Ramp operation is not used.
	1	Yes	Use the Start & End Ramp operation.
AP2-41 Start Ramp Acc	Refers to the time it takes to reach the minimum pump operation frequency for a Start & End Ramp operation (Freq Limit Lo) set at ADV- 25 when the inverter starts (it is different from DRV-03 acceleration slope).		
AP2-42 End Ramp Dec	Refers to the time it takes to reach the 0 step (stop) from the minimum pump operation frequency for a Start & End Ramp operation (Freq Limit Lo) set at ADV-25 (it is different from DRV-03 deceleration slope).		



In the figure above, AP2-41 defines the acceleration time to the minimum operation frequency ADV-25 (Freq Limt Lo**)**. AP2-42 defines the deceleration time from the minimum operation frequency to a stopped state. Time A (normal acceleration time set at DRV-03) and Time B (normal deceleration time set at DRV-04) in the figure will change according to the Acc/Dec slopes defined by AP2-41 and AP2-42.

8.1.6 AP2-45 Damper Operation

A damper is a device that controls the flow in a ventilation system. If a damper is used in a system, the inverter may be configured to operate according to the damper's operation status. One of the digital input terminals (IN-65–71) may be set to '45 (Damper Open)' to receive the damper open status input. During a damper operation, one of the relay outputs OUT-31–35 (Relay 1–5) may also be set to '33 (Damper Control)' to output a signal based on the damper's operation status. The inverter starts operating when both the run command and the damper open signal are activated. A relay output setting at OUT- 31~35 is not necessary.

When the time difference between the inverter run command and the damper open signal exceeds the delay time set at AP2-45 (Damper DT), damper error (Damper Err) occurs. If the damper open relay output and damper control input are set at the same time, and if the damper open signal is not received until the time set at AP2-45 (Damper DT) is elapsed (when the inverter is not operating), damper error (Damper Err) occurs.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP2	45	Damper check time	Damper DT	-	0.1–600.0	sec
IN	65~71	P1–P7 Px terminal configuration	P1~P7 Define	37(Damper open)	0-42	-
OUT	31~35	Multi-function relay 1–5	Relay 1~5	33(Damper Control)	0-43	-

Damper Operation Setting Details

Code	Description
AP2-45 Damper DT	Sets the damper open delay time. Detects the inverter run command or the damper open signal (whichever is received first) and outputs a damper error (Damper Err) if the other signal is not received until the time set at AP2-45 elapses.
IN-65~71 P1–P7 define	Sets one of the multi-functional terminals to '45 (Damper Open)' to enable damper operation.
OUT-31–35 Relay 1–5	Sets one of the relay outputs to '33 (Damper Control)' to provide a relay output when the inverter run command is turned on.

Note
Damper operation is one of the essential system features that are available in both HAND and AUTO modes.

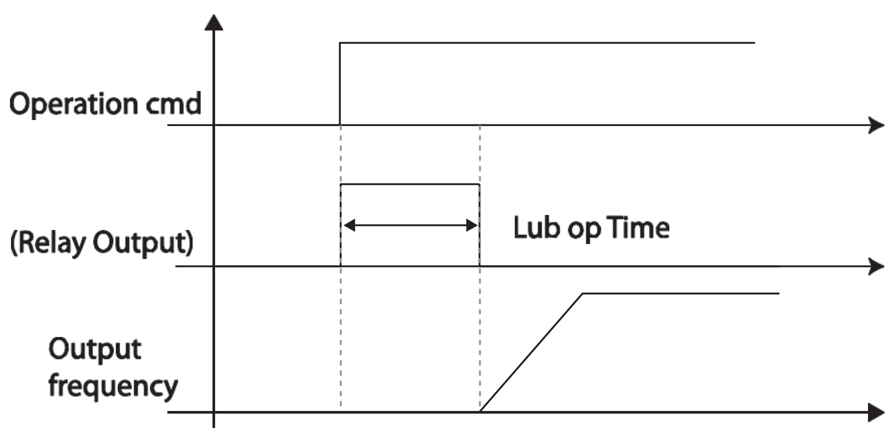
8.1.7 AP2-46 Lubrication Operation

Lubrication operation can be used for oil pump starters. The inverter outputs the lubrication signal through one of the output relays when the inverter receives a run command. The inverter does not start operating until the time set at AP2-46 (Lub Op Time) has elapsed and the Lubrication signal is turned off.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP2	46	Lubrication operation time	Lub Op Time		0.1–600.0	(sec)
OUT	31-35	Multi-function relay 1–5	Relay 1–5	30 (Lubrication)	0-43	-

Lubrication Operation Setting Details

Code	Description
AP2-46 Lub Op Time	Outputs the lubrication signal for a set time when the inverter run command is turned on. The inverter starts operating when the set time has elapsed.
OUT-31–35 Relay 1–5	Sets one of the output relays (OUT-31–35) to '30 (Lubrication)' to enable the Lubrication function.



Note

- The lubrication function can be used to delay inverter operations, depending on the working environment, since the inverter waits for the time set at AP2-46 (Lub Op Time) each time a run command is received.
- Lubrication operation is one of the essential system features that are available in both HAND and AUTO modes.

8.1.8 AP2-48 Pre-Heat Function

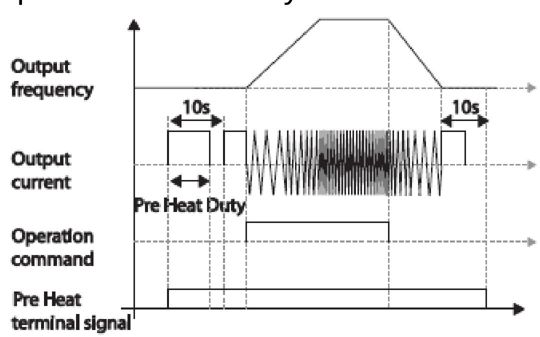
This function uses current to heat up the motor to remove moisture and prevent freezing when it is not in operation.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP2	48	Initial heating output current	Pre Heat Level	20	1–100	%
	49	Initial heating output duty	Pre Heat Duty	30	1–100	%
	50	DC input delay time	DC Inj Delay T	60.0	0.0–600.0	sec
IN	65~71	Terminal block input P1–P7	P1–P7 Define	36 (Pre Heat)	0-42	-

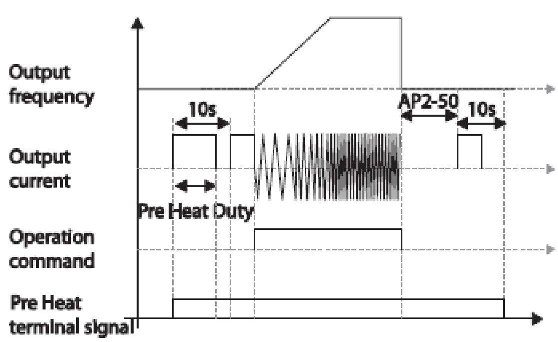
Pre-Heat Setting Details

Code	Description
AP2-48 Pre Heat Curr	Sets the current to be used for initial heating. Sets the current to motor no-load current % value.
AP2-49 Pre Heat Duty	Sets the duty (time) for the current to be used for initial heating, from 10 seconds to % value.
AP2-50 DC Inj Delay T	Sets a delay time to prevent from an over current trip that may occur when a DC input is applied after the inverter has stopped.
IN-65–71 P1–7 Define	Assign a digital input as the Pre Heat (36) function. Activate when closed.

The initial heating function continually operates when the digital input terminal is activated and until the inverter is started. When an inverter run command is made while the heating function is operating, the inverter starts operation immediately.



When the digital input is active, the initial heating operation starts after the inverter operation stops.



The diagram above shows the operation waveform related to AP2-50 DC Inj Delay T. The Pre Heat function performs when the inverter stop mode is set to Free Run and the Pre Heat signal is supplied. Then, if the inverter operation command is on, the inverter maintains acceleration and a fixed frequency. If the inverter operation command is off, the motor is in Free Run and the Pre Heat operations starts after the time amount set in AP2- 50.

Caution

- If the value for AP2-48 Pre Heat Curr is above the rated motor current value, it is limited by the rated motor current value.
- If the value for AP2-48 Pre Heat Curr is too high or the DC current output time is too long, the motor may overheat or be damaged and the Inver IOLT may also malfunction. Reduce the DC output current amount and DC output time to prevent from such damages.

8.2 Application Group 3 (AP3)

8.2.1 Time Event Scheduling

Time Event function enables the inverter to be fully automated. The user can program the inverter to operate among 4 Time Periods. Each period contains start/stop times for 7 days- 24 hours to program operation of the inverter. The inverter utilizes the RTC (Real-Time Clock) feature to set operating times.

To use the Time Event, set the current date and time. Three parameters need to be set to configure the Time event feature: Time Period Module, Time Event, and Exception Date.

An RTC battery is installed on the I/O CPU board of the H2 inverter and allows for approximately 5 to 6 years of inverter operation.

Time Period	Description
Time Period Module	Used to set the time periods of operation.
Time Event Module	Used to set the functions of the time periods.
Exception Date	Used to specify the exception date. Exception date has the highest priority.

4 Time period Module types, 8 Time Event Module types, and 8 Exception day types can be used to configure time events. The Time Event function works based on a series of configuration using the modules listed in the table above.

8.2.2 AP3 Time Event Parameter List

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP3	01	Current date	Now Date	01/01/2000	01/01/2000 ~ 12/31/2099 (Date)	Hz
	02	Current time	Now Time	0: 00	0: 00–23: 59	Sec
	03	Current day of the week	Now Weekday	0000001	0000000–1111111	-
	04	Summer Time Start date	Summer T Start	04/01	01/01 ~ Summer T Stop	Day
	05	Summer Time Finish date	Summer T Stop	11/31	Summer T Start~ 12/31(Date)	Day
	10	Period connection status	Period Status	-	-	-
	11	Time Period 1 Start time	Period1 StartT	24: 00	00:00 ~ 24:00	Min
	12	Time Period 1 End time	Period1 Stop T	24: 00	Period1 StartT ~ 24:00(Min)	Min
	13	Time Period 1 Day of the week	Period1 Day	0000000	0000000~1111111	-
	14	Time Period 2 Start time	Period2 StartT	24: 00	00:00 ~ 24:00	Min
	15	Time Period 2 End time	Period2 Stop T	24: 00	Period2 StartT ~ 24:00(Min)	Min
AP3	16	Time Period 2 Day of the week	Period2 Day	00000000	0000000~1111111	-
	17	Time Period 3 Start time configuration	Period3 StartT	24: 00	00:00 ~ 24:00	Min
	18	Time Period 3 End time	Period3 Stop T	24: 00	Period3 StartT ~ 24:00(Min)	Min
	19	Time Period 3 Day of the week	Period3 Day	0000000	0000000~1111111	

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
						-
	20	Time Period 4 Start time	Period4 StartT	24: 00	00:00 ~ 24:00	Min
	21	Time Period 4 End time	Period4 StopT	24: 00	Period4 StartT ~ 24:00(Min)	Min
	22	Time Period 4 Day of the week	Period4 Day	0000000	0000000~1111111	-
	30	Except1 Date Start time	Except1 StartT	24: 00	00:00 ~ 24:00	Min
	31	Except1 Date End time	Except1 Stop T	24: 00	Except1 StartT ~ 24:00(Min)	Min
	32	Except1 Date	Except1 Date	01/01	01/01–12/31	Day
	33-53	Exception Date 2–Exception Date 8 Parameter (The same condition and setting as Exception Date 1)				
	70	Time Event functions	Time Event En	0: No	0 No	
					1 Yes	
	71	Time Event configuration status	T-Event Status	-	-	
	72	Time Event 1 Connection	T-Event1Period	000000000000	000000000000 ~111111111111	
	73	Time Event 1 functions	T-Event1Define	0: None	0 None	
AP3					1 Fx	
					2 Rx	
					3 Speed-L	
					4 Speed-M	
					5 Speed-H	
					7 Xcel-L	
					8 Xcel-M	
					9 Xcel-H	
					10 Xcel Stop	
					11 Run Enable	
					12 2nd Source	
					13 Exchange	
					14 Analog Hold	
					15 I-Term Clear	
					16 PID Openloop	
					17 PID Gain 2	
					18 PID Ref Change	
					19 2nd Motor	
					20 Timer In	
					21 dis Aux Ref	
					22 Reserved	
					23 Reserved	
					24 Pre Heat	
					25 Reserved	
					26 Reserved	
					27 Sleep Wake Chg	
					28 PID Step Ref L	
					29 PID Step Ref M	
					30 PID Step Ref H	
	74–87	Time Event 2–Time Event 8 Parameter (The same setting range and initial value as Time Event 1)				

Time Event Function Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>AP3-01 Now Date
AP3-02 Now Time
AP3-03 Now Weekday</td><td>Sets the current date, time, and day of the week. The Time Event function is based on the setting. When the user sets the summer time start date, the current time is subtracted by one hour. ex) [AP3- 04 Summer T Start] is set to April 1, and if it is 1:59 on April 1, it will not be 2:00 a minute later and it will be 1:00 on April 1. If [AP3-05 Summer T Stop] is set to December 25th, then it will be 1:59 on December 25th, and it will be 3:00 on December 25 instead of 2:00 a minute later. Summer time is different for each country. The parameter is based on 2 o'clock. If there is no charge on the RTC battery, it is initialized to 00:00 on January 1, 2000 when the inverter power is off / on.</td></tr>
<tr><td>AP3-04 Summer T Start
AP3-05 Summer T Stop</td><td>Set the Summer time start and finish date.</td></tr>
<tr><td>AP3-06 Date format</td><td>Select the desired date format.
<table>
<tr><th colspan="2">Configuration</th><th>Function</th></tr>
<tr><td>0</td><td>YYYY/MM/DD</td><td>Year/Month/Day is displayed.</td></tr>
<tr><td>1</td><td>MM/DD/YYYY</td><td>Month/Day/Year is displayed (USA).</td></tr>
<tr><td>2</td><td>DD/MM/YYYY</td><td>The format of Day/Month/Year is displayed (Europe).</td></tr>
</table></td></tr>
<tr><td>AP3-10 Period Status</td><td>Bits 0–3 are used to indicate the time module that is currently in use among the 4 different time modules set at AP3-11–AP3-22.
Bits 4–11 are used to indicate the exception day that is set at AP3- 30–AP3-53.</td></tr>
<tr><td>AP3-11–AP3-20
Period 1–4 Start T</td><td>The start time for the 4 time periods can be set up to 4.</td></tr>
<tr><td>AP3-12–AP3-21
Period 1–4 Stop T</td><td>The end time for the 4 time periods can be set up to 4.</td></tr>
<tr><td>AP3-13–AP3-22
Period 1~4 Day</td><td>The Time period date for the operation can be set up to 4. It can be set on a weekly basis. If the bit is ‘1 (on)’, it indicates the relevant day is selected. If the Bit is ‘0 (off)’, it indicates the relevant day is
not selected.
<table>
<tr><th colspan="7">Bit</th></tr>
<tr><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Sunday</td><td>Monday</td><td>Tuesday</td><td>Wednesday</td><td>Thursday</td><td>Friday</td><td>Saturday</td></tr>
</table></td></tr>
<tr><td>AP3-30–AP3-51
Exception1–8 Start T</td><td>The operation start time for the 8 Exception days can be set.</td></tr>
<tr><td>AP3-31–AP3-52
Exception1–8 Stop T</td><td>The operation end time for the 8 Exception days can be set.</td></tr>
<tr><td>AP3-32–AP3-53
Exception1–8 Date</td><td>The date for the 8 Exception days can be set.</td></tr>
<tr><td>AP3-70
Time Event En</td><td>Enables or disables the Time Event
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>No</td><td>Time Event is not used.</td></tr>
<tr><td>1</td><td>Yes</td><td>Time Event is used.</td></tr>
</table></td></tr>
<tr><td>AP3-71
T-Event Status</td><td>It shows which T-Event from 1–8 is being performed.
<table>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>T-Event 8</td><td>T-Event 7</td><td>T-Event 6</td><td>T-Event 5</td><td>T-Event 4</td><td>T-Event 3</td><td>T-Event 2</td><td>T-Event 1</td></tr>
</table></td></tr>
<tr><td>AP3-72–86
T-Event1–8 Period</td><td>Select the desired module of the Time Module and Exception Day set in AP3-11–AP3-53 for the relevant events.
If the bit is 1, it indicates the relevant Time Module or Exception Day is selected. If the Bit is 0, it indicates the Time Module or Exception Day is not</td></tr>
</table>

<table>
<tr><th>Code</th><th colspan="12">Description</th></tr>
<tr><td rowspan="4"></td><td colspan="12">selected.</td></tr>
<tr><td colspan="12">bit</td></tr>
<tr><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Exception Date 8</td><td>Exception Date 7</td><td>Exception Date 6</td><td>Exception Date 5</td><td>Exception Date 4</td><td>Exception Date 3</td><td>Exception Date 2</td><td>Exception Date 1</td><td>Period 4</td><td>Period 3</td><td>Period 2</td><td>Period 1</td></tr>
<tr><td>AP3-73 ~ 87
T-Event1 ~ 8 Define</td><td colspan="12">Select the desired Event.
<table>
<tr><th colspan="4">Setting</th></tr>
<tr><td>0</td><td>None</td><td>16</td><td>PID Openloop</td></tr>
<tr><td>1</td><td>Fx</td><td>17</td><td>PID Gain2</td></tr>
<tr><td>2</td><td>Rx</td><td>18</td><td>PID Ref Change</td></tr>
<tr><td>3</td><td>Speed-L</td><td>19</td><td>2nd Motor</td></tr>
<tr><td>4</td><td>Speed-M</td><td>20</td><td>Timer In</td></tr>
<tr><td>5</td><td>Speed-H</td><td>21</td><td>Dis Aux Ref</td></tr>
<tr><td>7</td><td>Xcel-L</td><td>24</td><td>Pre Heat</td></tr>
<tr><td>8</td><td>Xcel-M</td><td>27</td><td>Sleep Wake Chg</td></tr>
<tr><td>9</td><td>Xcel-H</td><td>28</td><td>PID Step Ref L</td></tr>
<tr><td>10</td><td>Xcel Stop</td><td>29</td><td>PID Step Ref M</td></tr>
<tr><td>11</td><td>Run Enable</td><td>30</td><td>PID Step Ref H</td></tr>
<tr><td>12</td><td>2nd Source</td><td></td><td></td></tr>
<tr><td>13</td><td>Exchange</td><td></td><td></td></tr>
<tr><td>14</td><td>Analog Hold</td><td></td><td></td></tr>
<tr><td>15</td><td>I-Term Clear</td><td></td><td></td></tr>
</table></td></tr>
</table>

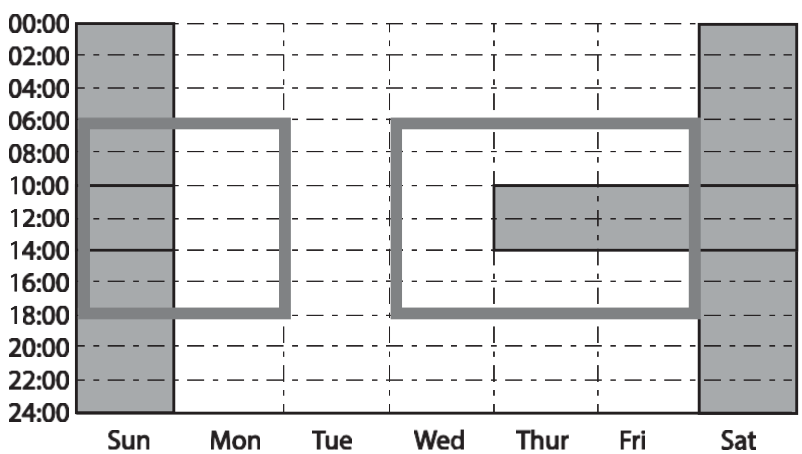
Time Period Parameter Setting

There are 4 Time Period Sets in the Time Event. Each Time Period Set has:

Period 1–4 Start (Start time), Period 1–4 Stop T (End time), and Period 1–4 Day (Operation day) for which they can be set.

<table>
<tr><th>Time Period</th><th colspan="4">Schedule</th></tr>
<tr><td rowspan="7">Time Period 1</td><td colspan="4">Every Sunday, Monday, Wednesday, Thursday, and Friday at 06: 00 (On) and 18: 00 (Off)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="6"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-11</td><td>Period1 StartT</td><td>06: 00</td></tr>
<tr><td>AP3-12</td><td>Period1 StopT</td><td>18: 00</td></tr>
<tr><td>AP3-13</td><td>Period1 Day</td><td>1101110</td></tr>
<tr></tr>
<tr><td rowspan="6">Time Period 2</td><td colspan="4">Every Sunday and Saturday for 24 hours (On)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="5"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-14</td><td>Period2 StartT</td><td>00: 00</td></tr>
<tr><td>AP3-15</td><td>Period2 StopT</td><td>24: 00</td></tr>
<tr><td>AP3-16</td><td>Period2 Day</td><td>1000001</td></tr>
<tr><td rowspan="6">Time Period 3</td><td colspan="4">Every Sunday, Thursday, Friday, and Saturday at 10: 00 (On) and 14: 00 (Off)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="5"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-17</td><td>Period3 StartT</td><td>10: 00</td></tr>
<tr><td>AP3-18</td><td>Period3 StopT</td><td>14: 00</td></tr>
<tr><td>AP3-19</td><td>Period3 Day</td><td>1000111</td></tr>
</table>

The tables above show the parameter values for Time Period 1, Time Period 2, and Time Period 3. When the parameters are set for the Time Periods 1-3, this indicates the Time Event function turns on and off on the following days and time.



<Time Period setting Time Chart>

Parameters Setting for Exception Date

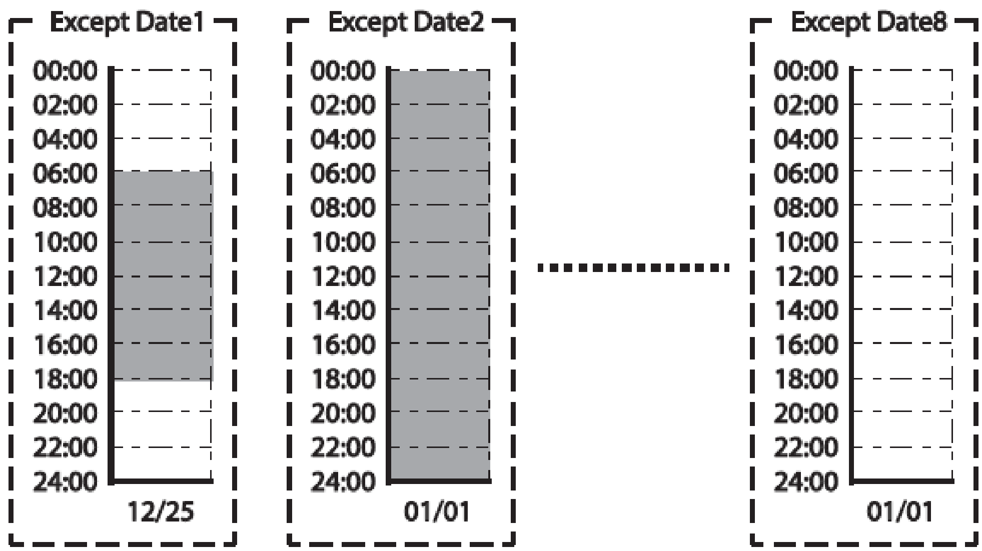
There are 8 Exception date modules in the Time Event function. They are used to specify the operation on particular days (public holidays, etc.). The settings for the start time and the end time are the same as the settings for the modules and can be set for particular days.

The Exception dates can be set redundantly with the Time periods. If the Time Periods and the Exception Dates are set redundantly, the inverter operates on the Exception Dates set.

Title	Setting Range	Description
Except1–8 Start T	00: 00–24: 00	Hour: Minutes (by the minute)
Except1–8 Stop T	00: 00–24: 00	Hour: Minutes
Except1–8 Date	1/1–12/31	Select the particular date (between 1/1 and 12/31)

<table>
<tr><th>Time Period</th><th colspan="4">Schedule</th></tr>
<tr><td rowspan="6">Exception Date 1</td><td colspan="4">Every Sunday, Monday, Wednesday, Thursday, and Friday at 06: 00 (On) and 18: 00 (Off)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="5"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-30</td><td>Except1 StartT</td><td>06: 00</td></tr>
<tr><td>AP3-31</td><td>Except1 StopT</td><td>18: 00</td></tr>
<tr><td>AP3-32</td><td>Except1 Day</td><td>12/25</td></tr>
<tr><td rowspan="6">Exception Date 2</td><td colspan="4">Every Sunday and Saturday for 24 hours (On)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="5"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-33</td><td>Except2 StartT</td><td>00: 00</td></tr>
<tr><td>AP3-34</td><td>Except2 StopT</td><td>24: 00</td></tr>
<tr><td>AP3-35</td><td>Except2 Day</td><td>01/01</td></tr>
<tr><td rowspan="6">Exception Date 3</td><td colspan="4">Every Sunday, Thursday, Friday, and Saturday at 10: 00 (On) and 14: 00 (Off)</td></tr>
<tr><td colspan="3">Time Schedule</td><td rowspan="5"></td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-36</td><td>Except3 StartT</td><td>10: 00</td></tr>
<tr><td>AP3-37</td><td>Except3 StopT</td><td>14: 00</td></tr>
<tr><td>AP3-38</td><td>Except3 Day</td><td>01/01</td></tr>
</table>

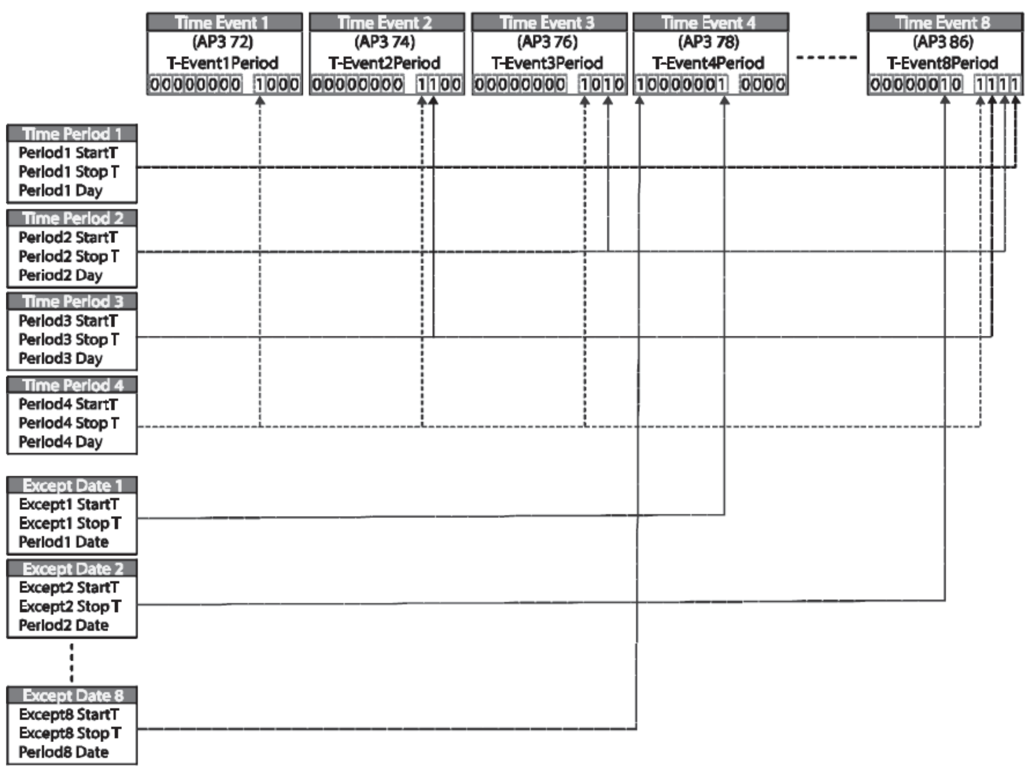
Title	Setting Range	Remarks
Except1–8 StartT	00: 00–24: 00	Hour: Minutes (by the minute)
Except1–8 Stop T	00: 00–24: 00	Hour: Minutes
Except1–8 Date	1/1–12/31	Select the particular date (between 1/1 and 12/31)



<The Time Chart for the Exception Day>

Connection settings for Time Period and Time Event

There are 8 Time event modules in the Time Event function. The parameters for T-Events 1–8 are used to set the connections to each module for the Time Period and the Exception Date. The parameters for T-Event 1–8 are used to specify the operation on particular days. Each Time event module can be set for the connections to 4 Time period modules and 8 Exception days. Time event modules are set as a bit unit in the parameters for Events 1–8. The diagram below shows the connections between the Time event modules and the time period modules. The Time Event 1 is connected to Time Period 4. The Time Event 8 is connected to Time Periods 1–4 and the Exception Dates 2.



Time Event Module Function Settings

The functions to be performed in the Time Event for T-Events 1–8 can be set with the 30 functions listed in AP3-73~AP3-87. There are 8 Time event modules in the Time Event. The parameters for T-Events 1–8 are used to set the connections to each module for the Time Period and the Exception Date. The parameters for T-Events 1–8 are used to specify the operation on particular days.

Example of the Time Event operations

If the Time events are set as the parameters below, the inverter operates as illustrated.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
DRV	06	Command Source	Cmd Ref Src	5: Time Event	0–9		-
	07	Frequency command source	Freq Ref Src	0: KeyPad	0–11		-
AP3	11	Time Period 1 Start time	Period1 StartT	10: 00	00: 00–24: 00		Min
	12	Time Period 1 End time	Period1 Stop T	20: 00	00: 00–24: 00		Min
	13	Time Period 1 Day of the week	Period1 Day	0110000	0000000–1111111		
	14	Time Period 2 Start time	Period2 StartT	12: 00	00: 00–24: 00		Min
	15	Time Period 2 End time	Period2 Stop T	17: 00	00: 00–24: 00		Min
	16	Time Period 2 Day of the week	Period2 Day	00100000	0000000–1111111		-
	70	Time Event configuration	Time Event En	1: YES	0	No	-
					1	Yes	
	72	Time Event 1 connection configuration	T-Event1Period	00000000000	000000000000–111111111111		
	73	Time Event 1 functions	T-Event1Define	1: Fx	0	None	
					1	Fx	
					2	Rx	
					3	Speed-L	
					4	Speed-M	
					5	Speed-H	
					7	Xcel-L	
					8	Xcel-M	
					9	Xcel-H	
					10	Xcel Stop	
					11	Run Enable	
					12	2nd Source	
					13	Exchange	
					14	Analog Hold	

					15	I-Term Clear	
					16	PID Openloop	
					17	PID Gain 2	
					18	PID Ref Change	
					19	2nd Motor	
					20	Timer In	
					21	dis Aux Ref	
					24	Pre Heat	
					27	Sleep Wake Chg	
					28	PID Step Ref L	
					29	PID Step Ref M	
					30	PID Step Ref H	
	74	Time Event 2 connection	T-Event2Period	00000000000	000000000000–111111111111		
	75	Time Event 2 functions	T-Event2Define	Same as AP3-73. See pg.272	0: None		
	76	Time Event 3 connection	T-Event3 Period	00000000000	0: None		
	77	Time Event 3 functions	T-Event3 Define	See AP3-73	0: None		
	78	Time Event 4 connection	T-Event4 Period	00000000000	0: None		
	79	Time Event 4 functions	T-Event4 Define	See AP3-73	0: None		
	80	Time Event 5 connection	T-Event5 Period	00000000000	0: None		
	81	Time Event 5 functions	T-Event5 Define	See AP3-73	0: None		
	82	Time Event 6 connection	T-Event6 Period	00000000000	0: None		
	83	Time Event 6 functions	T-Event6 Define	See AP3-73	0: None		
	84	Time Event 7 connection	T-Event7 Period	00000000000	0: None		
	85	Time Event 7 functions	T-Event7 Define	See AP3-73	0: None		
	86	Time Event 8 connection	T-Event8 Period	00000000000	0: None		
	87	Time Event 8 functions	T-Event8 Define	See AP3-73	0: None		

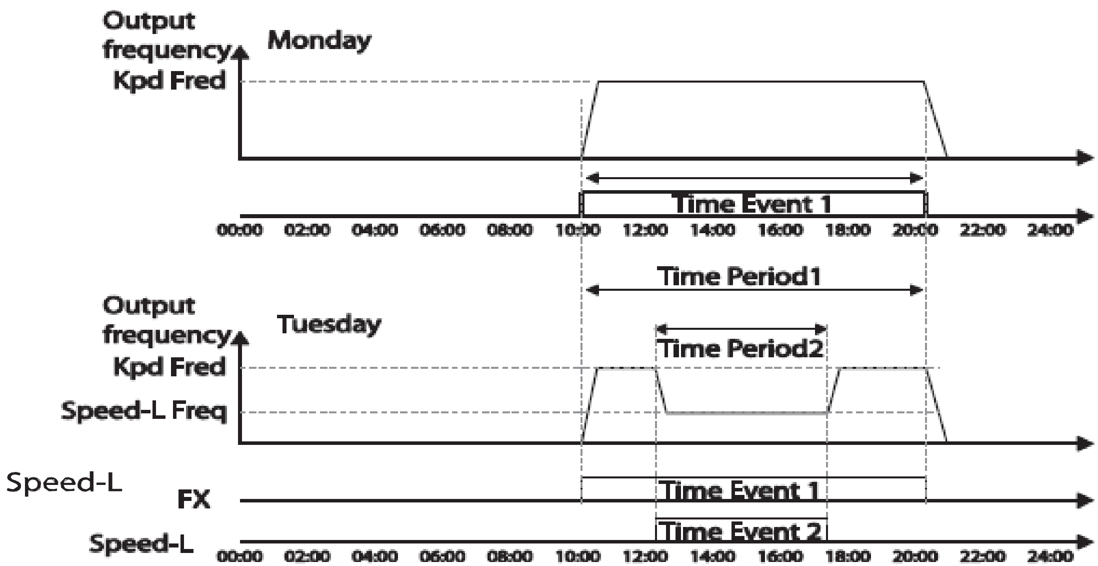
The parameters in the table above show the frequency command sources for the keypad and the operation command sources for the Time Event.

The following is an example of an inverter operation utilizing the Time Period modules 1 and 2 with Time Events 1 and 2:

Time Period 1 is used to operate the inverter on Mondays and Tuesdays from 10AM to 8PM. Time Period 2 is used to operate the inverter on Tuesday from 12PM to 5PM.

Time Event 1 triggers forward operations based on the frequency input on the keypad and continues the operation for the time set at Time Period module 1. Time Event 2 operates the inverter at Speed-L for the time set at Time Period module 2.

On Mondays, the inverter operates in the forward direction based on the frequency input on the keypad from 10AM to 8PM (Time Event 1). On Tuesdays, it operates again in the forward direction based on the keypad frequency input from 10AM to 12PM (Time Event 1), and then operates at Speed-L from 12PM to 5PM (Time Event 2). When the operation assigned by Time Event 2 is complete, the inverter resumes its Time Event 1 operation (the inverter operates based on the keypad frequency input from 5PM to 8PM).



<An example of Time Event>

Note
When repetitive frequency commands related to the frequency input command occur while the Time Event function is performing, Time Event performs its function in the order of the frequency command sources set in Freq Ref Src for DRV-07 (followed by Jog operation and multi-step acc/dec).

Caution
If a fault occurs during a time event operation, the inverter stops the operation and stays in a trip state. When this happens, there are two options to resume the stopped operation:

- Set PRT-08 (RST Restart) to 'YES' to allow the inverter to automatically restart after the trip condition is reset.
- Refresh the setting at AP3-70 (Time Event En). Set AP3-70 to 'Yes' from 'No'. If one of the input terminals (IN-65–71 Px Define) is assigned to it, turn the switch off then turn it back on to resume the time event operation.

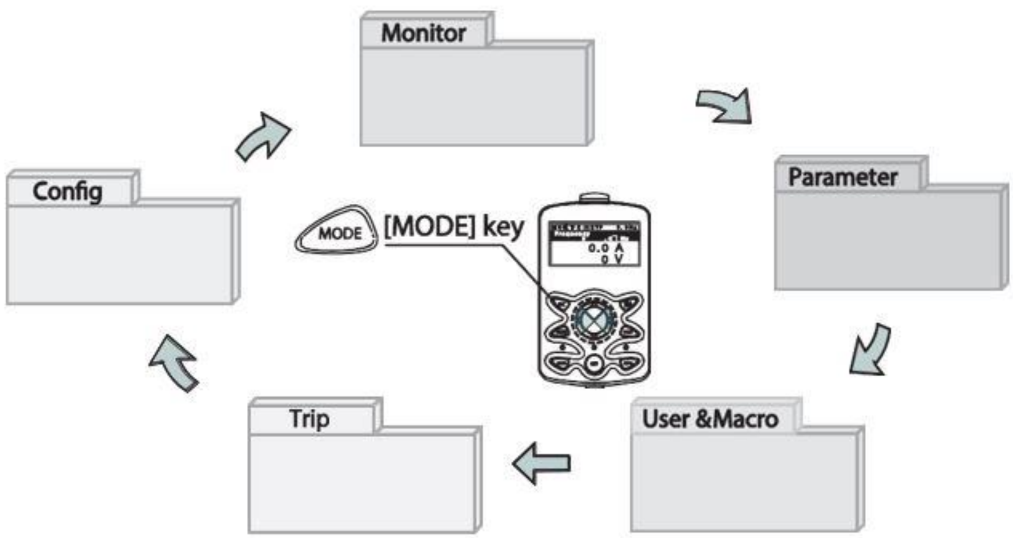
9 LCD Display Modes

9.1 LCD Display Mode Selection

The keypad enables movement among display modes and within each mode. It enables users to select, configure and view parameters and functions in each mode.

The following figure illustrates how to move through the display modes when you press the **MODE** button on the keypad. Continue to press the MODE button until you get to the desired mode.

User & Macro mode (U&M) is only displayed when a User Group has been created or a Macro group has been selected. Also, the **Trip mode** (TRP) is not displayed unless the inverter has an existing fault or a fault history.



Monitor Mode (MON) - Ref section *9.2*
Parameter Mode (PAR) - Ref section *9.3*
User & Macro Mode (U&M) - Ref section *9.4*
Trip Mode (TRP) - Ref section *9.5*
Configure Mode (CNF) - Ref section *9.6*

9.2 Monitor Mode (MON)

The inverter boots up in the Monitor Mode (MON). The inverter’s operating conditions can be monitored at the Monitor Mode display. A maximum of four items can be displayed.

Monitor Mode Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-20
AnyTime Para

CNF-21
Monitor Line-1

CNF-22
Monitor Line-2

CNF-23
Monitor Line-3</td><td>Select items to display in the Monitor Mode display. Monitor mode is the first displayed mode when the inverter is powered on. A total of four items can be displayed simultaneously. These include the AnyTime parameter (upper right corner of LCD) and Monitor Lines -1, -2 and -3. Parameters CNF-20~23 all share the same setting options as listed in the table below.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Frequency</td><td>During stop, displays the set frequency. During operation, displays the actual output frequency (Hz).</td></tr>
<tr><td>1</td><td>Speed</td><td>During stop, displays the set speed (rpm). During operation, displays the actual operating speed (rpm).</td></tr>
<tr><td>2</td><td>Output Current</td><td>Displays output current.</td></tr>
<tr><td>3</td><td>Output Voltage</td><td>Displays output voltage.</td></tr>
<tr><td>4</td><td>Output Power</td><td>Displays output power.</td></tr>
<tr><td>5</td><td>WHour Counter</td><td>Displays inverter power consumption.</td></tr>
<tr><td>6</td><td>DCLink Voltage</td><td>Displays DC bus voltage within the inverter.</td></tr>
<tr><td>7</td><td>DI Status</td><td>Displays input terminal status of the terminal block. Starting from the right, displays P7-P1.</td></tr>
<tr><td>8</td><td>DO Status</td><td>Displays output terminal status of the terminal block. Starting from the right,
Q1, Relay5 <- Relay1.</td></tr>
<tr><td>9</td><td>V1 Monitor[V]</td><td>Displays the input voltage value at terminal V1 (V).</td></tr>
<tr><td>10</td><td>V1 Monitor[%]</td><td>Displays input voltage terminal V1 value as a percentage.
If -10V, 0V, +10V is measured,
-100%, 0%, 100% will be displayed.</td></tr>
<tr><td>13</td><td>V2 Monitor[V]</td><td>Displays input voltage terminal V2 value (V).</td></tr>
<tr><td>14</td><td>V2 Monitor[%]</td><td>Displays input voltage terminal V2 value as a percentage.</td></tr>
<tr><td>15</td><td>I2 Monitor [mA]</td><td>Displays input current terminal I2 value (A).</td></tr>
<tr><td>16</td><td>I2 Monitor[%]</td><td>Displays input current terminal I2 value as a percentage.</td></tr>
<tr><td>17</td><td>PID Output</td><td>Displays output of PID controller.</td></tr>
<tr><td>18</td><td>PID Ref Value</td><td>Displays reference value of PID controller.</td></tr>
<tr><td>19</td><td>PID Fdb Value</td><td>Displays feedback value of PID controller.</td></tr>
<tr><td>20</td><td>Now Date</td><td>Displays the set Date (AP3-01).</td></tr>
<tr><td>21</td><td>Now Time</td><td>Displays the set Time (AP3-02).</td></tr>
<tr><td>22</td><td>Now Weekday</td><td>Displays the set day (AP3-03).</td></tr>
</table></td></tr>
<tr><td>CNF-24
Mon Mode Init</td><td>Selecting 1(Yes) initializes CNF-20-23.</td></tr>
</table>

Inverter power consumption
Values are calculated using voltage and current. Power is calculated every second and the results are accumulated. Setting CNF-62 (WH Count Reset) value to 1(Yes) will reset cumulated energy consumption. Power consumption is displayed as shown below:
Less than 1,000 kW: Units are in kW, displayed in 999.9 kW format.
1–99 MW: Units are in MW, displayed in 99.99 MWh format.
100–999 MW: Units are in MW, displayed in 999.9 MWh format.
More than 1,000 MW: Units are in MW, displayed in 9,999 MWh format and can be displayed up to 65,535 MW. (Values exceeding 65,535MW will reset the value to 0, and units will return to kW. It will be displayed in 999.9 kW format).

9.3 Parameter Mode (PAR)

The PAR Mode includes all the inverter parameter groups. Refer to section *4.2 Parameter Lists on page 82* for all groups included in the Parameter Mode.

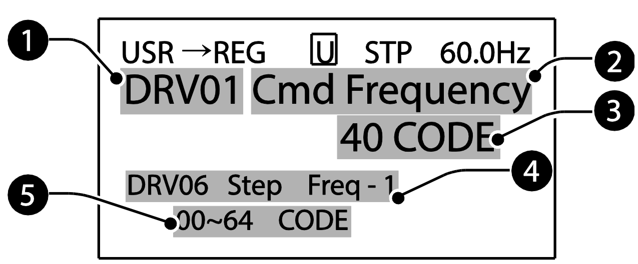
9.4 User & Macro Mode (U&M)

Create a unique list of most often used parameters (USR Group). Register user-selected parameters from the existing parameter groups.

9.4.1 User Group Setting Details

When completed, use the MODE button to move to the U&M Mode and access the USR Group parameters.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-42
Multi-Key Sel</td><td>At CNF-42, Select 1 (UserGrp SelKey) from the multi-function key setting options. When parameters are selected and registered in the USR group, the U&M Mode will appear and display user group (USR Grp) item on the LCD Keypad.

Follow the procedures below to register parameters to a user group.
<table>
<tr><th>No</th><th>Procedure</th></tr>
<tr><td>1</td><td>Set CNF-42 to 1 (UserGrp SelKey). A U icon will be displayed at the top of the LCD display.</td></tr>
<tr><td>2</td><td>In the parameter mode (PAR Mode), move to the parameter you need to register and press the [MULTI] key. For example, if the [MULTI] key is pressed in the frequency reference in DRV 01 (Cmd Frequency), the screen below will be displayed.


❶ Group name and parameter number of the parameter
❷ Name of the parameter</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>❸ Parameter number to be used in the user group. Pressing the [PROG/ENT] button on the parameter number (40 Parameter) will register DRV-01 as parameter 40 in the user group.
❹ Existing parameter registered as the user group parameter 40
❺ Setting range of the user group parameter. Entering 0 cancels the settings.</td></tr>
<tr><td>3</td><td>Set a parameter number (❸) to use to register the parameter in the user group. Select parameter number and press [PROG/ENT]button.</td></tr>
<tr><td>4</td><td>Changing the value in ❸ will also change the value in ❹. If no parameter is registered, ‘Empty Code’ will be displayed. Entering 0 cancels the settings.</td></tr>
<tr><td>5</td><td>The registered parameters are listed in the user group in U&M mode. You can register one parameter multiple times if necessary. For example, a parameter can be registered as parameter 2, parameter 11, and more in the user group.</td></tr>
</table>
Follow the procedures below to delete individual parameters from the user group.
<table>
<tr><th>No.</th><th>Settings</th></tr>
<tr><td>1</td><td>Set CNF- 42 to ‘1’ (UserGrp SelKey). A U icon will be displayed at the top of the LCD display.</td></tr>
<tr><td>2</td><td>In the USR group in U&M mode, move the cursor to the parameter that is to be deleted.</td></tr>
<tr><td>3</td><td>Press the [MULTI]button.</td></tr>
<tr><td>4</td><td>Move to YES on the deletion confirmation screen, and press the [PROG/ENT]button.</td></tr>
<tr><td>5</td><td>Deletion completed.</td></tr>
</table>
</td></tr>
<tr><td>CNF-45
UserGrp AllDel</td><td>Set to 1(Yes) to delete all registered parameters in the user group.</td></tr>
</table>

9.4.2 Macro Groups (MC1, MC2, MC3)

The Macro selection function pulls together various parameters into one group that are common to specific applications and load type. The H2 Series inverter includes 3 macros (Pump, Fan and Constant Torque). Groups MC1, MC2, or MC3 are displayed in the U&M Mode when the user selects the macro with parameter CNF-43. Parameters within each macro can be modified. Macro groups cannot be added by the user.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	43	Macro selection	Macro Select	0	Basic	0-3	-
				1	Pump		
				2	Fan		
				3	Constant Torque		

Accessing Macro Group - When a macro is selected at CNF-43 or during the Quick Start menu, press the Mode button to move to the U&M Mode that will now be displayed along with the MCx group of parameters. This MCx group will show all parameters in the specific macro group. The default settings within the MCx group are shown in the following tables and can be modified.

The parameters within each macro are tied to the same parameters in the various parameter groups. Changes made to macro group parameters are reflected in the other groups. Selecting '0 (Basic)' initializes all parameter changes to default settings.

9.4.2.1 MC1 - Pump Macro

The Pump Macro includes typical pump related parameter settings. Some of these are a ‘Squared’ V/Hz pattern for variable torque loads along with “S-Curve” acceleration and deceleration. A minimum frequency of 30 Hz. is set along with reverse run prevention. The PID group parameters are included but are not enabled. If enabled with MC1-43 (PID-01), the default control is normal PID and units are in PSI. The shaded settings are different from the standard inverter parameter settings.

MC1 ---> Pump						
Macro Group	Code	Related Parameter Code		Parameter Name	Setting	Value/Units
MC1	01	PRT	04	Load Duty	0	Normal
	02	DRV	03	Acc Time	20.0	sec
	03	DRV	04	Dec Time	30.0	sec
	04	DRV	06	Cmd Source	1	Fx/Rx-1
	05	DRV	07	Freq Ref Src	5	I2
	06	DRV	09	Control Mode	0	V/Hz.
	07	DRV	11	Jog Frequency	10.00	Hz
	08	DRV	12	Jog Acc Time	20.0	sec
	09	DRV	13	Jog Dec Time	30.0	sec
	10	DRV	15	Torque Boost	0	Manual
	11	DRV	16	Fwd Boost	2.0	%
	12	DRV	17	Rev Boost	2.0	%
	13	MOT	01	Motor Capacity	Defaults	
	14	MOT	02	Base Freq	60.00	Hz

MC1 ---> Pump						
	15	MOT	03	Pole Number	4	Pole
	16	MOT	04	Rated Slip	Defaults	
	17	MOT	05	Rated Curr	Defaults	
	18	MOT	06	NoloadCu rr	Defaults	
	19	BAS	07	V/F Pattern	1	Square
	20	BAS	69	Xcel Change Fr	0.00	Hz
	21	BAS	70	Acc Time-1	20.0	sec
	22	BAS	71	Dec Time-1	20.0	sec
	23	ADV	01	Acc Pattern	1	S-Curve
	24	ADV	02	Dec Pattern	1	S-Curve
	25	ADV	03	Acc S Start	40	%
	26	ADV	04	Acc S End	40	%
	27	ADV	05	Dec S Start	40	%
	28	ADV	06	Dec S End	40	%
	29	ADV	07	Start Mode	0	Accel
	30	ADV	08	Stop Mode	0	Decel
	31	ADV	09	Run Prevent	2	Reverse
	32	ADV	24	Freq Limit	1	Yes
	33	ADV	25	Freq Limit Lo	30.0	Hz
	34	ADV	26	Freq Limit Hi	60.0	Hz
	35	ADV	50	E-Save Mode	2	Auto
	36	ADV	51	Energy Save	20	%
	37	ADV	52	E-Save Det T	10	sec
	38	ADV	64	Fan Control	2	Temperature
	39	IN	65	P1 Define	1	Fx
	40	OUT	31	Relay 1	23	Trip
	41	OUT	32	Relay 2	14	Run
	42	OUT	33	Relay 3	0	None
	43	PID	01	PID Sel	0	No
	44	PID	03	PID Output	Monitor	%
	45	PID	04	PID Ref Value	Monitor	PSI
	46	PID	05	PID Fdb Value	Monitor	PSI
	47	PID	10	PID Ref 1 Src	0	Keypad
	48	PID	11	PID Ref 1 Set	50.00	PSI
	49	PID	20	PIDFdb Source	0	V1
	50	PID	25	PID P-Gain 1	50.00	%
	51	PID	26	PID I-Time 1	10.0	sec
	52	PID	30	PID Limit Hi	100.00	%
	53	PID	31	PID Limit Lo	0.00	%
	54	PID	36	PID Out Inv	0	No
	55	PID	50	PID Unit Sel	2	PSI
	56	PID	51	PID Unit Scale	2	x 1
	57	AP1	20	Soft Fill Sel	0	No
	58	AP1	21	Pre-PID Freq	30.00	Hz
	59	AP1	22	Pre-PID Delay	60.0	sec
	60	PRT	12	Lost Cmd Mode	1	Free-Run
	61	PRT	13	Lost Cmd Time	1.0	sec

MC1 ---> Pump						
	62	PRT	14	Lost Preset F	0.00	Hz
	63	PRT	15	AI Lost Level	0	Half of x1
	64	PRT	20	OL Trip Select	1	Free-Run
	65	PRT	21	OL Trip Level	120	%
	66	PRT	22	OL Trip Time	60.0	sec
	67	PRT	31	No Motor Trip	1	Free-Run
	68	PRT	32	No Motor Level	5	%
	69	PRT	33	No Motor Time	3.0	sec
	70	PRT	40	ETH Trip Sel	1	Free-Run
	71	PRT	41	Motor Cooling	0	Self-cool
	72	PRT	42	ETH 1 min	115	%
	73	PRT	43	ETH Cont	100	%
	74	PRT	60	PipeBroken Sel	2	Free-Run
	75	PRT	61	PipeBroken Lev	90.0	%
	76	PRT	62	PipeBroken DT	10.0	sec

9.4.2.2 MC2 Fan Macro

The Fan Macro includes typical fan related parameter settings. Some of these are a ‘Squared’ V/Hz pattern for variable torque loads along with “S-Curve” acceleration and deceleration. A minimal DC Start is set along with reverse run prevention. The shaded settings are different from the standard inverter parameter settings.

MC2 ---> Fan						
Macro Group	Code	Related Parameter Code		Parameter Name	Setting	Value/Units
MC2	01	PRT	04	Load Duty	0	Normal
	02	DRV	03	Acc Time	20.0	sec
	03	DRV	04	Dec Time	30.0	sec
	04	DRV	06	Cmd Source	1	Fx/Rx-1
	05	DRV	07	Freq Ref Src	5	I2
	06	DRV	09	Control Mode	0	V/Hz.
	07	DRV	15	Torque Boost	0	Manual
	08	DRV	16	Fwd Boost	2.0	%
	09	DRV	17	Rev Boost	2.0	%
	10	MOT	01	Motor Capacity	Defaults	
	11	MOT	02	Base Freq	60.00	Hz
	12	MOT	03	Pole Number	4	Pole
	13	MOT	04	Rated Slip	Defaults	
	14	MOT	05	Rated Curr	Defaults	
	15	MOT	06	NoloadCu rr	Defaults	
	16	BAS	07	V/F Pattern	1	Square
	17	ADV	01	Acc Pattern	1	S-Curve
	18	ADV	02	Dec Pattern	1	S-Curve
	19	ADV	03	Acc S Start	40	%

MC2 ---> Fan						
	20	ADV	04	Acc S End	40	%
	21	ADV	05	Dec S Start	40	%
	22	ADV	06	Dec S End	40	%
	23	ADV	07	Start Mode	1	DC-Start
	24	ADV	08	Stop Mode	0	Dec
	25	ADV	09	Run Prevent	2	Reverse
	26	ADV	12	DC-Start Time	3.00	sec
	27	ADV	13	DC Inj Level	25	%
	28	ADV	24	Freq Limit	0	No
	29	ADV	25	Freq Limit Lo	0.50	Hz
	30	ADV	26	Freq Limit Hi	60.0	Hz
	31	ADV	50	E-Save Mode	0	None
	32	ADV	51	Energy Save	0	%
	33	ADV	52	E-Save Det T	20.0	sec
	34	ADV	64	Fan Control	2	Temperature
	35	IN	65	P1 Define	1	Fx
	36	OUT	31	Relay 1	23	Trip
	37	OUT	32	Relay 2	14	Run
	38	OUT	33	Relay 3	0	None
	39	PRT	12	Lost Cmd Mode	1	Free-Run
	40	PRT	13	Lost Cmd Time	1.0	sec
	41	PRT	14	Lost Preset F	0.00	Hz
	42	PRT	15	AI Lost Level	0	Half of x1
	43	PRT	20	OL Trip Select	1	Free-Run
	44	PRT	21	OL Trip Level	120	%
	45	PRT	22	OL Trip Time	60.0	sec
	46	PRT	31	No Motor Trip	1	Free-Run
	47	PRT	32	No Motor Level	5	%
	48	PRT	33	No Motor Time	3.0	sec
	49	PRT	40	ETH Trip Sel	1	Free-Run
	50	PRT	41	Motor Cooling	0	Self-cool
	51	PRT	42	ETH 1 min	115	%
	52	PRT	43	ETH Cont	100	%

9.4.2.3 MC3 Constant Torque Macro

The constant torque macro sets the V/Hz curve (MC3-16) to Linear for constant torque loads along with an overload setting (MC3-36) of 150% / 1 min. It also sets Load Duty parameter MC3-01 (PRT-04) to Heavy Load. Note that this will change motor group (MOT) parameters to one setting lower than the inverter rating. Ex: if a 100 HP inverter is used, MOT-01, Motor Capacity will be set to 75 HP. An Auto Torque Boost (MC3-07) is also set. All other parameters are at default settings. The shaded settings are different from the standard inverter parameter settings.

MC3 ---> Constant Torque						
Macro Group	Code	Related Parameter Code		Parameter Name	Setting	Value/Units
MC3	01	PRT	04	Load Duty	1	Heavy
	02	DRV	03	Acc Time	20.0	sec
	03	DRV	04	Dec Time	30.0	sec
	04	DRV	06	Cmd Source	1	Fx/Rx-1
	05	DRV	07	Freq Ref Src	0	Keypad
	06	DRV	09	Control Mode	0	V/Hz.
	07	DRV	15	Torque Boost	2	Auto-2
	08	DRV	16	Fwd Boost	2.0	%
	09	DRV	17	Rev Boost	2.0	%
	10	MOT	01	Motor Capacity	Defaults	
	11	MOT	02	Base Freq	60.00	Hz
	12	MOT	03	Pole Number	4	Pole
	13	MOT	04	Rated Slip	Defaults	
	14	MOT	05	Rated Curr	Defaults	
	15	MOT	06	NoloadCu rr	Defaults	
	16	BAS	07	V/F Pattern	0	Linear
	17	ADV	01	Acc Pattern	0	Linear
	18	ADV	02	Dec Pattern	0	Linear
	19	ADV	07	Start Mode	0	Accel
	20	ADV	08	Stop Mode	0	Decel
	21	ADV	09	Run Prevent	0	None
	22	ADV	24	Freq Limit	0	No
	23	ADV	25	Freq Limit Lo	0.50	Hz
	24	ADV	26	Freq Limit Hi	60.0	Hz
	25	ADV	64	Fan Control	0	During Run
	26	IN	65	P1 Define	1	Fx
	27	IN	66	P2 Define	2	Rx
	28	OUT	31	Relay 1	23	Trip
	29	OUT	32	Relay 2	14	Run
	30	OUT	33	Relay 3	0	None
	31	PRT	12	Lost Cmd Mode	0	None
	32	PRT	13	Lost Cmd Time	1.0	sec
	33	PRT	14	Lost Preset F	0.00	Hz
	34	PRT	15	AI Lost Level	0	Half of x1
	35	PRT	20	OL Trip Select	1	Free-Run

MC3 ---> Constant Torque						
	36	PRT	21	OL Trip Level	150	%
	37	PRT	22	OL Trip Time	60.0	sec
	38	PRT	31	No Motor Trip	1	Free-Run
	39	PRT	32	No Motor Level	5	%
	40	PRT	33	No Motor Time	3.0	sec
	41	PRT	40	ETH Trip Sel	1	Free-Run
	42	PRT	41	Motor Cooling	0	Self-cool
	43	PRT	42	ETH 1 min	115	%
	44	PRT	43	ETH Cont	100	%

9.5 Trip Mode (TRP)

If the inverter trips, it immediately displays the fault in the TRP Mode. The “OFF” button on the LCD keypad will be flashing.

- Use the down arrow button to view the inverter data at the time of the fault.
- Faults can be reset by pressing the “OFF” button or from an external reset.
- Use the MODE button to move out of the TRP Mode to other display Modes.
- **Trip mode** (TRP) is not displayed unless the inverter has an existing fault or a fault history.

The inverter stores last 5 Faults. Last-1 is most recent.

Use Down Arrow button to view Fault data (TRP Codes 01 ~ 10). See table below.
Use Right Arrow button to move through the faults (1 -> 5).
Use Left Arrow button to move through the faults (5 -> 1).

Code	Name	LCD Display	Setting Range		Initial Value
00	Trip type display	Trip Name(x)	-		-
01	Frequency reference at trip	Output Freq	-		-
02	Output current at trip	Output Current	-		-
03	Acceleration/ Deceleration state at trip	Inverter State	-		-
04	DC section state	DCLink Voltage	-		-
05	NTC temperature	Temperature	-		-
06	Input terminal state	DI State	-		0000 0000
07	Output terminal state	DO State	-		00 0000
8[1]	Trip time after Power on	Trip On Time	-		00/00/00 00: 00
9[1]	Trip time after operation start	Trip Run Time	-		00/00/00 00: 00
10	Delete Fault History	Trip Delete?	0	No	
		Yes? Or No?	1	Yes	

[1] Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00:00)] format.

CNF-44	Clear Fault History	Erase All Trip	0	No	
			1	Yes	

CNF-44 can be used to clear the Fault History.

9.5.1 Fault and Warning List

The following is a list of faults and warnings that can occur while using the H2 inverter. For details, refer to *11, Troubleshooting on page 341*.

Category		LCD Display	Details
Major fault	Latch type	Over Current1	Over current trip
		Over Voltage	Over voltage trip
		External Trip	External signal, trip at digital input
		NTC Open	Temperature sensor fault
		Over Current2	ARM short current fault
		Option Trip-x*	Option fault*
		Over Heat	Over heat fault
		Out Phase Open	Output open-phase fault
		In Phase Open	Input open-phase fault
		Ground Trip	Ground fault
		Fan Trip	Fan fault
		E-Thermal	Motor overheat fault
		TB Trip	Terminal Board Connection fault
		IO Board Trip	IO Board connection fault
		No Motor Trip	No motor fault
		Low Voltage2	Low voltage fault during operation
		ParaWrite Trip	Write parameter fault
		Pipe Broken	Pipe Break fault
		Damper Err	Damper Err trip
		Over Load	Motor overload fault
		Under Load	Motor under load fault
		PC Repeat Err	Pump clean repeat fault
		Level Detect	Level detect trip
		Inverter OLT	Inverter overheating trip
		Thermal Trip	Motor overheating trip
		Lost Keypad	Lost keypad trip
		Broken Belt	Broken belt trip
		Pipe Broken	Pipe Broken trip
		Ext Brake	External brake fault
		Fuse Open	Fuse Open trip (315~500kW)
		InFAN Trip	Inner Fan trip (110~500kW)
	Level type	Low Voltage	Low voltage fault
		BX	Emergency stop fault
		Lost Command	Command loss trip
		Lost Keypad	Lost keypad trip
	Hardware damage (Fatal)	EEP Err	External memory error
		ADC Off Set	Analog input error
		Watch Dog-1	CPU Watch Dog fault
		Watch Dog-2	

Warning	KPD H.O.A Lock	Buttons (HAND, OFF and AUTO) on LCD - locked out with DRV-05
	Lost Command	Command loss fault warning
	Over Load	Overload warning
	Under Load	Under load warning
	Inv Over Load	Inverter overload warning
	Fan Warning	Fan operation warning
	DB Warn %ED	Braking resistor braking rate warning
	Low Battery	Low battery warning
	Check Line Plz	Connection or communication issue between the LCD and the Control PCB.
	Fire Mode	Fire mode warning
	Pipe Broken	Pipe Break warning
	Level Detect	Level detect warning
	Lost Keypad	Lost keypad warning
	Load Tune	Load curve tuning warning
	Broken Belt	Broken belt warning
	ParaWrite Fail	Smart copier error warning
	Rs Tune Err	Auto tuning warning(Rs)
	Lsig Tune Err	Auto tuning warning(Lsigma)
	InFAN Warning	Inner Fan Warning 150~800HP (110~500kW)

Note

- Latch type fault: The inverter requires a manual reset.
- Level type fault: The inverter will clear the fault when the condition is corrected or initialized.
- Fatal type fault: There is no way to reset the fault other than cycling power to the inverter.

9.6 Configure Mode (CNF)

The configure mode includes parameters to view and program various inverter features including:

- View inverter and keypad software versions
- Set 4 parameters to view in the Monitor menu
- Initialize parameter settings
- Assign MULTI button function
- Assign User Group parameters
- Select macro
- Read, Write and Save parameters
- Set time and date

9.6.1 Configure Mode Parameter List

Code	Name	LCD Display	Setting Range		Initial Value		Ref.
00	Jump code	Jump Code	1–99		42		p.74
01	Keypad language selection	Language Sel	0	English	0	English	-
02	LCD contrast adjustment	LCD Contrast	Adjust LCD contrast		-		-
10	Inverter S/W version	Inv S/W Ver	201.00		-		-
11	Keypad S/W version	Keypad S/W Ver	201.01		-		-
12	Keypad title version	KPD Title Ver	3.01		-		-
20	Display item	Anytime Para	0	Frequency	0	Frequency	p.280
21	Monitor mode display 1	Monitor Line-1	1	Speed	0	Frequency	p.280
22	Monitor mode display 2	Monitor Line-2	2	Output Current	2	OutputCurrent	p.280
23	Monitor mode display 3	Monitor Line-3	3	Output Voltage	3	OutputVoltage	p.280
			4	Output Power			
			5	Whour Counter			
			6	DCLink Voltage			
			7	DI Status			
			8	DO Staus			
			9	V1 Monitor(V)			
			10	V1 Monitor(%)			
			13	V2 Monitor(V)			
			14	V2 Monitor(%)			
			15	I2 Monitor(mA)			
			16	I2 Monitor(%)			
			17	PID Output			
			18	PID Ref Value			
			19	PID Fdb Value			
			20	Now Date			
			21	Now Time			
			22	Now Weekday			
24	Monitor mode initialize	Mon Mode Init	0	No	0	No	p.280
			1	Yes			
30	Option slot 1 type display	Option-1 Type	0	None	0	None	-
			5	LonWorks			
31	Option slot 2 type display	Not Used	-		-		-
32	Option slot 3 type display	Not Used	-		-		-
40	Parameter initialization	Parameter Init	0	No	0	No	p.293
			1	All Grp			
			2	DRV Grp			
			3	BAS Grp			
			4	ADV Grp			
			5	CON Grp			
			6	IN Grp			
			7	OUT Grp			
			8	COM Grp			
			9	PID Grp			
			10	AP1 Grp			
			11	AP2 Grp			
			12	AP3 Grp			

Code	Name	LCD Display	Setting Range		Initial Value		Ref.
			13	PRT Grp			
			14	APO Grp			
41	Display changed Parameter	Changed Para	0	View All	0	View All	p.294
			1	View Changed			
42	Multi key item	Multi-Key Sel	0	None	0	None	p.294
			1	UserGrp SelKey			
			2	Now Time			
43	Macro function item	Macro Select	0	Basic	0	Basic	p.294
			1	Pump			
			2	Fan			
			3	Constant Torque			
44	Trip history deletion	Erase All Trip	0	No	0	No	p.295
			1	Yes			
45	User registration code deletion	UserGrp AllDel	0	No	0	No	p.281
			1	Yes			
46	Read parameters	Parameter Read	0	No	0	No	p.295
			1	Yes			
47	Write parameters	Parameter Write	0	No	0	No	p.295
			1	Yes			
48	Save parameters	Parameter Save	0	No	0	No	p.295
			1	Yes			
50	Hide parameter mode	View Lock Set	0-9999			Unlocked	p.296
51	Password protection (hide parameters)	View Lock Pw	0-9999			Password	p.296
52	Lock parameter edit	Key Lock Set	0–9999			Unlocked	p.296
53	Password for locking parameter edit	Key Lock Pw	0–9999			Password	p.296
60	Additional title update	Add Title Up	Not Used				-
61	Simple/Basic parameter setting enabled on Power Up	Run QuickStart	0	No	1	Yes	p.297
			1	Yes			
62	Power consumption initialization	WHCount Reset	Not Used				
70	Accumulated inverter motion time	On-time	00000DAY 00:00		-		p.297
71	Accumulated inverter operation time	Run-time	00000DAY 00:00		-		p.297
72	Accumulated inverter operation time initialization	Time Reset	0	No	0	No	p.297
			1	Yes			
73[1]	Real Time	Real Time	Date-Format		View[1]		
74	Accumulated cooling fan operation time	Fan Time	00000DAY 00:00		-		p.297
75	Reset of accumulated cooling fan operation time	Fan Time Rst	0	No	0	No	p.297
			1	Yes			

[1] The date format can be changed according to the AP3-06 settings.

9.6.2 CNF-20 Monitor Mode (MON)

On the LCD keypad, the inverter's operating conditions can be monitored at the Monitor Mode display. A maximum of four items can be selected and monitored simultaneously. The items are selected in the Configure (CNF) Group. Monitoring mode displays three different items (CNF-21, 22 and 23) and one additional item (CNF-20) in the status bar at the top of the screen. Refer to section 9.2 Monitor Mode (MON) on page 280 for details on configuring Monitor Mode items.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	20	Display item condition display window	Anytime Para	0	Frequency	-	-
	21	Monitor mode display 1	Monitor Line-1	0	Frequency	-	Hz
	22	Monitor mode display 2	Monitor Line-2	2	Output Current	-	A
	23	Monitor mode display 3	Monitor Line-3	3	Output Voltage	-	V
	24	Monitor mode initialize	Mon Mode Init	0	No	-	-

9.6.3 CNF-40 Parameter Initialization

The parameters changed by the user can be initialized to the factory default settings. Initialize parameters in all groups by selecting 1 (All Grp) or select specific groups . The parameters cannot be initialized if the inverter is operating or during a fault condition.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	40	Parameter initialization	Parameter Init	0	No	0-14	

Parameter Initialization Setting Details

Code	Setting		LCD Display	Function
CNF-40 Parameter Init	0	No	No	-
	1	Initialize all groups	All Grp	Initialize all data. Select 1(All Grp) and press [PROG/ENT] button to start initialization. On completion, 0 (No) will be displayed.
	2	Initialize DRV group	DRV Grp	Initialize data by groups. Select initialize group and press [PROG/ENT] button to start initialization. On completion, 0 (No) will be displayed.
	3	Initialize BAS group	BAS Grp	
	4	Initialize ADV group	ADV Grp	
	5	Initialize CON group	CON Grp	
	6	Initialize IN group	IN Grp	
	7	Initialize OUT group	OUT Grp	
	8	Initialize COM group	COM Grp	
	9	Initialize PID group	PID Grp	
	10	Initialize AP1 group	AP1 Grp	
	11	Initialize AP2 group	AP2 Grp	
	12	Initialize AP3 group	AP3 Grp	
	13	Initialize PRT group	PRT Grp	
	14	Initialize APO group	APO Grp	

9.6.4 CNF-41 Changed Parameter Display

This feature displays all the parameters that are different from the factory defaults. Use this feature to track changed parameters.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	41	Changed parameter display	Changed Para	0	View All	-	-

Changed Parameter Display Setting Details

<table>
<tr><th>Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="3">CNF-41
Changed Para</td><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>View All</td><td>Display all parameters</td></tr>
<tr><td>1</td><td>View Changed</td><td>Display changed parameters only</td></tr>
</table>

9.6.5 CNF-42 User & Macro Mode (U&M)

Create a unique list of most often used parameters (USR Group). Register user-selected parameters from the existing parameter groups. The user group can carry up to a maximum of 64 parameter registrations. Refer to section *9.4 User & Macro Mode (U&M) on page 281* for User Group setting details.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	42	Multi-function button settings	Multi Key Sel	1	UserGrp SelKey	-	-
	45	Delete all user registered parameters	UserGrp AllDel	0	No	-	-

9.6.6 CNF-43 Macro Selection

The H2 Series inverter includes 3 macro groups of parameters (Pump, Fan and Constant Torque). A Macro group contains various parameters in one group that are common to specific applications. Refer to *9.4.2 Macro Groups (MC1, MC2, MC3) on page 283* for more details.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th>Setting Range</th><th>Unit</th></tr>
<tr><td rowspan="4">CNF</td><td rowspan="4">43</td><td rowspan="4">Macro selection</td><td rowspan="4">Macro Select</td><td>0</td><td>Basic</td><td rowspan="4">0-3</td><td rowspan="4">-</td></tr>
<tr><td>1</td><td>Pump</td></tr>
<tr><td>2</td><td>Fan</td></tr>
<tr><td>3</td><td>Constant Torque</td></tr>
</table>

9.6.7 CNF-44 Delete Trip History

The fault history can be deleted by programming CNF-44 to '1, Yes'. Refer to *9.5 Trip Mode (TRP) on page 288* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	44	Trip History deletion	Erase All Tript	0	No	0-1	-
				1	Yes		

9.6.8 CNF-46 Read, Write, and Save Parameters

Use read, write and save function parameters of the inverter to copy parameters from the inverter to the LCD keypad or from the LCD keypad to the inverter.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	46	Parameter read	Parameter Read	1	Yes	-	-
	47	Parameter write	Parameter Write	1	Yes	-	-
	48	Parameter save	Parameter Save	1	Yes	-	-

Read, Write, and Save Parameter Setting Details

Code	Description
CNF-46 Parameter Read	Copies saved parameters from the inverter to the LCD keypad. Saved parameters already on the LCD keypad will be deleted and replaced with copied parameters.
CNF-47 Parameter Write	Copies saved parameters from the LCD keypad to the inverter. Saved parameters on the inverter will be deleted and replaced with copied parameters. If an error occurs during parameter writing, previous saved data will be used. If there is no saved data on the LCD Keypad, 'EEP Rom Empty' message will be displayed.
CNF-48 Parameter Save	Parameters changes are saved to RAM. The changed values will be lost if the power is cycled. Select 1 (Yes) at CNF-48 to save the changed parameters to inverter memory.

9.6.9 CNF-50 Parameter View Lock

Use parameter view lock to hide parameters after registering and entering a user password.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF	50	Parameter view lock	View Lock Set	Unlocked	0–9999	
	51	Parameter view lock password	View Lock Pw	Password	0–9999	

Parameter View Lock Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-51
View Lock Pw</td><td>Register a password to be used with CNF-50. Follow the steps below to register a password.
<table>
<tr><th>No</th><th>Procedure</th></tr>
<tr><td>1</td><td>Pressing [PROG/ENT] button on CNF-51 will show the previous password input window. If registration is made for the first time, enter 0. It is the factory default.</td></tr>
<tr><td>2</td><td>If a password had been set, enter the saved password.</td></tr>
<tr><td>3</td><td>If the entered password matches the saved password, a new window prompting the user to enter a new password will be displayed (the process will not progress to the next stage until the user enters a valid password).</td></tr>
<tr><td>4</td><td>Register a new password.</td></tr>
<tr><td>5</td><td>After registration, parameter CNF-51 will be displayed.</td></tr>
</table></td></tr>
<tr><td>CNF-50
View Lock Set</td><td>To enable parameter view lock, enter a registered password. [Locked] sign will be displayed on the screen to indicate that parameter view lock is enabled. To disable parameter view lock, re-enter the password. The [locked] sign will disappear.</td></tr>
</table>

9.6.10 CNF-52 Parameter Lock

Use parameter lock to prevent unauthorized changes to parameter settings. To enable parameter lock, register a user password first in CNF-53. To lock and unlock parameter changes, enter the password in CNF-52.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF	52	Parameter lock	Key Lock Set	Unlocked	0-9999	-
	53	Parameter lock password	Key Lock PW	Password	0-9999	-

Parameter Lock Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-53
Key Lock Pw</td><td>Register a password to prohibit parameter modifications. Follow the procedures below to register a password.
<table>
<tr><th>No</th><th>Procedures</th></tr>
<tr><td>1</td><td>Press the [PROG/ENT] button on CNF-53 parameter and the saved password input window will be displayed. If password registration is being made for the first time, enter 0. It is the factory default.</td></tr>
<tr><td>2</td><td>If a saved password has been set, enter the saved password.</td></tr>
<tr><td>3</td><td>If the entered password matches the saved password, then a new window to enter a new password will be displayed. (The process will not move to next stage until the user enters a valid password).</td></tr>
<tr><td>4</td><td>Register a new password.</td></tr>
<tr><td>5</td><td>After registration, Parameter CNF-53 will be displayed.</td></tr>
</table></td></tr>
<tr><td>CNF-52
Key Lock Set</td><td>To enable parameter lock, enter the registered password. [Locked] sign will be displayed on the screen to indicate that parameter lock is enabled. Once enabled, pressing the [PROG/ENT] button on function parameter CNF-52 will not allow the display edit mode to run. To enable parameter modification, re-enter the password. The [Locked] sign will disappear.</td></tr>
</table>

Caution

If parameter view lock and parameter lock functions are enabled, no inverter operation related function changes can be made. It is very important that you memorize the password.

9.6.11 CNF-61 Quick Start Menu

The inverter will display the Quick Start menu on every power up. Parameter CNF-61 (Run Quick Start?) is set to “Yes” by default. To disable the Quick Start menu at power up, set CNF-61 to “No”. Refer to section *2.6 Run Quick Start on page 52* for more details.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range
CNF	61	Quick Start menu setting	Run QuickStart?	0	No	0 - 1
				1	Yes	

9.6.12 CNF-70 Operation Time Monitor

Monitors inverter and fan operation time.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	70	Accumulated Inverter Power On time	On-time	0/00/00 00:00		-	min
	71	Accumulated inverter operation time	Run-time	0/00/00 00:00		-	min
	72	Initialize inverter operation accumulated time	Time Reset	0	No	0–1	-

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	74	Cooling fan operation accumulated time	Fan time	0/00/00 00:00		-	min
	75	Initialize Cooling fan operation time	Fan Time Reset	0	No	0–1	-

Operation Time Monitor Setting Details

Code	Description
CNF-70 On-time	Displays accumulated power supply time (On-time). Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-71 Run-time	Displays accumulated time (Run-time) of voltage output by run command input. Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-72 Time Reset	Setting 1(Yes) will delete power supply accumulated time (On-time) and operation accumulated time (Run-time) and is displayed as 0/00/00 00:00 format.
CNF-74 Fan time	Displays accumulated time of inverter cooling fan operation. Information will be displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-75 Fan Time Reset	Setting 1(Yes) will delete cooling fan operation accumulated time (Fan-time) and will display it in 0/00/00 00:00 format.

10 RS-485 Communication Features

This section explains how to control the inverter with a PLC or a computer over a long distance using the RS-485 communication features. Connect the communication cables and set the communication parameters in the inverter. Refer to the communication protocols and parameters to configure and use the RS-485 communication features.

10.1 Communication Standards

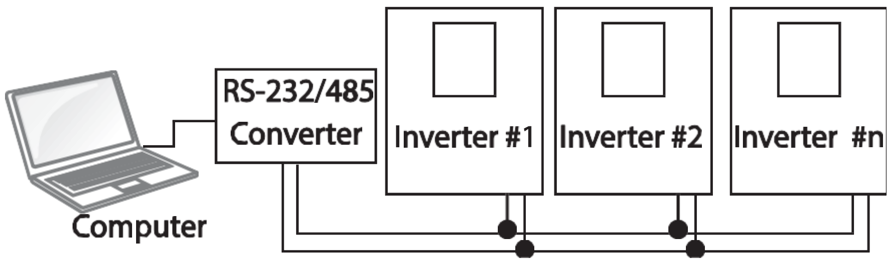
Following the RS-485 communication standards, H2 products exchange data with a PLC and computer. The RS-485 communication standards support the Multi-drop Link System and offer an interface that is strongly resistant to noise. Please refer to the following table for details about the communication standards.

Item	Standard
Communication method/ Transmission type	RS-485/Bus type, Multi-drop Link System
Inverter type name	H2
Number of connected inverters/ Transmission distance	Maximum of 16 inverters / Maximum1,200 m (recommended distance: within 700 m)
Recommended cable size	0.75 mm^2, (18 AWG), Shielded Type Twisted-Pair (STP) Wire
Installation type	Dedicated terminals (S+/S-/SG) on the control terminal block
Power supply	Supplied by the inverter - isolated power source from the inverter's internal circuit
Communication speed	1,200/2,400/4800/9,600/19,200/38,400/57,600/115,200 bps BACNET: 9600/19200/38400/76800 bps
Control procedure	Asynchronous communications system
Communication system	Half duplex system
Character system	Modbus-RTU: Binary
Stop bit length	1-bit/2-bit
Frame error check	2 bytes
Parity check	None/Even/Odd

10.2 Communication System Configuration

In an RS-485 communication system, the PLC or computer is the master device and the inverter is the slave device. When using a computer as the master, the RS-232/RS-485 converter must be integrated with the computer, so that it can communicate with the inverter. Specifications and performance of converters may vary depending on the manufacturer, but the basic functions are identical. Please refer to the converter manufacturer’s user manual for details about features and specifications.

Connect the wires and configure the communication parameters on the inverter by referring to the following illustration of the communication system configuration.



10.2.1 Communication Line Connection

Make sure that the inverter is turned off completely, and then connect the RS-485 communication line to the S+/S-/SG terminals of the terminal block. The maximum number of inverters you can connect is 16. For communication lines, use shielded twisted pair (STP) cables.

The maximum length of the communication line is 1,200 meters, but it is recommended to use no more than 700 meters of communication line to ensure stable communication.

Please use a repeater to enhance the communication speed when using a communication line longer than 1,200 meters or when using a large number of devices. A repeater is effective when smooth communication is not available due to noise interference.

Caution

When wiring the communication line, make sure that the SG (ground) terminals on the PLC and inverter are connected. SG terminals prevent communication errors due to electronic noise interference.

10.2.2 Setting Communication Parameters

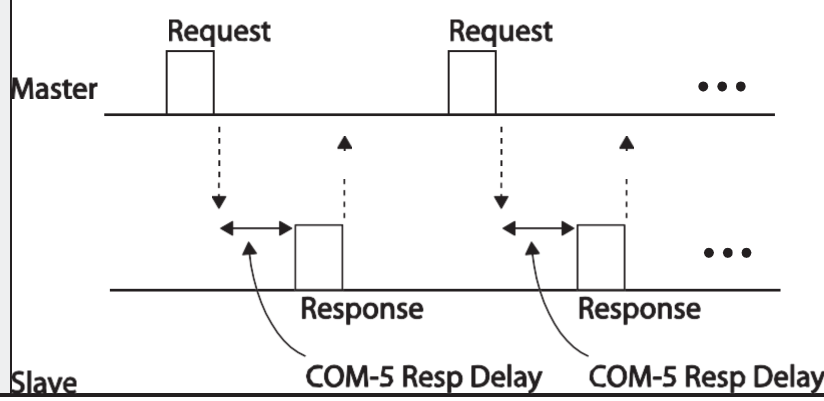
Before proceeding with setting communication configurations, make sure that the communication lines are connected properly. Turn on the inverter and set the communication parameters.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD Display</th><th colspan="2">Parameter Setting</th><th colspan="2">Setting range</th><th>Unit</th></tr>
<tr><td rowspan="7">COM</td><td>01</td><td>Built-in communication inverter ID</td><td>Int485 St ID</td><td colspan="2">1</td><td colspan="2">1–MaxComID[7]</td><td>-</td></tr>
<tr><td rowspan="3">02</td><td rowspan="3">Built-in communication protocol</td><td rowspan="3">Int485 Proto</td><td rowspan="3">0</td><td rowspan="3">ModBus-RTU</td><td>0</td><td>Modbus-RTU</td><td rowspan="3">-</td></tr>
<tr><td>4</td><td>BACnet</td></tr>
<tr><td>5</td><td>Metass-N2</td></tr>
<tr><td>03</td><td>Built-in communication speed</td><td>Int485 BaudR</td><td>3</td><td>9600 bps</td><td colspan="2">0–8</td><td>-</td></tr>
<tr><td>04</td><td>Built-in communication frame setting</td><td>Int485 Mode</td><td>0</td><td>D8/PN/S1</td><td colspan="2">0–3</td><td>-</td></tr>
<tr><td>05</td><td>Transmission delay after reception</td><td>Resp Delay</td><td colspan="2">5</td><td colspan="2">0–1000</td><td>msec</td></tr>
</table>

[7]*If COM-02 is set to ‘0’ (Modbus RTU), MaxComID is ‘250’. If set to ‘4’ (BACnet), MaxComID is ‘127’.

10.2.2.1.1 Communication Parameters Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>COM-01
Int485 St ID</td><td>Sets the inverter station ID between 1 and MaxComID.</td></tr>
<tr><td>COM-02
Int485 Proto</td><td>Select one of the three built-in protocols: Modbus-RTU, BACnet or Metasys-N2.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Modbus-RTU</td><td>Modbus-RTU compatible protocol</td></tr>
<tr><td>4</td><td>BACnet</td><td>BAC net protocol</td></tr>
<tr><td>5</td><td>Metasys-N2</td><td>Metasys-N2 protocol</td></tr>
</table></td></tr>
<tr><td>COM-03
Int485 BaudR</td><td>Set a communication setting speed up to 115,200 bps.
The maximum setting range changes depending on the protocol.
<table>
<tr><th>Setting</th><th>Communication Speed</th></tr>
<tr><td>0</td><td>1200 bps</td></tr>
<tr><td>1</td><td>2400 bps</td></tr>
<tr><td>2</td><td>4800 bps</td></tr>
<tr><td>3</td><td>9600 bps</td></tr>
<tr><td>4</td><td>19200 bps</td></tr>
<tr><td>5</td><td>38400 bps</td></tr>
<tr><td>6</td><td>56 Kbps (57,600 bps)</td></tr>
<tr><td>7</td><td>76.8 Kbps (76,800 bps)</td></tr>
<tr><td>8</td><td>115.2 Kbps (115,200 bps)</td></tr>
</table>
BACnet: If the COM-02 Int485 Proto setting is BACnet, the available communication speed settings are 9600 bps, 19200 bps, 76.8 kbps.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>Metasys-N2: If the COM-02 Int485 Proto setting is Metasys-N2, the communication speed is fixed to 9600 bps and COM-03 Int485 BaudR is not shown.</td></tr>
<tr><td>COM-04
Int485 Mode</td><td>Set a communication configuration. Set the data length, parity check method, and the number of stop bits.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>D8/PN/S1</td><td>8-bit data / no parity check / 1 stop bit</td></tr>
<tr><td>1</td><td>D8/PN/S2</td><td>8-bit data / no parity check / 2 stop bits</td></tr>
<tr><td>2</td><td>D8/PE/S1</td><td>8-bit data / even parity / 1 stop bit</td></tr>
<tr><td>3</td><td>D8/PO/S1</td><td>8-bit data / odd parity / 1 stop bit</td></tr>
</table>
If the COM-02 Int485 Proto setting is Metasys-N2, the communication frame composition is fixed to D8/PN/S1 and COM- 04 Int485 Mode is not visible.</td></tr>
<tr><td>COM-05
Resp Delay</td><td>Set the response time for the slave (inverter) to react to the request from the master. Response time is used in a system where the slave device response is too fast for the master device to process. Set this parameter to an appropriate value for smooth master-slave communication.

</td></tr>
</table>

10.2.3 Setting Operation Command and Frequency

After setting the DRV-06 Cmd Source parameter to '3 (Int 485)' and DRV-07 Freq Ref Src parameter to '6 (Int 485)', you can set common area parameters for the operation command and frequency via communication. For details about the operation command, refer to *5.1.3.4 Setting Operation Command and Frequency on page 106* and for details about the frequency command, refer to *5.1.4.6 Setting a Frequency Reference via RS-485 Communication on page 116*.

To select the built-in RS485 communication as the source of command, set DRV-07 to '6 (Int485)' on the keypad. Then, set common area parameters for the operation command and frequency via communication.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
DRV	06	Command source	Cmd Source	3	Int 485	0–5	-
	07	Frequency setting method	Freq Ref Src	6	Int 485	0–11	-

10.2.4 Command Loss Protective Operation

Configure the command loss decision standards and protective operations run when a communication problem lasts for a specified period of time.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	12	Speed command loss operation mode	Lost Cmd Mode	0	None	0–5	-
	13	Time to determine speed command loss	Lost Cmd Time	6	1.0	0.1–120.0	sec
	14	Operation frequency at speed command loss	Lost Preset F	0.00		0.00, Low Freq–High Freq	Hz.

Command Loss Protective Operation Setting Details

Code	Description		
PRT-12 Lost Cmd Mode PRT-13 Lost Cmd Time	Select the operation when a communication error has occurred and has lasted longer than the time set at PRT-13.		
	Setting		Function
	0	None	The speed command immediately becomes the operation frequency without any protection function.
	1	Free-Run	The inverter blocks output. The motor performs in free-run condition.
	2	Dec	The motor decelerates and then stops.
	3	Hold Input	Operates continuously with the speed of the inputted speed command until the loss of the speed command. The inverter calculates the average input value for 10

			seconds before the loss of the speed command and uses it as the speed reference.
	4	Hold Output	Operates continuously with the operate frequency before the speed loss. The inverter calculates the average output value for 10 seconds before the loss of the speed command and uses it as the speed reference.
	5	Lost Preset	The inverter operates at the frequency set at PRT-14 (Lost Preset F).
PRT-14 Lost Preset F	0.00, Low Freq–High Freq		Set the frequency for continued operation.

10.3 Modbus-RTU Communication

10.3.1 Setting Virtual Multi-function Inputs

Multi-function inputs can be controlled using a communication address (0h0385). Set parameters COM-70–77 to the functions to operate, and then set the BIT relevant to the function to 1 at 0h0385 to operate it. Virtual multi-function inputs operate independently from IN-65–71 digital multi-function inputs and cannot be set redundantly. Virtual multi-function input can be monitored using COM-82 (Virt DI Status). Before you configure the virtual multi-function inputs, set the DRV parameter according to the command source.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
COM	70–77	Communication multi-function input x	Virtual DI x (x: 1–8)	0	None	0–55	-
	82	Communication multi-function input monitoring	Virt DI Status	bit 7 bit 6 bit 5 bit 4 bit 3 bit 2 bit 1 bit 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0		0000 0000 – 1111 1111	bit

Example: When sending an Fx command by controlling virtual multi-function input in the common area via Int485, set COM-70 to ‘FX’ and set address 0h0385 to ‘0h0001’.

10.3.2 Saving Parameters Defined by Communication

If you turn off the inverter after setting the common area parameters or keypad parameters via communication and operate the inverter, the changes are lost and the values changed via communication revert to the previous setting values when you turn on the inverter.

Set CNF-48 to ‘1 (Yes)’ to allow all the changes over communication to be saved, so that the inverter retains all the existing values even after the power has been turned off.

Setting address 0h03E0 to ‘0’ and then setting it again to ‘1’ via communication allows the existing parameter settings to be saved. However, setting address 0h03E0 to ‘1’ and then setting it to ‘0’ does not carry out the same function.

Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
CNF	48	Save parameters	Parameter Save	0	No	0	No	-
						1	Yes	

10.3.3 Total Memory Map for Communication

Communication Area	Memory Map	Details
Communication common compatible area	0h0000–0h00FF	H2 Series compatible area
Parameter registration type area	0h0100–0h01FF	Areas registered at COM-31–38 and COM-51–58
	0h0200–0h023F	Area registered for User Group
	0h0240–0h027F	Area registered for Macro Group
	0h0280–0h02FF	Reserved
Communication common area	0h0300–0h037F	Inverter monitoring area
	0h0380–0h03DF	Inverter control area
	0h03E0–0h03FF	Inverter memory control area
	0h0400–0h0FFF	Reserved
	0h1100	DRV Group
	0h1200	MOT Group
	0h1300	BAS Group
	0h1400	ADV Group
	0h1500	CON Group
	0h1600	IN Group
	0h1700	OUT Group
	0h1800	COM Group
	0h1900	PID Group
	0h1A00	AP1 Group
	0h1B00	AP2 Group
	0h1C00	AP3 Group
	0h1D00	PRT Group
	0h1E00	APO Group

10.3.4 Parameter Group for Data Transmission

By defining a parameter group for data transmission, the communication addresses registered in the communication function group (COM) can be used in communication. Parameter group for data transmission may be defined to transmit multiple parameters at once, into the communication frame.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
COM	31–38	Output communication address x	Para Status-x (x: 1–8)	-	0000–FFFF	Hex
	51–58	Input communication address x	Para Control-x (x: 1–8)	-	0000–FFFF	Hex

Currently Registered CM Group Parameter

Address	Parameter	Assigned content by bit
0h0100–0h0107	Status Parameter-1–Status Parameter-8	Parameter communication code value registered at COM-31–38 (Read-only)
0h0110–0h0117	Control Parameter-1–Control Parameter-8	Parameter communication code value registered at COM-51–58 (Read/Write access)

Note
When registering control parameters, register the operation speed (0h0005, 0h0380, 0h0381) and operation command (0h0006, 0h0382) parameters at the end of a parameter control frame. For example, when the parameter control frame has 5 parameter control items (Para Control - x), register the operation speed at Para Control-4 and the operation command to Para Control-5.

10.3.5 Parameter Group for User/Macro Group

By defining user/macro parameter groups, communication can be carried out using the user defined group (USR Grp) and macro group (MCx Grp) addresses that are registered at the U&M mode. Parameter groups can only be defined when using the keypad.

Currently Registered User Group Parameters

Address	Parameter	Assigned Content by Bit
0h0200	User Grp. Code 1	Parameter value registered at U&M > USR → 1 (Read/Write)
0h0201	User Grp. Code 2	Parameter value registered at U&M > USR → 2 (Read/Write)
. .	. .	. .
0h023E	User Grp. Code 63	Parameter value registered at U&M > USR → 63 (Read/Write)
0h023F	User Grp. Code 64	Parameter value registered at U&M > USR → 64 (Read/Write)

Currently Registered Macro Group Parameters

Address	Parameter	Assigned Content by Bit
0h0240	Macro Grp. Code 1	Parameter value registered at U&M > MC → 1
0h0241	Macro Grp. Code 2	Parameter value registered at U&M > MC → 1
. . .	. . .	. . .
0h02A2	Macro Grp. Code 98	Parameter value registered at U&M > MC → 98
0h02A3	Macro Grp. Code 99	Parameter value registered at U&M > MC → 99

10.3.6 Modbus-RTU Protocol

10.3.6.1 Function Code and Protocol

In the following section, station ID is the value set at COM-01 (Int485 St ID), and the starting address is the communication address (starting address size is in bytes). For more information about communication addresses, refer to 10.3.7 *Compatible Common Area Parameter on page 311*.

Reading up to 8 Consecutive Inverter Parameters Based on the Set Number - Read Holding Register (Func. Code: 0x03) and Read Input Register (Func. Code: 0x04)

Read Holding Registers (Func. Code: 0x03) and Read Input Registers (Func. Code: 0x04) are processed identically by the inverter.

Codes	Description
Start Addr.	Starting address 1 of the inverter parameters (common area or keypad) to be read from.
No. of Reg.	Number of the inverter parameters (common area or keypad) to be read.
Byte Count	Byte number of normal response values based on the number of registers (No. of Reg).
Except. Code	Error codes

10.3.6.1.1 Request

Slave Station ID	Func. Code	Start Addr (Hi)	Start Addr (Lo)	No of Reg (Hi)	No of Reg (Lo)	CRC (Lo)	CRC (Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

10.3.6.1.2 Normal Response

Slave Station ID	Func. Code	Byte Count	Value (Hi)	Value (Lo)	…	Value (Hi)	Value (Lo)	CRC (Lo)	CRC (Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	…	1 byte	1 byte	1 byte	1 byte

* The number of Value(Hi) and Value(Lo) is changed by the [Request No. of Reg].

10.3.6.1.3 Error Response

Slave Station ID	Func. Code	Except. Code	CRC(Lo)	CRC(Hi)
1 byte	1 byte	1 byte	1 byte	1 byte

* Func. Code of the error response is [Request Func. Code] + 0x80.

10.3.6.1.4 Writing One Inverter Parameter Value (Func. Code: 0x06)

Codes	Description
Addr.	Address 1 of the inverter parameter (common area or keypad) to be written to.
Reg. Value	The inverter parameter (common area or keypad) value to write with.
Except. Code	Error codes

10.3.6.1.5 Request

Slave Station ID	Func.Code	Addr (Hi)	Addr(Lo)	Value(Hi)	Value(Lo)	CRC(Lo)	CRC(Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

10.3.6.1.6 Normal Response

Slave Station ID	Func.Code	Addr (Hi)	Addr(Lo)	Value(Hi)	Value(Lo)	CRC(Lo)	CRC(Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

10.3.6.1.7 Error Response

Slave Station ID	Func. Code	Except. Code	CRC(Lo)	CRC (Hi)
1 byte	1 byte	1 byte	1 byte	1 byte

* Func. Code of the error response is [Request Func. Code] + 0x80.

10.3.6.1.8 Writing Multiple Registers (Func. Code: 0x10)

Codes	Description
Start Addr.	Starting address 1 of the inverter parameters (common area or keypad) to be written to.
No. of Reg.	Number of the inverter parameters (common area or keypad) to be written.
Reg. Value	The inverter parameter (common area or keypad) values to write with.
Except. Code	Error codes

10.3.6.1.9 Request

Slave Station ID	Func. Code	Start Addr. (Hi)	Start Addr. (Lo)	No of Reg. (Hi)	No of Reg. (Lo)	Byte Count	Reg. Value (Hi)	Reg. Value (Lo)	CRC (Lo)	CRC (Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

10.3.6.1.10 Normal Response

Slave Station ID	Func. Code	Start Addr (Hi)	Start Addr (Lo)	No of Reg. (Hi)	No of Reg. (Lo)	CRC (Lo)	CRC (Hi)
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

10.3.6.1.11 Error Response

Slave Station ID	Func. Code	Except. Code	CRC(Lo)	CRC(Hi)
1 byte	1 byte	1 byte	1 byte	1 byte

* Func. Code of the error response is [Request Func. Code] + 0x80.

10.3.6.2 Exception Code

Code	
01	ILLEGAL FUNCTION
02	ILLEGAL DATA ADDRESS
03	ILLEGAL DATA VALUE
06	SLAVE DEVICE BUSY
14	WRITE PROTECTION

Example of Modbus-RTU Communication In Use

When the Acc time (Communication address 0x1103) is changed to 5.0 sec and the Dec time (Communication address 0x1104) is changed to 10.0 sec.

Frame Transmission from Master to Slave

Item	Station ID	Function	Starting Address	# of Register	Byte Count	Data 1	Data 2	CRC
Hex	0x01	0x10	0x1102	0x0002	0x04	0x0032	0x0064	0x1202
Desc.	COM- 01 Int485 St ID	Preset Multiple Register	Start Address-1 (0x1103-1)	-	-	50 (Acc time 5.0 sec)	100 (Dec time 10.0 sec)	-

Frame Transmission from Slave to Master

Item	Station Id	Function	Starting Address	# of Register	CRC
Hex	0x01	0x10	0x1102	0x0002	0xE534
Desc.	COM-01 Int485 St ID	Preset Multiple Register	Starting Address-1 (0x1103-1)	-	-

10.3.7 Compatible Common Area Parameter

The following are common area parameters compatible with Benshaw inverters (SG, GX, GM2, S/SW Series and H2 Series (Addresses 0h0000-0h0011 are for compatible common area parameters. Addresses 0h0012-0h001B are for the H2 Series inverter parameters.)

<table>
<tr><th>Comm. Address</th><th>Parameter</th><th>Scale</th><th>Unit</th><th>R/W</th><th colspan="2">Assigned Content by Bit</th></tr>
<tr><td>0h0000</td><td>Inverter model</td><td>-</td><td>-</td><td>R</td><td colspan="2">F: H2</td></tr>
<tr><td rowspan="9">0h0001</td><td rowspan="9">Inverter capacity</td><td rowspan="9">-</td><td rowspan="9">-</td><td rowspan="9">R</td><td colspan="2">0: 0.75kW, 1: 1.5kW, 2: 2.2kW</td></tr>
<tr><td colspan="2">3: 3.7kW 4: 5.5kW, 5: 7.5kW</td></tr>
<tr><td colspan="2">6: 11kW, 7: 15kW, 8: 18.5kW</td></tr>
<tr><td colspan="2">9: 22kW, 10: 30kW, 11: 37kW</td></tr>
<tr><td colspan="2">12: 45kW ,13: 55kW, 14: 75kW,</td></tr>
<tr><td colspan="2">15: 90kW, 16: 110kW, 17: 132kW</td></tr>
<tr><td colspan="2">18: 160kW, 19: 185kW, 20: 220kW</td></tr>
<tr><td colspan="2">21: 250kW, 22: 315kW, 23: 355kW</td></tr>
<tr><td colspan="2">24: 400kW, 25: 500kW</td></tr>
<tr><td rowspan="3">0h0002</td><td rowspan="3">Inverter input voltage</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">R</td><td colspan="2">0: 240 V product</td></tr>
<tr><td colspan="2">1: 480 V product</td></tr>
<tr><td colspan="2">2: 575 V product</td></tr>
<tr><td rowspan="2">0h0003</td><td rowspan="2">Version</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">R</td><td colspan="2">(Example) 0h0064: Version 1.00</td></tr>
<tr><td colspan="2">(Example) 0h0065: Version 1.01</td></tr>
<tr><td>0h0004</td><td>Reserved</td><td>-</td><td>-</td><td>R</td><td colspan="2">-</td></tr>
<tr><td>0h0005</td><td>Command frequency</td><td>0.01</td><td>Hz</td><td>R/W</td><td colspan="2">-</td></tr>
<tr><td rowspan="18">0h0006</td><td rowspan="18">Operation command (option)</td><td rowspan="18">-</td><td rowspan="18">-</td><td rowspan="18">R</td><td>B15</td><td>Reserved</td></tr>
<tr><td rowspan="10">B14-B9</td><td>0: Keypad Freq,</td></tr>
<tr><td>2-8: Terminal block multi-step speed</td></tr>
<tr><td>17: Up, 18: Down</td></tr>
<tr><td>19: STEADY</td></tr>
<tr><td>22: V1, 24: V2, 25: I2,</td></tr>
<tr><td>26: PULSE</td></tr>
<tr><td>27: Built-in 485</td></tr>
<tr><td>28: Communication option</td></tr>
<tr><td>30: JOG, 31: PID</td></tr>
<tr><td rowspan="6">B8-B6</td><td>0: Keypad</td></tr>
<tr><td>1: Fx/Rx-1</td></tr>
<tr><td>2: Fx/Rx-2</td></tr>
<tr><td>3: Built-in 485</td></tr>
<tr><td>4: Communication option</td></tr>
<tr><td>5: Time Event</td></tr>
<tr><td></td><td></td></tr>
</table>

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit	
				R/W	B5	Reserved
					B4-B0	16:Emergency stop
						8: W: Trip initialization (0➔1), R: Trip status
						4: Reverse operation (R)
						2: Forward operation (F)
						0: Stop (S)
0h0007	Acceleration time	0.1	sec	R/W	-	
0h0008	Deceleration time	0.1	sec	R/W	-	
0h0009	Output current	0.1	A	R	-	
0h000A	Output frequency	0.01	Hz	R	-	
0h000B	Output voltage	1	V	R	-	
0h000C	DC link voltage	1	V	R	-	
0h000D	Output power	0.1	kW	R	-	
0h000E	Operation status	-	-	R	B15	0: HAND, 1: AUTO
					B14	1: Frequency command source by communication (built-in, option)
					B13	1: Operation command source by communication (built-in, option)
					B12	Reverse operation command
					B11	Forward operation command
					B10	Reserved
					B9	Jog mode
					B8	Drive stopping
					B7	DC Braking
					B6	Speed reached
					B5	Decelerating
					B4	Accelerating
					B3	Fault - operates according to OUT-30 setting
					B2	Operating in reverse direction
					B1	Operating in forward direction
					B0	Stopped

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit	
0h000F	Fault information	-	-	R	B15	Reserved
					B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	H/W-Diag
					B9	Reserved
					B8	Reserved
					B7	Reserved
					B6	Reserved
					B5	Reserved
					B4	Reserved
					B3	Level Type trip
					B2	Reserved
					B1	Reserved
					B0	Latch Type trip
0h0010	Input terminal information	-	-	R	B15 –B7	Reserved
					B6	P7
					B5	P6
					B4	P5
					B3	P4
					B2	P3
					B1	P2
					B0	P1
0h0011	Output terminal information	-	-	R	B15	Reserved
					B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	Reserved
					B9	Reserved
					B8	Reserved
					B7	Reserved
					B6	Reserved
					B5	Q1
					B4	Relay 5
					B3	Relay 4
					B2	Relay 3
					B1	Relay 2
					B0	Relay 1
0h0012	V1	0.1	%	R	V1 input voltage	
0h0013	Thermal	0.1	%	R	Input Thermal	

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit
0h0014	V2	0.1	%	R	V2 input voltage
0h0015	I2	0.1	%	R	I2 input Current
0h0016	Motor rotation speed	1	Rpm	R	Displays existing motor rotation speed
0h0017–0h0019	Reserved	-	-	-	-
0h001A	Select Hz/rpm	-	-	R	0: Hz unit, 1: rpm unit
0h001B	Display the number of poles for the selected motor	-	-	R	Display the number of poles for the selected motor

10.3.8 H2 Expansion Common Area Parameter

10.3.8.1 Monitoring Area Parameter (Read Only)

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0300	Inverter model	-	-	H2: 000Fh	
0h0301	Inverter capacity	-	-	0.75 kW: 4008h, 1.5 kW: 4015h	
				2.2 kW: 4022h, 3.7 kW: 4037h	
				5.5 kW: 4055h, 7.5 kW: 4075h	
				11 kW: 40B0h, 15 kW: 40F0h	
				18.5 kW: 4125h, 22 kW: 4160h	
				30 kW: 41E0h, 37 kW: 4250h,	
				45 kW: 42D0h,55 kW: 4370h,	
				75 kW: 44B0h,90 kW: 45A0h,	
				110 kW: 46E0h, 132 kW: 4840h	
				160 kW: 4A00h, 185kW: 4B90h,	
				220 kW: 4DC0h, 250 kW: 4FA0h,	
				315 kW: 53B0h, 355 kW: 5630h,	
				400 kW: 5900h, 500 kW: 5F40h	
0h0302	Inverter input voltage/power (Single phase, 3-phase), cooling method	-	-	200 V 3-phase forced cooling: 0231h	
				400 V 3-phase forced cooling: 0431h	
				600 V 3-phase forced cooling: 0831h	
0h0303	Inverter S/W version	-	-	(ex) 0h0064: Version 1.00 0h0065: Version 1.01	
0h0304	Reserved	-	-	-	
0h0305	Inverter Operation State	-	-	B15	0:Normal State 4:Warning occurred 8:Fault occurred
				B14	
				B13	
				B12	
				B11–	-
				B8	
				B7	1: Speed searching
					2: Accelerating
				B6	3: Operating at constant rate
					4: Decelerating
				B5	5: Decelerating to stop
					6: H/W OCS
				B4	7: S/W OCS
					8: Dwell operating
				B3	0: Stopped 1: Operating in forward direction
				B2	

<table>
<tr><th>Comm. Address</th><th>Parameter</th><th>Scale</th><th>Unit</th><th colspan="2">Assigned content by bit</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>B1</td><td rowspan="2">2: Operating in reverse direction
3: DC operating</td></tr>
<tr><td>B0</td></tr>
<tr><td rowspan="16">0h0306</td><td rowspan="16">Inverter operation frequency command source</td><td rowspan="16">-</td><td rowspan="16">-</td><td>B15</td><td rowspan="8">Operation command source 0: Keypad
1: Communication option
3: Built-in RS 485
4: Terminal block</td></tr>
<tr><td>B14</td></tr>
<tr><td>B13</td></tr>
<tr><td>B12</td></tr>
<tr><td>B11</td></tr>
<tr><td>B10</td></tr>
<tr><td>B9</td></tr>
<tr><td>B8</td></tr>
<tr><td>B7</td><td rowspan="8">Frequency command source 0: Keypad speed
1: Keypad torque
2-4: Up/Down operation speed
5: V1, 7: V2, 8: I2
9: Pulse
0: Built-in RS 485
11: Communication option
13: Jog
14: PID
25-31: Multi-step speed frequency</td></tr>
<tr><td>B6</td></tr>
<tr><td>B5</td></tr>
<tr><td>B4</td></tr>
<tr><td>B3</td></tr>
<tr><td>B2</td></tr>
<tr><td>B1</td></tr>
<tr><td>B0</td></tr>
<tr><td>0h0307</td><td>Keypad S/W version</td><td>-</td><td>-</td><td colspan="2">(Ex.) 0h0064: Version 1.00</td></tr>
<tr><td>0h0308</td><td>Keypad title version</td><td>-</td><td>-</td><td colspan="2">(Ex.) 0h0065: Version 1.01</td></tr>
<tr><td>0h0309</td><td>IO Board Version</td><td>-</td><td>-</td><td colspan="2">(Ex.) 0h0064: Version 1.00 (Ex.) 0h0065: Version 1.01</td></tr>
<tr><td>0h030A–0h30F</td><td>Reserved</td><td>-</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>0h0310</td><td>Output current</td><td>0.1</td><td>A</td><td colspan="2">-</td></tr>
<tr><td>0h0311</td><td>Output frequency</td><td>0.01</td><td>Hz</td><td colspan="2">-</td></tr>
<tr><td>0h0312</td><td>Output rpm</td><td>0</td><td>Rpm</td><td colspan="2">-</td></tr>
<tr><td>0h0313</td><td>Reserved</td><td>-</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>0h0314</td><td>Output voltage</td><td>1</td><td>V</td><td colspan="2">-</td></tr>
<tr><td>0h0315</td><td>DC Link voltage</td><td>1</td><td>V</td><td colspan="2">-</td></tr>
<tr><td>0h0316</td><td>Output power</td><td>0.1</td><td>kW</td><td colspan="2">-</td></tr>
<tr><td>0h0317</td><td>Reserved</td><td>-</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>0h0318</td><td>PID reference</td><td>0.1</td><td>%</td><td colspan="2">PID reference value</td></tr>
<tr><td>0h0319</td><td>PID feedback</td><td>0.1</td><td>%</td><td colspan="2">PID feedback value</td></tr>
<tr><td>0h031A</td><td>Display the number of poles for the 1st motor</td><td>-</td><td>-</td><td colspan="2">Displays the number of poles for the first motor</td></tr>
</table>

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h031B	Display the number of poles for the 2nd motor	-	-	Displays the number of poles for the 2nd motor	
0h031C	Display the number of poles for the selected motor	-	-	Displays the number of poles for the selected motor	
0h031D	Select Hz/rpm	-	-	0: Hz, 1: rpm	
0h031E –0h031F	Reserved	-	-	-	
0h0320	Digital input information			B15– B7	Reserved
				B6	P7 (I/O board)
				B5	P6 (I/O board)
				B4	P5 (I/O board)
				B3	P4 (I/O board)
				B2	P3 (I/O board)
				B1	P2 (I/O board)
				B0	P1 (I/O board)
0h0321	Digital output information	-	-	B15– B9	Reserved
				B8-B6	Reserved
				B5	Q1
				B4	Relay 5
				B3	Relay 4
				B2	Relay 3
				B1	Relay 2
				B0	Relay 1
0h0322	Virtual digital input information	-	-	B15– B8	Reserved
				B7	Virtual DI 8 (COM-77)
				B6	Virtual DI 7 (COM-76)
				B5	Virtual DI 6 (COM-75)
				B4	Virtual DI 5 (COM-74)
				B3	Virtual DI 4 (COM-73)
				B2	Virtual DI 3 (COM-72)
				B1	Virtual DI 2 (COM-71)
				B0	Virtual DI 1 (COM-70)
0h0323	Display the selected motor	-	-	0: 1st motor/1: 2nd motor	
0h0324	AI1	0.01	%	Analog input V1 or Thermal (I/O board)	
0h0325	AI2	0.01	%	Analog input V2 or I2 (I/O board)	
0h0326	Reserved	-	-	Reserved	
0h0327	Reserved	-	-	Reserved	

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0328	AO1	0.01	%	Analog output 1 (I/O board)	
0h0329	AO2	0.01	%	Analog output 2 (I/O board)	
0h032A	Reserved	0.01	%	Reserved	
0h032B	Reserved	0.01	%	Reserved	
0h032C	Reserved	-	-	Reserved	
0h032D	Reserved	-	-	Reserved	
0h032E	Consumption energy (kWh)	0.1	kWh	Consumption energy (kWh)	
0h032F	Consumption energy (MWh)	1	MWh	Consumption energy (MWh)	
0h0330	Latch type trip information - 1	-	-	B15	PC Repeat Err
				B14	Over Heat Trip
				B13	Reserved
				B12	External Trip
				B11	Damper Err
				B10	Pipe Break
				B9	NTC Open
				B8	Reserved
				B7	Reserved
				B6	In Phase Open
				B5	Out Phase Open
				B4	Low Voltage2
				B3	E-Thermal
				B2	Inverter OLT
				B1	Under Load
				B0	Over Load
0h0331	Latch type trip information - 2	-	-	B15	Reserved
				B14	MMC Interlock
				B13	Reserved
				B12	Reserved
				B11	Reserved
				B10	Option Trip-1
				B9	No Motor Trip
				B8	Reserved
				B7	IO Board Trip
				B6	Broken Belt
				B5	ParaWrite Trip
				B4	TB Trip
				B3	Fan Trip
				B2	Thermal Trip
				B1	Level Detect

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
				B0	Reserved
0h0332	Level type trip information	-	-	B15– B4	Reserved
				B3	Lost Keypad
				B2	Lost Command
				B1	Low Voltage
				B0	BX
0h0333	H/W Diagnosis Trip information	-	-	B15– B3	Reserved
				B2	Watchdog-1 error
				B1	EEP Err
				B0	ADC Offset
0h0334	Warning information-1	-	-	B15	Broken Belt
				B14	Low Battery
				B13	Load Tune
				B12	Fan Exchange
				B11	CAP. Warning
				B10	Level Detect
				B9	Reserved
				B8	Lost Keypad
				B7	Pipe Break
				B6	Fire Mode
				B5	DB Warn %ED
				B4	Fan Warning
				B3	Lost Command
				B2	Inv Over Load
				B1	Under Load
				B0	Over Load
0h0335	Latch type trip information -3	-	-	B15	Reserved
				–	Reserved
				B4	Reserved
				B3	Overcurrent2 Trip
				B2	Overvoltage Trip
				B1	Overcurrent1 Trip
				B0	Ground Fault
0h0336	Warning information-2	-	-	B15	Reserved
				~	Reserved
				B3	KPD H.O.A Lock
				B2	Lsig Tune Err
				B1	Rs Tune Err
				B0	ParaWrite Fail

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0337–0h0339	Reserved	-	-	Reserved	
0h033A	Proc PID Output	0.01	%	Process PID Output (%)	
0h033B	Proc PID UnitScale Ref	Proc Unit	Proc Unit	Unit Scaled Process PID reference value	
0h033C	Proc PID UnitScale Fdb	Proc Unit	Proc Unit	Unit Scaled Process PID feedback value	
0h0340	On Time date	0	Day	Total number of days the inverter has been powered on	
0h0341	On Time Minute	0	Min	Total number of minutes excluding the total number of On Time days	
0h0342	Run Time date	0	Day	Total number of days the inverter has driven the motor	
0h0343	Run Time minute	0	Min	Total number of minutes excluding the total number of Run Time days	
0h0344	Fan Time date	0	Day	Total number of days the heat sink fan has been running	
0h0345	Fan Time minute	0	Min	Total number of minutes excluding the total number of Fan Time days	
0h0346–0h0348	Reserved	-	-	Reserved	
0h0349	Reserved	-	-	-	
0h034A	Option 1	-	-	0: None, 5: LonWorks	
0h034B	Reserved	-	-	Reserved	
0h034C	Reserved			Reserved	
0h034D–0h034F	Reserved	-	-	Reserved	
0h0355	Reserved	-	-	Reserved	
0h0356	Reserved	-	-	Reserved	
0h035C	Application Status	-	-	B15 –B2	Reserved
				B1	Fire Mode
				B0	Pump Clean
0h035D	Inv Temperature	0	°C	Heatsink Temperature	
0h035E	Power Factor	0.1	-	Output power factor	

10.3.8.2 Control Area Parameter (Read/Write)

Comm. Address	Parameter	Scale	Unit	Assigned Content by Bit	
0h0380	Frequency command	0.01	Hz	Command frequency setting	
0h0381	RPM command	1	Rpm	Command rpm setting	
0h0382	Operation command	-	-	B15–B4	Reserved
				B3	0 ➔ 1: Free-run stop
				B2	0 ➔ 1: Trip initialization
				B1	0: Reverse command, 1: Forward command
				B0	0: Stop command, 1: Run command
				Example: Forward operation command 0003h, Reverse operation command 0001h	
0h0383	Acceleration time	0.1	sec	Acceleration time setting	
0h0384	Deceleration time	0.1	sec	Deceleration time setting	
0h0385	Virtual digital input control (0: Off, 1: On)	-	-	B15–B8	Reserved
				B7	Virtual DI 8 (COM-77)
				B6	Virtual DI 7 (COM-76)
				B5	Virtual DI 6 (COM-75)
				B4	Virtual DI 5 (COM-74)
				B3	Virtual DI 4 (COM-73)
				B2	Virtual DI 3 (COM-72)
				B1	Virtual DI 2 (COM-71)
				B0	Virtual DI 1 (COM-70)
0h0386	Digital output control (0: Off, 1: On)	-	-	B15–B9	Reserved
				B8-B6	Extended IO PCB
				B5	Q1
				B4	Relay 5
				B3	Relay 4
				B2	Relay 3
				B1	Relay 2
				B0	Relay 1
0h0387	KPD H.O.A Lock	1	-	0 : Locked, 1 : During Run, 2 : Unlocked	
0h0388	PID reference	0.1	%	Process PID reference	
0h0389	PID feedback value	0.1	%	Process PID feedback	
0h038A	Motor rated current	0.1	A	-	
0h038B	Motor rated voltage	1	V	-	
0h038C–0h038D	Reserved	-	-	Reserved	
0h038E	Proc PID Unit	Proc	Proc	Unit Scale Process PID reference	

Comm. Address	Parameter	Scale	Unit	Assigned Content by Bit
	Reference	Unit	Unit	
0h038F	Proc PID Unit Feedback	Proc Unit	Proc Unit	Unit Scale Process PID feedback
0h0390–0h0399	Reserved	-	-	Reserved
0h039A	Anytime Para	-	-	Set the CNF-20 value (refer to 9.6.2 on page 293)
0h039B	Monitor Line-1	-	-	Set the CNF-21 value (refer to 9.6.2 on page 293)
0h039C	Monitor Line-2	-	-	Set the CNF-22 value (refer to 9.6.2 on page 293)
0h039D	Monitor Line-3	-	-	Set the CNF-23 value (refer to 9.6.2 on page 293)
0h039E–0h039F	Reserved			Reserved
0h03A0	PID Ref 1 Aux Value	0.1	%	PID Aux 1 reference
0h03A1	PID Ref 2 Aux Value	0.1	%	PID Aux 2 reference
0h03A2	PID Feedback Aux Value	0.1	%	PID Aux feedback
0h03A3	Proc PID Aux 1 Unit Scale	Proc Unit	Proc Unit	Unit Scale PID Aux 1 reference
0h03A4	Proc PID Aux 2 Unit Scale	Proc Unit	Proc Unit	Unit Scale PID Aux 2 reference
0h03A5	Proc PID Fdb Aux Unit Scale	Proc Unit	Proc Unit	Unit Scale PID Aux feedback
0h03A6–0h03AF	Reserved			Reserved
0h03B0	Reserved			Reserved
0h03B1	Reserved			Reserved
0h03B2	Reserved			Reserved
0h03B3	Reserved			Reserved
0h03B4	Reserved			Reserved
0h03B5	Reserved			Reserved
0h03B6	Reserved			Reserved
0h03B7	Reserved			Reserved
0h03B8	Reserved			Reserved

Note

A frequency set via communication using the common area frequency address (0h0380, 0h0005) is not saved even when used with the parameter save function. To save a changed frequency to use after a power cycle, follow these steps:

1. Set DRV-07 to ‘Keypad-1’ and select a target frequency.
2. Set the frequency via communication into the parameter area frequency address (0h1101).
3. Perform the parameter save (0h03E0: '1') before turning off the power. After the power cycle, the frequency set before turning off the power is displayed.

10.3.8.3 Inverter Memory Control Area Parameter (Read and Write)

Comm. Address	Parameter	Scale	Unit	Change During Running	Function
0h03E0	Save parameters	-	-	X	0: No, 1: Yes
0h03E1	Monitor mode initialization	-	-	O	0: No, 1: Yes
0h03E2	Parameter initialization	-	-	X	0: No, 1: All Grp 2: DRV Grp 3: MOT Grp 4: BAS Grp 5: ADV Grp 6: CON Grp 7: IN Grp 8: OUT Grp 9: COM Grp 10: PID Grp 11:AP1 Grp 12: AP2 Grp 13: AP3 Grp 14: PRT Grp Setting is prohibited during faulted state.
0h03E3	Display changed	-	-	O	0: No, 1: Yes
0h03E4	Macro Function Setting	-	-	X	0: Basic 1: Compressor 2: Supply Fan 3: Exhaust Fan 4: Cooling Tower 5: Circul. Pump 6: Vacuum Pump 7: Constant Torq
0h03E5	Delete all fault history	-	-	O	0: No, 1: Yes
0h03E6	Delete user-registrated codes	-	-	O	0: No, 1: Yes
0h03E7	Hide parameter mode	0	Hex	O	Write: 0–9999 Read: 0: Unlock, 1: Lock
0h03E8	Lock parameter mode	0	Hex	O	Write: 0–9999 Read: 0: Unlock, 1: Lock
0h03E9	Easy start on (easy parameter setup mode)	-	-	O	0: No, 1: Yes
0h03EA	Initializing power consumption	-	-	O	0: No, 1: Yes
0h03EB	Initialize inverter operation accumulative time	-	-	O	0: No, 1: Yes

0h03EC	Initialize cooling fan accumulated operation time	-	-	O	0: No, 1:Yes

Note

- When setting parameters in the inverter memory control area, the values are reflected to the inverter operation and saved. Parameters set in other areas via communication are reflected to the inverter operation, but are not saved. All set values are cleared following an inverter power cycle and revert back to its previous values. When setting parameters via communication, ensure that a parameter save is completed prior to shutting the inverter down.
- Set parameters very carefully. After setting a parameter to '0' via communication, set it to another value. If a parameter has been set to a value other than '0' and a non-zero value is entered again, an error message is returned. The previously-set value can be identified by reading the parameter when operating the inverter via communication.
- The addresses 0h03E7 and 0h03E8 are parameters for entering the password. When the password is entered, the condition will change from Lock to Unlock, and vice versa. When the same parameter value is entered continuously, the parameter is executed just once. Therefore, if the same value is entered again, change it to another value first and then re-enter the previous value. For example, if you want to enter 244 twice, enter it in the following order: 244 ➔ 0 ➔ 244.
- If the communication parameter settings are initialized by setting the address 0h03E2 to [1: All Grp] or [9: COM Grp], or if any Macro function item is modified by setting the address 0h03E4, all the communication parameter settings are reverted to the factory default. If this happens, the inverter may not be able to properly receive responses from the upper-level devices due to the changes in the settings.
- If there is an undefined address in the addresses for reading multiple consecutive data defined in the common area, the undefined address returns 0xFFFF while all the others return normal response. If all the consecutive addresses are undefined, one return code is received from the first undefined address only.
- If there is an undefined address in the addresses for writing into multiple consecutive data defined in the common area, or if the value that is being written is not a valid one, no error response about the wring operation is returned. If all the consecutive addresses are undefined, or if all the date is invalid, one return code is received from the first undefined address only.

Caution

It may take longer to set the parameter values in the inverter memory control area because all data is saved to the inverter. Be careful as communication may be lost during parameter setup if parameter setup is continues for an extended period of time.

10.4 BACnet Communication

10.4.1 What is BACnet Communication?

BACnet (Building Automation and Control network) is a communication network frequently used in building automation. BACnet introduces the concept of object-oriented systems, and defines standardized objects. By exchanging data, this function makes communication possible between products from different companies. It also standardizes some of the general services carried out by using these standard objects.

10.4.2 BACnet Communication Standards

Application	Items	Specification
Connection	Interface	5 Pin Pluggable connector
	Data transmission	RS-485 MS/TP, Half-duplex
	Cable	Twisted pair (1 pair and shield)
Communication	BACnet MS/TP	Stated in ANSI/ASHRAE Standards 135-2004
	Baud Rate	Supports 9600, 19200, 38400, 76800 bps
	MAC Address	1–127
	Start/Stop bit	Start 1 bit, Stop ½ bit
	Parity check	None/Even/Odd

10.4.3 BACnet Quick Communication Start

Follow the instructions below to configure the BACnet network

1 Set five multi-function input terminals (IN-65–71 PxDefine) to 'Interlock 1' – 'Interlock 5' respectively, in the correct motor order.

Note

- When auto change mode selection (AP1–55) is set to '0 (None)' or '1 (Aux)', and if 5 motors are operated, including the main motor, the interlock numbers 1,2,3,4,5 refer to the motors connected to Relay 1,2,3,4,5 (If interlock numbers 1,2,3,4,5 are connected to Relay 1,2,3,4,5 at the inverter output terminal).
- If auto change mode selection (AP1-55) is set to '2 (Main)', and the main and auxiliary motors are connected to the inverter output terminal Relay 1,2,3,4, Interlock 1,2,3,4 are the motors connected to Relay 1,2,3,4. Set COM-04 Int485 Mode.

2 Set the Device Object Instances for COM-21 and 22 and define the values. The device object instances must have uniquevalues.

3 Set COM-01 (Int485 St ID) by entering a value (for BACnet, the Int485 station ID must be set within a range of 0–127). The station ID value set at COM-01 must be within the value range defined by the Max Master Property of different Master for MS/TP token passing.

4 Test the network and make sure the BACnet communication is working properly.

Group	Code	Name	LCD display	Parameter Setting	Setting Range		Unit
COM	03	Communication Speed	Baudrate	9600 bps	0	1200[1]	
					1	2400[1]	
					2	4800[1]	
					3	9600	
					4	19200	
					5	38400	
					6	56Kbps[1]	
					7	76.8Kbps	
					8	115.2Kbps[1]	
	04	Communication Mode	Int485 Mode	D8/PN/S1	0	D8/PN/S1	
					1	D8/PN/S2	
					2	D8/PE/S1	
					3	D8/PO/S1	
	20	Maximum number of BACnet Masters	BAC Max Master	127	1–127		-
	21	BACnet device number 1	BAC Dev Inst1	237	0–4194		-
	22	BACnet device number 2	BAC Dev Inst2	0	0–999		-
	23	BACnet device password	BAC PassWord	0	0–32767		-

1) 1200 bps, 2400 bps, 4800 bps, 56Kbps, 115.2Kbps cannot be set in communication speed setting in case of BACnet communication.

10.4.3.1.1 BACnet Parameter Setting Details

Code	Description
COM-01 Int485 ST ID (MAC ID)	Refers to MACID setting parameter used in BACnet. All MACIDs of the inverter using BACnet must be set before connecting to BUS. MACID must have the unique value from the Network to be connected to MACID. If BACnet is used, the value must be within 0–127. Communication is not available if the value is not included in the range.
COM-03 Baud Rate	Sets the communication speed to use in the network.
COM-83 BAC Mas Master	Range for Max Master that is the number of devices currently connected to the communication Line is 1–127, and the default value is 127.
COM-84–85 BAC Dev Inst 1–2	BACnet Device Instance is used to identify BACnet Device, and must be set as the unique value in the BACnet network. It is used efficiently when finding BACnet Device of other Devices while installing. The following formula is used to calculate the Device Instance value: (COM-84 X 1000) + COM-85 Therefore, in the Device Instance value, COM-84 takes the thousands and higher places (fourth digit and over) and COM-85 takes the hundreds and lower places (third digit and below). COM-84 and COM-85 have the ranges of 0–4194 and 0–999 respectively, because Device Instance can have the value within 0–4,194,302.
COM-86 BAC Password	Refers to the password used for Warm/Cold Start. COM-86 Password parameter can be set within 0–32767, and the default value is 0. If the parameter setting range is set to 1–32768, the Password value set at BACnet Master and the value set at COM-86 must be the same to operate Warm/Cold Start. If COM-86 Password is set to ‘0’, the password of BACnet Master is ignored and Warm/Cold Start is operated.

Note
MaxMaster and MACID affect performing Network communication. It is recommended to set as small value as possible, and to set the continuous value for MACID. If the values are set as explained above, efficient Token Passing Configuration is possible because each Master tries to give Token to Device set as its own (MACD+1).

10.4.4 Protocol Implementation

The following table summarizes the information required to implement a BACnet system. Refer to each section of the table to implement a BACnet system properly.

Category	Items	Remarks
BACnet Services	I-Am (Answer to Who-Is, when broadcast or reset after power-up)	
	I-Have (Answer to Who-Has)	
	Read Property	
	Write Property	
	Device Communication Control	Ignores Password in Device Communication Control
	Reinitialize Device	Warm/Cold Starts (Supports Password) Start Backup, End Backup, Start Restore, End Restore, or Abort Restore services are NOT available.
Data Link Layer	BACnet communication card supports an MS/TP Master Data Link Layer	Supported Standards: MS/TP Available speed: 9600, 19200, 38400, and 76800 bps
MAC ID/Device Object Instance configuration	Set at COM-01 Int485 ST ID (MAC ID). The Device Object Instances are set at COM-21 and COM-22.	
MAX Master Property	Set at COM-20 (MAX Master Value).	

10.4.5 Object Map

Property	Object Type						
	Device	BI	BV	AI	AO	MSI	MVI
Object Identifier	O	O	O	O	O	O	O
Object Name	O	O	O	O	O	O	O
Object Type	O	O	O	O	O	O	O
System Status	O						
Vendor Name	O						
Vendor Identifier	O						
Model Name	O						

Property	Object Type						
	Device	BI	BV	AI	AO	MSI	MVI
Firmware Revision	O						
Appl Software Revision	O						
Location	O						
Protocol Version	O						
Protocol Revision	O						
Services Supported	O						
Object Types Supported	O						
Object List	O						
Max APDU Length	O						
APDU Timeout	O						
Number APDU Retries	O						
Max Master	O						
Max Info Frames	O						
Device Address Binding	O						
Database Revision	O						
Preset Value		O	O	O	O	O	O
Description	O	O	O	O	O	O	O
Status Flags		O	O	O	O	O	O
Event State		O	O	O	O	O	O
Reliability		O	O	O	O	O	O
Out-of-Service		O	O	O	O	O	O
Number of states						O	O
State text						O	O
Units				O	O		
Polarity		O					
Active Text		O	O				
Inactive Text		O	O				

*** BI**–Binary Input / **BV**–Binary Value / **AI**–Analog Input / **AV**–Analog Value / **MSI**–Multistate Input / **MSV**–Multistate Value
You can read/write in Location and Description only if it is the device object. You can write a maximum of 29 words.

10.4.5.1 Analog Value Object Instance

Instance ID	Object Name	Description	Setting Range	Units	R/W
AV1	CommTimeoutSet	Command timeout setting	0.1–120.0	Secs	R/W
AV2	AccelTimeSet	Accelerate time setting	0.0–600.0	Secs	R/W
AV3	DecelTimeSet	Decelerate time setting	0.0–600.0	Secs	R/W
AV4	CommandFreqSet	Command frequency setting**	0.00–DRV-20	Hz	R/W
AV5	PIDReferenceSet	PID reference setting	0–100.0	%	R/W
AV6	PIDFeedbackSet	PID feedback setting	0–100.0	%	R/W

Caution

- When PowerOn Resume (COM-96) is set to 'yes', value is saved even if the power of the inverter is disconnected. When PowerOn Resume (COM-96) is set to 'no', value is not saved if the power of the inverter is disconnected.
- A value higher than the maximum frequency (DRV-20) cannot be used. The maximum frequency can be set by using the keypad. This value can be used when Freq Ref Src (DRV-07) isset to 'Int 485'.
- AV2, AV3 and AV4 are used to provide acceleration/deceleration rate and frequency reference commands. These can be written in AUTO mode only.

10.4.5.2 Multi-state Value Object Instance

Instance ID	Object Name	Description	Setting Range	Units	R/W
MSV1	LostCommand	Command lost operation setting	0: None 1: FreeRun 2: Dec 3: HoldInput 4: HoldOutput	MSG	R/W
			5: LostPreset		

10.4.5.3 Binary Value Object Instance

Instance ID	Object Name	Description	Active /Inactive Text	R/W
BV1	StopCmd	Stop command	False/True	R/W
BV2	RunForwardCmd	Run forward command	False/True	R/W
BV3	RunReverseCmd	Run reverse command	False/True	R/W
BV4	ResetFaultCmd	Fault reset command	False/True	R/W
BV5	FreeRunStopCmd	Free run stop command	False/True	R/W
BV6	Relay1Cmd	Relay 1 On/Off command	False/True	R/W
BV7	Relay2Cmd	Relay 2 On/Off command	False/True	R/W
BV8	Relay3Cmd	Relay 3 On/Off command	False/True	R/W
BV9	Relay4Cmd	Relay 4 On/Off command	False/True	R/W
BV10	Relay5Cmd	Relay 5 On/Off command	False/True	R/W
BV11	Q1Cmd	Q 1 On/Off command	False/True	R/W

10.4.5.4 Analog Input Object Instance

Instance ID	Object Name	Description	Units	R/W
AI1	InvCap (kW)	Inverter capacity	kW	R
AI2	InvCap (HP)	Inverter capacity	HP	R
AI3	InvVoltageClass	Inverter voltage type	Volts	R
AI4	OutputCurrent	Output current	Amps	R
AI5	OutputFreq	Output frequency	Hz	R
AI6	OutputVolgate	Output voltage	Volts	R
AI7	DCLinkVoltage	DC Link voltage	Volts	R
AI8	OutputPower	Output power	kW	R
AI9	AI1	Value of Analog 1	%	R
AI10	AI2	Values of Analog 2	%	R

Instance ID	Object Name	Description	Units	R/W
AI11	OutputRPM	Output speed	RPM	R
AI12	Pole	Pole number of the motor	-	R
AI13	InvStatus	Information of the inverter state (Refer to address 0h0305 in the common area)(Note1)	-	R
AI14	LatchTripInfo1	Latch type trip information1 (Refer to address 0h0330 in the common area)(Note1)	-	R
AI15	LatchTripInfo2	Latch type trip information2 (Refer to address 0h0331 in the common area)(Note1)	-	R
AI16	LatchTripInfo3	Latch type trip information3 (Refer to address 0h0335 in the common area)(Note1)	-	R
AI17	LevelTripInfo	Level type trip information (Refer to address 0h0332 in the common area)(Note1)	-	R
AI18	HWDIagInfo	H/W Diagnosis trip information (Refer to address 0h0333 in the common area)*	-	R
AI19	WarningInfo	Warning information (Refer to address 0h0334 in the common area)*	-	R
AI20	KiloWattHour	Output power by kW/h	kW/h	R
AI21	MegaWattHour	Output power by MW/h	MW/h	R
AI22	PowerFactor	Power factor	-	R
AI23	RunTimeDay	Run time by day	Day	R
AI24	RunTimeMin	Run time by minute	Day	R
AI25	PidOutValue	PID Output Value	%	R
AI26	PidReferenceValu e	PID Reference Value	%	R
AI27	PidFeedbackValue	PID Feedback Value	%	R

* Refer to Compatible Common Area Parameter page 311.

10.4.5.5 Binary Input Object Instance

Instance ID	Object Name	Description	R/W
BI1	Stopped	Stop state	R
BI2	RunningForward	Running forward	R
BI3	RunningReverse	Running reverse	R
BI4	Tripped	Trip occurred	R
BI5	Accelerating	Accelerating	R
BI6	Decelerating	Decelerating	R
BI7	SteadySpeed	Operating at steady speed	R
BI8	RunningDC	Operating at a 0 step speed	R
BI9	Stopping	Stopping	R
BI10	FwdRunCommandState	Forward run command state	R
BI11	RevRunCommandState	Reverse run command state	R
BI12	P1	P1 state	R
BI13	P2	P2 state	R
BI14	P3	P3 state	R
BI15	P4	P4 state	R
BI16	P5	P5 state	R
BI17	P6	P6 state	R
BI18	P7	P7 state	R
BI19	Relay1	Relay1 state*	R
BI20	Relay2	Relay2 state*	R
BI21	Relay3	Relay3 state*	R
BI22	Relay4	Relay4 state*	R
BI23	Relay5	Relay5 state*	R
BI24	Q1	Q1 state	R
BI25	SpeedSearch	Speed search operating	R
BI26	HWOCS	H/W OCS occurred	R
BI27	SWOCS	S/W OCS occurred	R
BI28	RunningDwell	Dwell operating state	R
BI29	SteadyState	Steady state	R
BI30	Warning	Warning state	R

Caution

OUT-31–35 (Relay1–5) must be set to ‘0 (none)’ to control outputs via communication.

10.4.5.6 MultiState Input Object Instance

Instance ID	Object Name	Description	Units	R/W
MSI1	UnitsDisplay	Displays Unit setting	1 Hz 2 RPM	R

10.4.5.7 Error Message

Display	Description
serviceserror+7	Inconsistent parameters
propertyerror+9	Invalid data type
serviceserror+10	Invalid access method
serviceserror+11	Invalid file start
serviceserror+29	Service request denied
objecterror+31	Unknown object
propertyerror+0	Property other
propertyerror+27	Read access denied
propertyerror+32	Unknown property
propertyerror+37	Value out of range
propertyerror+40	Write access denied
propertyerror+42	Invalid array index
clienterror+31	Unknown device
resourceserror+0	Resources other
clienterror+30	Time out
abortreason+4	Segmentation not supported
rejectreason+4	Invalid tag
clienterror+0xFF	No invoke id
securityerror+26	Password failure

10.5 Metasys-N2 Communication

10.5.1 Metasys-N2 Quick Communication Start

Follow the instructions below to configure the Metasys-N2 network.

1. Set COM-02 (Int485 Proto) to ‘5 (Metasys-N2)’.
2. Set the network communication speed to ‘9600 bps.’
3. Configure the communication modes and make sure that they are fixed to Data Bit 8 / No Parity Bit/ Start Bit 1 / Stop Bit 1.
4. Test the network and make sure Metasys-N2 communication is working properly.

10.5.2 Metasys-N2 Communication Standard

Item	Standards
Communication speed	9600 bps
Control procedure	Asynchronous communications system
Communication system	Half duplex system
Cable	Twisted pair (1 pair and shield)
Character system	LS485: ASCII (8bit) Modbus-RTU: Binary (7/8 bit) Metasys-N2: ASCII (8bit)
Start/Stop bit	Start 1bit, Stop 1bit
Error check	RS485: Checksum (2byte)
	Modbus-RTU: CRC16 (2byte) Metastys-N2: CRC16 (2byte)
Parity check	None

10.5.3 Metasys-N2 Protocol I/O Point Map

10.5.3.1 Analog Output

The output point map controlling the inverter from the Metasys-N2 master.

No.	Name	Range		Unit	Description
AO1	Command Frequency	0.0–Max Freq		Hz	Command frequency setting**
AO2	Accel Time	0.0–600.0		Sec	ACC time setting*
AO3	Decel Time	0.0–600.0		Sec	DEC time setting*
AO4	Drive mode	0	KeyPad	-	Drive mode setting
		1	Fx/Rx-1		
		2	Fx/Rx-2		
		3	Int. 485		
		4	FieldBus		
		5	Time Event		
AO5	Freq mode	0	–KeyPad-1	-	Frequency mode setting
		1	–KeyPad-2		
		2	V1		
		3	–Reversed		
		4	V2		
		5	I2		
		6	Int485		
		7	FieldBus		
		8	Reversed		
		9	Pulse		

Caution

- When PowerOn Resume (COM-96) is set to ‘yes’, value is saved even if the power of the inverter is disconnected. If PowerOn Resume (COM-96) is set to ‘no’, value is not saved when the power of the inverter is disconnected.
- Cannot set the value higher than the maximum frequency (DRV-20). The maximum frequency can be set by using the keypad. This value can be used when Freq Ref Src (DRV-07) isset to ‘Int 485’.

10.5.3.2 Binary Output

The output point map controlling the inverter from the Metasys-N2 master.

No.	Name	Range	Description
BO1	Stop Command	1: Stop	Stop command
BO2	Run Forward Command	1: Forward Run	Forward run command
BO3	Run Reverse Command	1: Reverse Run	Reverse run command
BO4	Reset Fault	1: Reset	Fault reset command
BO5	Free-Run Stop	1: Bx	Free-run stop command

10.5.3.3 Analog Input

Metasys-N2 master monitors inverter state.

No.	Name	Unit	Description
AI1	Output Current	Amps	Output current
AI2	Output Frequency	Hz	Output frequency
AI3	Output Speed	RPM	Output speed
AI4	Trip Code	-	Trip code information (Refer to Common Area parameter address 0h000F)*
AI5	Latch Trip Info1	-	'Latch' type fault information 1 (Refer to Common Area parameter address 0h0330)*
AI6	Latch Trip Info2	-	'Latch' type fault information 2
			(Refer to Common Area parameter address 0h0331)*
AI7	Latch Trip Info3	-	'Latch' type fault information 3 (Refer to Common Area parameter address 0h0335)*
AI8	Level Trip Info	-	'Level' type fault information (Refer to Common Area parameter address 0h0332)(1)
AI9	H/W Diagnosis Trip Info	-	H/W Diagnosis fault information (Refer to Common Area parameter address 0h0333)(1)
AI10	Warning Info	-	Warning information (Refer to Common Area parameter address 0h0334)(1)

* Refer to Compatible Common Area Parameter page 311.

10.5.3.4 Binary Input

Metasys-N2 master unit monitors the inverter input and output status in binary codes. The following table lists the binary codes used and their meanings.

No.	Name	Description
BI1	Stopped	1 – Stopped
BI2	Running Forward	1 – Forward operation is running.
BI3	Running Reverse	1 – Reverse operation is running.
BI4	Tripped	1 – Fault occurred.
BI5	Accelerating	1 –Accelerating
BI6	Decelerating	1 –Decelerating
BI7	Reached Full Speed	1 –Running at a steady speed (frequency reference)
BI8	DC Braking	1 – Running on DC power source
BI9	Stopping	1–Stopping is in progress.
BI10	P1 Input	1–True / 0 - False
BI11	P2 Input	1–True / 0–False
BI12	P3 Input	1–True / 0–False
BI13	P4 Input	1–True / 0–False
BI14	P5 Input	1–True / 0–False
BI15	P6 Input	1–True / 0–False
BI16	P7 Input	1–True / 0–False
BI17	Relay1 State	1–On / 0 - Off
BI18	Relay2 State	1–On / 0 - Off
BI19	Relay3 State	1–On / 0 - Off
BI20	Relay4 State	1–On / 0 - Off
BI21	Relay5 State	1–On / 0 - Off
BI22	Q1 (OC1) State	1–On / 0 - Off

10.5.3.5 Error Code

Defined Codes	Description
00	The device has been reset. Currently waiting for the ‘Identity Yourself’ command.
01	Undefined command
02	Checksum error has occurred.
03	Data size exceeded the input buffer (message is bigger than the device buffer size).
05	Data field error (input message size does not fit the command type)
10	Invalid data (message value is out of the range)
11	Invalid command for data type (command does not fit the message frame)
12	Command is not accepted (device has ignored a command due to a fault. The master device sends a ‘Status Update Request’).

11 Troubleshooting

This chapter explains how to troubleshoot problems when the inverter protective functions are activated (faults and warnings). If the inverter does not work normally after following the suggested troubleshooting steps, contact BENSHAW Technical Support..

11.1 Trip and Warning

When the inverter detects a fault, it stops the operating (trips) and displays the fault message in the TRP (Trip) Group. Detailed information about the fault can be viewed on the LCD display at parameters TRP-01 ~ TRP-10. Warnings are also displayed at the TRP Group with the same details as the faults. When more than 2 trips occur at roughly the same time, the keypad displays the higher priority fault code. Use the [Up], [Down], [Left] or [Right] arrow buttons on the keypad to view the fault information. The fault conditions are categorized as follows:

Level: When the fault is corrected, the fault or warning signal is reset and the fault is not saved in the fault history.

Latch: When the fault is corrected and a reset is performed (keypad or external), the fault or warning signal clears. The fault is saved in the Fault History (TRP Group).

Fatal: When the fault is corrected, the fault or warning signal is reset only after the inverter power is cycled (Off then On), When powered off, wait until the charge indicator light goes off then turn the inverter on again. If the inverter is still in a faulted condition after powering it on again, please contact the supplier or the BENSHAW customer service center.

11.1.1 Faults

Protection Functions for Output Current and Input Voltage

<table>
<tr><th>LCD Display</th><th>Type</th><th>Description</th></tr>
<tr><td>Over Current1</td><td>Latch</td><td>Displayed when inverter output current exceeds 180% of the rated current.</td></tr>
<tr><td>Over Voltage</td><td>Latch</td><td>Displayed when internal DC bus voltage exceeds the specified value.
<table>
<tr><td rowspan="3">OV Fault</td><td>240V Inverter</td><td>410V ± 10</td></tr>
<tr><td>480V Inverter</td><td>820V ± 10</td></tr>
<tr><td>575V Inverter</td><td>980V ± 10</td></tr>
</table></td></tr>
<tr><td>Low Voltage</td><td>Level</td><td>Displayed when internal DC bus voltage is less than the specified value. NOTE: The LV Trip level will vary depending on MOT-10 (Input Voltage) setting.
<table>
<tr><td rowspan="3">Low voltage Fault</td><td>240V Inverter</td><td>180V ± 10</td></tr>
<tr><td>480V Inverter</td><td>360V ± 10</td></tr>
<tr><td>575V Inverter</td><td>430V ± 10</td></tr>
</table></td></tr>
<tr><td>Low Voltage2</td><td>Latch</td><td>Displayed when internal DC bus voltage is less than the</td></tr>
</table>

LCD Display	Type	Description
		specified value during inverter operation. Requires reset.
Ground Trip	Latch	Displayed when a ground fault occurs on the output side of the inverter and causes the current to exceed the specified value. The specified value varies depending on inverter capacity.
E-Thermal	Latch	Displayed based on inverse time-limit thermal characteristics to prevent motor overheating. Operates when PRT-40 is set to a value other than ‘0’.
Out Phase Open	Latch	Displayed when the 3-phase inverter output has one or more phases in an open circuit condition. Operates when bit 0 of PRT-05 is set to ‘1’.
In Phase Open	Latch	Displayed when the 3-phase inverter input has one or more phases in an open circuit condition. Operates only when bit 1 of PRT-05 is set to ‘1’.
Inverter OLT	Latch	Displayed when the inverter has been protected from overload and resultant overheating based on inverse time-limit thermal characteristics. Allowable overload rates for the inverter are 120% for 1 min (ND rating) and 140% for 5 sec.
No Motor Trip	Latch	Displayed when the motor is not connected during inverter operation. Operates when PRT-31 is set to ‘1’, Free-Run.
Over Load	Latch	Displayed when PRT-20 is set to a value other than ‘0’ and the conditions set with PRT-21 and PRT-22 are detecting a motor overload.
Under Load	Latch	Displayed when PRT- 27 is set to a value other than ‘0’ and the conditions set with parameters PRT-23 ~ PRT 28 are detecting an under load condition.
Ext-Brake	Latch	Displayed when output current is less than the brake release current (ADV-41) for longer than the brake release delay time (ADV-42).

Protection Functions Using Abnormal Internal Circuit Conditions and External Signals

LCD Display	Type	Description
Over Heat	Latch	Displayed when the temperature of the inverter heat sink exceeds the specified value.
Over Current2	Latch	Displayed when the DC circuit in the inverter detects a specified level of excessive, short circuit current.
External Trip	Latch	Displayed when an external fault signal is activated at the multi-function terminal. Set one of the multi-function input terminals at IN-65~71 to ‘4 (External Trip)’ to enable external trip.
BX	Level	Inverter Output Disable: Displayed when the inverter output is blocked by a signal activated at the multi-function terminal. Set one of the multi- function input terminals at IN-65~IN-71 to ‘5 (BX)’ to enable output block function.

LCD Display	Type	Description
H/W-Diag	Fatal	Displayed when an error is detected in the memory (EEPRom), analog-digital converter output (ADC Off Set) or CPU watchdog (Watch Dog-1, Watch Dog-2). EEP Err: An error in reading/writing parameters due to keypad or memory (EEPRom) fault. ADC Off Set: An error in the current sensing circuit (U/V/W terminal, current sensor, etc.).
NTC Open	Latch	Displayed when an error is detected in the temperature sensor of the Insulated Gate Bipolar Transistor (IGBT).
Fan Trip	Latch	Displayed when an error is detected in the cooling fan(s). Set PRT-79 to '0' to activate fan trip.
InFan Trip	Latch	Occurs when an abnormality is detected with the internal cooling fan(s). Applies to 150 ~ 800 HP. Activates when PRT-79 is set to 0 (Trip).
Thermal Trip	Latch	Triggered when the input from an external temperature sensor (PTC) is higher (or lower) than the level set by the user. Refer to parameters PRT-34 ~ PRT-38.
Lost KeyPad	Latch	Triggered when a communication error occurs between the keypad and the inverter, when the keypad is the command source, and PRT-11 (Lost KPD Mode) is set to any other value than '0'.
Fuse Open	Latch	Internal input fuse open for inverters 500 HP and larger.
TB Trip	Latch	Abnormality at the I/O TB PCB.
I/O Board Trip	Latch	Communication abnormality between I/O CPU PCB and Control PCB.
Check Line Plz	Level	Connection or communication issue between the LCD and the Control PCB.

H2 Pump related Faults

LCD Display	Type	Description
Damper Err	Latch	Triggered when the damper open signal or run command signal is longer than the value set at AP2-45 (Damper CheckT) during a fan operation.
PC Repeat Err	Latch	Triggered when the pump clean operation is operated frequently. The conditions may be modified with the AP2-36~ AP2-37 settings.
Pipe Broken	Latch	Triggered when a pipe is broken during the pump operation. Associated parameters PRT-60 ~ PRT-62.
Level Detect	Latch	Triggered when the inverter output current or power is lower or higher than the set values. Associated parameters PRT-

		71 ~ PRT-77.
Broken Belt	Latch	Triggered when PRT-91 is set to Free Run. Related settings in PRT-92 ~ PRT-95

Option Protection

LCD Display	Type	Description
Lost Command	Level	Displayed when a frequency or operation command error is detected during inverter operation by controllers other than the keypad (e.g., using a terminal block and a communication mode). Activate by setting PRT-12 to any value other than ‘0’.
IO Board Trip	Latch	Displayed when the I/O board or external communication card is not connected to the inverter or has a bad connection.
ParaWrite Trip	Latch	Displayed when communication fails during parameter writing. Occurs due to a control cable fault or a bad connection.
Option Trip-1	Latch	Displayed when a communication error is detected between the inverter and the communication board. Occurs when a communication option card is installed.

11.1.2 Warning Messages

LCD Display	Description
Over Load	Displayed when PRT-17 is set to ‘1 (Yes)’ to enable OL warning and motor is overloaded. Related parameters PRT-17 ~ PRT-19. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘5’ (Over Load)’ to receive the overload warning output signals.
Under Load	Displayed when PRT-25 is to ‘1 (Yes)’ and the motor is underloaded. Related parameters PRT-25 ~ PRT- Set output relays or Q1 (OUT-31–35 or OUT-36) to ’7 (Under Load)’ to receive the underload warning output signals.
INV Over Load	Displayed when the overload time equivalent to 60% of the inverter overheat protection (inverter IOLT) level is accumulated. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘6 (IOL)’ to receive the inverter overload warning output signal.
Lost Command	Lost command warning alarm occurs even with PRT-12 set to ‘0’. The warning alarm occurs based on the condition set at PRT-13-15. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘13 (Lost Command)’ to receive the lost command warning output signals.
Fan Warning	Displayed when an error is detected from the cooling fan while PRT-79 is set to’1 (Yes)’. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘8 (Fan Warning)’ to receive the fan warning output signals.
DB Warn %ED	Displayed when the DB resistor usage rate exceeds the set value. Set the detection level at PRT-66.

Fire Mode	Fire Mode forces the inverter to ignore certain faults and continues to operate. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘27 (Fire Mode)’ to receive the fire mode warning output signals.
Pipe Broken	Displayed when a pipe is broken during pump operation. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘28 (Pipe Broken)’ to receive the pipe break warning output signals.
Lost Keypad	Displayed when a communication error occurs between the keypad and the inverter, when PRT-11 (Lost KPD Mode) is set to any other value than ‘0’, and a run command is given from the keypad. Set output relays or Q1 (OUT-31–35 or OUT-36) to ‘24 (Lost KPD)’ to receive the lost keypad warning output signals.
Level Detect	Displayed during a level detect state. Set PRT-70 to ‘1 (warning)’ to enable.
Low Battery	Displayed when the RTC battery voltage drops to (or below) 2 V. To receive a warning output signal, set PRT-90 (Low Battery) to ‘Yes’.
Broken Belt	Displayed when PRT-91 is set to warning and the inverter senses the condition of a broken belt.
Load Tune	Displayed when the function of load tuning is not normal . Values of ‘AP2-03 and AP2-04’ are more than the values of ‘AP2-09 and AP2-10’.
PareWrite Fail	Displayed when the smart copier download/upload is not normal.
Rs Tune Err	Displayed when the function of Rs tuning is not normal . For example, auto tuning is performed without wiring the motor.
Lsig Tune Err	Displayed when the function of Lsigma tuning is not normal . For example, auto tuning is performed without wiring the motor.
KPD H.O.A Lock	If [DRV-05 KPD H.O.A Lock] is set to locked, message flashes for one second when any HAND-OFF-AUTO button is pressed.
InFan Warning	Occurs when an abnormality is detected in the cooling fan inside the inverter 150 HP ~ 800 HP (110 kW to 500 kW).
Backspin Time	Backspin timer is a protection function enabled when the timer (PRT-01) is set to any value above “0”. During the set time, inverter displays the warning message and ignores the run command signal and the fault auto reset & restart signals. After the PRT-01 Backspin Time expires, the inverter automatically restarts according to the reset & restart signal status.

11.2 Troubleshooting Faults

When a fault or warning occurs due to a protection function, refer to the following table for possible causes and remedies.

Type	Cause	Remedy
Over Load	The load is greater than the motor's rated capacity.	Ensure that the motor and inverter have appropriate capacity ratings.
	The set value for the overload trip level (PRT-21) is too low.	Increase the set value for the overload trip level.
Under Load	There is a motor-load connection problem.	Replace the motor and inverter with models with lower capacity.
	The set value for underload level (PRT-24) is less than the system's minimum load.	Reduce the set value for the underload level.
Over Current1	Acc/Dec time is too short, compared to load inertia (GD^2).	Increase Acc/Dec time.
	The inverter load is greater than the rated capacity.	Replace the inverter with a model that has increased capacity.
	The inverter supplied an output while the motor was idling.	Operate the inverter after the motor has stopped or use the speed search function (CON-70).
	The mechanical brake of the motor is operating too fast.	Check the mechanical brake.
Over Voltage	Deceleration time is too short for the load inertia (GD^2).	Increase the acceleration time.
	A generative load occurs at the inverter output.	Use the braking unit.
	The input voltage is too high.	Determine if the input voltage is above the specified value.
Low Voltage	The input voltage is too low.	Determine if the input voltage is below the specified value.
	A load greater than the power capacity is connected to the system (a welder, direct motor connection, etc.)	Increase the power capacity.
	The magnetic contactor connected to the power source has a faulty connection.	Replace the magnetic contactor.
Low Voltage2	The input voltage has decreased during the operation.	Determine if the input voltage is above the specified value.
	An input phase-loss has occurred.	Check the input wiring.
	The power supply magnetic contactor is faulty.	Replace the magnetic contractor.
Ground Trip	A ground fault has occurred in the inverter output wiring.	Check the output wiring.
	The motor insulation is damaged.	Replace the motor.
E-Thermal	The motor has overheated.	Reduce the load or operation frequency.
	The inverter load is greater than the rated capacity.	Replace the inverter with a model that has increased capacity.
	The set value for electronic thermal	Set an appropriate electronic thermal

Type	Cause	Remedy
	protection is too low.	level.
	The inverter has been operated at low speed for an extended duration.	Replace the motor with a model that supplies extra power to the cooling fan.
Out Phase Open	The magnetic contactor on the output side has a connection fault.	Check the magnetic contactor on the output side.
	The output wiring is faulty.	Check the output wiring.
In Phase Open	The magnetic contactor on the input side has a connection fault.	Check the magnetic contactor on the input side.
	The input wiring is faulty.	Check the input wiring.
	The DC bus capacitors need to be replaced.	Replace the DC bus capacitors. Contact the retailer or the BENSHAW customer service center.
Inverter OLT	The load is greater than the rated motor capacity.	Replace the motor and inverter with models that have increased capacity.
	The torque boost level is too high.	Reduce the torque boost level.
Over Heat	There is a problem with the cooling system.	Determine if a foreign object is obstructing the air inlet, outlet, or vent.
	The inverter cooling fan has been operated for an extended period.	Replace the cooling fan.
	The ambient temperature is too high.	Keep the ambient temperature below 50 C.
Over Current2	Output wiring is short-circuited.	Check the output wiring.
	There is a fault with the electronic semiconductor (IGBT).	Do not operate the inverter. Contact the retailer or the BENSHAW customer service center.
NTC Open	The ambient temperature is too low. There is a fault with the internal temperature sensor.	Keep the ambient temperature above - 10 C. Contact the retailer or the BENSHAW customer service center.
Fan Lock / In Fan	A foreign object is obstructing the fan's air vent.	Remove the foreign object from the air inlet or outlet.
	The cooling fan needs to be replaced.	Replace the cooling fan.
Check Line Plz	LCD communication issue.	Check: 1. LCD Cable(s) and Connections 2. Change LCD 3. Replace Control PCB

11.3 Troubleshooting Other Faults

When a fault other than those identified as faults or warnings occurs, refer to the following table for possible causes and remedies.

Type	Cause	Remedy
Parameters cannot be set.	The inverter is in operation (driving mode).	Stop the inverter to change to program mode and set the parameter.
	The parameter access is incorrect.	Check the correct parameter access level and set the parameter.
	The password is incorrect.	Check the password, disable the parameter lock and set the parameter.
	Low voltage is detected.	Check the power input to resolve the low voltage and set the parameter.
The motor does not rotate.	The frequency command source is set incorrectly.	Check the frequency command source setting.
	The operation command source is set incorrectly.	Check the operation command source setting.
	Power is not supplied to the terminal R/S/T.	Check the terminal connections R/S/T and U/V/W.
	The charge lamp is turned off.	Turn on the inverter.
	The operation command is off.	Turn on the operation command. (RUN).
	The motor is locked.	Unlock the motor or lower the load level.
	The load is too high.	Operate the motor independently.
	An emergency stop signal is input.	Reset the emergency stop signal.
	The wiring for the control circuit terminal is incorrect.	Check the wiring for the control circuit terminal.
	The input option for the frequency command is incorrect.	Check the input option for the frequency command.
	The input voltage or current for the frequency command is incorrect.	Check the input voltage or current for the frequency command.
	The PNP/NPN mode is selected incorrectly.	Check the PNP/NPN mode setting.
	The frequency command value is too low.	Check the frequency command and input a value above the minimum frequency.
	The [OFF] button is pressed.	Check that the stop state is normal, if so resume operation normally.
	Motor torque is too low.	Increase the amount of the torque boost. If the fault remains, replace the inverter with a model with increased capacity.
The motor rotates in the opposite direction to the command.	The wiring for the motor output cable is incorrect.	Determine if the cable on the output side is wired correctly to the phase (U/V/W) of the motor.
	The signal connection between the control circuit terminal (forward/reverse rotation) of the inverter and the forward/reverse rotation signal on the	Check the forward/reverse rotation wiring.

Type	Cause	Remedy
	control panel side is incorrect.	
The motor only rotates in one direction.	Reverse rotation prevention is selected.	Remove the reverse rotation prevention.
	The reverse rotation signal is not provided, even when a 3-wire sequence is selected.	Check the input signal associated with the 3-wire operation and adjust as necessary.
The motor is overheating.	The load is too heavy.	Reduce the load. Increase the Acc/Dec time.
		Check the motor parameters and set the correct values.
		Replace the motor and the inverter with models with appropriate capacity for the load.
	The ambient temperature of the motor is too high.	Lower the ambient temperature of the motor.
	The phase-to-phase voltage of the motor is insufficient.	Use a motor that can withstand phase-to-phase voltages surges greater than the maximum surge voltage.
		Only use motors suitable for applications with inverters.
		Connect the AC reactor to the inverter output (set the carrier frequency to 3 kHz).
	The motor fan has stopped or the fan is obstructed with debris.	Check the motor fan and remove any foreign objects.
The motor stops during acceleration.	The load is too high.	Reduce the load.
		Increase the amount of the torque boost.
		Replace the motor and the inverter with models with capacity appropriate for the load.
	The current is too big.	If the output current exceeds the rated load, decrease the torque boost.
The motor stops when connected to load.	The load is too high.	Reduce the load.
		Replace the motor and the inverter with models with capacity appropriate for the load.
The motor does not accelerate.	The frequency command value is low.	Set an appropriate value.
	The load is too high.	Reduce the load and increase the acceleration time. Check the mechanical brake status.
The acceleration time is too long.	The acceleration time is too long.	Change the acceleration time.
	The combined values of the motor properties and the inverter parameter are incorrect.	Change the motor related parameters.
	The stall prevention level during acceleration is low.	Change the stall prevention level.
	The stall prevention level during operation is low.	Change the stall prevention level.

Type	Cause	Remedy
Motor speed varies during operation.	There is a high variance in load.	Replace the motor and inverter with models with increased capacity.
	The input voltage varies.	Reduce input voltage variation.
	Motor speed variations occur at a specific frequency.	Adjust the output frequency to avoid a resonance area.
The motor rotation is different from the setting.	The V/F pattern is set incorrectly.	Set a V/F pattern that is suitable for the motor specification.
The motor deceleration time is too long even with Dynamic Braking (DB) resistor connected.	The deceleration time is set too long.	Change the setting accordingly.
	The motor torque is insufficient.	If motor parameters are normal, it is likely to be a motor capacity fault. Replace the motor with a model with increased capacity.
	The load is higher than the internal torque limit determined by the rated current of the inverter.	Replace the inverter with a model with increased capacity.
While the inverter is in operation, a control unit malfunctions, or noise occurs.	Noise occurs due to switching inside the inverter.	Change the carrier frequency to the minimum value.
		Install a micro surge filter in the inverter output.
When the inverter is operating, the earth leakage breaker is activated.	An earth leakage breaker will interrupt the supply if current flows to ground during inverter operation.	Connect the inverter to a ground terminal.
		Check that the ground resistance is less than 100Ω for 200 V inverters and less than 10Ω for 400 V inverters.
		Check the capacity of the earth leakage breaker and make the appropriate connection, based on the rated current of the inverter.
		Lower the carrier frequency.
		Make the cable length between the inverter and the motor as short as possible.
The motor vibrates severely and does not rotate normally.	Phase-to-phase voltage of 3-phase power source is not balanced.	Check the input voltage and balance the voltage.
		Check and test the motor's insulation.
The motor makes humming, or loud noises.	Resonance occurs between the motor's natural frequency and the carrier frequency.	Slightly increase or decrease the carrier frequency.
	Resonance occurs between the motor's natural frequency and the inverter's output frequency.	Slightly increase or decrease the carrier frequency.
		Use the frequency jump function to avoid the frequency band where resonance occurs.
The motor vibrates/hunts.	The frequency input command is an external, analog command.	In situations of noise inflow on the analog input side that results in command interference, change the

Type	Cause	Remedy
		input filter time constant (IN-07).
	The wiring length between the inverter and the motor is too long.	Ensure that the total cable length between the inverter and the motor is less than 200 m (50 m for motors rated 3.7 kW or lower).
The motor does not come to a complete stop when the inverter output stops.	It is difficult to decelerate sufficiently, because DC braking is not operating normally.	Adjust the DC braking parameter.
		Increase the set value for the DC braking current.
		Increase the set value for the DC braking stopping time.
The output frequency does not increase to the frequency reference.	The frequency reference is within the jump frequency range.	Set the frequency reference higher than the jump frequency range.
	The frequency reference is exceeding the upper limit of the frequency command.	Set the upper limit of the frequency command higher than the frequency reference.
	Because the load is too heavy, the stall prevention function is working.	Replace the inverter with a model with increased capacity.
The cooling fan does not rotate.	The control parameter for the cooling fan is set incorrectly.	Check the control parameter setting for the cooling fan.

12 Maintenance

This chapter explains:
- Periodic Inspections
- Storage and Disposal of the product.

The Benshaw model H2 series inverters are an industrial electronic product with advanced semiconductor components. A reasonable life expectancy of 8 to 10 years can be expected however, there are factors that may affect their continued long-term operation. Environmental issues (temperature and humidity) and mechanical issues (vibration and connections) are the most common reasons for premature failure of inverters. To avoid problems, it is recommended to perform periodic inspections of the inverter.

Caution
- Be sure to remove the drive's power input while performing maintenance. Lock out all sources of power.
- Preventive maintenance should always be performed by a trained technician.
- Be sure to perform maintenance only after checking that the DC bus voltage has discharged. The voltage between terminal P1-N (or P2-N) should be less than 30VDC. The DC bus capacitors in the electronic circuit can still be charged even after the power is turned off. The DC bus LED is not a definitive indication of the absence of DC voltage.

12.1 Periodic Inspection Summary

Refer to the attached Table for specific frequency of inspection.

- **The conditions of the installed location**
  - Observe any physical damage to enclosure or enclosure degradation.
  - Any signs of liquid leakage into the enclosure.
  - Any signs of corrosion or rust resulting from leakage into the enclosure.

- **The conditions of the inverter cooling. Causes for abnormal heating are:**
  - Check for any deposits or dirt inside the enclosure, in the cooling fans/filters and the inverter fan(s). Remove with compressed air.
  - Check the rotating condition of the cooling fan(s).

- **Abnormal vibration**
  - Are there any loose nuts or bolts because of the vibration?
  - Loose connections will show signs of heated connectors and wires. Tighten or replace.

12.2 Periodic Inspection Items

	Inspection Item	Inspection	Period: Monthly	Period: 1 year	Period: 2 year	Inspection Method	Criterion	Customer use: Check/ Initial /Date
Environment	Ambient Temperature/ Humidity	Is the ambient temperature and humidity within the design range?	X			Measure/ Monitor (Thermometer, Hygrometer, Recorder)	Temperature: -10°C~+40°C	
							Humidity: Under 90% non-condensing	
Physical Inspection	Physical	Any signs of physical damage to the enclosure of the inverter?		X		Visual	Yes/No	
		Any signs of liquid leaking into enclosure of the inverter?		X				
		Are there any signs of rust inside the inverter enclosure?		X				
		Are there any signs of rust inside the panel where the inverter is housed.?		X				
		Are there any abnormal vibrations or oscillations of the inverter/Panel?		X				
	Physical (Cables and Connections)	Are there any signs of overheated connections (discolored lugs, insulation melted)?		X		Visual	Yes/No	
		Are there any signs of rusted or corroded connections?		X				
		Are there any signs of cracked terminal blocks?		X				
		Is there any damage to cable insulation?		X				
	Physical (Fans)	Inspect fans and filters for debris and dust accumulation.	X					
		Inspect fans for free rotation.	X					
Non-Powered inverter Checks/Measurements	IGBT Module	Check the resistance between each of the terminals.			X	Disconnect the inverter three phase input and measure the resistance between R, S, T and P, N.	Refer to "How to Check Power Components" using Digital or Analog meter.	
	Input Diode/SCR Modules					Disconnect the inverter three phase output and measure the resistance between U, V, W and P, N.		
	DC Bus Capacitors	Is there any visible leakage coming out?			X	Visual check	Yes/No	

	Inspection Item	Inspection	Period: Monthly	Period: 1 year	Period: 2 year	Inspection Method	Criterion	Customer use: Check/ Initial /Date
		Inspect the pressure relief vent (or pin). Is there any swelling or rupture?			X			
	Motor (Note 1)			X		Megger Test	500 MΩ	
Powered inverter - Not Running Checks/Measurements	Input Voltages	Is the input voltage from the main within spec of the inverter?		X		Measure the voltage between the terminals R, S, T.	inverter rating +/-15%	
		Is the input voltage from the main balanced within spec of the inverter?			X		2%	
	DC Bus Voltage	Is the DC Bus Higher or Lower than normal?			X	Measure the DC Voltage between the Pos. and Neg. terminals of the inverter.	Input Voltage x SQRT2 (+/- 10%)	
	Cooling Fan	Is there any abnormal oscillations or noise?		X		Turn OFF the power and turn the fan by hand.	Must rotate smoothly.	
	Trip Circuit (Input to inverter)	Is inverter trip circuit functional?		X		Identify the inverter input trip circuit. Open or Close external trip mechanism.	inverter must trip.	
Powered inverter - Running Checks/Measurements	Output Voltages	Is there any voltage imbalance between phases of the output?			X	Measure the voltage between the output terminals U, V and W.	Tol. +/- 2%230V (5V)460V (10V).	
		Does the displayed Output Voltage agree with measurement?			X	Display parameter for Output Voltage, compare to measured value.	Tol. -10% + 20% Note 2	
	Output Current	Is there any current imbalance between phases of the output?			X	Measure the current out of each phase U, V, W.	Tol. +/-3% Note 2	
		Does the displayed Output Current agree with measurement?			X	Display parameter for Output Current, compare to measured value.	Tol. +/-5% Note 2	
	Motor	Are there any abnormal vibrations or noise?		X		Auditory, sensory, visual check.	Mounting and Coupling	
		Is there any unusual odor?		X		Check for overheat and damage.		
Note 1	Do not run an insulation resistance test (Megger) on the inverter or with inverter connected to supply and motor, damage will occur.							
Note 2	Multimeter measurements of inverter output could vary depending on the type of meter.							

12.3 Storage

If you are not using the product for an extended period, adhere to the following guidelines:

- Store the product in the same environmental conditions as specified. Refer to section 0.
  - When storing the product for a period longer than 3 months, store it between 14°F and 86°F
  - (-10˚Cto 30˚C) to prevent depletion of the electrolytic capacitors. *See Caution below.*
  - Do not expose the inverter to snow, rain, fog, or dust.
  - Package the inverter in a way that prevents contact with moisture. Keep the moisture level below 70% in the package by including a desiccant, such as silica gel.
  - Do not allow the inverter to be exposed to dusty or humid environments. If the inverter is installed in such environments (for example, a construction site) and the inverter will be unused for an extended period, remove the inverter and store it in a safe place.

> Caution
> If the VFD has been stored for one year, capacitors start to lose their charging characteristics and can become depleted. To prevent depletion, turn on the product once a year and allow the device to operate for 30-60 min. Run the device under no-load conditions.

12.4 Disposal

When disposing of the product, categorize it as general industrial waste. Recyclable materials are included in the product, so recycle them whenever possible. The packing materials and all metal parts can be recycled. The plastic can also be recycled.

13 Technical Specifications

13.1 Input and Output Specifications

240 V, 7.5 HP - 25 HP (5.5–18.5 kW)

Model **VFD-RSI-XXX–H2-2C**			**007**	**010**	**015**	**020**	**025**
240V 3φ Input	Normal Duty 120% OL	HP	7.5	10	15	20	25
		kW	5.5	7.5	11	15	18.5
		Amps	22	30	42	56	69
	Heavy Duty 150% OL	HP	5	7.5	10	15	20
		kW	3.7	5.5	7.5	11	15
		Amps	17	24	32	46	60
240V 1φ Input	Normal Duty 120% OL	HP	3.0	5.0	7.5	10.0	-
		Amps	11	16	23	30	37
Rated Output	Rated Capacity (kVA)		8.4	11.4	16.0	21.3	26.3
	Output Frequency		0–400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)				
	Output Voltage (V)		3-Phase 0–240 V				
Rated Input	Voltage (V)	Three-Phase	3-Phase 200–240 VAC (-15%–+10%)				
		Single-Phase	1-Phase 240 VAC (-5%–+10%)				
	Input Frequency	Three- Phase	50–60 Hz (+/-5%)				
		Single- Phase	60 Hz (+/-5%) only				
	Rated Current (A)		23.7	32.7	46.4	62.3	77.2
Weight lbs. (kg)			7.3 (3.3)	7.3 (3.3)	7.3 (3.3)	10.1 (4.6)	15.6 (7.1)
Heat Dissipation (W)			180	248	330	451	600
Degree of Protection			IP20, UL Open (UL Type 1 achieved with optional conduit box)				

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on a 220 V supply voltage for 240 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

240 V, 30 HP - 125 HP (22 kW - 90 kW)

Model VFD-RSI-XXX–H2-2C			030	040	050	060	075*	100*	125*
240V 3φ Input	Normal Duty 110%*/120% OL	HP	30	40	50	60	75	100	125
		kW	22	30	37	45	55	75	90
		Amps	82	110	142	169	223	264	325
	Heavy Duty 150% OL	HP	25	30	40	50	60	75	100
		kW	18.5	22	30	37	45	55	75
		Amps	68	81	106	136	169	195	255
240V 1φ Input	Normal Duty 110%*/120% OL	HP	15	20	25	30	40	50	60
		Amps	45	58	78	92	122	145	178
Rated Output	ND Rated Capacity (kVA)		31.2	41.9	54.1	64.4	85	100.6	123.8
	Output Frequency		0–400 Hz (V/Hz, Slip Comp.)						
	Output Voltage (V)		3-Phase 0–240 V						
Rated Input	Voltage (V)	Three-Phase	3-Phase 200–240 VAC (-15%–+10%)						
		Single-Phase	1-Phase 240 VAC (-5%–+10%)						
	Input Frequency	Three-Phase	50–60 Hz (+/-5%)						
		Single-Phase	60 Hz (+/-5%) only						
	Rated Current (A)		74.8	101	131.2	159	211.1	251.4	313.2
Weight lbs. (kg)			55.8 (25.3)	72.5 (32.9)	86.4 (39.2)	90.6 (41.1)	118.2 (53.6)	121.9 (55.3)	159.2 (72.2)
Heat Dissipation (W)			893	1245	1480	1814	2150	2963	3438
Degree of Protection			UL Open (IP20), UL Type 1 achieved with optional conduit box						

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on a 220 V supply voltage for 240 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

480 V, 7.5 HP - 30 HP (5.5–22 kW)

Model **VFD-RSI-XXX–H2-4C**			**007**	**010**	**015**	**020**	**025**	**030**
480V 3φ Input	Normal Duty 120% OL	HP	7.5	10	15	20	25	30
		kW	5.5	7.5	11	15	18.5	22
		Amps	12	16	24	30	38	45
	Heavy Duty 150% OL	HP	5.0	7.5	10	15	20	25
		kW	3.7	5.5	7.5	11	15	18.5
		Amps	8	12	15	22	28	35
480V 1φ Input	Normal Duty 120% OL	HP	3-5	5	10	10	15	20
		Amps	6.8	9.2	14	17	22	26
Rated Output	Rated Capacity (kVA)		9.1	12.2	18.3	23.0	29.0	34.3
	Output Frequency		0–400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)					
	Output Voltage (V)		3-Phase 0–480 V					
Rated Input	Voltage (V)	Three-Phase	3-Phase 380–480 VAC (-15%–+10%)					
		Single-Phase	1-Phase 480 VAC (-5%–+10%)					
	Input Frequency	Three-Phase	50–60 Hz (+/-5%)					
		Single-Phase	60 Hz (+/-5%) only					
	Rated Current (A)		12.2	17.5	26.5	33.4	42.5	50.7
Weight lbs. (kg)			7.3 (3.3)	7.3 (3.3)	7.5 (3.4)	10.1 (4.6)	10.6 (4.8)	16.5 (7.5)
Heat Dissipation (W)			172	237	322	451	615	740
Degree of Protection			IP20, UL Open (UL Type 1 achieved with optional conduit box)					

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on a 440 V supply voltage for 480 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

480 V, 40 HP - 125 HP (30.0–90.0 kW)

Model VFD-RSI-XXX–H2-4C			040	050	060	075	100	125
480V 3φ Input	Normal Duty 120% OL	HP	40	50	60	75	100	125
		kW	30	37	45	55	75	90
		Amps	61	75	91	107	142	169
	Heavy Duty 150% OL	HP	30	40	50	60	75	100
		kW	22	30	37	45	55	75
		Amps	41	55	67	81	106	136
480V 1φ Input	Normal Duty 120% OL	HP	25	30	30	40	50-60	60
		Amps	36	39	47	55	73	86
Rated Output	Rated Capacity (kVA)		46.5	57.1	69.4	82.0	108.2	128.8
	Output Frequency		0–400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)					
	Output Voltage (V)		3-Phase 0–480 V					
Rated Input	Voltage (V)	Three-Phase	3-Phase 380–480 VAC (-15%–+10%)					
		Single- Phase	1-Phase 480 VAC (-5%–+10%)					
	Input Frequency	Three- Phase	50–60 Hz (+/-5%)					
		Single- Phase	60 Hz (+/-5%) only					
	Rated Current (A)		69.1	69.3	84.6	100.1	133.6	160.0
Weight lbs. (kg)			16.5 (7.5)	57.3 (26)	77.2 (35)	77.2 (35)	94.8 (43)	94.8 (43)
Heat Dissipation (W)			880	1170	1443	1710	2090	2775
Degree of Protection			IP20, UL Open (UL Type 1 achieved with optional conduit box)					

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on a 440 V supply voltage for 480 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

480 V, 150 HP - 800 HP (110.0–500.0 kW)

Model **VFD-RSI-XXX–H2-4C**			**150**	**200**	**250**	**300**	**400**	**500**	**650**	**800**
480V 3φ Input	Normal Duty 110% OL	HP	150	200	250	300	400	500	650	800
		kW	110	132	160	185	250	315	400	500
		Amps	223	264	325	370	481	613	770	962
	Heavy Duty 150% OL	HP	125	150	200	250	300	400	500	600
		kW	90	110	132	160	185	250	315	375
		Amps	169	195	255	303	375	478	591	740
Rated Output	Rated Capacity (kVA)		170	201	248	282	367	467	587	733
	Output Frequency		0–400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless)							
	Output Voltage (V)		3-Phase 0–480 V							
Rated Input	Voltage (V)	Three-Phase	3-Phase 380–500VAC (-15%–+10%)							
	Input Frequency	Three-Phase	50–60 Hz (+/-5%)							
	Rated Current (A)		215.1	254.6	315.3	358.9	469.3	598.1	751.3	938.6
Weight lbs. (kg)			123 (55.8)	123 (55.8)	164.7 (74.7)	164.7 (74.7)	264.6 (120)	409 (185.5)	409 (185.5)	584 (265)
Heat Dissipation (W)			3960	4752	5600	6475	8500	10.4k	13.2k	16k
Degree of Protection			7.5HP ~ 300 HP (5.5kW ~ 185kW): IP20, UL Open (UL Type 1 achieved with optional conduit box). 400 HP ~ 800 HP (250kW ~ 500kW): IP00, UL Open (UL Type 1 achieved with optional conduit box).							

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on a 440 V supply voltage for 480 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

575 V, 7.5 HP - 30 HP (5.5–22 kW)

Model VFD-RSI-XXX–H2-61			**007**	**010**	**015**	**020**	**025**	**030**
575V 3φ Input	Normal Duty 110% OL	HP	7.5	10	15	20	25	30
		kW	5.5	7.5	11	15	18.5	22
		Amps	9	12	17	23	27	34
	Heavy Duty 150% OL	HP	5	7.5	10	15	20	25
		kW	3.7	5.5	7.5	11	15	18.5
		Amps	6.6	9	12	17	23	27
Rated Output	ND Rated Capacity (kVA)		9	12	16.9	22.9	26.9	33.9
	Output Frequency		0–120 Hz (V/Hz, Slip Comp., IM Sensorless)					
	Output Voltage (V)		3-Phase 0–600 V					
Rated Input	Voltage (V)	Three- Phase	3-Phase 525-600 VAC (-15%–+10%)					
	Input Frequency	Three- Phase	60 Hz (+/-5%)					
	ND Rated Current (A)		8	10.7	15.3	20.9	25	30.8
	HD Rated Current (A)		6.5	8.9	12	17.2	23.5	27
Weight lbs.			20.86	21.21	21.87	22.09	22.35	31.53
(kg)			(9.46)	(9.62)	(9.92)	(10.02)	(10.14)	(14.3)
Heat Dissipation (W)			132	167	266	478	696	799
Degree of Protection			UL Type 1 with installed conduit box					

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on the Normal Duty rating and 575 V for 575 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

575 V, 40 HP - 125 HP (30.0–90.0 kW)

Model VFD-RSI-XXX–H2-6C			**040**	**050**	**060**	**075**	**100**	**125**
575V 3φ Input	Normal Duty 110% OL	HP	40	50	60	75	100	125
		kW	30	37	45	55	75	90
		Amps	43	55	64	80	104	128
	Heavy Duty 150% OL	HP	30	40	50	60	75	100
		kW	22	30	37	45	55	75
		Amps	34	43	55	64	80	104
Rated Output	ND Rated Capacity (kVA)		42.8	54.8	63.7	79.7	103.6	127.5
	Output Frequency		0–120 Hz (V/Hz, Slip Comp., IM Sensorless)					
	Output Voltage (V)		3-Phase 0–600 V					
Rated Input	Voltage (V)	Three-Phase	3-Phase 525-600 VAC (-15%–+10%)					
	Input Frequency	Three-Phase	60 Hz (+/-5%)					
	ND Rated Current (A)		40.2	52	60	74	102	123
	HD Rated Current (A)		35.2	45	57	65	87	110
Weight lbs.			32.32	55.07	74.12	74.25	96.12	96.43
(kg)			(14.66)	(24.98)	(33.62)	(33.68)	(43.60)	(43.74)
Heat Dissipation (W)			786	954	1327	1559	1850	2355
Degree of Protection			IP20, UL Open (UL Type 1 achieved with optional conduit box)					

- The horse power rating is based on a standard 4-pole motor rating.
- The KVA rating is based on the Normal Duty rating and 575 V for 575 V inverters.
- The rated output current is limited based on the carrier frequency set at CON-04.

13.2 Product Specification Details

Items		Description	
Control	Control method	V/F control, Slip Compensation, Sensorless Vector (IM* and PM**) with Torque Limits (240V and 480V only) * IM Sensorless does not apply to 240V, 30HP~125HP. ** PM Sensorless does not apply to 240V, 30HP~125HP, 480V, 150HP~800HP and all 575V inverters.	
	Frequency setting resolution	Digital command: 0.01 Hz Analog command: 0.06 Hz (60 Hz standard)	
	Frequency accuracy	1% of maximum output frequency	
	V/F pattern	Linear, Square reduction, User V/F	
	Overload capacity (Normal Duty)	240V, 7.5 HP ~ 60 HP	120% / 1 min.
		240V, 75 HP ~ 125 HP	110% / 1 min.
		480V, 7.5 HP ~ 125 HP	120% / 1 min.
		480V, 150 HP ~ 800 HP	110% / 1 min.
		575V, 7.5 HP ~ 125 HP	110% / 1 min.
	Overload capacity (Heavy Duty)	240V, 5.0 HP ~ 100 HP	150% / 1 min.
		480V, 5.0 HP ~ 600 HP	150% / 1 min.
		575V, 5.0 HP ~ 100 HP	150% / 1 min.
	Torque boost	Manual torque boost, automatic torque boost	
Operation	**Operation Type**		
	Start/Stop	Keypad, Terminal Strip, Communications	
	Frequency (Speed) Settings	Analog Inputs: (1) 0–10 V, (1) 0/4–20 mA, Switch selectable to 0–10 Vdc	
		Digital Inputs: Keypad, Fixed Speed, Pulse Train	
		Communications: RS-485 (Modbus), Metasys-N2, BACnet, Fieldbus Options	
	Functions	**Basic**	**Advanced**
		Quick Start Menu	Sensorless Vector Control*
		Start/Stop Operation	IM* and PM** motors
		Start/Stop Modes	Auto Tuning
		Frequency Reference Sources	Torque Limits
		Auxiliary Frequency Reference	PID Control
		Multi-Step Speeds	Slip Compensation
		Multi-Step Accel/Decel Times	Event Timer (RTC)
		2nd Source (HOA)	Energy Save Mode
		Accel/Decel Times	Regen Avoidance
		Accel/Decel Patterns	VFD Fan Control
		Dwell Frequency Operation	
		Jog	**Other**
		Auto Start	Timer Relay Input/Output Function
		Auto Reset/Restart	Pre Heat
		Jog and Jog Start	Oil Pump Starter Control
		FWD/REV Run Prevention	Damper Monitor and Control

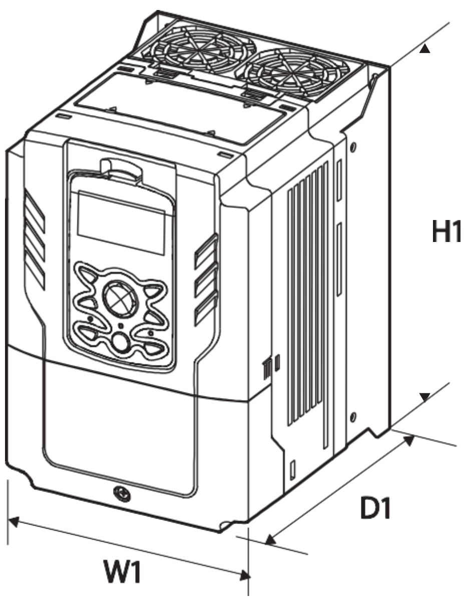
Items			Description		
			Frequency Limits		
			Jump Frequencies		**Loss of Power**
			3-Wire Control		Ride Through (KEB)
			Fire Mode		Safe Stop
					Speed Search
			V/Hz. Control Pattern		
			Linear, Squared, User V/Hz		**Braking**
			Torque Boost		DC Injection Braking
					Stall Prevention
					Power Braking
					Flux Braking
					External Brake Control
			H2 Pump Software		
			Lead/Lag and Alternating		Broken Pipe Detection
			Jockey Pump Control		BACnet and Metasys-N2
			MMC - Multi-Motor Control		Pump Load Tuning
			Pre-Fill, Soft Fill		Decel Valve Ramp
			Start and End Ramp		Time Event Scheduling
			Backspin Timer		Flow Compensation
			Pump Clean Operation		Energy Saving Operation
	Input	Analog	(1) 0–10 V, (1) 0/4–20 mA, Switch selectable to 0–10 Vdc		
	Input	Digital inputs	(7), Select PNP (Source) or NPN (Sink) mode. NO/NC selectable. Functions of the digital inputs are set with parameters IN-65 through IN-71.		
	Input	Functions	Forward/Reverse Operation Reset External Trip Emergency Stop Output Disable (Bx) Jog Fixed Speed - Step Freq's Run Enable/Disable (Safety) 3-Wire Control Select Damper Monitor and Control		2nd Source - HOA/LOR Up/Down Operation Analog Hold PID Disable Jog Start FWD/REV Pre-Excite Timer Input Fire Mode Event Timer Pre-Heat
	Input	Pulse train	0–32 kHz, Low Level: 0–0.8 V, High Level: 3.5–12 V		
	Output	(1) Fault relay (Form C)	N.O.: Less than AC 250 V, 2A, DC 30 V, 3A N.C.: Less than AC 250 V, 1A, DC 30 V, 1A		
	Output	(4)Programmable relays (Form A)	N.O.: Less than AC 250 V, 5 A Less than DC 30 V, 5 A		
	Output	(1) open collector terminal	Less than DC 26 V, 50 mA		
	Output	(2) Analog Outputs	AO1: 0(4) - 20 mA, Switch selectable to 0–10 Vdc AO2: 0-10VDC Frequency, Current, Voltage, Power, DC Bus Voltage, Fixed, more.		
	Output	Pulse train	Maximum 32 kHz, 0–12 V		

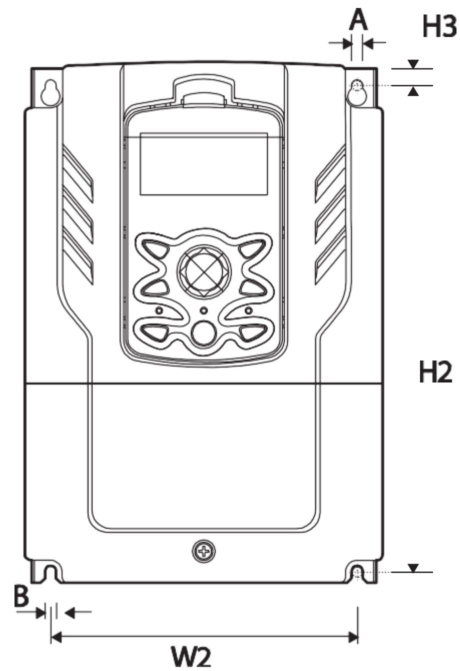
Items		Description
Protection functions	Trip	Motor Over Load Under Load Over Current 1 Over Voltage Low Voltage Low Voltage2 Ground Fault E-Thermal Out Phase Open In Phase Open Inverter Over Load No Motor Trip Inverter Over Heat Over Current 2 External Trip Hardware Diagnostic Fan Trip Internal Fan Trip Motor Over Heat (PTC Input) Lost Keypad Fuse Open Pipe Broken Broken Belt Lost Speed Reference I/O Board Trip **Fan/Pump related trips** Damper Trip Level Detect Trip Pump Cleaning Trip
	Alarm	Overload/underload, Lost Command, Inverter overload, DB (braking) rate alarm, Pump Clean, Pipe Broken, Broken Belt, Fire Mode, Level Detection (LDT).
	Instantaneous Power Loss	Less than 8 ms: Continue Operation More than 8 ms: KEB and/or Auto restart operation
Structure/ working environment	Cooling type	Forced fan cooling structure
	Protection structure	UL Open, IP 20: 7.5 HP ~ 300 HP (5.5 kW ~ 185 kW) UL Open, IP 00: 400 HP ~ 800 HP (250 kW ~ 500kW) UL Type 1 with conduit box (option) installation (up to 800 HP).
	Ambient temperature	14°F~104°F (- 10°C~40°C) 2.5% / amp current derating up to 122°F (50°C) max. No ice or frost should be present.
	Ambient humidity	Relative humidity less than 95% RH (to avoid condensation)
	Storage temperature.	-4°F–149°F (-20°C - 65°C)
	Environment	Prevent contact with corrosive gases, flammable gases, oil stains, dust, and other pollutants. 7.5 HP ~ 800 HP (5.5 kW ~ 500 kW) Pollution Degree 2
	Altitude	Maximum 3,280 ft (1,000m) above sea level for standard operation. Above derate the drive rated voltage and the rated output current by 1% for every 328 ft (100m) up to 13,123 ft (4,000m) max.
	Vibration	Less than 1.0 G (9.8 m/sec^2).
	Pressure	10 ~ 15 PSI (70-106 kPa)

* IM Sensorless: Does not apply to 240V, 30~125 HP inverters.
** PM Sensorless: Does not apply to 240V, 30~125 HP, 480V, 150~800 HP and all 575V Inverters.

13.3 External Dimensions

240V: 7.5 HP ~ 15 HP (5.5 kW ~ 11 kW)
480V: 7.5 HP ~ 15 HP (5.5 kW ~ 11 kW)





240V

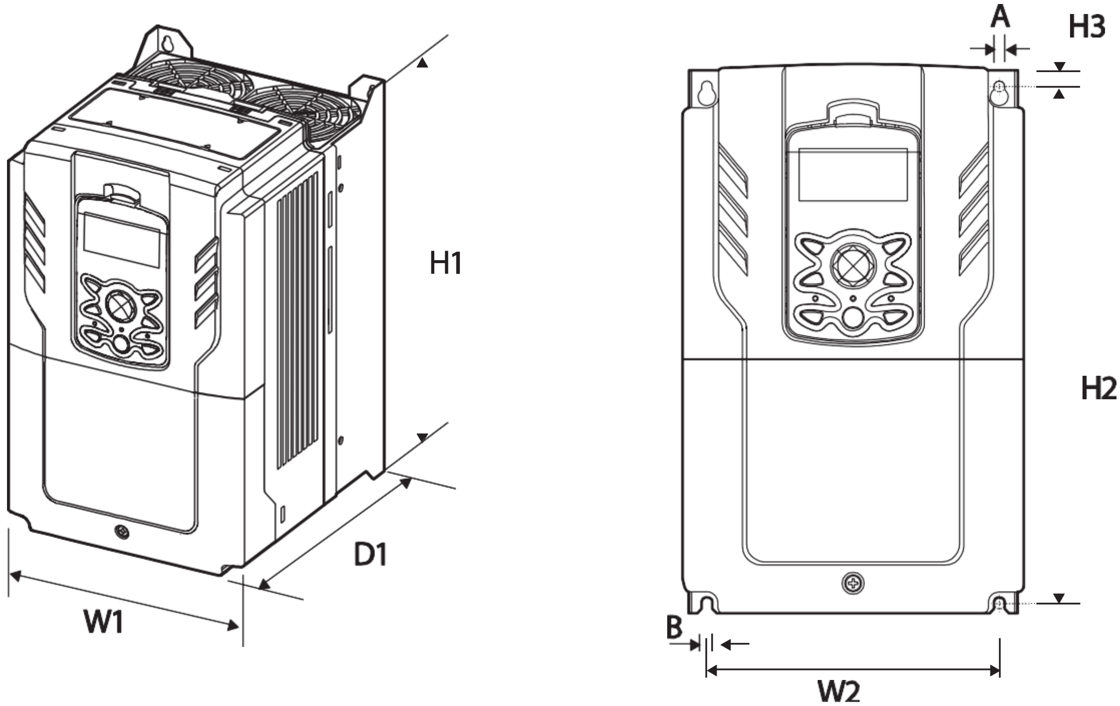
kW	HP	VFD	H1	H2	H3	W1	W2	D1	A	B
5.5	7.5	VFD-RSI-007-H2-2C	9.13 (232)	8.52 (216.5)	0.41 (10.5)	6.30 (160)	5.39 (137)	7.13 (181)	0.20 (5)	0.20 (5)
7.5	10	VFD-RSI-010-H2-2C								
11	15	VFD-RSI-015-H2-2C								

480V

kW	HP	VFD	H1	H2	H3	W1	W2	D1	A	B
5.5	7.5	VFD-RSI-007-H2-4C	9.13 (232)	8.52 (216.5)	0.41 (10.5)	6.30 (160)	5.39 (137)	7.13 (181)	0.20 (5)	0.20 (5)
7.5	10	VFD-RSI-010-H2-4C								
11	15	VFD-RSI-015-H2-4C								

Units: Inches (mm)

240V: 20 HP ~ 25 HP (15 ~ 18.5 kW)
480V: 20 HP ~ 40 HP (15 ~ 30 kW)



240V

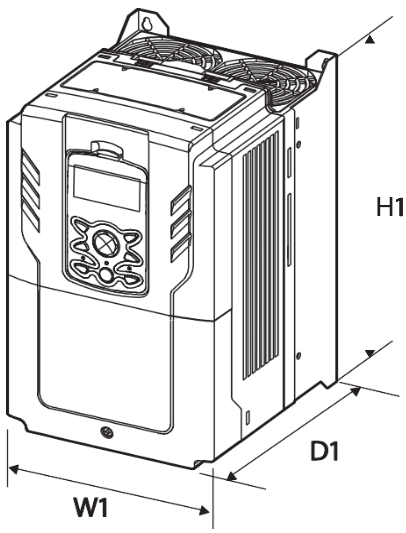
kW	HP	VFD	H1	H2	H3	W1	W2	D1	A	B
15	20	VFD-RSI-020-H2-2C	11.42 (290)	10.78 (273.7)	0.45 (11.3)	7.09 (180)	6.18 (157)	8.08 (205.3)	0.20 (5)	0.20 (5)
18.5	25	VFD-RSI-025-H2-2C	13.78 (350)	13.03 (331)	0.51 (13)	8.66 (220)	7.63 (193.8)	8.79 (223.2)	0.24 (6)	0.24 (6)

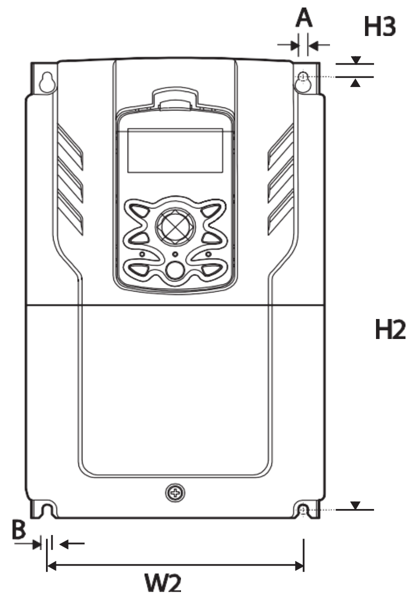
480V

<table>
<tr><th>kW</th><th>HP</th><th>VFD</th><th>H1</th><th>H2</th><th>H3</th><th>W1</th><th>W2</th><th>D1</th><th>A</th><th>B</th></tr>
<tr><td>15</td><td>20</td><td>VFD-RSI-020-H2-4C</td><td rowspan="2">11.42 (290)</td><td rowspan="2">10.78 (273.7)</td><td rowspan="2">0.45 (11.3)</td><td rowspan="2">7.09 (180)</td><td rowspan="2">6.18 (157)</td><td rowspan="2">8.08 (205.3)</td><td rowspan="2">0.20 (5)</td><td rowspan="2">0.20 (5)</td></tr>
<tr><td>18.5</td><td>25</td><td>VFD-RSI-025-H2-4C</td></tr>
<tr><td>22</td><td>30</td><td>VFD-RSI-030-H2-4C</td><td rowspan="2">13.78 (350)</td><td rowspan="2">13.03 (331)</td><td rowspan="2">0.51 (13)</td><td rowspan="2">8.66 (220)</td><td rowspan="2">7.63 (193.8)</td><td rowspan="2">8.79 (223.2)</td><td rowspan="2">0.24 (6)</td><td rowspan="2">0.24 (6)</td></tr>
<tr><td>30</td><td>40</td><td>VFD-RSI-040-H2-4C</td></tr>
</table>

Units: Inches (mm)

240V: 30 HP ~ 60 HP (22 kW ~ 45 kW)
480V: 50 HP ~ 125 HP (37 kW ~ 90 kW)
575V: 50 HP ~ 125 HP (37 kW ~ 90 kW)





240V

kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
22	30	VFD-RSI-030-H2-2C	17.72 (450)	16.87 (428.5)	0.55 (14)	10.83 (275)	9.13 (232)	-	11.18 (284)	0.28 (7)	0.28 (7)
30	40	VFD-RSI-040-H2-2C	20.08 (510)	19.15 (486.5)	0.63 (16)	12.81 (325)	11.1 (282)	-	11.18 (284)	0.28 (7)	0.28 (7)
37	50	VFD-RSI-050-H2-2C	21.65 (550)	20.65 524.5)	0.63 (16)	12.81 (325)	10.84 (275)	-	12.17 (309)	0.35 (9)	0.35 (9)
45	60	VFD-RSI-060-H2-2C									

480V

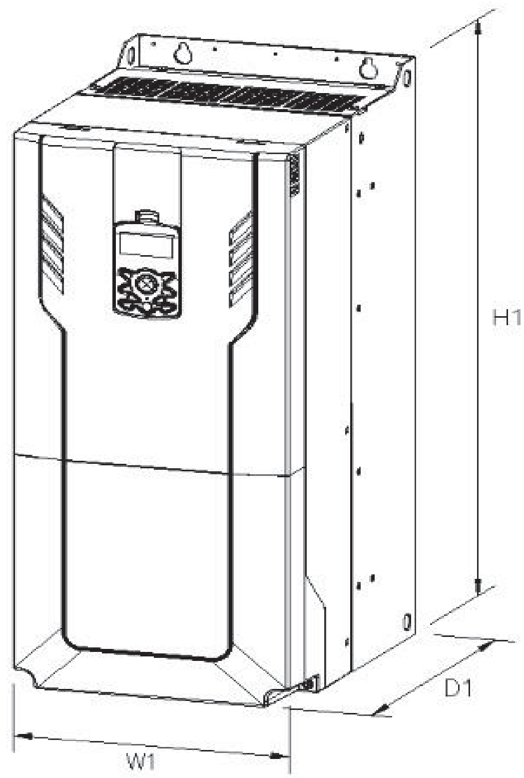
kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
37	50	VFD-RSI-050-H2-4C	17.72 (450)	16.87 (428.5)	0.55 (14)	10.83 (275)	9.13 (232)	-	11.18 (284)	0.28 (7)	0.28 (7)
45	60	VFD-RSI-060-H2-4C	20.08 (510)	19.15 (486.5)	0.63 (16)	12.80 (325)	11.10 (282)	-	11.18 (284)	0.28 (7)	0.28 (7)
55	75	VFD-RSI-075-H2-4C									
75	100	VFD-RSI-100-H2-4C	21.65 (550)	20.65 (524.5)	0.63 (16)	12.81 (325)	10.84 (275)	-	12.17 (309)	0.35 (9)	0.35 (9)
90	125	VFD-RSI-125-H2-4C									

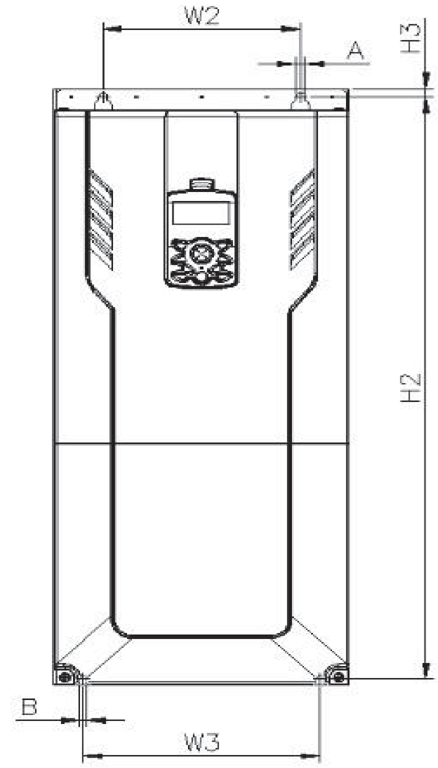
575V

kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
37	50	VFD-RSI-050-H2-6C	17.72 (450)	16.87 (428.5)	0.55 (14)	10.83 (275)	9.13 (232)	-	11.18 (284)	0.28 (7)	0.28 (7)
45	60	VFD-RSI-060-H2-6C	20.08 (510)	19.15 (486.5)	0.63 (16)	12.80 (325)	11.10 (282)	-	11.18 (284)	0.28 (7)	0.28 (7)
55	75	VFD-RSI-075-H2-6C									
75	100	VFD-RSI-100-H2-6C	21.65 (550)	20.65 (524.5)	0.63 (16)	12.81 (325)	10.84 (275)	-	12.17 (309)	0.35 (9)	0.35 (9)
90	125	VFD-RSI-125-H2-6C									

Units: Inches (mm)

240V: 75 HP ~ 125 HP (55 kW ~ 90 kW)
480V: 150 HP ~ 300 HP (110 ~ 185 kW)





240V

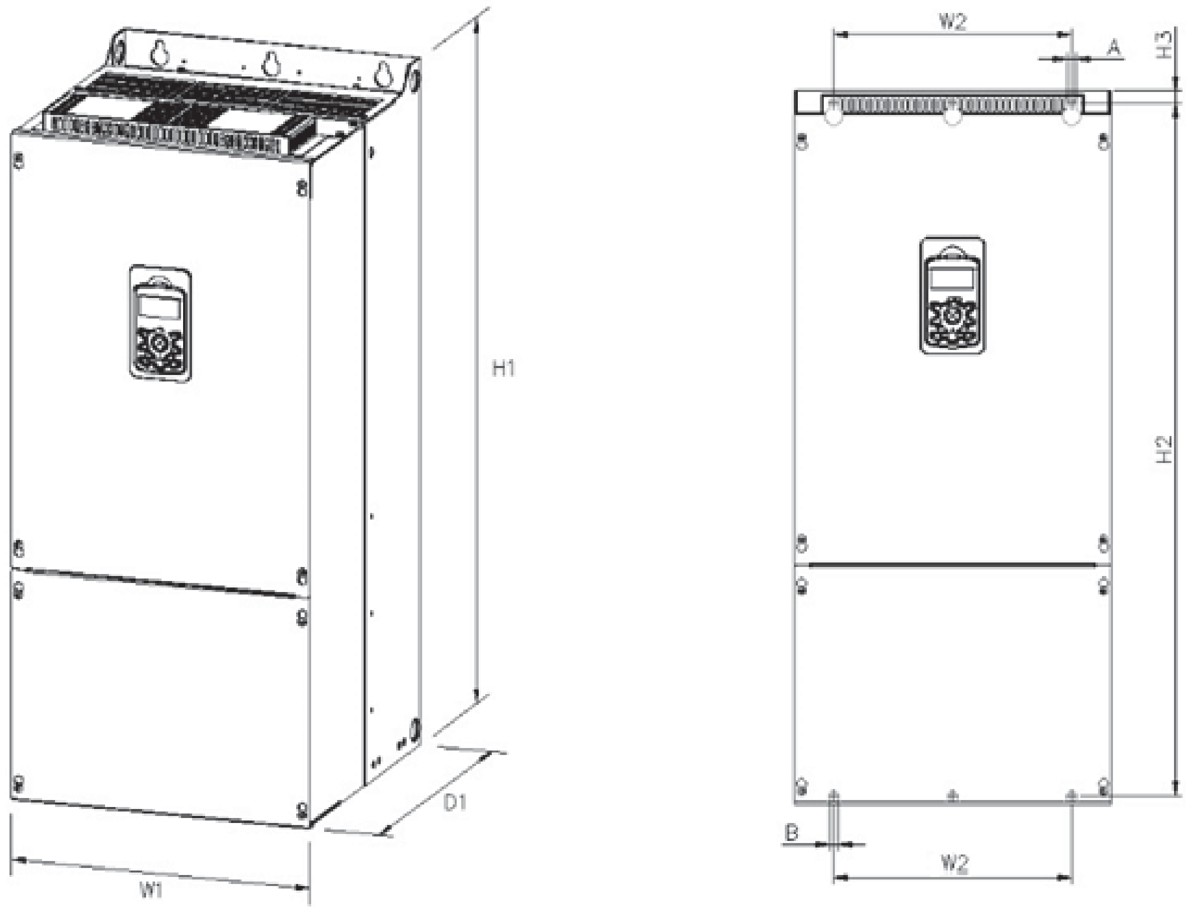
kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
55	75	VFD-RSI-075-H2-2C	27.80 (706)	27.11 (688.5)	0.37 (9.5)	11.81 (300)	7.87 (200)	9.45 (240)	15.21 (386)	0.35 (9)	0.35 (9)
75	100	VFD-RSI-100-H2-2C									
90	125	VFD-RSI-125-H2-2C	27.76 (705)	26.99 (685.5)	0.37 (9.5)	14.96 (380)	11.81 (300)	11.81 (300)	15.59 (396)	0.35 (9)	0.35 (9)

480V

kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
110	150	VFD-RSI-150-H2-4C	27.80 (706)	27.11 (688.5)	0.37 (9.5)	11.81 (300)	7.87 (200)	9.45 (240)	15.21 (386)	0.35 (9)	0.35 (9)
132	200	VFD-RSI-200-H2-4C									
160	250	VFD-RSI-250-H2-4C	27.76 (705)	26.99 (685.5)	0.37 (9.5)	14.96 (380)	11.81 (300)	11.81 (300)	15.59 (396)	0.35 (9)	0.35 (9)
185	300	VFD-RSI-300-H2-4C									

Units: Inches (mm)

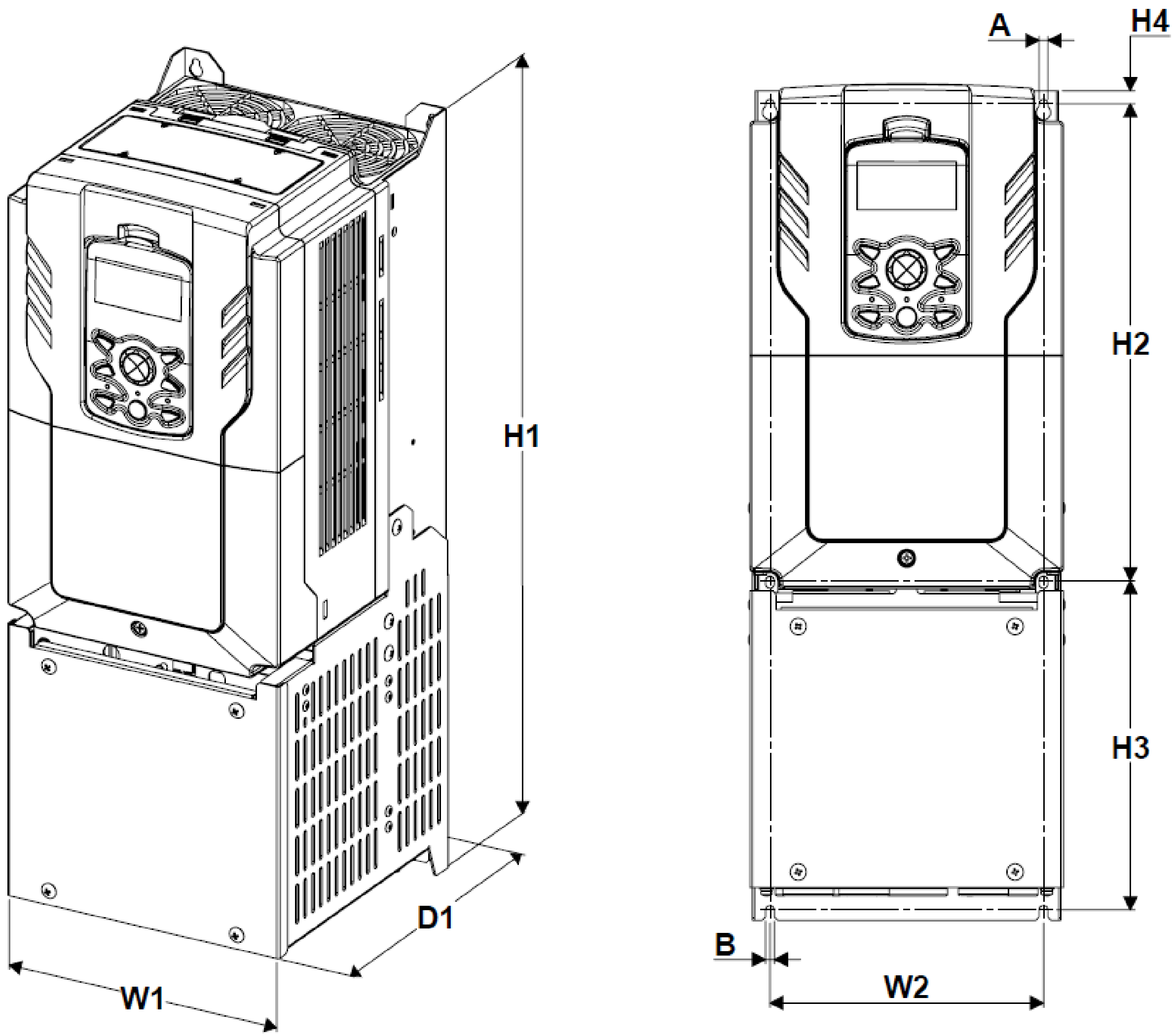
480V: 400 HP ~ 800 HP (250 ~ 500 kW)



kW	HP	VFD	H1	H2	H3	W1	W2	W3	D1	A	B
250	400	VFD-RSI-400-H2-4C	36.31 (922.3)	35.26 (895.5)	0.61 (15.5)	17.32 (440)	12.61 (320)	-	17.34 (440)	0.43 (11)	0.43 (11)
315	500	VFD-RSI-500-H2-4C	39.37 (1000)	38.27 (972)	0.59 (15)	23.62 (600)	16.54 (420)	-	19.69 (500)	0.55 (14)	0.55 (14)
400	650	VFD-RSI-650-H2-4C									
500	800	VFD-RSI-800-H2-4C	41.50 (1054)	40.20 (1021)	0.79 (20)	30.55 (776)	19.69 (500)	-	19.69 (500)	0.55 (14)	0.55 (14)

Units: Inches (mm)

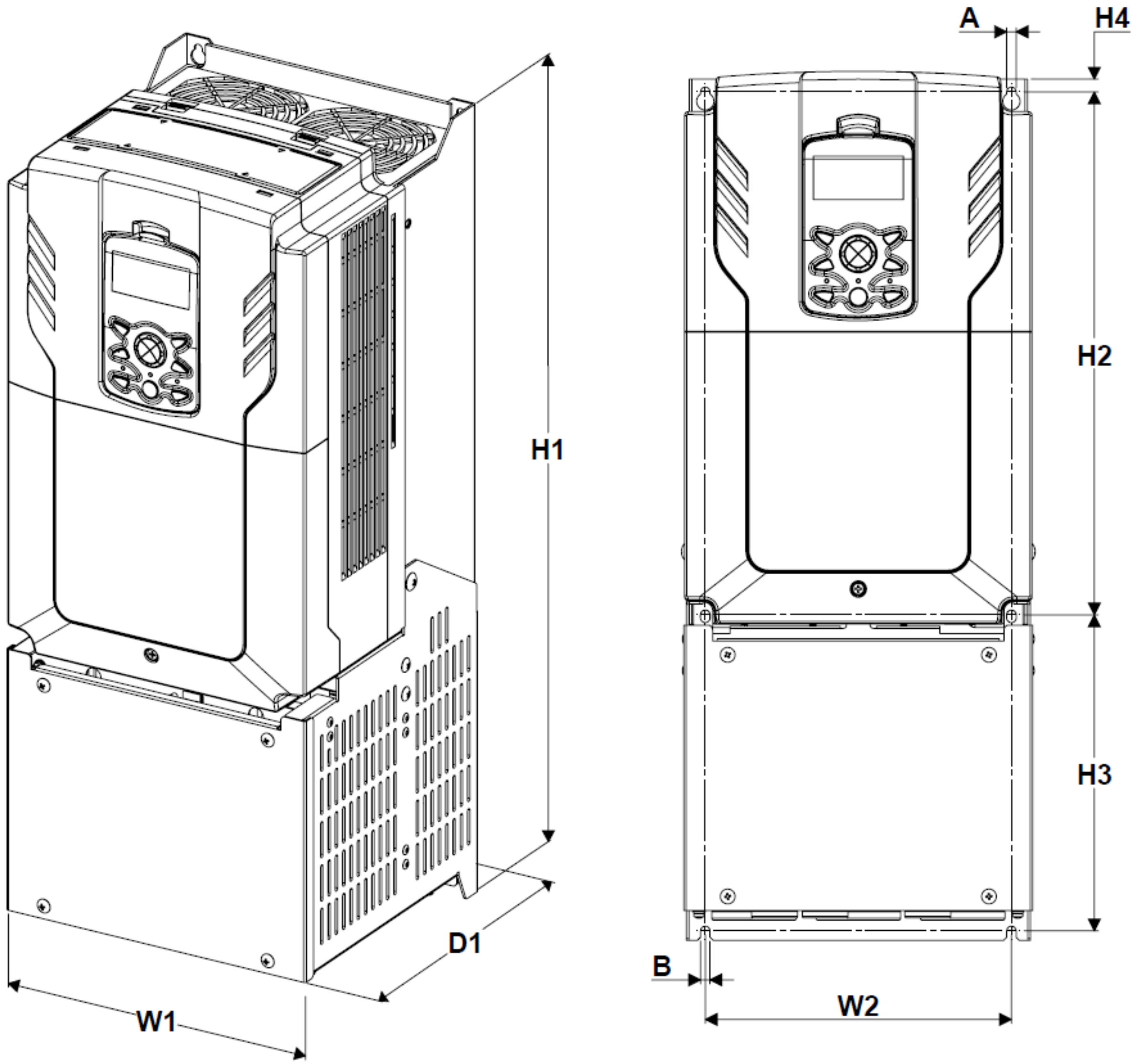
575V: 7.5 HP ~ 25 HP (5.5 kW ~ 18.5 kW)



kW	HP	VFD	H1	H2	H3	H4	W1	W2	D1	A	B
5.5	7.5	VFD-RSI-007-H2-61	18.90 (480)	10.78 (273.7)	7.44 (189)	0.30 (7.5)	7.09 (180)	6.18 (157)	8.08 (205.3)	0.20 (5)	0.20 (5)
7.5	10	VFD-RSI-010-H2-61									
11	15	VFD-RSI-015-H2-61									
15	20	VFD-RSI-020-H2-61									
18.5	25	VFD-RSI-025-H2-61									

Units: Inches (mm)

575V: 30 HP ~ 40 HP (22 ~ 30 kW)



kW	HP	VFD	H1	H2	H3	H4	W1	W2	D1	A	B
22	30	VFD-RSI-030-H2-61	21.65 (550)	13.03 (331)	7.87 (200)	0.31 (8)	8.69 (220.8)	7.63 (193.8)	8.79 (223.2)	0.24 (6)	0.24 (6)
30	40	VFD-RSI-040-H2-61									

Units: Inches (mm)

13.4 Terminal Screw Specification

Power Input/Output Terminal Screw Specification

Product	kW	HP	R/S/T, U/V/W Terminal Screw Size	Screw Torque in-lbs (Nm)
240V	5.5	7.5	M4	11 - 12 (1.2 - 1.4)
240V	7.5	10	M4	11 - 12 (1.2 - 1.4)
240V	11	15	M4	11 - 12 (1.2 - 1.4)
240V	15	20	M5	18 - 21 (2.0 - 2.4)
240V	18.5	25	M5	18 - 21 (2.0 - 2.4)
240V	22	30	M8	49 - 58 (5.5 - 6.6)
240V	30	40	M8	49 - 58 (5.5 - 6.6)
240V	37	50	M8	49 - 58 (5.5 - 6.6)
240V	45	60	M8	49 - 58 (5.5 - 6.6)
240V	55	75	M10	78 - 106 (8.8 - 11.96)
240V	75	100	M10	78 - 106 (8.8 - 11.96)
240V	90	125	M12	158 - 186 (17.87 - 21.07)
480V	5.5	7.5	M4	11 - 12 (1.2 - 1.4)
480V	7.5	10	M4	11 - 12 (1.2 - 1.4)
480V	11	15	M4	11 - 12 (1.2 - 1.4)
480V	15	20	M5	18 - 21 (2.0 - 2.4)
480V	18.5	25	M5	18 - 21 (2.0 - 2.4)
480V	22	30	M5	18 - 21 (2.0 - 2.4)
480V	30	40	M5	18 - 21 (2.0 - 2.4)
480V	37	50	M8	49 - 58 (5.5 - 6.6)
480V	45	60	M8	49 - 58 (5.5 - 6.6)
480V	55	75	M8	49 - 58 (5.5 - 6.6)
480V	75	100	M8	49 - 58 (5.5 - 6.6)
480V	90	125	M8	49 - 58 (5.5 - 6.6)
480V	110	150	M10	78 - 106 (8.8 - 11.96)
480V	132	200	M10	78 - 106 (8.8 - 11.96)
480V	160	250	M12	158 - 186 (17.87 - 21.07)
480V	185	300	M12	158 - 186 (17.87 - 21.07)
480V	250	400	M12	158 - 186 (17.87 - 21.07)
480V	315	500	M8 X 2 M12 X 1	53 - 80 (6 - 9) 158 - 186 (17.87 - 21.07)
480V	400	650	M8 X 2 M12 X 1	53 - 80 (6 - 9) 158 - 186 (17.87 - 21.07)
480V	500	800	M10 X 2 M16 X 1	78 - 106 (8.8 ~ 11.96) 425 - 444 (48.05 ~ 50.11)
575 V	5.5	7.5	M5	18 - 21 (2.0 - 2.4)
575 V	7.5	10	M5	18 - 21 (2.0 - 2.4)
575 V	11	15	M5	18 - 21 (2.0 - 2.4)
575 V	15	20	M5	18 - 21 (2.0 - 2.4)
575 V	18.5	25	M5	18 - 21 (2.0 - 2.4)
575 V	22	30	M5	18 - 21 (2.0 - 2.4)
575 V	30	40	M5	18 - 21 (2.0 - 2.4)
575 V	37	50	M8	49 - 58 (5.5 - 6.6)
575 V	45	60	M8	49 - 58 (5.5 - 6.6)
575 V	55	75	M8	49 - 58 (5.5 - 6.6)
575 V	75	100	M8	49 - 58 (5.5 - 6.6)
575 V	90	125	M8	49 - 58 (5.5 - 6.6)

Control Circuit Terminal Screw Specification

Terminal	Terminal Screw Size	Screw Torque in-lbs. (Nm)
P1–P7 / CM, VR, V1, I2 / TI / S+, S-, SG / A1/B1/C1, A2-C2, A3-C3, A4-C4, A5-C5 / AO1, AO2 / 24V, Q1, EG	M3	1.95 - 2.2 (0.22 ~ 0.25)

Caution

Apply rated torques to the terminal screws. Loose screws may cause short circuits and malfunctions. Tightening the screw too much may damage the terminals and cause short circuits and malfunctions. Use copper wires only with 600 V, 90°C rating for the power terminal wiring, and 300 V, 75°C rating for the control terminal wiring.

13.5 Dynamic Braking Resistor Specification

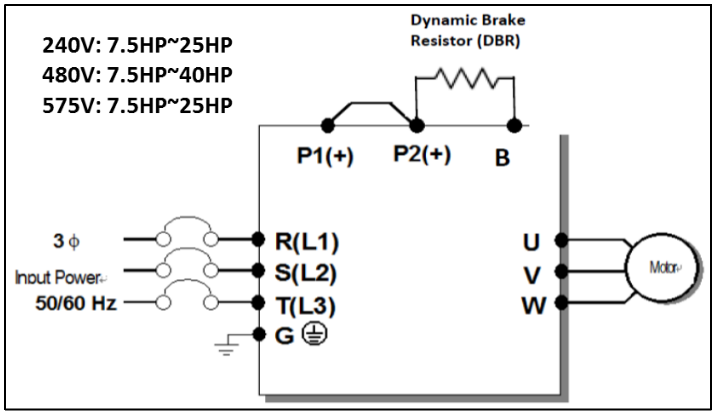
			Brake Torque 100% (Normal Duty) VFD Brake Resistor Specification			Brake Torque 150% (Heavy Duty) VFD Brake Resistor Specification		
HP	**Benshaw VFD Part Number**	**Internal Brake IGBT**	**Resistor (Ω)**	**Wattage [W] (%ED=5%)**	**Wattage [W] (%ED=10%)**	**Resistor (Ω)**	**Wattage [W] (%ED=5%)**	**Wattage [W] (%ED=10%)**
7.5	**VFD-RSI-007-H2-2C**	Yes	33	600	1200	20	800	1600
10	**VFD-RSI-010-H2-2C**	Yes	20	800	1600	15	1200	2400
15	**VFD-RSI-015-H2-2C**	Yes	15	1200	2400	10	2400	4800
20	**VFD-RSI-020-H2-2C**	Yes	10	2400	4800	8	2400	4800
25	**VFD-RSI-025-H2-2C**	Yes	8	2400	4800	6	2600	5200
30	**VFD-RSI-030-H2-2C**	No	7	2400	4800	5	3600	7200
40	**VFD-RSI-040-H2-2C**	No	5	3600	7200	3	6000	12000
50	**VFD-RSI-050-H2-2C**	No	4	4800	9600	3	6000	12000
60	**VFD-RSI-060-H2-2C**	No	3	6000	12000	2	9600	19200
75	**VFD-RSI-075-H2-2C**	No	3	6000	12000	2	9600	19200
100	**VFD-RSI-100-H2-2C**	No	2	9600	19200	1.5	12000	24000
125	**VFD-RSI-125-H2-2C**	No	2	9600	19200	1	18000	36000
7.5	**VFD-RSI-007-H2-4C**	Yes	120	700	1400	85	1000	2000
10	**VFD-RSI-010-H2-4C**	Yes	90	1000	2000	60	1200	2400
10	**VFD-RSI-015-H2-4C**	Yes	60	1200	2400	40	2000	4000
20	**VFD-RSI-020-H2-4C**	Yes	45	2000	4000	32	2400	4800
25	**VFD-RSI-025-H2-4C**	Yes	35	2400	4800	20	3600	7200
30	**VFD-RSI-030-H2-4C**	Yes	30	2400	4800	20	3600	7200
40	**VFD-RSI-040-H2-4C**	Yes	20	3600	7200	16	5000	10000
50	**VFD-RSI-050-H2-4C**	No	16.9	3200	6400	12	5000	10000
60	**VFD-RSI-060-H2-4C**	No	11.4	4800	9600	10	6400	12800
75	**VFD-RSI-075-H2-4C**	No	11.4	4800	9600	8.4	7200	14400
100	**VFD-RSI-100-H2-4C**	No	8.4	6400	12800	6	10000	20000
125	**VFD-RSI-125-H2-4C**	No	4.0	16000	32000	5	13000	26000
150	**VFD-RSI-150-H2-4C**	No	4.0	16000	32000	4	16000	32000
200	**VFD-RSI-200-H2-4C**	No	4.0	16000	32000	3.4	20000	40000
250	**VFD-RSI-250-H2-4C**	No	3.4	20000	40000	2.8	24000	48000
300	**VFD-RSI-300-H2-4C**	No	2.8	24000	48000	2.4	26000	52000
400	**VFD-RSI-400-H2-4C**	No	Contact Benshaw for sizing of both the DBU and Resistor			Contact Benshaw for sizing of both the DBU and Resistor		
500	**VFD-RSI-500-H2-4C**	No						
650	**VFD-RSI-650-H2-4C**	No						
800	**VFD-RSI-800-H2-4C**	No						

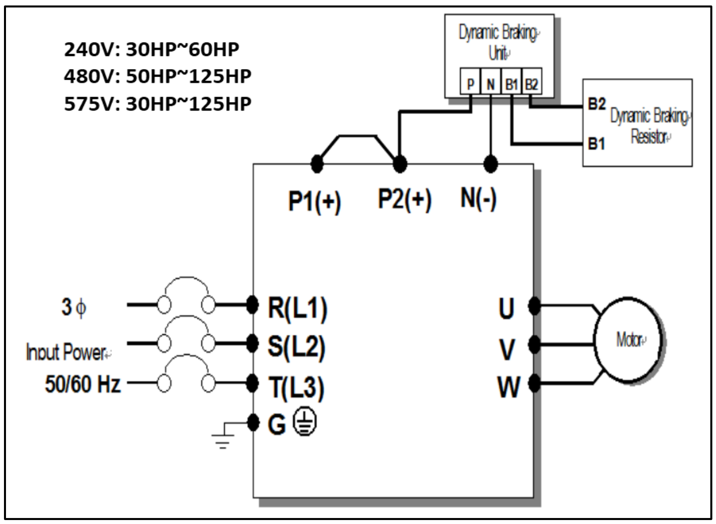
			Brake Torque 100% (Normal Duty) VFD Brake Resistor Specification			Brake Torque 150% (Heavy Duty) VFD Brake Resistor Specification		
HP	**Benshaw VFD Part Number**	**Internal Brake IGBT**	**Resistor (Ω)**	**Wattage [W] (%ED=5%)**	**Wattage [W] (%ED=10%)**	**Resistor (Ω)**	**Wattage [W] (%ED=5%)**	**Wattage [W] (%ED=10%)**
7.5	**VFD-RSI-007-H2-61**	Yes	160.0	700	1400	100	1100	2200
10	**VFD-RSI-010-H2-61**	Yes	120.0	900	1800	80	1400	2800
15	**VFD-RSI-015-H2-61**	Yes	80.0	1400	2800	54	2000	4000
20	**VFD-RSI-020-H2-61**	Yes	60.0	1800	3600	40	2700	5400
25	**VFD-RSI-025-H2-61**	Yes	48.0	2400	4800	32	3400	6800
30	**VFD-RSI-030-H2-61**	No	40.0	2800	5600	27	4000	8000
40	**VFD-RSI-040-H2-61**	No	30.0	3600	7200	20	5400	10800
50	**VFD-RSI-050-H2-6C**	No	24.0	4500	9000	16	6800	13600
60	**VFD-RSI-060-H2-6C**	No	20.0	5400	10800	13	8400	16800
75	**VFD-RSI-075-H2-6C**	No	16.0	6800	17600	11	10000	20000
100	**VFD-RSI-100-H2-6C**	No	12.0	9000	18000	8	14000	28000
125	**VFD-RSI-125-H2-6C**	No	10.0	11000	22000	7	17000	34000

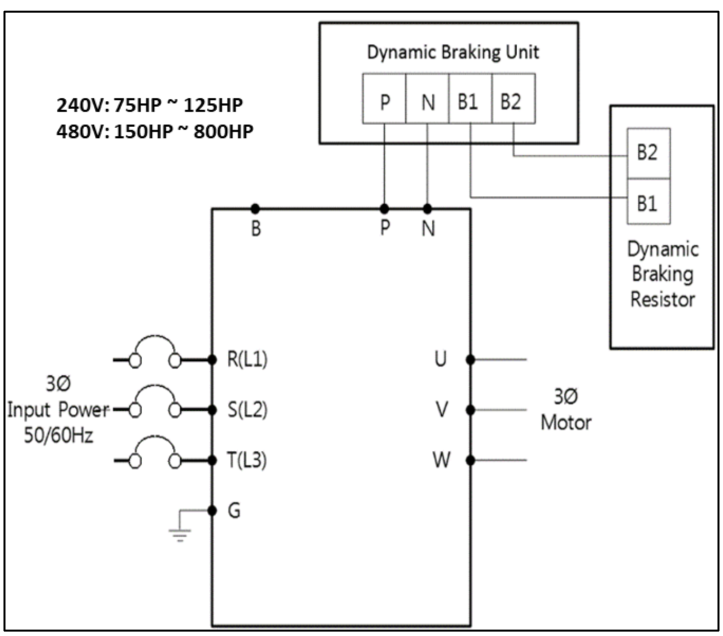
- If the ED% is increased to 10%, the rated capacity (W) of the brake resistor must be doubled.
- Related parameter: PRT-66 (ED%) Range 0 - 30%.
- Output Relays (OUT-31~ OUT-35 can be set to (25): DBWarn%ED which toggles the output when duty cycle is exceeded.

13.5.1 Basic Wiring - DBR and DBU

Dynamic Brake Resistor (DBR) and Dynamic Brake Unit DBU)







13.6 Continuous Rated Current Derating

13.6.1 Derating for Single Phase Input

A Single-phase power source can be safely applied to three-phase **(240V and 480V only)** rated inverter's provided that care is taken to properly oversize the inverter. The output is always three phase. Below is a summary of operating conditions that occur in the inverter when powered with a single-phase power source compared to a three-phase source. For more detail, see Benshaw Application Note - Sizing inverters for use with a Single-Phase Power Source.

Frequency - The DC bus ripple becomes 120 Hz vs. the normal 360 Hz. from a three-phase power source. The result is the DC bus ripple voltage is higher and the DC Bus circuit is subject to higher stress for the inverter to deliver equivalent power. **Output current ratings are valid for a 60 Hz single-phase power source only.**

Input Current - The input current through the two phases of the diode bridge converter will approximately double.

Harmonics - Input current harmonics increase resulting in current distortion levels of 90% THD_i and greater compared to approximately 40% with a three-phase power source. The result is a lower input power factor. **A line reactor is always required**. Size the reactor based on inverter rating.

Voltage - A stricter input voltage tolerance of –5% applies compared to -15% when powering the inverter with a three-phase power source. The average bus voltage will be lower than the equivalent from a three-phase power source. The minimum input voltage must be no less than 228Vac for 240 volt models and 456Vac for 480 volt models. It will be necessary to maintain a rigid incoming line voltage so that adequate motor voltage can be produced. To minimize the effect of voltage deprivation at the motor, consider operating the motor at reduced speed (reduced power) or using a motor with a base voltage that is lower than the incoming AC power source rating (EX: 480V source, 415V motor).

The result of all the above is that derating the inverter's output current and horsepower is required. Improper selection of the inverter will result in poor performance and premature failure. Refer to the ratings table in *13.1 Input and Output Specifications on page 357*. **Identify the inverter's rated output current with single phase input conditions**. This rating must meet or exceed the motor current rating.

Precautions

- Add a line reactor matched to the inverter rating. A three phase reactor can be wired as single phase. Connect single-phase power source to R(L1) and T(L3).
- Output current ratings are valid for a 60Hz power source only.
- Verify minimum input voltage.
- If an input phase open fault occurs, turn off the input phase open protection (PRT-05).
- Set Motor Data and Protections - Set the parameters that are related to motor
- information (MOT Group), Overload trip (PRT-20~22) and E-thermal functions (PRT-40~43).

13.6.2 Derating based on Carrier Frequency

The continuous rated current of the inverter is derated when the carrier frequency (CON-04) is increased. Refer to the following tables for derating percentages based on inverter Voltage and HP rating.

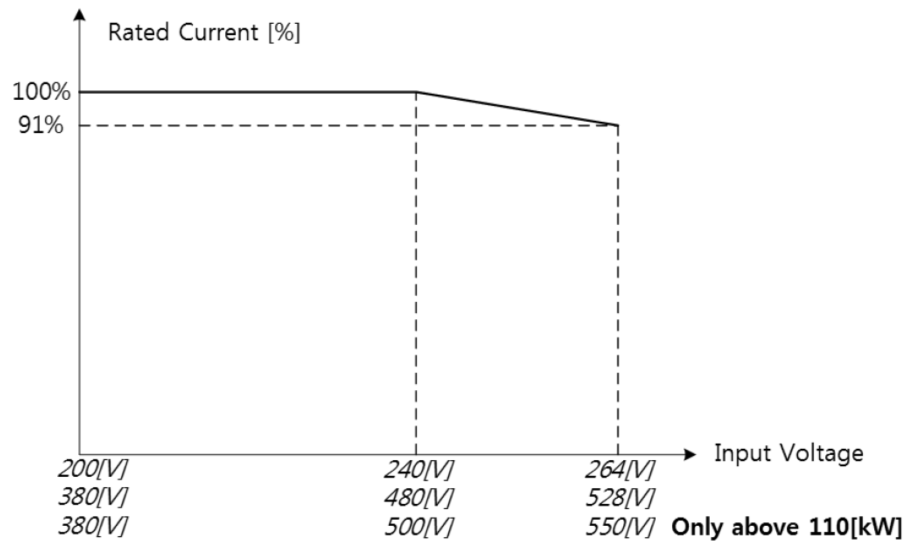
				Current Derate %		
				Carrier Frequency (kHz.)		
Voltage	kW	HP	Default	1~3	4~8	9~15
240	5.5~18.5	7.5~25	3	100	70	60
480	5.5~18.5	7.5~25	3	100	65	55
	22~30	30~40	3	100	65	50

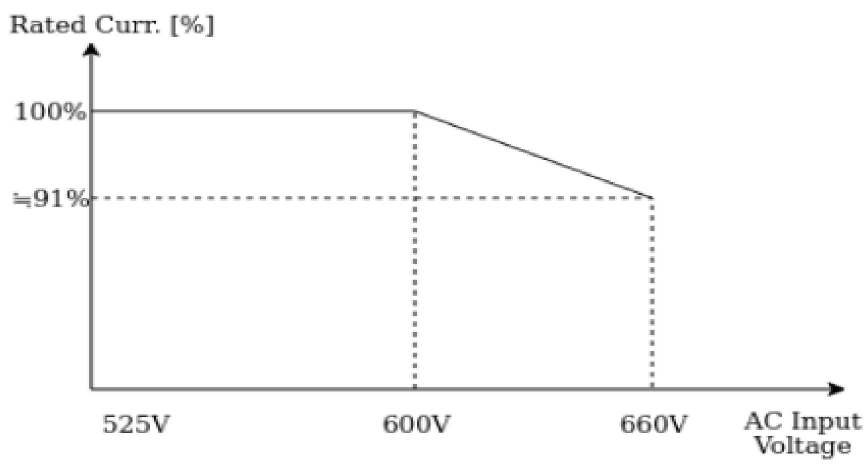
				Current Derate %						
				Carrier Frequency (kHz.)						
Voltage	kW	HP	Default	1~1.5	2	3	4	5	6~7	8~10
240	22~30	30~40	3	100	100	100	94	88	77	60
	37~45	50~60	3	100	100	100	88	77	55	-
	55~90	75~125	2	100	100	92	84	76	-	-
480	37~55	50~75	3	100	100	100	60	60	60	60
	75~90	100~125	3	100	100	100	55	55	55	-
	110~315	150~500	2	100	100	76	76	76	-	-
	400	650	1.5	100	95	75	75	-		
	500	800	1.5	100	92	65	65			

				Current Derate %					
				Carrier Frequency (kHz.)					
Voltage	kW	HP	Default	2.3kHz	3kHz	5kHz	7kHz	10kHz	15kHz
575	5.5~22	7.5~30	2.3	100	100	87	74	55	30
	30	40	2.3	100	100	87	74	55	-
	37~55	50~75	2.3	100	100	88	77	60	-
	75	100	2.3	100	94	77	60	-	-
	90	125	2.3	100	92	71	50	-	-

13.6.3 Derating based on Input Voltage

The continuous rated current of the inverter can be limited when higher than normal input voltages are applied. The default settings for AC Input Voltage (MOT-10) are 240V, 480V and 600V. For input voltages higher than the 240V, 480V and 600V, up to a maximum of +10%, refer to the following graphs for current derating percentages.





13.6.4 Derating based on Ambient Temperature

The continuous rated output current of the inverter is limited when installed in an environment with higher than normal ambient temperatures. The operating temperature rating of the inverters is 104°F (40°C). The required derating is 2.5% of the output amps for every degree (°C) above 104°F (40°C), up to a maximum of 122°F (50°C).

13.7 Heat Emission and Efficiency

The following table provides data on the heat generated by the inverters. Heat emissions are based on operation at room temperature at the default carrier frequency.

Voltage	Part Number	kW Rating	HP	Efficiency (%)	Total Losses (Watts)	Internal Losses (W)	External Losses (W)
240V	VFD-RSI-007-H2-2C	5.5	7.5	97.50	180	39	141
	VFD-RSI-010-H2-2C	7.5	10	97.50	248	39	209
	VFD-RSI-015-H2-2C	11	15	97.60	330	39	291
	VFD-RSI-020-H2-2C	15	20	97.90	451	39	412
	VFD-RSI-025-H2-2C	18.5	25	98.00	600	39	561
	VFD-RSI-030-H2-2C	22	30	96.94	893	55	838
	VFD-RSI-040-H2-2C	30	40	96.85	1245	55	1,190
	VFD-RSI-050-H2-2C	37	50	97.00	1480	103	1,377
	VFD-RSI-060-H2-2C	45	60	96.97	1814	103	1,710
	VFD-RSI-075-H2-2C	55	75	97.09	2150	248	1,903
	VFD-RSI-100-H2-2C	75	100	97.05	2963	248	2,715
	VFD-RSI-125-H2-2C	90	125	97.18	3438	262	3,176
Voltage	Part Number	kW Rating	HP	Efficiency (%)	Total Losses (Watts)	Internal Losses (W)	External Losses (W)
480V	VFD-RSI-007-H2-4C	5.5	7.5	97.70	172	43	129
	VFD-RSI-010-H2-4C	7.5	10	97.70	237	43	194
	VFD-RSI-015-H2-4C	11	15	97.70	322	43	279
	VFD-RSI-020-H2-4C	15	20	97.90	451	43	408
	VFD-RSI-025-H2-4C	18.5	25	97.90	615	43	572
	VFD-RSI-030-H2-4C	22	30	98.00	740	43	697
	VFD-RSI-040-H2-4C	30	40	98.00	880	107	773
	VFD-RSI-050-H2-4C	37	50	98.10	1170	107	1,063
	VFD-RSI-060-H2-4C	45	60	98.10	1443	107	1,336
	VFD-RSI-075-H2-4C	55	75	98.20	1710	107	1,603
	VFD-RSI-100-H2-4C	75	100	98.20	2090	107	1,983
	VFD-RSI-125-H2-4C	90	125	98.30	2775	107	2,668
	VFD-RSI-150-H2-4C	110	150	98.40	3960	257	3,703
	VFD-RSI-200-H2-4C	132	200	98.40	4752	257	4,495
	VFD-RSI-250-H2-4C	160	250	98.50	5600	272	5,328
	VFD-RSI-300-H2-4C	185	300	98.50	6475	272	6,203
	VFD-RSI-400-H2-4C	250	400	98.60	8500	286	8,214
	VFD-RSI-500-H2-4C	315	500	98.70	10.4k	479	9,916
	VFD-RSI-650-H2-4C	400	650	98.70	13.2k	479	12,721
	VFD-RSI-800-H2-4C	500	800	98.80	16k	671	15,329
Voltage	Part Number	kW Rating	HP	Efficiency (%)	Total Losses (Watts)	Internal Losses (W)	External Losses (W)
575V	VFD-RSI-007-H2-61	5.5	7.5	97.70	224	43	129
	VFD-RSI-010-H2-61	7.5	10	97.70	282	43	194
	VFD-RSI-015-H2-61	11	15	97.70	376	43	279
	VFD-RSI-020-H2-61	15	20	97.90	527	43	408
	VFD-RSI-025-H2-61	18.5	25	97.90	644	43	572
	VFD-RSI-030-H2-61	22	30	98.00	773	43	697
	VFD-RSI-040-H2-61	30	40	98.00	992	107	773
	VFD-RSI-050-H2-6C	37	50	98.10	1245	107	1,063
	VFD-RSI-060-H2-6C	45	60	98.10	1496	107	1,336
	VFD-RSI-075-H2-6C	55	75	98.20	1848	107	1,603
	VFD-RSI-100-H2-6C	75	100	98.20	2553	107	1,983
	VFD-RSI-125-H2-6C	90	125	98.30	2942	107	2,668

UL mark

The UL mark applies to products in the United States and Canada. This mark indicates that UL has tested and evaluated the products and determined that the products satisfy the UL standards for product safety. If a product received UL certification, this means that all components inside the product had been certified for UL standards as well. Suitable for Installation in a Compartment Handing Conditioned Air.

CE mark

The CE mark indicates that the products carrying this mark comply with European safety and environmental regulations. European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers and the EMC guidelines for safe noise control.

Low Voltage Directive

We have confirmed that our products comply with the Low Voltage Directive (EN 61800-5-1).

EMC Directive

The Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3) covers requirements stated for drives.

EAC mark

The EAC (EurAsian Conformity) mark is applied to the products before they are placed on the market of the Eurasian Customs Union member states.

It indicates the compliance of the products with the following technical regulations and requirements of the Eurasian Customs Union:

Technical Regulations of the Customs Union 004/2011 “On safety of low voltage equipment”

Technical Regulations of the Customs Union 020/2011 “On electromagnetic compatibility of technical products”

Manual Revision History

Revision History

Rev.	Date	Edition	Software	S/W Date	Changes
00	Dec-20	Standard	201.00	11/26/2020	Initial Release
01	June-2022	Standard	203.00	07/13/2022	Added 575V Inverters
02	Dec-2022	Standard	201.01	12/16/2022	Added 240V Inverters

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